2022

Virginia Marshbird Survey Annual Report: 2022

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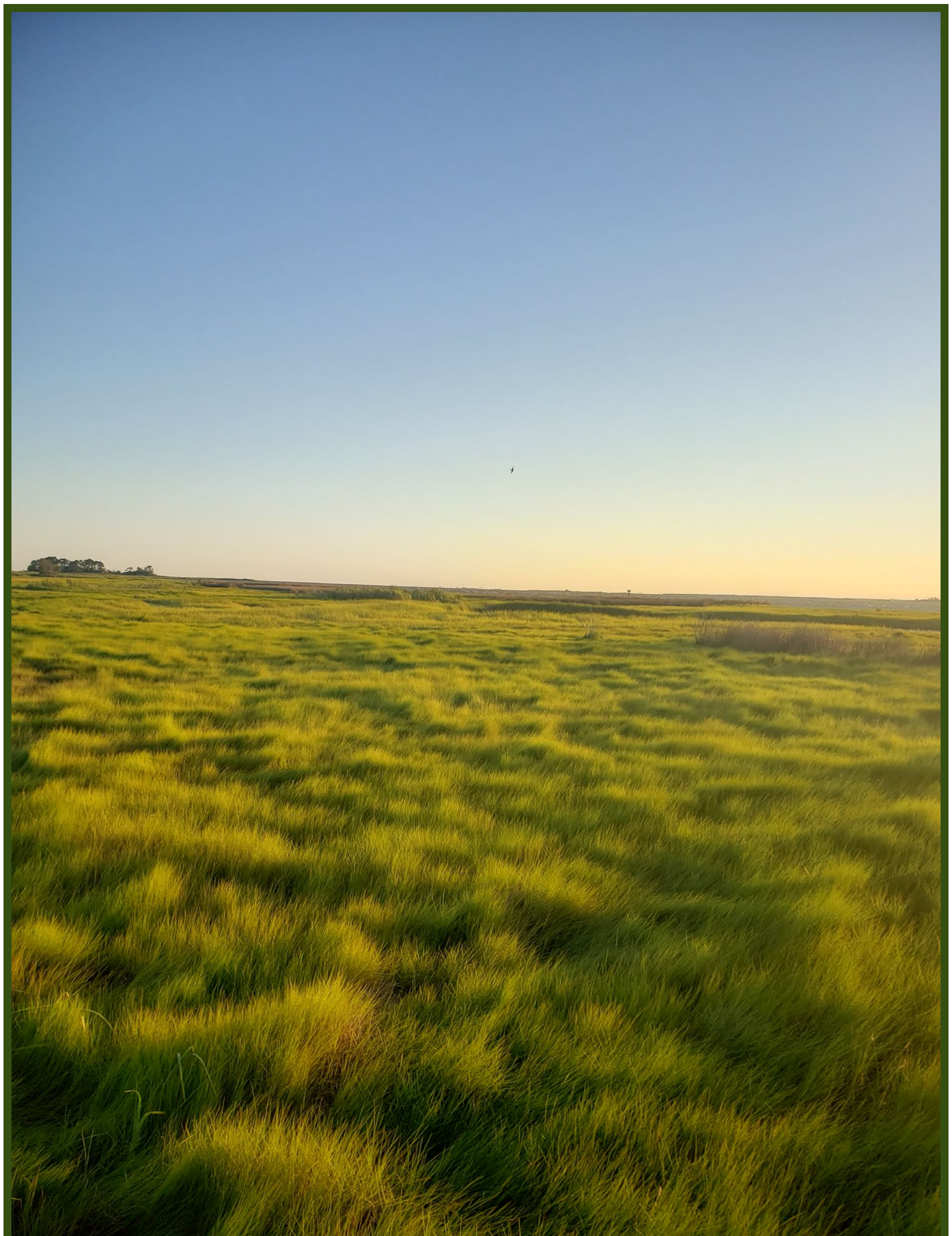

VIRGINIA MARSHBIRD SURVEY

ANNUAL REPORT: 2022

THE CENTER FOR CONSERVATION BIOLOGY

WILLIAM & MARY

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Project Partners:
Virginia Institute for Marine Resources
The Center for Conservation Biology
Virginia Department of Wildlife Resources
Virginia Department of Conservation and Recreation
The Nature Conservancy

Front Cover Image: Point Count location along the Deep Creek Route within a high marsh plant community that has persisted since before 1937. Photograph by Chance Hines.

The Center for Conservation Biology is an organization dedicated to discovering innovative solutions to environmental problems that are both scientifically sound and practical within today's social context. Our philosophy has been to use a general systems approach to locate critical information needs and to plot a deliberate course of action to reach what we believe are essential information endpoints.

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EXECUTIVE SUMMARY

Over the past thirty years many marsh-obligate birds have experienced catastrophic declines along the Atlantic Coast. The presumptive cause for these declines appears to be ongoing sea-level rise and associated drops in key demographic parameters related to repeated inundation. One of the natural processes believed to mitigate sea-level induced habitat loss is the establishment of new marsh area upslope of existing marshes as inundation reaches higher elevations. Although this process is believed to maintain some marsh function within suitable landscapes, the extent to which marsh migration compensates for the wildlife value of existing marshes remains unclear. We surveyed the breeding marsh-bird community within newly created (via marsh migration) and reference marshes to compare marsh-obligate bird occupancy patterns. We found that whether marshes were established before or after 1937 for bayside marshes and 1949 for seaside marshes was important in predicted occupancy for six of eight species with sufficient data. Marshes that were more recently created were negatively associated with occupancy for all six of those species but the relationship was significant for only two species, willet and seaside sparrow. We plan to continue surveying the same marsh network in 2023 as well as more difficult to access points further from the mainland edge to better understand how recent marsh creation affects occupancy patterns.

BACKGROUND

Context

The Chesapeake Bay is the largest estuary in North America and a variety of wildlife depend upon the extensive system of tidal marshes associated with the Bay for habitat (Stevenson et al 1985). Included among animals that use saltmarshes in the Chesapeake Bay are several species of birds adapted to tidal life that depend on marshes for nesting (i.e. marsh-obligates, Greenberg and Droege 1990, Greenberg and Maldonado 2006). Marsh-obligate species have experienced catastrophic declines along the Atlantic Coast over the last 30 years, including some areas of the Chesapeake Bay (Watts in review). Examples include the eastern black rail (*Laterallus jamaicensis jamaicensis)* and the saltmarsh sparrow (*Ammospiza caudacuta)*. Eastern black rails have experienced both a significant range contraction and a steep reduction in population size throughout their remaining range (ACJV 2020a). The form is now listed as federally threatened and is endangered in six states (including Virginia) along the Atlantic Coast. Without heroic intervention, the saltmarsh sparrow has been projected to go extinct during the 21st century and has been proposed for federal listing (ACJV 2020b).

The presumptive cause for the decline in salt marsh-nesting birds is ongoing sea-level rise and associated drops in key demographic parameters related to repeated inundation. One of the natural processes believed to mitigate sea-level induced habitat loss is the establishment of new marsh area upslope of existing marshes as inundation reaches higher elevations. Although this process is believed to maintain some marsh function within suitable landscapes, the extent to which marsh migration compensates for the wildlife value of existing marshes remains unclear.

Our overarching objectives are to 1) evaluate newly created marsh areas as habitat for the obligate breeding bird community and 2) compare the newly established community to reference bird communities within historic marshes.

METHODS

Survey Network

The focal area for the effort is the northern portion of Virginia's Eastern Shore (Figure 1) and includes Doe Creek Wildlife Management Area (WMA, Figure 2), Saxis WMA (Figure 2), and Mutton Hunk Fen Natural Area Preserve (Figure 3). Our aim was to compare marshes that had recently converted from upland to those that had existed for longer periods of time so we compared aerial photography from 1937 for the bayside of the eastern shore and 1949 for the seaside to aerial photography from 2021 using the VIMS shoreline change viewer (Hardaway et al. 2020). We identified high and low marsh patches that had converted from forest or agriculture as well as high marsh patches that converted to low marsh, high marsh patches that persisted since before the imagery, and low marsh patches that persisted since before the imagery. We also inspected each patch for the presence of historic agriculture use including abandoned fence lines and irrigation ditches.

Figure 1. Survey points in Accomack County, Virginia.

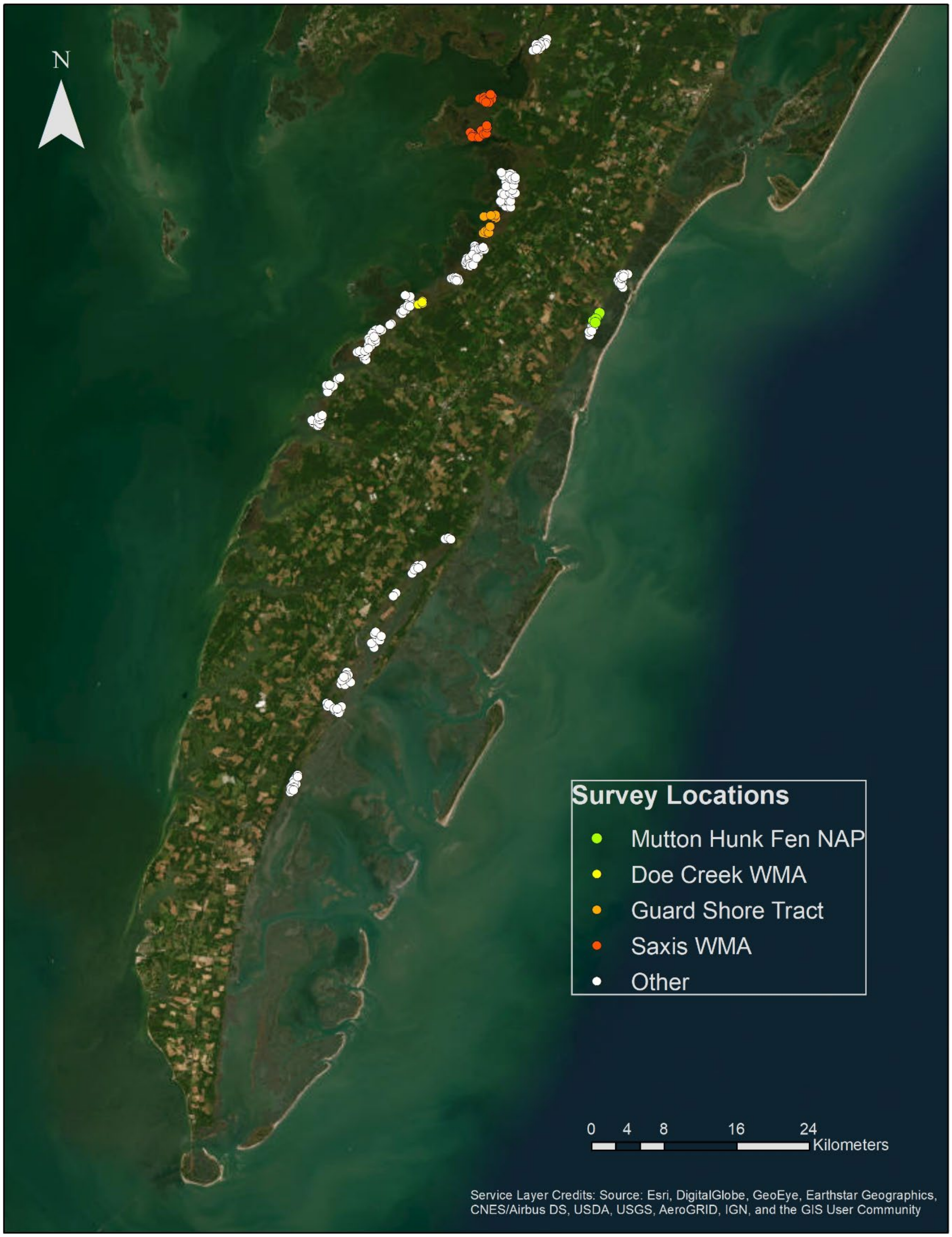

Figure 2. Survey points at Department of Wildlife Resources Properties in Accomack County, Virginia.

Figure 3. Survey points at Mutton Hunk Fen Natural Area Preserve in Accomack County, Virginia.

Survey Protocol

Bird Surveys – Surveys were conducted between sunrise and four hours after sunrise between April 15 and July 15. We conducted four rounds of surveys at each point with ≥10 days between surveys at each point. The first two survey periods and second two survey periods were conducted on either side of 10 June. We recorded environmental variables at each point that may have influenced detection including date (ordinal day of year), wind speed (Beaufort Wind Scale), and sky conditions (scale 1:5, clear, partly cloudy, cloudy, fog, drizzle). Surveys consisted of 5 minutes of silence followed by five 1-minute tracks of bird calls from each of black rail, Virginia rail, king rail, clapper rail and saltmarsh sparrow. We recorded the number of birds observed within three distance bands (0-50 m, 51-100 m, and >100 m) for each species heard or seen.

Vegetation Surveys – We surveyed vegetation between 22 June and 24 July. We estimated the percentage of upland, saltmarsh-terrestrial border, high marsh, low marsh, and open water habitats within 50 m of the survey point. We also estimated the percentage of habitat each plant species composed as well as the number of large living trees (>2 m high), short living trees (<2 m high), and snags within 50 m of the survey point.

Statistical Analyses

We estimated occupancy for 11 marsh-obligate species including American black duck (*Anas rubripes*), clapper rail (*Rallus crepitans*), king rail (*Rallus elegans*), Virginia rail (*Rallus limicola*), least bittern (*Ixobrychus exilis*), marsh wren (*Cistothorus palustris*), sedge Wren (*Cistothorus stellaris*), saltmarsh sparrow (*Ammospiza caudacuta*) and seaside sparrow (*Ammospiza maritima*). We report raw occupancy as the number of survey points a species was observed (any distance form observer)/total number of survey points for marsh obligate species. For species with robust data, we limit analyses to observations within 50 m to more accurately estimate effects of vegetation and other parameters on occupancy (Mackenzie et al. 2002) using the package 'unmarked' (Fiske and Chandler 2011) in Program R (R Core Team 2021). We constructed models that included environmental variables and observer identity as predictors within the detection function of our occupancy model, an intercept-only model that included no environmental predictors within the detection function for each marshbird species. After determining which predictors to include within the detection function, we constructed models that included those predictors as well as binary and continuous variables in the occupancy function. Binary predictors included whether the survey occurred on the bayside or seaside, whether the survey was located in a recently created marsh and whether the survey was located in an abandoned agricultural field. Continuous predictors included the percentage of each broad habitat type within 50 m of the survey point, the percentage of each plant species within 50 m of each habitat point, and the number of large living trees, small living trees, and snags within 50 m of the survey point. We also constructed models that included all combinations of binary predictors. We retained any single binary or combination of binary predictors if the model had a lower AIC score than the model containing only the intercept for the occupancy function. We then evaluated whether the addition of any single broad habitat, plant species or number of small, large, or dead trees resulted in a lower AIC. All continuous predictors were scaled.

RESULTS

During the 2022 field season, we conducted 952 surveys at 238 survey points (Appendix I). We detected a total of 21,162 birds, including 5,406 birds observed between 1- 50 m, 6,662 birds between 51-100 m, and 9,094 birds greater than 100 m away from the observer. On average, we observed 5.7 total birds and 2.9 species within 50 m of the observer per point count at marshes created since 1937 on the bayside of the eastern shore and those created since 1949 on the seaside of the eastern shore. We also observed 5.7 birds per point at marshes that persisted between the two time periods but the number of species was fewer at 2.5 birds per point.

We were unable to incorporate detection and other predictors of interest for three species including American black duck, black rail, and sedge wren because data was too sparse. Whether a marsh existed prior to 1937 on the bayside or 1949 on the seaside was included in the top model for six of eight species with sufficient data. The relationship between occupancy and recently created marsh was negative for all six species, though the effect was only significant for two species, including willet and seaside sparrow (See below for details).

American Black Duck – We recorded American black duck at 17 of 238 (4.4%) survey locations. Data was too sparse to incorporate detection rate and other predictors of interest. The majority of these survey locations were along three survey routes including Bagwell (4 points), Saxis South (5 points) and Saxis North (3 points, Appendix I).

Willet – We recorded willet at 123 of 238 (32.0%) survey locations. We included observer identity within the detection function for this species and willet were more likely to occur in marshes that existed prior to the 1937 and 1949 benchmarks (1.10 ±0.43, p=0.011) and marshes with greater proportions of tall *Sporobulus alterniflorus* (0.72±0.24, p=0.003). The proportion of saltmarsh terrestrial border within 50 m of the survey point was also included in the model for this species but the effect was not significant (-0.46±0.28, p=0.103).

Least Bittern – We recorded least bitterns at 36 of 238 (9.4%) survey locations. We included observer identity within the detection function for this species. Whether the marsh patch was located on Seaside or Bayside (Bayside: 23.38 ±120.7, p = 0.846), in a an area where agriculture was historically practiced (Agricultural evidence: 7.06±37.5, p = 0.851), whether the marsh recently created (Recently created β: -9.51±40.7, p=0.815), and the proportion of pine within 50 m (-24.34±160.7, p=0.880) were all included within the top-ranked model, but no effect was significant.

Clapper Rail – We recorded clapper rails at 189 of 238 (49.2%) survey locations. We included observer identity within the detection function for this species and clapper rails were more likely to occur in marshes on the bayside (2.38 ±0.91, p=0.008), where evidence of agriculture was absent (-1.73 ±0.82, p=0.031), where saltmarsh-terrestrial border was less abundant (-0.83 ±0.30, p=0.005) and common reed (*Phragmites australis*

australis) was less abundant (-0.58 ±0.25, p=0.020). Whether the marsh patch was recently created was also included in the model for this species but the effect was not significant (Recently created β: -0.89±58, p=0.121).

King Rail – King rail and clapper rails are known to hybridize and vocalizations of hybrids are difficult to distinguish as one species or the other. We recorded intermediate vocalizations like these as king rail and included these birds as king rails for analyses. We recorded king rails at 35 of 238 (14.7%) survey locations. We included observer identity within the detection function for this species and king rails were more likely to occupy marsh patches where black needlerush (*Juncus roemerianus*) was more abundant (4.64 ±2.14, p=0.030). Whether the marsh patch was recently created (Recently created: -2.76±2.47, p = 0.265), evidence of past agriculture was observed (past agriculture use: 5.01±3.02, p=0.096), and proportion of high marsh (-2.08 ±1.49, p=0.163) were also included in the model but their effects were not significant.

Virginia Rail – We recorded Virginia rails at 94 of 238 (39.5%) survey locations. We did not include any predictors within the detection function for this species. Virginia rails were more likely to occupy marsh patches on the bayside (2.18±0.78, p<0.001) and where black needlerush was more abundant (2.18 ±0.78, p<0.001).

Black Rail – We had a single black rail detection out of our 238 (0.4%) survey points so we were unable to incorporate detection and other predictors into our occupancy analysis. The one detection occurred at Free School Marsh at Saxis WMA on 1 June at 8:50 AM in response to a black rail vocalization track. This detection occurred in a marsh patch that existed prior to 1937, does not exhibit evidence of past agricultural use and is dominated by black needlerush.

Marsh Wren – We recorded marsh wrens at 79 of 238 (20.1%) survey locations. We included observer identity within the detection function for this species and marsh wrens were more likely to occur in marshes with higher percentages of black needlerush (0.82±0.23, p<0.001). Whether the marsh patch was located on the bayside and seaside was also included in the model for this species but the effect was not significant (Bayside β: 13.83±108.59, p=0.910).

Sedge Wren – We recorded a single sedge wren at one of 238 (0.4%) survey locations so we were unable to incorporate detection and other predictors into our occupancy analysis. The one detection occurred at a marsh patch that existed prior to 1937 along the Cattail Creek survey route (Appendix I) on 7 July. Prior to this detection a sedge wren had been observed off-survey at a hummock in Michael Marsh on 22 and 23 June.

Seaside Sparrow – We recorded seaside sparrows at 140 of 238 (36.5%) survey locations. We did not include any predictors within the detection function for this species. Seaside sparrows were more likely to occupy marsh patches on the bayside (4.118 ±0.67, p<0.001), lacking evidence of past agricultural use (1.60±0.46, p<0.001), existing since 1937 on bayside or 1949 on seaside (2.34±0.53, p=0.001), and higher percentages of blackneedlerush (0.95±0.30, p=0.001). The percentage of saltmarsh-terrestrial border was also included in the model for this species but the effect was not significant (-0.44±0.28, p=0.120).

Saltmarsh Sparrow – We recorded saltmarsh sparrows at 20 of 238 (5.2%) survey locations. We included observer identity within the detection function for this species. The number of large trees within 50 m of the survey point (-0.40±0.45, p=0.380) and whether the point was located in recently created marsh (newly created β: -4.24±5.64, p=0.452) were both included in the top model but their effects were not significant. This species overwinters in the study area and is known to depart wintering grounds as late as early June, but data was not sufficient to incorporate predictors when limiting analyses to the two later rounds (post June 10). However, saltmarsh sparrows were observed at five of 109 existing salt-marsh patches and five of 129 newly established saltmarsh patches prior to June 10 and at seven of 109 existing salt-marsh patches compared to two of 129 newly established saltmarsh patches after June 10.

FUTURE DIRECTION

We plan to conduct surveys during the 2023 breeding season at the same points that were surveyed during the 2022 breeding season as well as at additional points that we were unable to access on foot. The additional points will be accessed by boat and we hope the data collected at these additional points will allow more in-depth occupancy analyses for species that were data-deficient like the saltmarsh sparrow.

ACKNOWLEDGMENTS

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APPENDICES

Appendix I. Results of occupancy surveys at all survey points during the 2022 breeding season including the latitude, longitude, total number of species, number of birds observed ≤50 m, number of birds observed between 51 and 100 m, number of birds observed >100 m from the observer and the total number of birds observed at each point (total).

Route	Point	Latitude	Longitude	Species	≤50 m	51-100 m	>100 m	total	Property Owner/Manager
Buck Creek	BC-01	37.73146	-75.7969	19	23	22	16	61	Tom Mooney
Buck Creek	BC-02	37.73248	-75.7988	24	5	36	30	71	Tom Mooney
Buck Creek	BC-03	37.73462	-75.7981	21	12	27	35	74	Tom Mooney
Buck Creek	BC-04	37.7363	-75.7967	16	18	14	29	61	Tom Mooney
Buck Creek	BC-05	37.73667	-75.7994	19	21	22	41	84	Tom Mooney
Buck Creek	BC-06	37.73655	-75.8021	20	23	30	40	93	Tom Mooney
Buck Creek	BC-07	37.73747	-75.8054	15	16	9	37	62	Tom Mooney
Buck Creek	BC-08	37.73819	-75.8033	21	25	19	14	58	Tom Mooney
Buck Creek	BC-09	37.73827	-75.7980	22	14	27	47	88	Tom Mooney
Bell's North	BH-01	37.59091	-75.7182	30	5	58	36	99	Virginia Historic Conservation Properties LLC
Bell's North	BH-02	37.59207	-75.7150	29	3	38	36	77	Virginia Historic Conservation Properties LLC
Bell's North	BH-03	37.59080	-75.7126	31	6	18	60	84	Virginia Historic Conservation Properties LLC
Bell's North	BH-04	37.57054	-75.7413	16	2	26	37	65	Quinby Preserve Partners LLC
Bell's North	BH-05	37.57015	-75.7456	24	12	33	37	82	Quinby Preserve Partners LLC
Bell's North	BH-06	37.56811	-75.7449	24	6	17	58	81	Quinby Preserve Partners LLC
Bell's North	BH-07	37.56696	-75.749	20	23	27	26	76	Quinby Preserve Partners LLC
Bell's North	BH-08	37.56809	-75.7483	21	16	35	171	222	Quinby Preserve Partners LLC
Bell's North	BH-09	37.56404	-75.7511	22	3	39	22	64	Quinby Preserve Partners LLC
Bell's Neck	BK-01	37.54614	-75.7695	23	12	21	46	79	Bradley, Katherine Wachowiak
Bell's Neck	BK-02	37.54849	-75.7672	20	15	6	49	70	Bradley, Katherine Wachowiak
Bell's Neck	BK-03	37.51817	-75.7873	22	13	29	21	63	Gerard Hennessey
Bell's Neck	BK-04	37.51465	-75.7815	21	17	8	87	112	Gerard Hennessey

Route	Point	Latitude	Longitude	Species	≤50 m	51-100 m	>100 m	total	Property Owner/Manager
Bell's Neck	BK-05	37.51325	-75.7857	18	0	10	88	98	Gerard Hennessey
Bell's Neck	BK-06	37.51138	-75.7829	20	18	41	44	103	Gerard Hennessey
Bell's Neck	BK-07	37.51099	-75.7872	15	3	9	71	83	Gerard Hennessey
Bell's Neck	BK-08	37.50942	-75.7914	19	14	10	28	52	Gerard Hennessey
Bell's Neck	BK-10	37.51649	-75.7885	25	24	52	27	103	Gerard Hennessey
Bailey's Ridge	BR-01	37.85080	-75.6533	25	27	20	36	83	Jim Behrman
Bailey's Ridge	BR-02	37.85073	-75.6556	18	27	15	31	73	Jim Behrman
Bailey's Ridge	BR-03	37.85255	-75.6558	18	18	37	19	74	Jim Behrman
Bailey's Ridge	BR-04	37.85127	-75.6583	12	23	19	19	61	Jim Behrman
Bailey's Ridge	BR-05	37.85305	-75.6594	19	18	26	23	67	Jim Behrman
Bailey's Ridge	BR-06	37.85416	-75.6621	15	18	19	33	70	Jim Behrman
Bailey's Ridge	BR-07	37.85569	-75.6637	21	12	33	24	69	Jim Behrman
Bailey's Ridge	BR-08	37.85547	-75.6607	16	24	16	20	60	Jim Behrman
Bailey's Ridge	BR-09	37.85648	-75.6588	20	5	19	52	76	Jim Behrman
Bailey's Ridge	BR-10	37.85612	-75.6564	22	26	29	31	86	Jim Behrman
Bailey's Ridge	BR-11	37.85733	-75.6547	26	22	20	68	110	Jim Behrman
Bailey's Ridge	BR-12	37.85567	-75.6533	25	19	46	56	121	Jim Behrman
Brownsville	BV-01	37.45769	-75.8282	28	23	31	31	85	The Nature Conservancy
Brownsville	BV-02	37.45771	-75.8251	25	9	14	69	92	The Nature Conservancy
Brownsville	BV-03	37.45949	-75.8212	18	19	42	40	101	The Nature Conservancy
Brownsville	BV-04	37.45691	-75.8223	17	40	15	21	76	The Nature Conservancy
Brownsville	BV-05	37.45437	-75.8236	23	25	38	38	101	The Nature Conservancy
Brownsville	BV-06	37.45615	-75.8244	21	12	19	57	88	The Nature Conservancy
Brownsville	BV-07	37.45608	-75.8271	27	6	28	83	117	The Nature Conservancy
Brownsville	BV-08	37.45986	-75.8318	25	25	42	38	105	The Nature Conservancy
Brownsville	BV-09	37.46135	-75.8337	23	23	28	34	85	The Nature Conservancy
Brownsville	BV-10	37.46231	-75.8355	26	23	15	43	81	The Nature Conservancy
Brownsville	BV-11	37.45961	-75.8348	23	3	129	86	218	The Nature Conservancy
Bagwell	BW-01	37.81106	-75.6966	15	16	13	23	52	The Nature Conservancy
Bagwell	BW-02	37.80943	-75.6975	17	18	25	41	84	The Nature Conservancy

Route	Point	Latitude	Longitude	Species	≤50 m	51-100 m	>100 m	total	Property Owner/Manager
Bagwell	BW-03	37.80766	-75.6981	18	39	12	22	73	The Nature Conservancy
Bagwell	BW-04	37.80566	-75.6970	21	32	23	26	81	The Nature Conservancy
Bagwell	BW-05	37.80788	-75.6957	14	33	23	26	82	The Nature Conservancy
Bagwell	BW-06	37.80905	-75.6940	18	31	36	40	107	The Nature Conservancy
Bagwell	BW-07	37.81143	-75.6940	16	16	19	20	55	The Nature Conservancy
Bagwell	BW-08	37.81066	-75.6902	22	25	25	15	65	The Nature Conservancy
Bagwell	BW-09	37.80842	-75.6900	17	25	23	17	65	The Nature Conservancy
Bagwell	BW-10	37.80661	-75.6937	19	26	36	49	111	The Nature Conservancy
Bagwell	BW-11	37.80484	-75.6932	20	23	37	57	117	The Nature Conservancy
Bagwell	BW-12	37.80570	-75.6905	24	20	42	53	115	Brian Andrew Blake and James Warren Blake
Cattail Creek	CC-01	37.86804	-75.6503	15	13	17	29	59	Scott or Jeannette Delude
Cattail Creek	CC-06	37.86053	-75.6600	16	20	17	25	62	Tammy McCullough
Cattail Creek	CC-08	37.86428	-75.6518	14	15	19	33	67	Calvin Gladding
Cattail Creek	CC-09	37.86222	-75.6546	12	15	22	31	68	Tammy McCullough
Cattail Creek	CC-10	37.86094	-75.6512	22	22	24	28	74	Tammy McCullough
Cattail Creek	CC-11	37.86193	-75.6489	21	20	22	42	84	Calvin Gladding
Cattail Creek	CC-12	37.86670	-75.6538	11	16	9	22	47	Scott & Jeannette Delude
Cedar Point	CP-01	37.47839	-75.8119	26	30	36	66	132	Jim Payne
Cedar Point	CP-02	37.47646	-75.8175	23	30	18	36	84	Polk Kellam
Cedar Point	CP-03	37.47698	-75.8215	24	19	21	54	94	Polk Kellam
Cedar Point	CP-04	37.47852	-75.8190	21	23	24	27	74	Polk Kellam
Cedar Point	CP-05	37.48008	-75.8206	27	3	57	57	117	Polk Kellam
Cedar Point	CP-06	37.48084	-75.8183	25	16	33	49	98	Jim Payne
Cedar Point	CP-07	37.48271	-75.8187	23	5	36	51	92	Jim Payne
Cedar Point	CP-08	37.48208	-75.8165	21	14	44	30	88	Jim Payne
Cedar Point	CP-09	37.48308	-75.8152	21	21	23	48	92	Jim Payne
Cedar Point	CP-10	37.48409	-75.8167	16	17	13	32	62	Jim Payne
Cedar Point	CP-11	37.48441	-75.8140	18	14	78	21	113	Jim Payne
Cedar Point	CP-12	37.48666	-75.8158	16	43	49	68	160	Jim Payne
Cashville	CV-01	37.71090	-75.8292	23	27	27	33	87	Fishmor Enterprises LLC

Route	Point	Latitude	Longitude	Species	≤50 m	51-100 m	>100 m	total	Property Owner/Manager
Cashville	CV-02	37.71185	-75.8328	21	29	23	15	67	Fishmor Enterprises LLC
Cashville	CV-03	37.71164	-75.8359	21	37	18	29	84	Fishmor Enterprises LLC
Cashville	CV-04	37.70979	-75.8352	23	17	31	24	72	Salty Dog Properties LLC
Cashville	CV-05	37.70800	-75.8353	22	21	30	14	65	Fishmor Enterprises LLC
Cashville	CV-06	37.70850	-75.8330	25	24	29	19	72	Salty Dog Properties LLC
Cashville	CV-07	37.70615	-75.8347	27	30	27	16	73	Salty Dog Properties LLC
Cashville	CV-08	37.71717	-75.8228	25	6	26	25	57	Jack Murray
Cashville	CV-09	37.71624	-75.8248	23	20	9	9	38	Jack Murray
Cashville	CV-10	37.71528	-75.8224	26	38	25	14	77	
Cashville	CV-11	37.70676	-75.8307	22	48	30	17	95	
Cashville	CV-12	37.70518	-75.8306	29	35	65	25	125	
Deep Creek	DE-01	37.76742	-75.7609	17	22	14	21	57	Commonwealth of Virginia
Deep Creek	DE-02	37.76877	-75.7625	15	18	13	29	60	
Deep Creek	DE-04	37.77165	-75.7591	9	27	10	19	56	
Deep Creek	DE-05	37.77046	-75.7571	14	7	15	12	34	Accomack County
Deep Creek	DE-06	37.77215	-75.7563	13	22	17	17	56	Accomack County
Deep Creek	DE-07	37.77335	-75.7534	20	86	11	12	109	Accomack County
Deep Creek	DE-08	37.77382	-75.7557	15	26	21	31	78	Accomack County
Deep Creek	DE-09	37.77654	-75.7526	20	16	33	36	85	
Deep Creek	DE-10	37.77829	-75.7537	13	12	30	37	79	
Deep Creek	DE-11	37.78114	-75.7531	16	11	28	25	64	The Nature Conservancy
Deep Creek	DE-12	37.78184	-75.7578	11	31	18	9	58	The Nature Conservancy
Doe Creek	DK-01	37.79508	-75.7123	16	45	17	19	81	No owner Listed
Doe Creek	DK-02	37.79584	-75.7100	13	40	34	34	108	No owner Listed
Doe Creek	DK-03	37.79365	-75.7086	20	45	25	45	115	Roberty and Debra Teutsch
Doe Creek	DK-04	37.79336	-75.7070	24	38	25	30	93	Roberty and Debra Teutsch
Doe Creek	DK-05	37.79337	-75.7047	23	53	43	24	120	No owner Listed
Doe Creek	DK-06	37.79504	-75.7060	18	39	26	25	90	No owner Listed
Doe Creek	DK-07	37.79564	-75.7075	17	38	29	28	95	No owner Listed
Doe Creek	DK-08	37.77482	-75.7448	29	4	31	81	116	Bill Nickel

Route	Point	Latitude	Longitude	Species	≤50 m	51-100 m	>100 m	total	Property Owner/Manager
Doe Creek	DK-09	37.77564	-75.7408	27	36	47	64	147	Bill Nickel
Doe Creek	DK-10	37.77650	-75.7412	24	22	33	48	103	Bill Nickel
Doe Creek	DK-11	37.77745	-75.7408	21	22	30	36	88	Bill Nickel
Guard Shore	GS-01	37.84343	-75.6799	12	23	23	19	65	Commonweath of Virginia, DWR
Guard Shore	GS-02	37.84443	-75.6731	17	22	30	15	67	Commonweath of Virginia, DWR
Guard Shore	GS-03	37.84470	-75.6685	20	36	34	45	115	Bailey's Ridge LLC
Guard Shore	GS-04	37.84333	-75.6699	17	26	48	27	101	Bailey's Ridge LLC
Guard Shore	GS-05	37.84223	-75.6681	19	27	17	62	106	Bailey's Ridge LLC
Guard Shore	GS-06	37.83575	-75.6737	27	35	30	38	103	James Keelen
Guard Shore	GS-07	37.83245	-75.6763	22	17	25	41	83	
Guard Shore	GS-08	37.83219	-75.6788	15	23	27	31	81	
Guard Shore	GS-09	37.83068	-75.6808	19	33	23	41	97	
Guard Shore	GS-10	37.83007	-75.6780	20	19	29	50	98	
Guard Shore	GS-11	37.83083	-75.6749	27	16	54	55	125	Gopa Ten LLC
Klondike	KL-01	37.68792	-75.8401	27	17	44	69	130	Gerald Negley, yuling Deng
Klondike	KL-02	37.68695	-75.8436	15	36	28	32	96	Gerald Negley, yuling Deng
Klondike	KL-03	37.68470	-75.8423	20	23	29	22	74	Gerald Negley, yuling Deng
Klondike	KL-04	37.68605	-75.8405	27	21	38	44	103	Gerald Negley, yuling Deng
Klondike	KL-05	37.68270	-75.8442	18	14	26	40	80	Kenneth Timmons
Klondike	KL-06	37.68201	-75.8489	20	30	31	39	100	Kenneth Timmons
Klondike	KL-08	37.68293	-75.8468	22	7	23	36	66	Kenneth Timmons
Klondike	KL-09	37.68092	-75.8470	19	24	24	29	77	Kenneth Timmons
Klondike	KL-10	37.67949	-75.8444	21	18	17	45	80	Kenneth Timmons
Klondike	KL-11	37.68135	-75.8424	18	13	24	21	58	Kenneth Timmons
Marks	MA-01	37.82071	-75.6892	12	15	17	22	54	The Nature Conservancy
Marks	MA-02	37.81902	-75.6888	16	18	24	39	81	The Nature Conservancy
Marks	MA-03	37.81720	-75.6889	15	16	16	29	61	The Nature Conservancy
Marks	MA-04	37.81387	-75.6910	10	23	19	36	78	The Nature Conservancy
Marks	MA-05	37.81536	-75.6882	11	27	19	38	84	
Marks	MA-06	37.81101	-75.6870	15	30	17	28	75	Rantz Properties

Route	Point	Latitude	Longitude	Species	≤50 m	51-100 m	>100 m	total	Property Owner/Manager
Marks	MA-07	37.81263	-75.6853	20	23	26	32	81	
Marks	MA-08	37.81585	-75.6843	22	40	29	20	89	
Marks	MA-09	37.81824	-75.6853	22	21	25	24	70	Sara Eser & John Leche II
Marks	MA-10	37.81866	-75.6827	24	21	27	33	81	Sara Eser & John Leche II
Marks	MA-11	37.81952	-75.6807	30	14	45	41	100	Thomas Cross
Marks	MA-12	37.81763	-75.6797	26	21	29	39	89	Sara Eser & John Leche II
Marks	MA-13	37.82353	-75.6867	23	16	21	37	74	
Marks	MA-14	37.82177	-75.6869	26	31	16	55	102	
Midchesconessex	MC-01	37.75454	-75.7813	21	18	24	41	83	Terence & Judith Malarkey
Midchesconessex	MC-02	37.75561	-75.7832	21	15	18	53	86	
Midchesconessex	MC-03	37.75352	-75.7836	17	15	21	16	52	
Midchesconessex	MC-04	37.75313	-75.7862	24	39	20	19	78	
Midchesconessex	MC-05	37.75175	-75.7906	19	13	22	21	56	Jayne & Jeanne Collier
Midchesconessex	MC-06	37.75486	-75.787	15	38	25	27	90	no information available
Midchesconessex	MC-07	37.75375	-75.7892	17	18	19	30	67	
Midchesconessex	MC-08	37.75976	-75.7715	25	50	61	61	172	James & Georgene Palmer; Jeffrey & Tina Tranauskas
Midchesconessex	MC-09	37.75863	-75.7733	19	29	51	78	158	James & Georgene Palmer; Jeffrey & Tina Tranauskas
Midchesconessex	MC-10	37.75805	-75.7682	27	17	29	36	82	James & Georgene Palmer; Jeffrey & Tina Tranauskas
Mutton Hunk	MH-01	37.76796	-75.5656	26	124	25	133	282	Comonwealth of Virginia, DCR
Mutton Hunk	MH-02	37.76610	-75.5667	30	34	38	41	113	Comonwealth of Virginia, DCR
Mutton Hunk	MH-03	37.76480	-75.5680	18	37	23	26	86	Comonwealth of Virginia, DCR
Mutton Hunk	MH-04	37.76327	-75.5692	21	33	31	32	96	Comonwealth of Virginia, DCR
Mutton Hunk	MH-05	37.76200	-75.5714	23	22	54	11	87	Comonwealth of Virginia, DCR
Mutton Hunk	MH-06	37.76050	-75.5697	28	24	33	79	136	David Larson & Janis Turner
Mutton Hunk	MH-07	37.76011	-75.5718	26	69	50	15	134	David Larson & Janis Turner
Mutton Hunk	MH-08	37.75794	-75.5708	21	26	18	82	126	David Larson & Janis Turner
Mutton Hunk	MH-09	37.75794	-75.5732	27	65	37	22	124	David Larson & Janis Turner
Mutton Hunk	MH-10	37.75391	-75.5729	18	32	45	48	125	Raymond Edwards & Alexander Boyd
Mutton Hunk	MH-11	37.75340	-75.5758	12	28	32	28	88	Raymond Edwards & Alexander Boyd
Mutton Hunk	MH-12	37.75054	-75.5752	17	16	43	41	100	Raymond Edwards & Alexander Boyd

Route	Point	Latitude	Longitude	Species	≤50 m	51-100 m	>100 m	total	Property Owner/Manager
Michael's Marsh	MI-01	37.87229	-75.6489	20	10	20	43	73	Poulson LLC
Michael's Marsh	MI-02	37.87413	-75.6489	18	7	21	17	45	Poulson LLC
Michael's Marsh	MI-03	37.87270	-75.6518	9	13	9	4	26	Poulson LLC
Michael's Marsh	MI-04	37.87526	-75.6544	20	16	20	12	48	Commonwealth of VA
Michael's Marsh	MI-05	37.87631	-75.6514	12	11	15	20	46	Poulson LLC
Michael's Marsh	MI-06	37.87719	-75.6539	20	17	16	7	40	Commonwealth of VA
Michael's Marsh	MI-07	37.87644	-75.6574	17	25	12	21	58	Commonwealth of VA
Michael's Marsh	MI-10	37.87466	-75.6569	11	17	15	13	45	Commonwealth of VA
Modest Town	MT-01	37.79514	-75.5457	17	20	27	45	92	Tom Young & Cedar Creek Real Estate Investments LLC
Modest Town	MT-02	37.79730	-75.5454	18	20	41	32	93	Tom Young & Cedar Creek Real Estate Investments LLC
Modest Town	MT-03	37.79838	-75.5435	14	35	49	25	109	Tom Young & Cedar Creek Real Estate Investments LLC
Modest Town	MT-04	37.79835	-75.5411	12	18	46	54	118	Tom Young & Cedar Creek Real Estate Investments LLC
Modest Town	MT-05	37.79846	-75.5373	12	18	21	62	101	Tom Young & Cedar Creek Real Estate Investments LLC
Modest Town	MT-06	37.79646	-75.5418	20	29	38	68	135	Tom Young & Cedar Creek Real Estate Investments LLC
Modest Town	MT-07	37.79525	-75.5432	26	10	68	58	136	Tom Young & Cedar Creek Real Estate Investments LLC
Modest Town	MT-08	37.7927	-75.5429	16	28	56	38	122	Tom Young & Cedar Creek Real Estate Investments LLC
Modest Town	MT-09	37.79045	-75.544	24	17	35	71	123	Tom Young & Cedar Creek Real Estate Investments LLC
Modest Town	MT-10	37.78789	-75.5421	17	38	57	91	186	Tom Young & Cedar Creek Real Estate Investments LLC
Modest Town	MT-11	37.79195	-75.5461	15	10	25	59	94	Tom Young & Cedar Creek Real Estate Investments LLC
Modest Town	MT-12	37.79366	-75.5473	16	29	35	40	104	Tom Young & Cedar Creek Real Estate Investments LLC
Quinby	QB-01	37.54824	-75.7324	29	26	50	29	105	
Quinby	QB-02	37.54662	-75.734	32	44	31	53	128	
South Chesconessex	SC-01	37.74942	-75.7888	28	12	39	70	121	Tom Mooney
South Chesconessex	SC-02	37.74799	-75.7899	24	19	30	74	123	Tom Mooney
South Chesconessex	SC-03	37.74730	-75.7873	23	24	30	84	138	Tom Mooney
South Chesconessex	SC-04	37.74517	-75.7871	17	17	37	54	108	Tom Mooney
South Chesconessex	SC-05	37.74390	-75.7901	23	19	37	43	99	Tom Mooney
South Chesconessex	SC-06	37.74214	-75.7921	20	22	37	29	88	Tom Mooney
South Chesconessex	SC-07	37.74021	-75.7944	23	6	30	41	77	Tom Mooney
South Chesconessex	SC-08	37.74292	-75.7944	16	20	23	41	84	Tom Mooney

Route	Point	Latitude	Longitude	Species	≤50 m	51-100 m	>100 m	total	Property Owner/Manager
South Chesconessex	SC-09	37.74459	-75.7925	20	23	13	43	79	Tom Mooney
South Chesconessex	SC-10	37.74597	-75.7906	17	16	28	34	78	Tom Mooney
South Chesconessex	SC-11	37.74633	-75.7932	21	17	26	19	62	Tom Mooney
South Chesconessex	SC-12	37.74811	-75.7940	23	15	20	36	71	Tom Mooney
Saxis North	SN-01	37.93558	-75.6843	19	11	22	40	73	Commonwealth of Virginia, DWR
Saxis North	SN-02	37.93691	-75.6801	13	48	19	5	72	Commonwealth of Virginia, DWR
Saxis North	SN-03	37.93581	-75.6780	18	30	13	23	66	Commonwealth of Virginia, DWR
Saxis North	SN-04	37.93433	-75.6802	8	32	28	6	66	Lance and Charles Fisher
Saxis North	SN-05	37.93269	-75.6781	23	41	15	14	70	Commonwealth of Virginia, DWR
Saxis North	SN-06	37.93252	-75.6753	20	19	14	43	76	Lance and Charles Fisher
Saxis North	SN-07	37.93467	-75.6751	18	17	20	55	92	Commonwealth of Virginia, DWR
Saxis North	SN-08	37.93510	-75.6722	16	33	21	18	72	Commonwealth of Virginia, DWR
Saxis North	SN-09	37.93716	-75.6744	14	26	29	15	70	Commonwealth of Virginia, DWR
Saxis North	SN-11	37.93904	-75.6733	18	26	33	40	99	Jon and Nicole Van Doren
Saxis South	SS-01	37.90915	-75.6935	11	18	28	18	64	
Saxis South	SS-02	37.90713	-75.6905	13	12	13	31	56	
Saxis South	SS-03	37.90556	-75.6916	14	12	16	19	47	Commonwealth of Virginia, DWR
Saxis South	SS-04	37.90574	-75.6888	14	8	19	18	45	Commonwealth of Virginia, DWR
Saxis South	SS-05	37.90524	-75.685	18	34	45	18	97	Commonwealth of Virginia, DWR
Saxis South	SS-06	37.91076	-75.6827	24	13	23	38	74	
Saxis South	SS-07	37.90866	-75.6825	19	24	27	28	79	
Saxis South	SS-08	37.90782	-75.6799	13	27	15	23	65	
Saxis South	SS-09	37.90845	-75.6778	14	19	19	26	64	
Saxis South	SS-10	37.91098	-75.6780	16	26	18	31	75	
Saxis South	SS-11	37.91302	-75.6767	23	27	30	37	94	
Saxis South	SS-12	37.91479	-75.6773	12	26	22	8	56	David Hunter & Charlene Isle Montgomery
Webb's Marsh	WB-01	37.40588	-75.8643	29	14	37	126	177	Mill Creek Retreat
Webb's Marsh	WB-02	37.40418	-75.8642	25	16	27	109	152	Mill Creek Retreat
Webb's Marsh	WB-03	37.40351	-75.8665	23	26	42	83	151	Mill Creek Retreat
Webb's Marsh	WB-04	37.40163	-75.8682	27	66	39	26	131	Dimitrios and Nicholas Hionis

Route	Point	Latitude	Longitude	Species	≤50 m	51-100 m	>100 m	total	Property Owner/Manager
Webb's Marsh	WB-05	37.39928	-75.8682	28	18	22	96	136	Dimitrios and Nicholas Hionis
Webb's Marsh	WB-07	37.39759	-75.8698	22	8	18	36	62	The Nature Conservancy
Webb's Marsh	WB-09	37.39602	-75.8714	25	17	34	33	84	The Nature Conservancy
Webb's Marsh	WB-10	37.39416	-75.8710	25	20	29	47	96	The Nature Conservancy
Webb's Marsh	WB-11	37.39360	-75.8688	20	18	16	44	78	The Nature Conservancy
Webb's Marsh	WB-12	37.39229	-75.8718	26	4	33	52	89	The Nature Conservancy