



Monitoring Salt Marsh Vegetation at Colonial National Historical Park

2014 Summary Report

Natural Resource Data Series NPS/NCBN/NRDS—2015/791



ON THE COVER

Salt marsh at Colonial National Historical Park (COLO).
Photograph by Robin Baranowski

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May 2015

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

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Please cite this publication as:

Nicosia, E. L. 2015. Monitoring salt marsh vegetation at Colonial National Historical Park: 2014 summary report. Natural Resource Data Series NPS/NCBN/NRDS—2015/791. National Park Service, Fort Collins, Colorado.

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Abstract

The Northeast Coastal and Barrier Network (NCBN) began monitoring salt marsh vegetation on a biennial basis at Colonial National Historical Park (COLO) in 2008. This report summarizes the fourth year of vegetation data collected at COLO during the summer of 2014.

Vegetation monitoring at five sites was conducted July 14-18, 2014. The percent cover of each vegetation species and non-vegetation cover type within each 1 m² plot (n = 242) was visually estimated using a revised Braun-Blanquet method. Twenty-four vegetation species and two non-vegetation cover types were observed. During the data QC process, it was determined that the percent cover of dead vegetation and bare ground was overestimated during the 2014 field season; therefore these data were removed from the summary presented in this report.

Introduction

National Park Service (NPS) managers need accurate information about how, when and why natural systems change over time in order to make sound management decisions. To address this need, the NPS initiated natural resource monitoring through the Natural Resource Challenge. The Inventory and Monitoring Program (I&M), the key component of this effort, organizes 270 park units into 32 networks tasked with conducting long-term ‘vital signs’ monitoring (Fancy et al. 2009). Vital signs are defined as measurable, early warning signals that may indicate change in the long-term health of natural systems. Early detection of potential problems allows park managers to take steps in restoring or maintaining the ecological health of park resources.

The Northeast Coastal and Barrier Network (NCBN) consists of eight parks extending along the Northeast Atlantic Coast. Vital Signs chosen as part of the Network’s monitoring plan include salt marsh vegetation communities, nekton communities, essential estuarine water quality parameters, and specific coastal geomorphologic features (Stevens et al. 2005). Detailed monitoring protocols have been developed and implemented in the eight parks. This annual report summarizes salt marsh vegetation data collected at Colonial National Historical Park (COLO), according to the protocol developed by James-Pirri et al. (In Review)—Monitoring Salt Marsh Vegetation: A Protocol for the National Park Service’s Long-Term Monitoring Program, Northeast Coastal and Barrier Network.

Methods

Permanent Site Selection

Due to time constraints and extreme difficulties accessing the monitoring sites during the 2008 and 2010 field seasons (Paternaude and Pooler 2010 a, b), a thorough field reconnaissance was conducted in May 2011. After eliminating all sites requiring extensive canoeing or hiking, five permanent, 5-8 hectare salt marsh sites were randomly selected for monitoring at COLO (Figure 1) in 2012. The number of sites chosen within the park was based on available habitat as well as the logistics and feasibility of sampling all sites within one week. Detailed information about the site selection process and sampling design can be found in *Monitoring Vegetation in Salt Marshes: A Protocol for the National Park Service's Long-Term Monitoring Program, Northeast Coastal and Barrier Network* (James-Pirri et al. In Review). Vegetation sampling at the permanent sites established in 2012 is currently being conducted biennially.



Figure 1. Locations of permanent monitoring sites established by NCBN at Colonial National Historical Park (COLO) in 2012. Vegetation monitoring will be conducted at these five sites on a biennial basis.

Vegetation Plot Selection and Data Collection

Vegetation sampling was conducted once at each of the five sites (Table 1). Ten transects extending from bay to upland were systematically placed based on a single random start. Plots were located by treating the total length of all transects as a single transect and randomly selecting points (*i.e.*, plots) along this total length. This combination of systematic transects and replicate plots is necessary to ensure interspersed plots throughout the marsh study area, thus providing a representative sample of all salt marsh communities (*e.g.*, low marsh, high marsh).

Table 1. Sampling dates and number of vegetation plots sampled at five marsh sites at COLO in 2014.

Site	Dates	Total
5	7/16/2014	50
13	7/18/2014	50
19	7/14/2014	42
23	7/17/2014	50
30	7/15/2014	50

For each plot, all vegetation species and non-vegetation cover types were recorded (Table 2), and the estimated percent cover was determined using a modified Braun-Blanquet cover scale (0: 0%; 1: <1%; 2: 1-5%; 3: 6-25%; 4: 26-50%; 5: 51-75%; 6: 76-100%), (Kent and Coker 1992).

Table 2. Definition of standard cover type categories used in the Northeast Coastal and Barrier Network salt marsh vegetation monitoring protocol (James-Pirri et al. In Review).

Live vascular plants	Identified by species (herbaceous and shrubs).
Standing non-living vascular plants	Identified by species (e.g., <i>S. alterniflora</i> Not Living). This category only includes standing dead (attached) plants that are from a previous year's growth. There may be some dead leaves from this year's growth (e.g., the ends of leaves or leaves that are being replaced by new growth, etc.). In cases where dead leaves are from the current growing season, plant cover is recorded as live.
Macroalgae	Identified by species. This category generally includes the rockweeds (e.g., <i>Fucus</i> , <i>Ascophyllum</i>). Microalgae (e.g., diatom mats) and fine filamentous algae are not included in this category.
Bare ground	Includes mud, sand, microalgae cover, etc. These are areas that are not flooded with water and are devoid of standing live, standing dead, or macroalgae. There can be a thin film of surface water within the bare ground category.
Water	Permanent standing water is identified in plots that are partly within a creek, ditch, marsh pool, or flooded panne.
Wrack/litter	Wrack is material that has floated into the plot. This is generally dead (not attached) plant material, but could also be trash. Litter is dead plant material that is highly decomposed and is no longer attached.
Trash	Items such as logs, old piers, tires, etc.
Rock	Boulders or rocks can be found on the surface of northern New England marshes.

Data Summary

Vegetation

Vegetation data were recorded using the modified Braun-Blanquet scale as described above (Kent and Coker 1992). For summary purposes, each Braun-Blanquet value was converted to the midpoint of the percent range it represented (Table 2) as described in Wikum and Shanholtzer (1978). A detailed description of the analyses and formulae are presented in the salt marsh vegetation protocol (James-Pirri et al. In Review).

Table 3. Modified Braun-Blanquet scale and corresponding midpoint values for determining percent cover of salt marsh vegetation.

BB Value	Percent Cover	Midpoint
0	0%	0%
1	< 1%	0.50%
2	1 - 5%	3%
3	6 - 25%	15.50%
4	26 - 50%	38%
5	51 - 75%	63%
6	76 - 100%	88%

Wikum and Shanholtzer (1978) outline a method for calculating an importance value for each species. So as not to confuse this value with ecological importance, we refer to it as a ‘relative prevalence’ value. Although Wikum and Shanholtzer (1978) present their importance value as a sum of the percent frequency and percent cover values, we have chosen to average these values so that relative prevalence is on a more readily interpretable percent scale. We present the relative percent prevalence for each species and non-vegetation cover type as the average of the relative percent cover and the relative percent frequency. A detailed description of the analyses and formulae are presented in the salt marsh vegetation protocol (James-Pirri et al. In Review).

Relative percent cover is the percentage of all plots that each species covers relative to all other species present in the plots. The sum of all relative percent cover values for all species and non-vegetation cover types equals 100%. Relative percent frequency is the number of plots where each species is present, relative to all other species observed in the plots. The sum of the relative percent frequency values for all species and non-vegetation cover type equals 100%.

In addition to relative percent prevalence, we report the average percent cover of each species and non-vegetation cover type for all plots combined. Because the relative percent prevalence incorporates both percent frequency and percent cover, it provides information about how a species is distributed (*i.e.*, its ‘patchiness’) throughout the salt marsh and may differ substantially from the average percent cover for a given species.

Species are grouped by salinity tolerance (USDA 2015) to help characterize the vegetation community. If any vegetation species in the sample plots are listed by the United States Department of Agriculture (USDA) or the Commonwealth of Virginia as exotic, invasive, threatened, endangered, or rare, these species are noted in the vegetation data summary. Information about plants listed by each state is available online (USDA 2015). Additional information can be obtained from the Virginia Department of Conservation and Recreation (VA DCR) website (Hefferman et al. 2014) and a report produced by the VA DCR (Townsend 2014). If any species from one of the above categories is observed, the plots are noted in Appendix A which includes a table of all vegetation sample plots and their respective Universal Transverse Mercator (UTM) coordinates.

Results

Vegetation

Twenty-four vegetation species and two non-vegetation cover types were recorded at five monitoring sites at COLO in 2014 (Table 4). During the data QC process, it was determined that the percent cover of dead vegetation and bare ground was overestimated during the 2014 field season; therefore these data were removed from the summary presented in this report. Species are grouped by salinity tolerances (USDA 2012). One of the species, *Phragmites australis*, is listed by the Commonwealth of Virginia as highly invasive (Hefferman et al. 2014). The coordinates for plots where *P. Australis* was present are provided in Appendix A. None of the vegetation species observed in 2014 are federally or state listed as threatened, endangered, or rare (USDA 2015, Townsend 2014). Tables summarizing vegetation data by site are provided in the Appendices.

Table 4. Average percent cover (Average % Cover $\pm$ SE), frequency, and relative percent prevalence of each plant species and non-vegetation cover type observed at COLO in 2014. Data were summarized over all 242 plots. Percent cover was estimated using the midpoint values of Braun-Blanquet percent ranges (Table 2). “*” species is listed as invasive by the Commonwealth of Virginia (Hefferman et al. 2014).

Cover Type						
Salinity Tolerance						
Species	Common Name	Avg. % Cover $\pm$ SE	Freq	Rel. %Cover	Rel. % Freq.	Rel. % Prevalence
Vegetation		60.4 $\pm$ 2.0	225	68.1	71.8	69.9
High Salinity Tolerance		21.8 $\pm$ 1.7	205	24.6	32.5	28.6
<i>Spartina cynosuroides</i>	big cordgrass	18.4 $\pm$ 1.7	185	20.8	20.8	20.8
<i>Schoenoplectus robustus</i>	saltmarsh bulrush	1.7 $\pm$ 0.3	57	1.9	6.4	4.2
<i>Juncus roemerianus</i>	black needle rush	1.0 $\pm$ 0.3	33	1.1	3.7	2.4
<i>Juncus gerardii</i>	black grass	0.6 $\pm$ 0.2	10	0.6	1.1	0.8
<i>Distichlis spicata</i>	spikegrass	0.1 $\pm$ 0.1	4	0.1	0.4	0.2
<i>Taxodium distichum</i>	bald cypress	< 0.05	1	< 0.05	0.1	< 0.05
Medium Salinity Tolerance		3.7 $\pm$ 0.5	97	4.2	15.0	9.6
<i>Schoenoplectus pungens</i> var. <i>pungens</i>	common threesquare	1.5 $\pm$ 0.3	62	1.6	7.0	4.3
<i>Polygonum punctatum</i>	dotted smartweed	1.3 $\pm$ 0.2	48	1.5	5.4	3.5
<i>Typha angustifolia</i>	narrowleaf cattail	0.3 $\pm$ 0.1	16	0.3	1.8	1.1
<i>Morella cerifera</i>	Southern bayberry	0.5 $\pm$ 0.4	3	0.6	0.3	0.4
<i>Baccharis halimifolia</i>	Eastern baccharis	0.1 $\pm$ 0.1	2	0.1	0.2	0.2
<i>Lythrum lineare</i>	wand lythrum	< 0.05	2	< 0.05	0.2	0.1
<i>Toxicodendron radicans</i>	poison ivy	< 0.05	1	< 0.05	0.1	< 0.05
Low Salinity Tolerance		33.8 $\pm$ 2.0	190	38.1	22.8	30.5
<i>Peltandra virginica</i>	green arrow arum	30.9 $\pm$ 1.9	184	34.8	20.7	27.8
<i>Phragmites australis</i> *	common reed*	2.0 $\pm$ 0.7	12	2.2	1.3	1.8
<i>Zizaniopsis miliacea</i>	giant cutgrass	0.8 $\pm$ 0.5	5	0.9	0.6	0.8
<i>Juniperus virginiana</i>	Eastern red-cedar	0.1 $\pm$ 0.1	1	0.1	0.1	0.1
<i>Mikania scandens</i>	climbing hempvine	< 0.05	1	< 0.05	0.1	< 0.05

Cover Type						
Salinity Tolerance						
Species	Common Name	Avg. % Cover $\pm$ SE	Freq	Rel. %Cover	Rel. % Freq.	Rel. % Prevalence
No Salinity Tolerance		0.4 $\pm$ 0.2	4	0.4	0.5	0.4
<i>Pinus rigida</i>	pitch pine	0.3 $\pm$ 0.2	2	0.4	0.2	0.3
<i>Acer rubrum</i>	red maple	< 0.05	1	< 0.05	0.1	< 0.05
<i>Apios americana</i>	groundnut	< 0.05	1	< 0.05	0.1	< 0.05
<i>Teucrium canadense</i>	American germander	< 0.05	1	< 0.05	0.1	< 0.05
Unknown Salinity Tolerance		0.8 $\pm$ 0.4	10	0.9	1.0	1.0
<i>Leersia</i> species	cutgrass species	0.3 $\pm$ 0.3	3	0.4	0.3	0.4
Unknown plant	unknown plant	0.2 $\pm$ 0.2	2	0.2	0.2	0.2
<i>Vitis</i> species	grape	0.2 $\pm$ 0.2	2	0.2	0.2	0.2
Unknown Grass	unknown grass	0.1 $\pm$ 0.1	3	0.1	0.3	0.2
Non-Vegetation		12.3 $\pm$ 1.8	63	13.9	7.1	10.5
water	water	12.3 $\pm$ 1.8	63	13.9	7.1	10.5
Incidental Cover		16.0 $\pm$ 1.7	184	18.1	20.7	19.4
wrack & litter	wrack / litter	16.0 $\pm$ 1.7	184	18.1	20.7	19.4

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Appendix A: Coordinates for vegetation plots sampled at COLO in 2014.

Table A-1. Coordinates for vegetation plots sampled at COLO site 5 in 2014, UTM, Zone 18, NAD 83, meters.

Plot ID	UTMX (east)	UTMY (north)	Plot ID	UTMX (east)	UTMY (north)
C5V1014_2014	345667	4118492	C5V3214_2014	345274	4118492
C5V1114_2014	345570	4118466	C5V3314_2014	345275	4118481
C5V114_2014	345274	4118440	C5V3414_2014	345274	4118484
C5V1214_2014	345517	4118511	C5V3514_2014	345526	4118321
C5V1314_2014	345518	4118529	C5V3614_2014	345469	4118514
C5V1414_2014	345375	4118461	C5V3714_2014	345473	4118445
C5V1514_2014	345322	4118529	C5V3814_2014	345519	4118482
C5V1614_2014	345523	4118396	C5V3914_2014	345571	4118438
C5V1714_2014	345372	4118466	C5V4014_2014	345271	4118503
C5V1814_2014	345422	4118477	C5V4114_2014	345325	4118411
C5V1914_2014	345276	4118427	C5V414_2014	345321	4118512
C5V2014_2014	345421	4118498	C5V4214_2014	345521	4118479
C5V2114_2014	345524	4118411	C5V4314_2014	345519	4118494
C5V214_2014	345571	4118462	C5V4414_2014	345569	4118505
C5V2214_2014	345478	4118316	C5V4514_2014	345371	4118504
C5V2314_2014	345375	4118430	C5V4614_2014	345615	4118550
C5V2414_2014	345274	4118463	C5V4714_2014	345473	4118411
C5V2514_2014	345522	4118400	C5V4814_2014	345323	4118522
C5V2614_2014	345324	4118431	C5V4914_2014	345470	4118479
C5V2714_2014	345665	4118498	C5V5014_2014	345471	4118503
C5V2814_2014	345526	4118362	C5V514_2014	345376	4118413
C5V2914_2014	345617	4118461	C5V614_2014	345272	4118513
C5V3014_2014	345377	4118377	C5V714_2014	345372	4118486
C5V3114_2014	345327	4118392	C5V814_2014	345327	4118427
C5V314_2014	345376	4118417	C5V914_2014	345422	4118474

Table A-2. Coordinates for vegetation plots sampled at COLO site 13 in 2014, UTM, Zone 18, NAD 83, meters. '*' indicates an invasive or exotic species (*Phragmites australis*) was observed in the plot (Hefferman et al. 2014).

Plot ID	UTMX (east)	UTMY (north)	Plot ID	UTMX (east)	UTMY (north)
C13V1014_2014	342203	4120457	C13V3214_2014	342187	4120206
C13V1114_2014	342126	4120322	C13V3314_2014	342259	4120450
C13V114_2014	342101	4120324	C13V3414_2014	342246	4120164
C13V1214_2014	342102	4120504	C13V3514_2014	342252	4120164
C13V1314_2014	342240	4120489	C13V3614_2014	342282	4120269
C13V1414_2014	342256	4120163	C13V3714_2014	342178	4120388
C13V1514_2014	342219	4120491	C13V3814_2014	342255	4120161
C13V1614_2014	342126	4120473	C13V3914_2014	342132	4120464
C13V1714_2014	342250	4120489	C13V4014_2014	342278	4120267
C13V1814_2014*	342129	4120357	C13V4114_2014*	342244	4120417
C13V1914_2014	342232	4120203	C13V414_2014	342231	4120272
C13V2014_2014*	342176	4120282	C13V4214_2014	342193	4120351
C13V2114_2014	342217	4120313	C13V4314_2014	342085	4120435
C13V214_2014	342197	4120204	C13V4414_2014	342094	4120433
C13V2214_2014	342266	4120307	C13V4514_2014	342182	4120207
C13V2314_2014*	342239	4120383	C13V4614_2014*	342181	4120317
C13V2414_2014	342127	4120285	C13V4714_2014	342296	4120447
C13V2514_2014	342183	4120459	C13V4814_2014*	342210	4120420
C13V2614_2014	342196	4120351	C13V4914_2014	342217	4120274
C13V2714_2014*	342212	4120315	C13V5014_2014*	342286	4120377
C13V2814_2014	342234	4120311	C13V514_2014	342095	4120504
C13V2914_2014*	342207	4120277	C13V614_2014	342118	4120322
C13V3014_2014	342301	4120476	C13V714_2014*	342133	4120357
C13V3114_2014	342265	4120232	C13V814_2014	342295	4120483
C13V314_2014	342051	4120367	C13V914_2014	342026	4120402

Table A-3. Coordinates for vegetation plots sampled at COLO site 19 in 2014, UTM, Zone 18, NAD 83, meters.

Plot ID	UTMX (east)	UTMY (north)	Plot ID	UTMX (east)	UTMY (north)
C19V1014_2014	343706	4119186	C19V3214_2014	343682	4119175
C19V1114_2014	343730	4119110	C19V3514_2014	343700	4119138
C19V114_2014	343831	4119156	C19V3614_2014	343858	4119211
C19V1214_2014	343869	4119036	C19V3714_2014	343863	4119170
C19V1314_2014	343909	4119146	C19V3914_2014	343719	4119102
C19V1414_2014	343699	4119184	C19V4014_2014	343921	4119150
C19V1514_2014	343611	4119143	C19V414_2014	343926	4119200
C19V1714_2014	343798	4119142	C19V4214_2014	344022	4119108
C19V1914_2014	343836	4119200	C19V4314_2014	343899	4119185
C19V2014_2014	343993	4119000	C19V4414_2014	343592	4119136
C19V2114_2014	343749	4119208	C19V4614_2014	343873	4119039
C19V214_2014	343853	4119166	C19V4814_2014	343734	4119111
C19V2214_2014	344022	4118932	C19V4914_2014	343893	4119136
C19V2314_2014	343811	4119191	C19V5014_2014	343831	4119244
C19V2414_2014	343855	4119031	C19V5114_2014	343747	4119117
C19V2514_2014	343894	4119183	C19V5314_2014	343848	4119162
C19V2614_2014	343716	4119145	C19V5414_2014	343697	4119137
C19V2814_2014	343759	4119210	C19V614_2014	343730	4119105
C19V2914_2014	343788	4119225	C19V714_2014	343722	4119196
C19V3014_2014	343839	4119202	C19V814_2014	343890	4119138
C19V314_2014	343878	4119178	C19V914_2014	344022	4119018

Table A-4. Coordinates for vegetation plots sampled at COLO site 23 in 2014, UTM, Zone 18, NAD 83, meters. '*' indicates an invasive or exotic species (*Phragmites australis*) was observed in the plot (Hefferman et al. 2014).

Plot ID	UTMX (east)	UTMY (north)	Plot ID	UTMX (east)	UTMY (north)
C23V1014_2014	342632	4120653	C23V3214_2014	342711	4120723
C23V1114_2014	342745	4120684	C23V3314_2014	342518	4120700
C23V114_2014*	342457	4120612	C23V3414_2014	342480	4120584
C23V1214_2014	342410	4120586	C23V3514_2014	342507	4120709
C23V1314_2014	342373	4120550	C23V3614_2014	342661	4120774
C23V1414_2014	342363	4120559	C23V3714_2014	342560	4120653
C23V1514_2014	342773	4120728	C23V3814_2014	342575	4120713
C23V1614_2014	342470	4120676	C23V3914_2014	342786	4120715
C23V1714_2014	342785	4120720	C23V4014_2014	342611	4120753
C23V1814_2014	342470	4120596	C23V4114_2014*	342502	4120641
C23V1914_2014	342440	4120630	C23V414_2014	342555	4120733
C23V2014_2014	342483	4120664	C23V4214_2014	342414	4120581
C23V2114_2014	342564	4120648	C23V4314_2014	342578	4120710
C23V214_2014	342649	4120709	C23V4414_2014	342772	4120733
C23V2214_2014	342751	4120750	C23V4514_2014	342434	4120558
C23V2314_2014	342715	4120715	C23V4614_2014	342717	4120715
C23V2414_2014	342516	4120699	C23V4714_2014	342760	4120743
C23V2514_2014	342573	4120641	C23V4814_2014	342464	4120605
C23V2614_2014	342650	4120709	C23V4914_2014	342673	4120763
C23V2714_2014	342364	4120484	C23V5014_2014	342486	4120658
C23V2814_2014	342723	4120708	C23V514_2014	342362	4120562
C23V2914_2014	342791	4120711	C23V614_2014	342640	4120719
C23V3014_2014	342406	4120589	C23V714_2014	342460	4120690
C23V3114_2014	342439	4120551	C23V814_2014	342485	4120580
C23V314_2014	342438	4120553	C23V914_2014	342584	4120705

Table A-5. Coordinates for vegetation plots sampled at COLO site 30 in 2014, UTM, Zone 18, NAD 83, meters.

Plot ID	UTMX (east)	UTMY (north)	Plot ID	UTMX (east)	UTMY (north)
C30V1014_2014	343205	4120306	C30V3214_2014	343300	4120452
C30V1114_2014	343171	4120442	C30V3314_2014	343392	4120435
C30V114_2014	343300	4120439	C30V3414_2014	343364	4120295
C30V1214_2014	343300	4120471	C30V3514_2014	343139	4120247
C30V1314_2014	343301	4120464	C30V3614_2014	343331	4120455
C30V1414_2014	343109	4120309	C30V3714_2014	343299	4120322
C30V1514_2014	343171	4120438	C30V3814_2014	343331	4120282
C30V1614_2014	343141	4120232	C30V3914_2014	343235	4120351
C30V1714_2014	343108	4120316	C30V4014_2014	343267	4120469
C30V1814_2014	343137	4120483	C30V4114_2014	343365	4120418
C30V1914_2014	343364	4120268	C30V414_2014	343363	4120280
C30V2014_2014	343235	4120395	C30V4214_2014	343331	4120467
C30V2114_2014	343140	4120430	C30V4314_2014	343140	4120290
C30V214_2014	343205	4120236	C30V4414_2014	343394	4120398
C30V2214_2014	343107	4120268	C30V4514_2014	343108	4120239
C30V2314_2014	343203	4120525	C30V4614_2014	343267	4120228
C30V2414_2014	343108	4120496	C30V4714_2014	343364	4120341
C30V2514_2014	343204	4120267	C30V4814_2014	343267	4120462
C30V2614_2014	343171	4120230	C30V4914_2014	343205	4120186
C30V2714_2014	343140	4120295	C30V5014_2014	343173	4120468
C30V2814_2014	343234	4120481	C30V514_2014	343331	4120508
C30V2914_2014	343233	4120544	C30V614_2014	343270	4120313
C30V3014_2014	343299	4120421	C30V714_2014	343303	4120318
C30V3114_2014	343300	4120240	C30V814_2014	343205	4120217
C30V314_2014	343204	4120316	C30V914_2014	343172	4120498

Appendix B: Vegetation frequency summarized by site.

Table B-1. Frequency of each plant species and non-vegetation cover type observed at COLO in 2014. Data were summarized for each site and over all 242 plots. '--' species was not observed at the site. '*' species is listed as invasive by the Commonwealth of Virginia (Hefferman et al. 2014).

Cover Type		Site (no. of plots)					
Salinity Tolerance							
Species	Common Name	5 (50)	13 (50)	19 (42)	23 (50)	30 (50)	All (242)
Vegetation		48	45	39	47	46	225
High Salinity Tolerance		48	43	36	45	33	205
<i>Spartina cynosuroides</i>	big cordgrass	48	36	32	43	26	185
<i>Schoenoplectus robustus</i>	saltmarsh bulrush	20	10	5	11	11	57
<i>Juncus roemerianus</i>	black needle rush	4	9	9	4	7	33
<i>Distichlis spicata</i>	spikegrass	--	--	4	--	--	4
<i>Juncus gerardii</i>	black grass	--	6	--	4	--	10
<i>Taxodium distichum</i>	bald cypress	--	1	--	--	--	1
Medium Salinity Tolerance		8	26	23	31	9	97
<i>Schoenoplectus pungens</i> var. <i>pungens</i>	common threesquare	6	16	17	17	6	62
<i>Polygonum punctatum</i>	dotted smartweed	--	14	7	22	5	48
<i>Baccharis halimifolia</i>	eastern baccharis	2	--	--	--	--	2
<i>Lythrum lineare</i>	wand lythrum	--	--	2	--	--	2
<i>Morella cerifera</i>	southern bayberry	--	1	2	--	--	3
<i>Toxicodendron radicans</i>	poison ivy	1	--	--	--	--	1
<i>Typha angustifolia</i>	narrowleaf cattail	--	5	5	6	--	16
Low Salinity Tolerance		25	43	29	47	46	190
<i>Peltandra virginica</i>	green arrow arum	24	40	27	47	46	184
<i>Juniperus virginiana</i>	Eastern red-cedar	1	--	--	--	--	1
<i>Mikania scandens</i>	climbing hempvine	--	--	1	--	--	1
<i>Phragmites australis</i> *	common reed*	--	10	--	2	--	12
<i>Zizaniopsis miliacea</i>	giant cutgrass	--	1	4	--	--	5

Cover Type		Site (no. of plots)					
Salinity Tolerance							
Species	Common Name	5 (50)	13 (50)	19 (42)	23 (50)	30 (50)	All (242)
No Salinity Tolerance		1	2	--	1	--	4
<i>Acer rubrum</i>	red maple	1	--	--	--	--	1
<i>apios americana</i>	groundnut	--	1	--	--	--	1
<i>Pinus rigida</i>	pitch pine	--	1	--	1	--	2
<i>Teucrium canadense</i>	American germander	--	1	--	--	--	1
Unknown Salinity Tolerance		1	3	5	1	--	10
<i>Leersia</i> species	cutgrass species	--	1	2	--	--	3
Unknown plant	unknown plant	--	--	2	--	--	2
<i>Vitis</i> species	grape	--	2	--	--	--	2
Unknown Grass	unknown grass	1	--	1	1	--	3
Non-Vegetation		11	17	11	15	9	63
water	water	11	17	11	15	9	63
Incidental Cover		48	44	26	44	22	184
wrack & litter	wrack / litter	48	44	26	44	22	184

Appendix C: Vegetation relative percent cover summarized by site.

Table C-1. Relative percent cover of each plant species and non-vegetation cover type observed at COLO in 2014. Data were summarized for each site and over all 242 plots. '--' species was not observed at the site. '*' species is listed as invasive by the Commonwealth of Virginia (Hefferman et al. 2014).

Cover Type		Relative Cover %					
Salinity Tolerance		Site (No. of Plots)					
Species	Common Name	5 (50)	13 (50)	19 (42)	23 (50)	30 (50)	All (242)
Vegetation		52.8	63.6	64.9	78.9	81.9	68.1
High Salinity Tolerance		44.9	17.0	35.6	16.2	10.1	24.6
<i>Spartina cynosuroides</i>	big cordgrass	41.1	12.0	32.7	13.5	5.5	20.8
<i>Schoenoplectus robustus</i>	saltmarsh bulrush	3.5	1.1	1.1	0.8	3.2	1.9
<i>Juncus roemerianus</i>	black needle rush	0.3	2.3	1.1	0.6	1.4	1.1
<i>Juncus gerardii</i>	black grass	--	1.6	--	1.4	--	0.6
<i>Distichlis spicata</i>	spikegrass	--	--	0.7	--	--	0.1
<i>Taxodium distichum</i>	bald cypress	--	0.1	--	--	--	< 0.05
Medium Salinity Tolerance		1.1	6.5	6.9	5.1	1.4	4.2
<i>Schoenoplectus pungens</i> var. <i>pungens</i>	common threesquare	0.6	1.5	4.5	1.7	0.4	1.6
<i>Polygonum punctatum</i>	dotted smartweed	--	2.9	0.6	2.7	1.0	1.5
<i>Morella cerifera</i>	southern bayberry	--	1.8	0.9	--	--	0.6
<i>Typha angustifolia</i>	narrowleaf cattail	--	0.3	0.8	0.7	--	0.3
<i>Baccharis halimifolia</i>	eastern baccharis	0.4	--	--	--	--	0.1
<i>Lythrum lineare</i>	wand lythrum	--	--	0.2	--	--	< 0.05
<i>Toxicodendron radicans</i>	poison ivy	0.1	--	--	--	--	< 0.05
Low Salinity Tolerance		6.4	37.0	20.6	56.7	70.3	38.1
<i>Peltandra virginica</i>	green arrow arum	6.1	26.9	15.5	56.5	70.3	34.8
<i>Phragmites australis</i> *	common reed*	--	9.8	--	0.1	--	2.2
<i>Zizaniopsis miliacea</i>	giant cutgrass	--	0.3	5.1	--	--	0.9
<i>Juniperus virginiana</i>	Eastern red-cedar	0.3	--	--	--	--	0.1
<i>Mikania scandens</i>	climbing hempvine	--	--	0.1	--	--	< 0.05

Cover Type		Relative Cover %					
Salinity Tolerance		Site (No. of Plots)					
Species	Common Name	5 (50)	13 (50)	19 (42)	23 (50)	30 (50)	All (242)
No Salinity Tolerance		0.1	0.9	--	0.9	--	0.4
<i>Pinus rigida</i>	pitch pine	--	0.8	--	0.9	--	0.4
<i>Acer rubrum</i>	red maple	0.1	--	--	--	--	< 0.05
<i>Apios americana</i>	groundnut	--	0.1	--	--	--	< 0.05
<i>Teucrium canadense</i>	American germander	--	0.1	--	--	--	< 0.05
Unknown Salinity Tolerance		0.3	2.1	1.7	0.1	--	0.9
<i>Leersia</i> species	cutgrass species	--	1.3	0.5	--	--	0.4
Unknown plant	unknown plant	--	--	1.1	--	--	0.2
<i>Vitis</i> species	grape	--	0.8	--	--	--	0.2
Unknown Grass	unknown grass	0.3	--	0.1	0.1	--	0.1
Non-Vegetation		6.8	16.4	19.9	11.7	15.9	13.9
water	water	6.8	16.4	19.9	11.7	15.9	13.9
Incidental Cover		40.4	20.0	15.2	9.5	2.2	18.1
wrack & litter	wrack / litter	40.4	20.0	15.2	9.5	2.2	18.1

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NPS 333/128566, May 2015

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