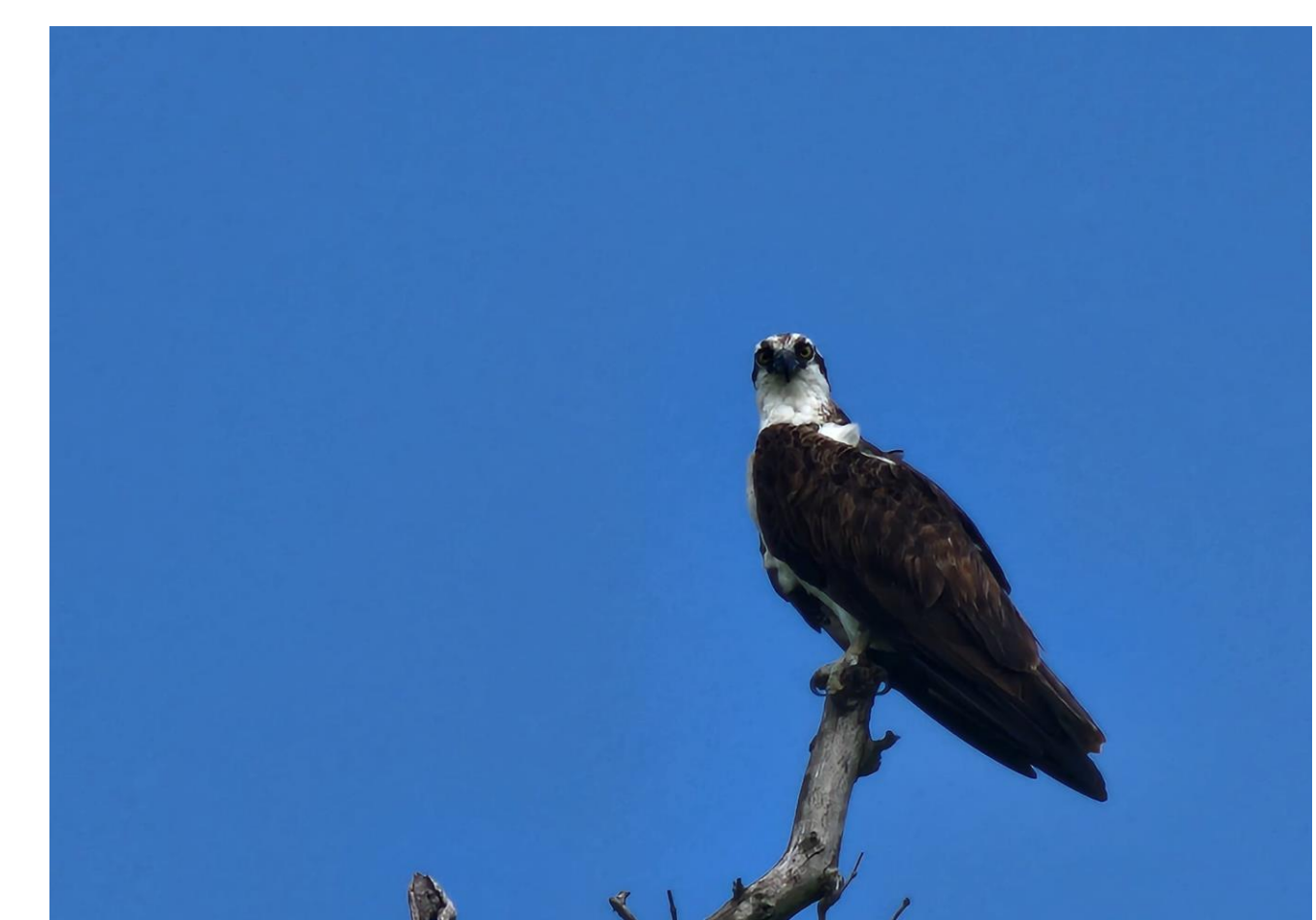


Microplastics in Shorebird Guano in Sandy Hook & Caven Point, NJ

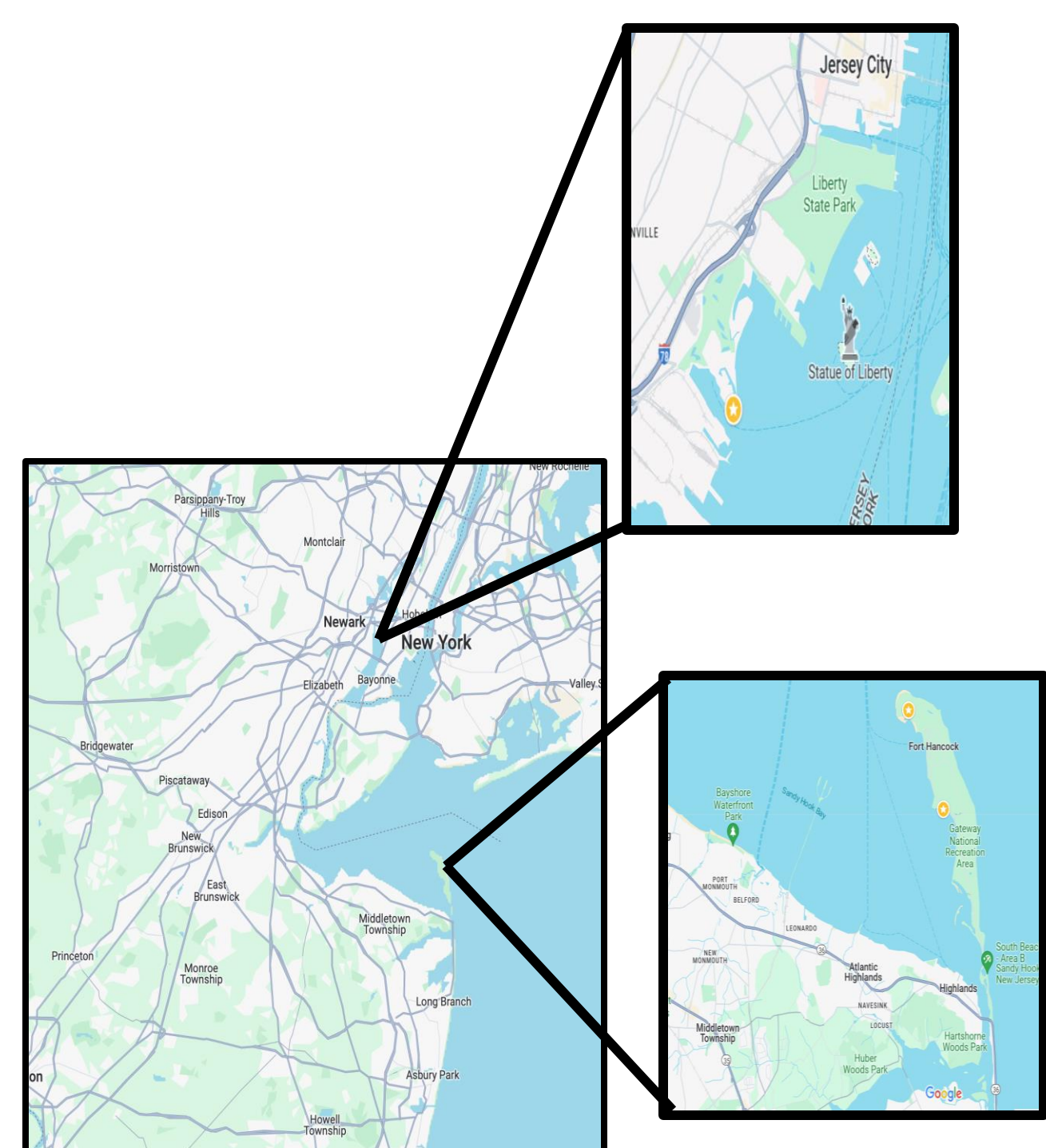
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Introduction

- The Hudson Raritan Estuary is an important habitat that serves as nesting and feeding grounds for shorebirds. (NOAA).
- Shorebirds that inhabit this region have a wide variety of specialized feeding methods for different foods.
- It is well known that shorebirds can ingest copious amounts of microplastics and marine debris (Ward *et al.*, 2022)
- Are there site-specific differences in shorebird feeding methodology between an urbanized site and a more rural site? Are shorebirds in urbanized areas more likely to ingest microplastics than those in more rural sites?

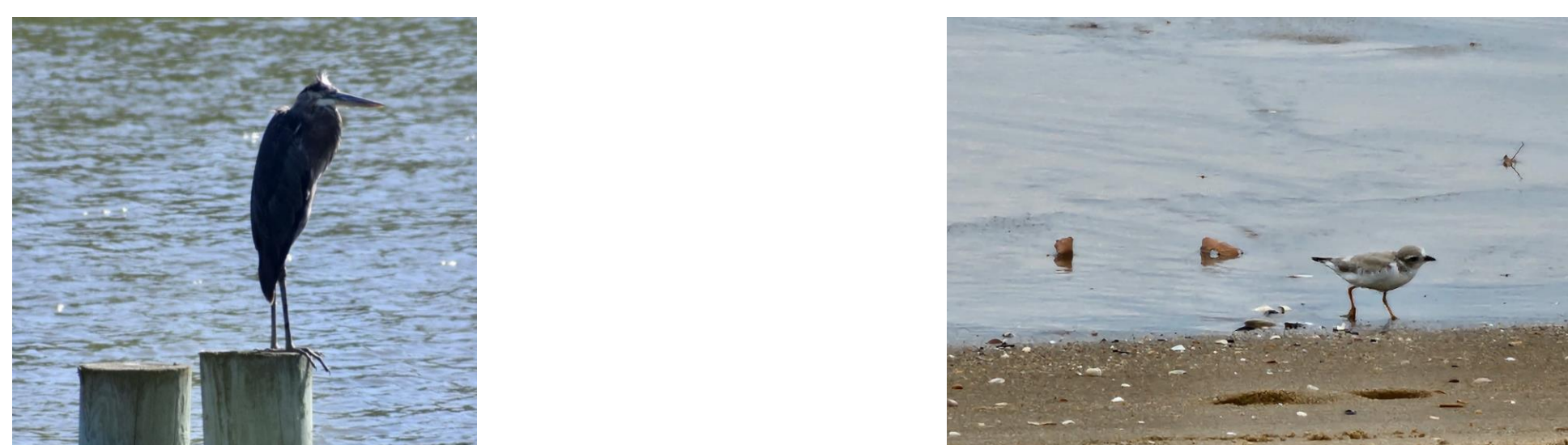
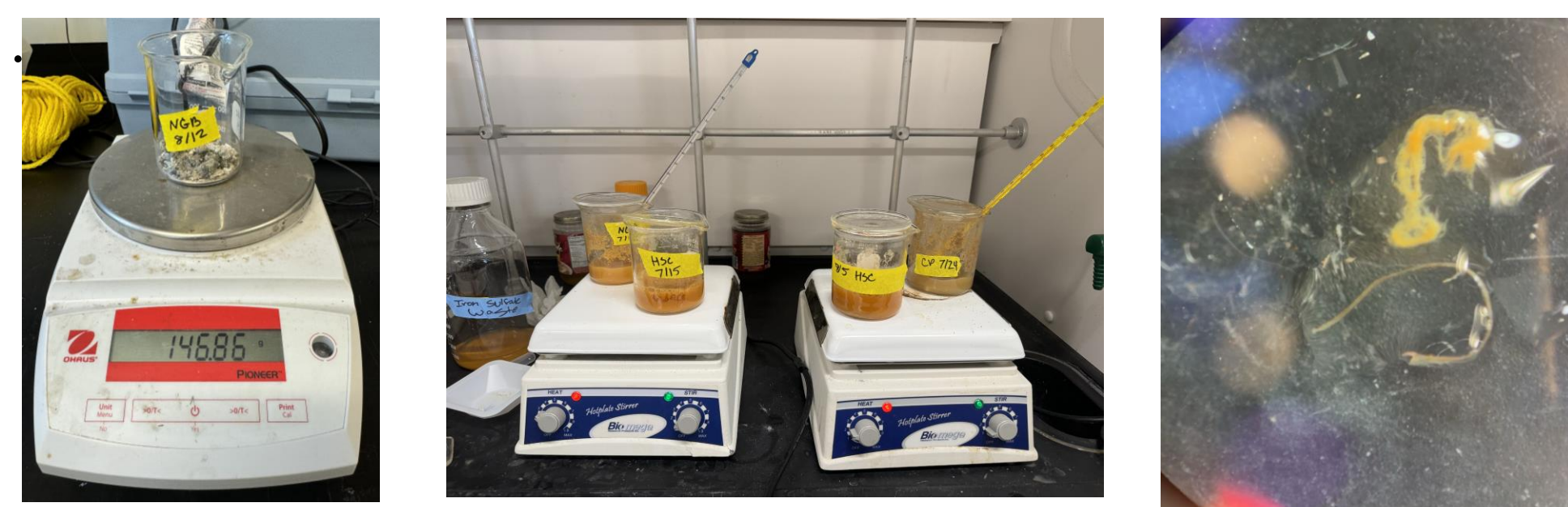
Methods



Sites: 3 were chosen, along an urbanization gradient, in the lower Hudson Raritan Estuary. They were Caven Point at Liberty State Park and Nine Gun Battery and Horseshoe Cove at Sandy Hook.

Bird counts: Weekly bird counts were performed at each site, 2 10-minute counts around low tide. Time of day varied based on when low tide was. Any bird spotted within a 180° of the spot was recorded.

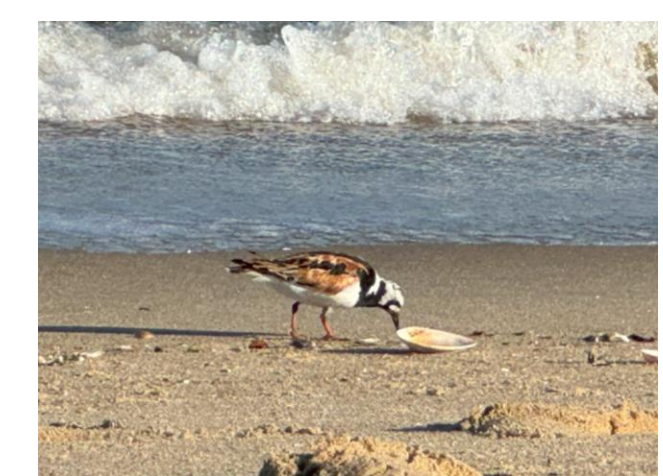
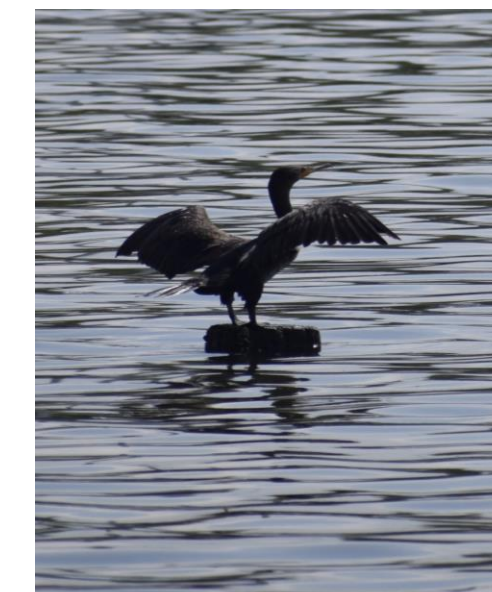
Microplastics: Samples of guano were collected on the beach near the birds observed. Any guano found within the 180° view was gathered using a metal chisel and trowel. Samples were placed on aluminum dishes and dried in an oven overnight at 60°C and digested with hydrogen peroxide/ iron sulfide to remove organic material (Fenton reaction). Any remaining plastics were observed under 3x light microscope.



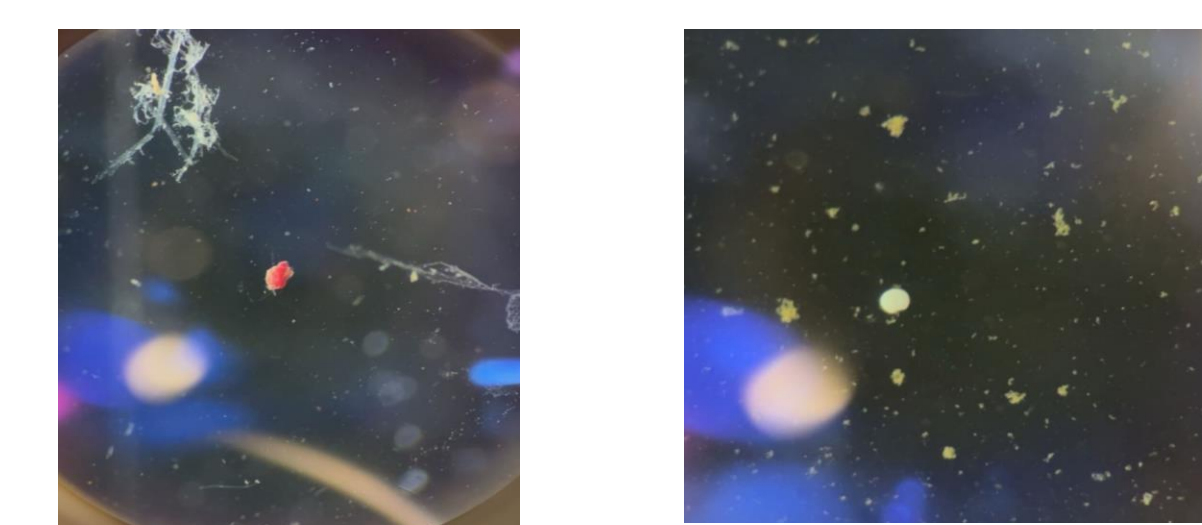
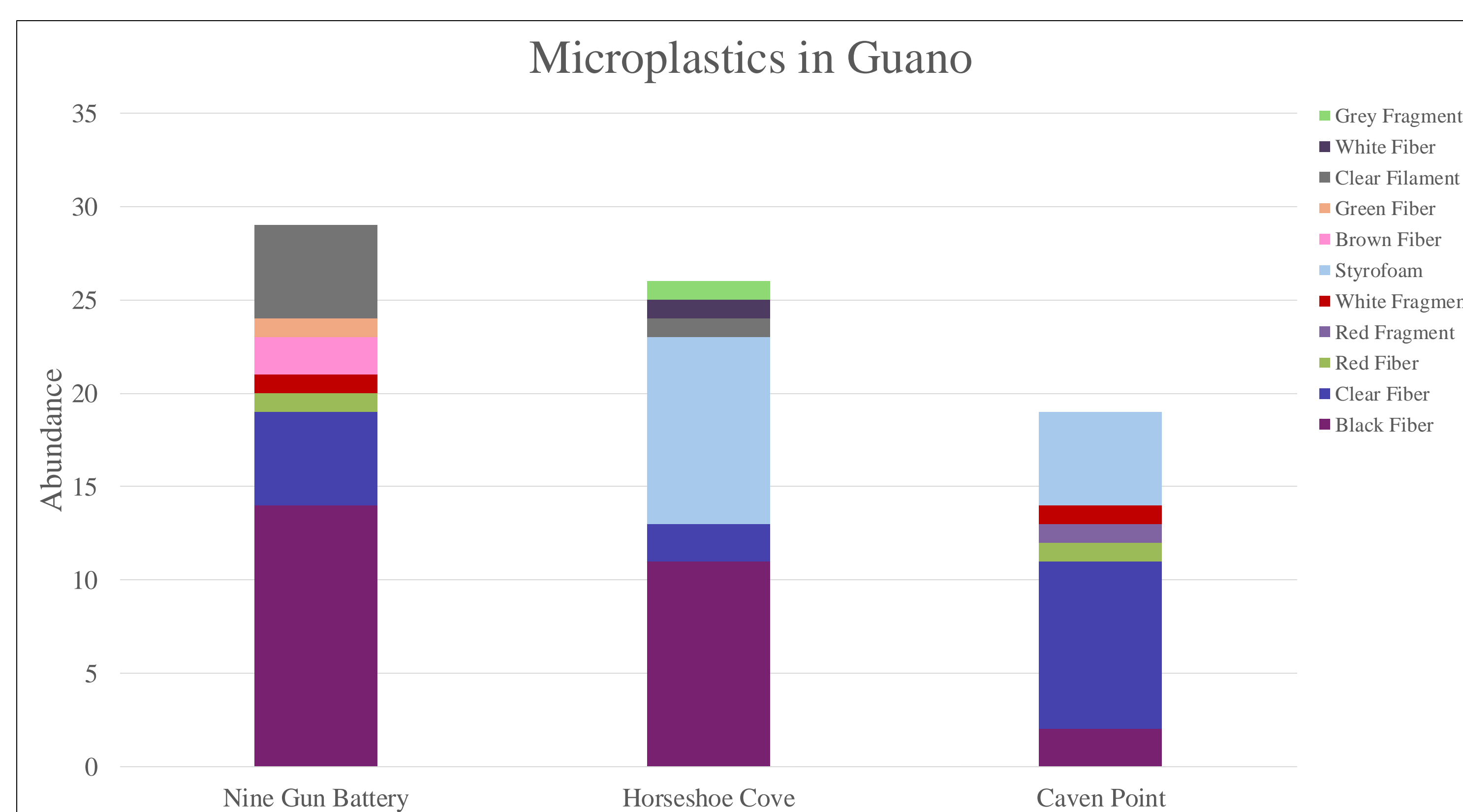
Top row: Digestion of guano via Fenton Reaction; microplastics under 4x magnification. Bottom row: Great Blue Heron (Caven Point), Piping Plover (Nine Gun Battery)

Results

Bird Species	Scientific Name	Type of Feeder	Behavior	Nine Gun Battery	Horseshoe Cove	Caven Point
American Oystercatcher	<i>Haematopus palliatus</i>	Aquatic Insectivore	Forage on Falling Tides	X		X
Laughing Gull	<i>Leucophaeus atricilla</i>	Aquatic Insectivore	Ground Forager, Opportunistic	X	X	X
Sanderling	<i>Calidris alba</i>	Aquatic Insectivore	Probing	X		
Semipalmated Sandpiper	<i>Calidris pusilla</i>	Aquatic Insectivore	Ground Forager	X	X	
Willet	<i>Tringa semipalmata</i>	Aquatic Insectivore	Probing		X	
Great Blue Heron	<i>Ardea herodias</i>	Carnivore	Wader			X
Great Egret	<i>Ardea alba</i>	Carnivore	Wader		X	
Canadian Geese	<i>Branta canadensis</i>	Herbivore	Ground Forager			X
European Starling	<i>Sturnus vulgaris</i>	Insectivore	Ground Forager	X		
Killdeer	<i>Charadrius vociferus</i>	Insectivore	Ground Forager		X	
Piping Plover	<i>Charadrius melodus</i>	Insectivore	Ground Forager	X		
Ruddy Turnstone	<i>Arenaria interpres</i>	Insectivore	Ground Forager	X		
Tree Swallow	<i>Tachycineta bicolor</i>	Insectivore	Aerial Forager	X		
Great Black-Backed Gull	<i>Larus marinus</i>	Omnivore	Ground Forager, Opportunistic	X	X	
Herring Gull	<i>Larus argentatus</i>	Omnivore	Ground Forager	X	X	
Mallards	<i>Anas platyrhynchos</i>	Omnivore	Dabbler			X
Red-Winged Blackbird	<i>Agelaius phoeniceus</i>	Omnivore	Ground Forager	X		X
Ring-Billed Gull	<i>Larus delawarensis</i>	Omnivore	Ground Forager, Opportunistic	X	X	
Black Skimmer	<i>Rynchops niger</i>	Piscivore	Aerial Forager	X	X	
Common Tern	<i>Sterna hirundo</i>	Piscivore	Aerial Diver	X	X	X
Double Crested Cormorants	<i>Nannopterum auritum</i>	Piscivore	Diving	X	X	X
Least Tern	<i>Sternula antillarum</i>	Piscivore	Aerial Diver	X		
Osprey	<i>Pandion haliaetus</i>	Piscivore	Aerial Diver	X	X	
Snowy Egret	<i>Egretta thula</i>	Piscivore	Stalking		X	
Juvenile Gulls	Unknown	-	-	X	X	X
TOTAL SPECIES RICHNESS				18	14	9



(Top-Bottom): Double Crested Cormorant (Caven Point), Least Tern (Nine Gun Battery), Ruddy Turnstone (Nine Gun Battery)



(Left to Right): Red fragment under 4x magnification, Styrofoam under 4x magnification.

- Nine Gun Battery had the highest species richness (18), while Caven Point had the lowest (9). Richness varied daily but increased as summer proceeded. Horseshoe Cove saw an increased Simpson's Index as summer proceeded, whereas Nine Gun Battery and Caven Point saw no significant change.
- Microplastics were found at all three sites, Nine Gun Battery had the most pieces (29) and Caven Point had the least amount (19).
- Of the 74 pieces of microplastics found the most common were black fibers (27), clear fibers (16), and Styrofoam (15).

Conclusions

Bird Species: 25 different species of birds were observed from the three sites. More rare species were seen in the Sandy Hook sites (i.e., Ruddy Turnstone, Piping Plover), whereas in Caven Point species that are typically found in an urban setting were more commonly observed (i.e., Canadian Goose, Laughing Gull).

Microplastics: The amount of microplastics found was influenced by the number of samples collected ($n=26$ at Nine Gun Battery, $n=13$ in Horseshoe Cove, $n=7$ in Caven Point). It should also be noted sand was collected with the samples and may have been the source of some of the microplastics; methodologies will be refined for next summer to gather more data.

Acknowledgements

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