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Parker River National Wildlife Refuge: 2021 Report

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Methods

To measure the effectiveness of runneling in the Parker River National Wildlife Refuge (PRNWR), baseline assessments of hydrology, vegetation, water chemistry, and avian biodiversity were conducted in 2020 and 2021. In 2020, seven study sites were identified on Plum and Pine Island, consisting of three sites to be runnelled, two sites designated as no-action control sites, and two sites that naturally breached (Figures 1a and b). For comparison of the hydrology of natural pools to the other sites, two small, natural pools were selected (Figures 1b). At each runnel, control, and natural breach site, two 50m transects were run along the pool edge on opposing sides. Five locations along each transect were selected by a random number generator and a 0.5m² quadrat (plot) was placed on the marsh platform and then flipped into the pool. Within each plot, visual percent cover of vegetation by species was estimated and a water sample was drawn using a sipper and preserved in a zinc acetate solution to be later tested for sulfides. In the field, water samples were also analyzed for salinity (ppm) and redox (Eh). For hydrology assessments, pressure transducers (Onset, Model U20L) were used as water level recorders (WLRs) and housed in PVC cases and mounted to fenceposts set in creeks (2) and pools (9) at each of the nine sites. To account for avian presence and diversity, point counts were conducted at each site: once in 2020 and twice in 2021. Although saltmarsh sparrows were the primary species of concern, all birds observed or heard in a five-minute period within a 100m radial plot in each treatment area (3 runnel, 2 control, and 2 natural breaches) as well as the megapool located on Refuge Road on Plum Island were recorded.

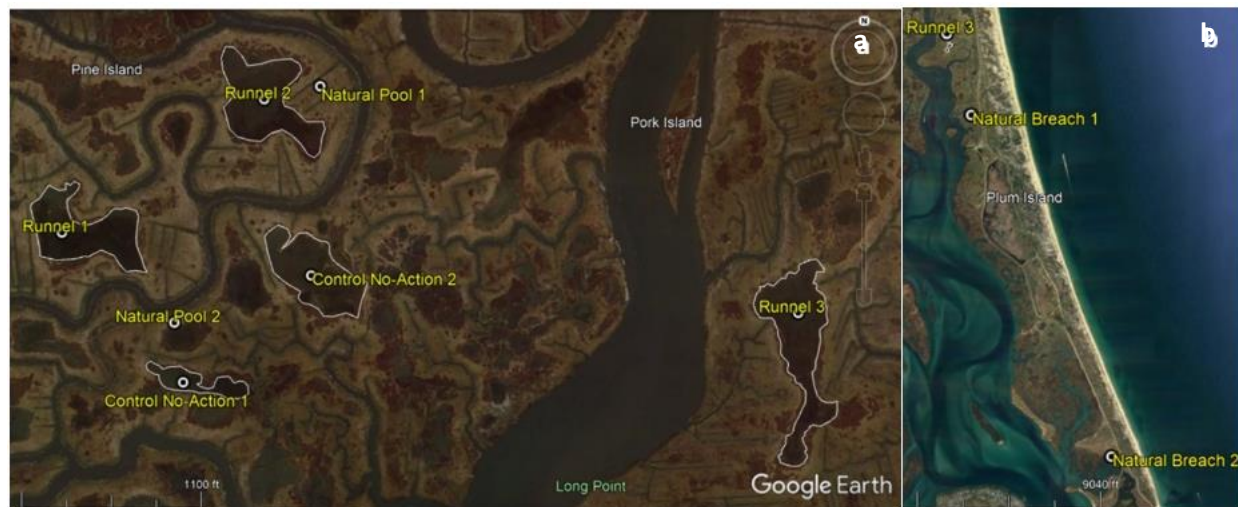


Figure 1: Seven study sites at Parker River National Wildlife Refuge designated as runnels, controls, or natural breaches, and two natural pools.

Results

Hydrology

In 2020, WLRs (11) were placed at each of the nine study sites and two more in creeks (Plum and Pine Islands) from 25 August to 6 November. The same 11 WLRs were replaced from 30 to April and 11 June 2021 at the same sites. For analysis, one lunar cycle per year was used to find mean high tide (HT) and low tide (LT) as well as the percentage of time the marsh was flooded. In 2020, mean HT was higher and the marsh was flooded more often than in 2021, however, there were more and higher tides in the early fall verses the early summer (Figures 2 and 3). Once the runnels have been established in early 2022, WLRs will be deployed from May to October to be able to compare water elevation profiles before and after remediation.

Table 1: Flooding frequency, and average high (HT) and low (LT) tides +/- standard error of the mean from data gathered in 2020 and 2021 at the 11 study sites at Parker River National Wildlife Refuge.

Site	Flood Frequency (%)		2020				2021			
			2020		2021		2021		2021	
	2020	2021	Mean HT (m)		Mean LT		Mean HT		Mean LT	
Creek (East)	48	22	1.418	± 0.033	-0.166	± 0.002	1.320	± 0.030	-0.247	± 0.002
Creek (West)	45	18	1.436	± 0.033	0.210	± 0.003	1.330	± 0.030	-0.047	± 0.004
Runnel (West)	100	32	1.647	± 0.009	1.620	± 0.004	1.558	± 0.008	1.535	± 0.005
Runnel (North)	100	100	1.640	± 0.009	1.614	± 0.004	1.598	± 0.010	1.571	± 0.005
Runnel (East)	40	28	1.542	± 0.017	1.500	± 0.009	1.477	± 0.017	1.431	± 0.009
Control (South)	100	69	1.550	± 0.016	1.483	± 0.003	1.471	± 0.012	1.434	± 0.004
Control (North)	76	24	1.594	± 0.011	1.561	± 0.003	1.544	± 0.011	1.505	± 0.005
Natural Breach (North)	36	18	1.393	± 0.027	1.212	± 0.012	1.372	± 0.022	1.283	± 0.003
Natural Breach (South)	55	25	1.472	± 0.029	1.220	± 0.001	1.305	± 0.030	1.070	± 0.001
Natural Pool (North)	61	16	1.530	± 0.019	1.476	± 0.011	1.408	± 0.019	1.354	± 0.013

Natural Pool (South) 85 47 1.539 ± 0.015 1.493 ± 0.007 1.443 ± 0.014 1.406 ± 0.009

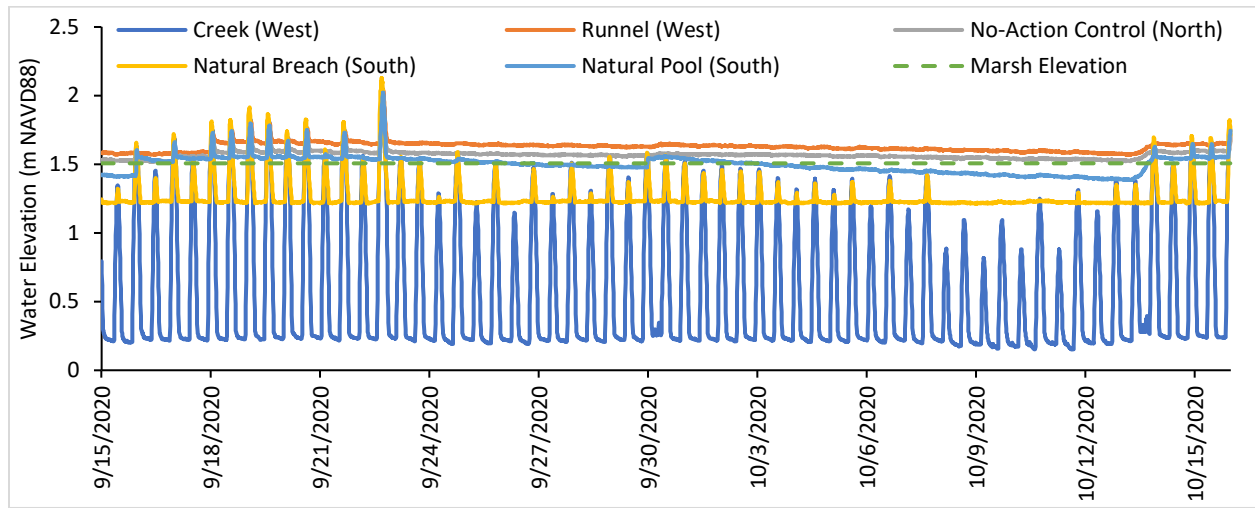


Figure 2: One lunar month tidal cycle in 2020 for one set of study sites (runnel, control, breach, and pool) at the Parker River National Wildlife Refuge with a creek tidal cycle and average marsh elevation.

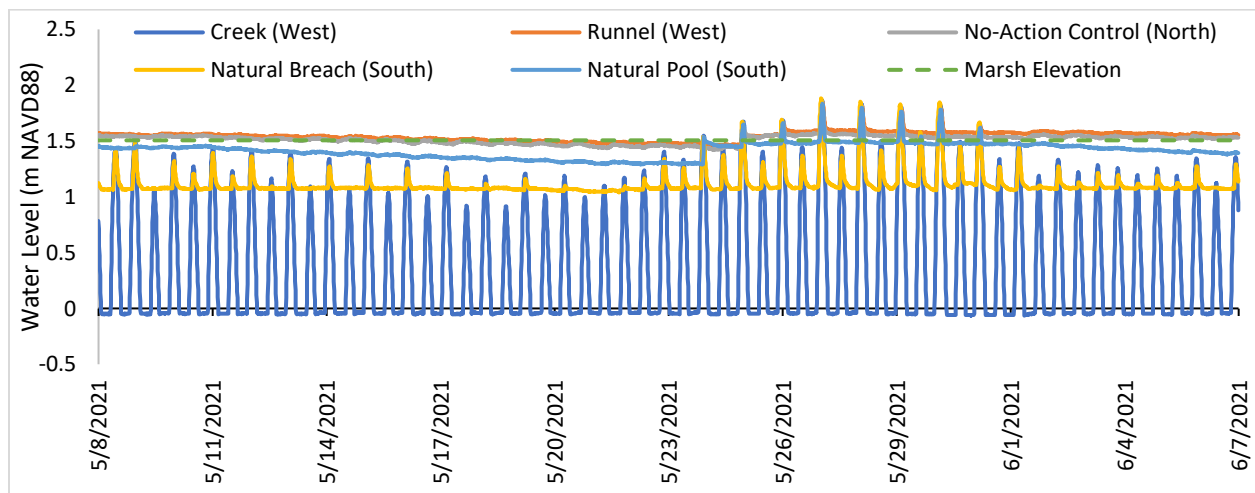


Figure 3: One lunar month tidal cycle in 2021 for one set of study sites (runnel, control, breach, and pool) at the Parker River National Wildlife Refuge with a creek tidal cycle and average marsh elevation.

Vegetation Analysis

Vegetation surveys in 2020 were unable to be completed until early October, but in 2021, were able to be completed by early August. Natural breaches not only had the greatest amount of vascular vegetation (Figures 4 and 5), but also significantly higher species richness (5.4 ± 0.4 species) than runnel sites (3.4 ± 0.4 species) or control sites (2.6 ± 0.4 species) ($F_2 = 10.6$; $p > 0.001$). During the study, the natural breaches continued to breach, which is evident by the reducing flooding and increased vascular plant coverage in 2021. Once runnels are established, vegetation surveys will be conducted again and compared to baseline data in 2020 and 2021 to determine the impact of runneling. From 2020 and

2021, little change was seen in plant coverage at control or runnels as they continue to lack vascular vegetation.

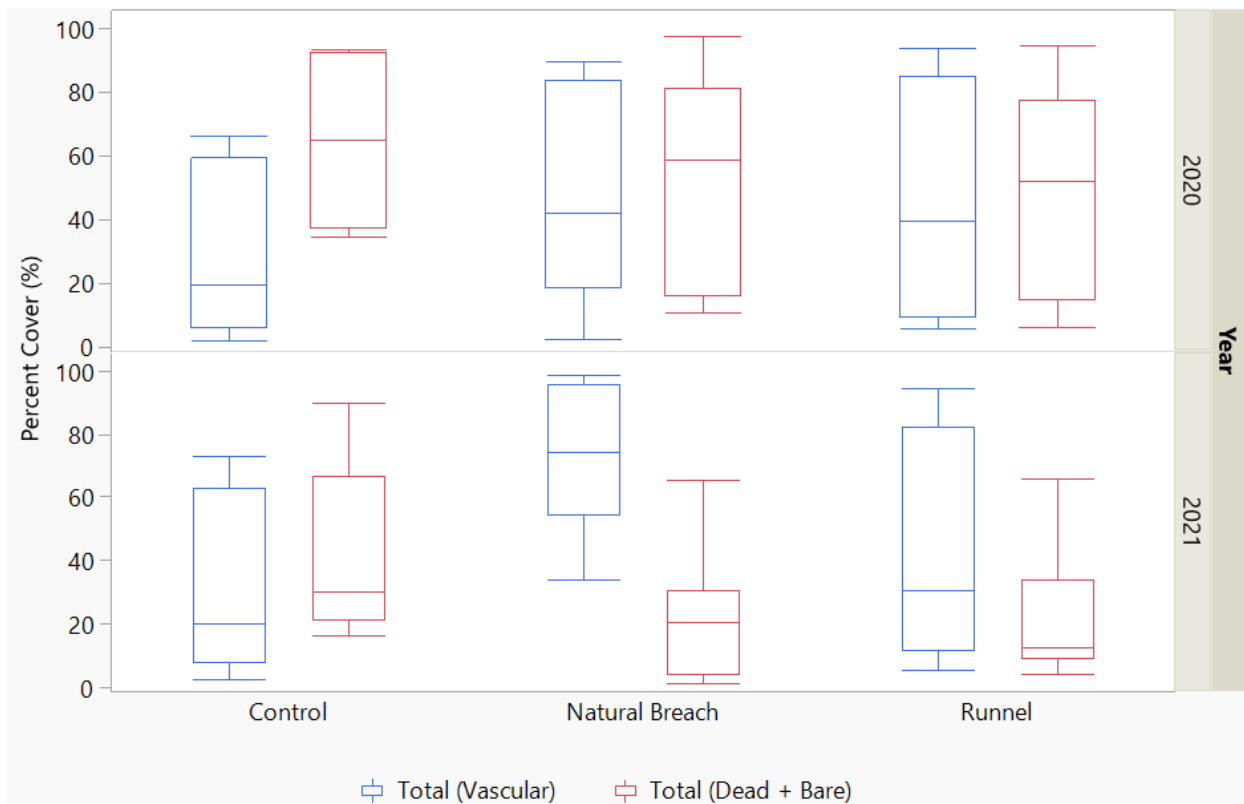


Figure 4: Total percent cover of vascular plants and dead/bare ground in the three types of study sites (no-action control, natural breach, and runnel) at the Parker River National Wildlife Refuge in 2020 and 2021.

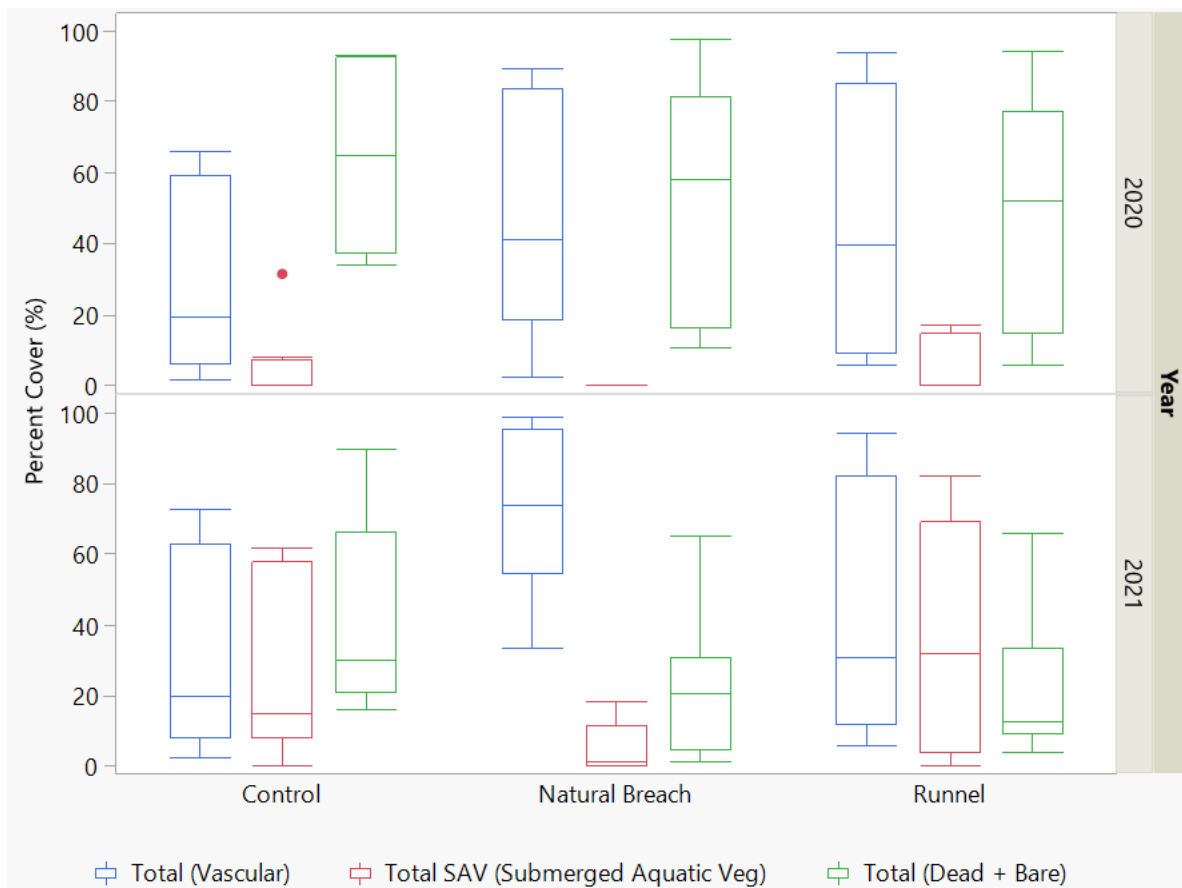


Figure 5: Total percent cover of vascular plants, submerged vegetation, and dead/bare ground in the three types of study sites (no-action control, natural breach, and runnel) at the Parker River National Wildlife Refuge in 2020 and 2021.

Water Chemistry

Although water samples were collected in 2020, samples were corrupted in the lab, so only data from 2021 was used for analysis. Although pH levels were seemingly lower at natural breaches in both the pool and on the platform (Figure 6), the differences were not significant between sites ($F_2=1.7$; $p=0.2$). In addition to the lower pH, natural breaches the sulfides at those sites in both the pool and platform were lower (Figure 7) than the other sites, making it a more favorable site for grasses to grow.

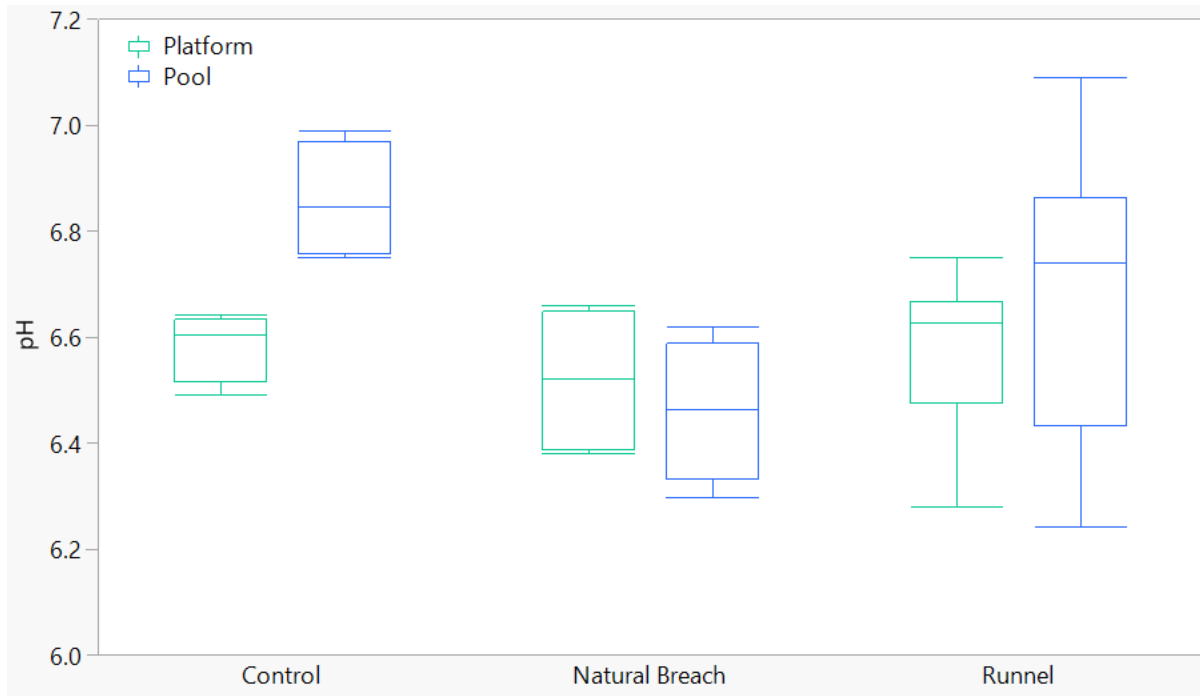


Figure 6: Spread of pH levels in pools and on the marsh platform at the three types of study sites (controls, natural breaches, and runnels) at Parker River National Wildlife Refuge in 2021.

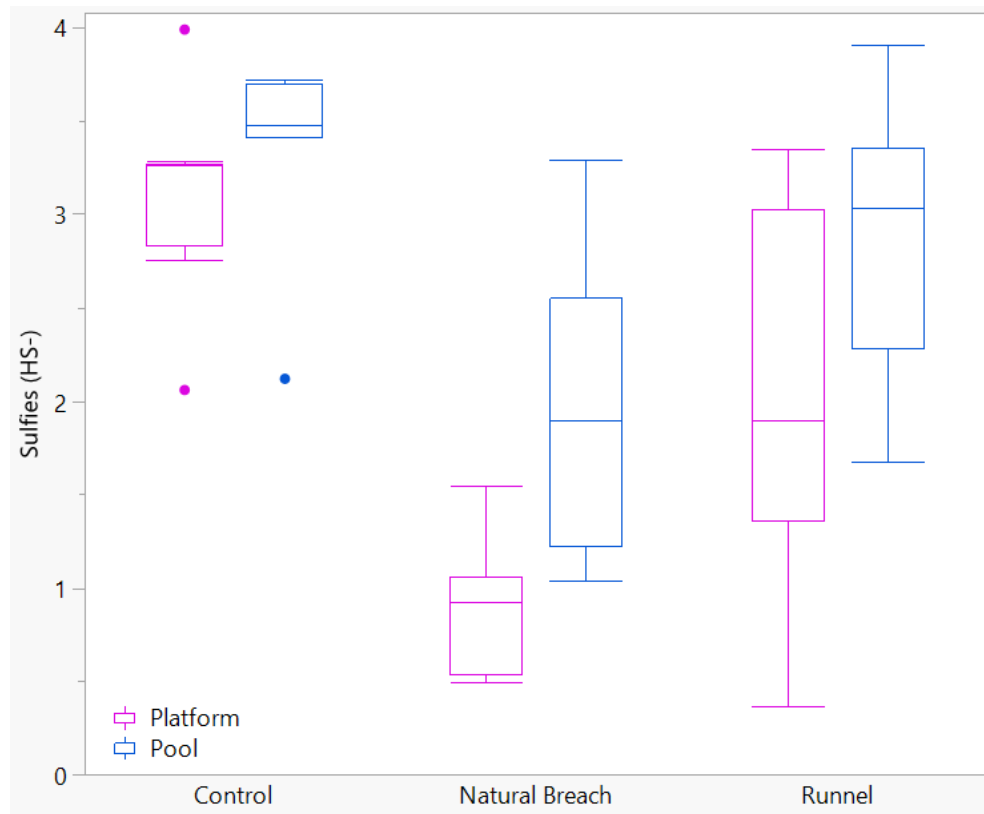


Figure 7: Dissolved hydrogen sulfides in pools and on the marsh platform at the three types of study sites (controls, natural breaches, and runnels) at Parker River National Wildlife Refuge in 2021.

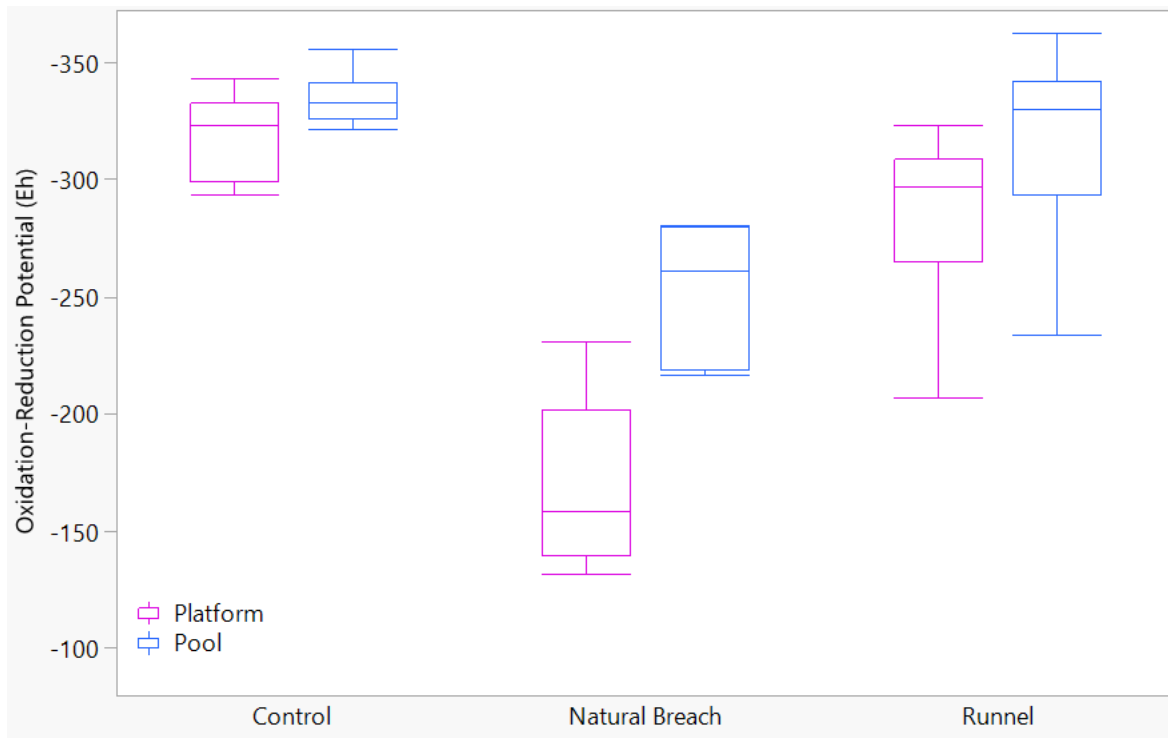


Figure 8: Oxidation-reduction potential in pools and on the marsh platform at the three types of study sites (controls, natural breaches, and runnels) at Parker River National Wildlife Refuge in 2021.

Birding Point Counts

Due to constraints, avian point counts in 2020 did not occur until September, after the focal breeding season, and only four of the sites were accessible during the morning hours. In 2020, a total of 15 species (73 birds) were observed at the four sites, most of which were American Black Ducks (23) and Greater Yellowlegs (25) and only one unidentifiable sparrow flew by. In 2021, 24 species (S) were detected, primarily willets (51), sparrows (13 saltmarsh sparrows, 11 seaside sparrows, 11 Nelson's sparrows, 2 field sparrows, and 13 unidentifiable sparrows), red-winged blackbirds (20), killdeer (19), and sandpipers (7 semipalmated and 4 unknown). The overall Shannon Diversity Index (H) for 2020 was 1.9 with an evenness (J) of 0.7 whereas, in 2021, the overall Shannon Diversity Index was 2.4 for June and 2.2 for July with over 150 birds observed and an evenness of 0.8 for each month. Biodiversity varied across sites and years (Table 2). Point counts will be conducted again in 2022 once runnels have been established.

Table 2: Shannon Diversity Index (H), species richness (S), and species evenness (J) at the different study sites at Parker River National Wildlife Refuge from 2020 and 2021 avian point counts.

Site	2020			June 2021			July 2021		
	H	S	J	H	S	J	H	S	J
<i>Big Pool</i>	0.892	4	0.643	1.808	8	0.869	1.256	6	0.701
<i>Natural Breach 1</i>	1.277	7	0.656	1.639	7	0.842	1.897	9	0.864
<i>Natural Breach 2</i>	0.637	2	0.918	1.736	7	0.892	1.439	5	0.894
<i>No-Action Control 1</i>	-	-	-	1.885	8	0.907	1.848	8	0.888

<i>No-Action Control 2</i>	-	-	-	1.586	6	0.885	2.032	9	0.925
<i>Runnel 1</i>	-	-	-	1.601	6	0.893	1.75	8	0.842
<i>Runnel 2</i>	-	-	-	1.809	7	0.93	2.081	10	0.904
<i>Runnel 3</i>	1.311	5	0.815	1.529	7	0.876	1.691	6	0.944