# Prall's Island Heron Rookery Restoration and Harbor Herons Studies
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**Executive Summary**

A complex of wading bird colonies, locally known as the "harbor herons," started nesting on small islands of the Greater NY/NJ Harbor in the early 1950s, and has been a flagship for biodiversity in the Harbor Bight region ever since. The Harbor Heron breeding colonies support nine species, Black-crowned Night-Heron (*Nycticorax nycticorax*), Great Egret (*Ardea alba*), Snowy Egret (*Egretta thula*), Glossy Ibis (*Plegadis falcinellus*), Cattle Egret (*Bubulcus ibis*), Yellow-crowned Night-Heron (*Nyctanassa violacea*), Little Blue Heron (*E. caerulea*), Green Heron (*Butorides virescens*), and Tri-colored Heron (*E. tricolor*). All of these species are NJ or NY species of conservation concern, and the two night-herons are listed as NJ State threatened. Harbor Herons are currently breeding on in the outer harbor island, Hoffman Island; in Jamaica Bay on Elder's Point East and Subway Island, and on South Brother Island and Mill Rock in the East River. They have previously nested on Shooter's, Prall's Islands and Isle of Meadows in the Arthur Kill, on North Brother Island in the East River, and on Canarsie Pol in Jamaica Bay

Agencies in the region are faced with the need to manage wetlands altered by human development so that they can continue to provide suitable habitat for the Harbor Herons. These urban habitats that support wildlife populations outside of the nesting areas must be identified, their value and use as a resource documented, and if habitat restoration or enhancement has occurred, the effects of these efforts should be evaluated. Furthermore, natural habitats within the NY/NJ Metropolitan area that support these highly visible and charismatic heron species may provide the only contact with wildlife that millions of people in the local area experience. The US Army Corps of Engineers and The Port Authority of New York & New Jersey *Comprehensive Restoration Plan for the Hudson-Raritan Estuary* and the Harbor Herons Subcommittee of the Harbor Estuary Program's "Harbor Herons Conservation Plan" provide historical perspective of Harbor Herons and their breeding and foraging habitat, identify threats to the persistence of these species in the harbor, and lay out a plan of action for protecting these birds in the future.

Prall's Island, once an active nesting site in the Arthur Kill (bordered by Staten Island on the east and New Jersey west) for harbor herons, has supported little nesting activity since the late 1990s, although herons continue to nest elsewhere in the harbor. Though the exact cause of the failure of the nesting herons to return is not certain, it is largely attributed to impacts to and loss of habitat. Prall's was identified by the New York-New Jersey Harbor & Estuary Program Habitat Working Group as a potential site for restoration of the degraded habitat to a state in which it can once again support a colony of nesting herons, egrets, and ibis. This report includes the results of a study, conducted by New York City Audubon and New Jersey Audubon in partnership with New York City Department of Parks and Recreation to assess the use of habitat by land- and harbor herons, conduct a social attraction pilot study, and better understand foraging behavior of nearby populations prior to restoration of the island (beginning in late 2013) as a baseline for future (post-restoration) assessment.

Prall's is currently being used by landbirds (defined here as all other non-harbor heron species observed), either during migration or breeding. Landbirds as well as harbor herons were documented, so that the effects of restoration on multiple populations could be observed more comprehensively. During the fall of 2012 and spring of 2013, Audubon used mist netting, spot mapping, and point counts to document the presence of 58 species, 47 (81%) of which were landbirds. Thirteen species were confirmed breeding pairs 14 species were likely breeders. Thirty-one species do not or are unlikely to breed on Prall's. Many fewer birds were netted during the spring as compared to the fall. This may reflect the relative population sizes of spring vs fall migrants or may be an artifact of sample size.

Before wading birds are attracted to a restored island to nest, care must be taken to ascertain that threats to their nesting success are minimized. Using camera traps, nest predators (raccoons) as well as egg predators (skunks and fox) were documented on the island, demonstrating the need for a solution such as using predator-proof sheet metal flashing on nesting trees, to address the predator issue before any attempt is made to attract nesting wading birds deter predators. Removing predators is not a feasible response: mammals can easily swim the distance from the mainland of Staten Island to Prall's.

In the interest of attracting birds to the site once habitat has been restored and nest sites protected, decoys were piloted as a possible attraction mechanism. In this pilot, wading birds were successfully attracted to an underused portion of a stream, for foraging, at a test site in northern New Jersey by the addition of decoys.

To additionally establish baseline population information for nearby nesting colonies, harbor herons nesting surveys were conducted in 2012 and 2013. Prall's and Shooter's Island and the Isle of Meadows continue to not support nesting waterbirds. However, nearby Hoffman Island, in the outer harbor, supports the largest and most diverse colony in the harbor. The theory is that birds moved from the Arthur Kill Islands to Hoffman and Swinburne. Given restoration of appropriate habitat, portions of the Hoffman colony may move back to the Arthur Kill.

In order to know how individuals from the different nesting colonies in the harbor are using the surrounding habitat, we have been banding birds and documenting nest contents. As the program continues and more birds are banded, we will be able to create a map, from band returns, of where the birds go to forage during the breeding season and where they spend their winter.

In addition to nesting habitat, foraging and roosting habitat are important to the ecology of long-legged wading birds in the harbor. New Jersey Audubon and New York City Audubon have been conducting a citizen science-based foraging study that documents the use of habitat in the watershed by these birds. Many of the birds feed and forage in good numbers in New Jersey. We have also been able to document fall roost areas used by wading birds. Without these critical areas, nesting birds would not be able to sustain themselves and raise their young.

This study established a pre-restoration baseline for Prall's Island's (and surrounding area) landbird and harbor herons populations, potential nesting bird predators, and completed a pilot of using decoys as social attractors. The results illustrate the value of the limited nesting habitat in the harbor for harbor herons and the potential importance of restoring Prall's Island, in the Arthur Kill, as bird habitat. With habitat restoration, predator exclusions, and additional wading bird attractants (decoys and vocalizations), there is good potential for Prall's Island to once again support a colony of herons, egrets, and ibis.

## Introduction

The overall project addresses the disappearance and potential restoration of a breeding colony of long-legged wading birds (herons, egrets, and ibis, hereafter called Harbor Herons) in a region of the New York Harbor that was in the 1980's a thriving colony. In addition, a social attraction pilot The project focuses on two types of restoration for Harbor Herons: habitat/vegetation and colony composition/behavioral. The project is being undertaken to establish protocols for restoring nesting habitat for Harbor Herons on urban islands and to compile a rubric for evaluating success of the restoration effort.

Prall's Island, an 80 acre island located in the Arthur Kill between Staten Island and New Jersey, was one of the first New York/New Jersey Harbor Estuary islands colonized by the Harbor Herons in the 1970s, and was abandoned as a breeding colony in 2006. Prall's Island was originally a salt marsh until it was filled in during the 1930s with dredge material from the Arthur Kill. Today, representative plant communities include forested uplands, grasslands, and meadows, with a perimeter of high and low salt marsh.

The suite of species collectively known as the Harbor Herons includes Black-crowned Night-Heron (*Nycticorax nycticorax*), Great Egret (*Ardea alba*), Snowy Egret (*Egretta thula*), GlossyIbis (*Plegadis falcinellus*, Little Blue Heron (*Egretta caerulea*), Cattle Egret, Tricolored Heron (*Egretta tricolor*), and Green Heron (*Butorides striatus*). Additionally, during the past 10 years, special attention has been given to the monitoring of co-occurring harbor herons: Double-crested Cormorant (*Phalacrocorax auritus*), Herring Gull (*Larus argentatus*), and Great Black-backed Gull (*Larus marinus*). The value of these species and the need for adequate nesting and foraging habitat led to their inclusion as a Target Ecosystem Characteristic (TEC) in the USACE/Port Authority of NY/NJ/HEP Comprehensive Restoration Plan for the Hudson-Raritan Estuary. The New York/New Jersey Harbor Estuary Program identifies Prall's Island/Arthur Kill as a Restoration Priority Site and the New York State Department of State has designated Prall's Island as a Significant Coastal Fish and Wildlife Habitat.

The most immediate threats to the Harbor Herons identified in the Harbor Herons Conservation Plan (Elbin and Tsipoura 2010) are human disturbance in the colony and in foraging areas, habitat degradation from development, invasive species, and pollutants. Science-based management actions need to be taken today to address these threats and to provide the best chances of success for a viable bird community in the harbor.

The New Jersey Wildlife Action Plan (WAP) lists colonial waterbirds as one of the suites of species of greatest conservation concern for coastal areas in the northern and the Raritan Bay conservation zones of the Piedmont Plains and describes bird surveys with the purpose of populating the biotics database as one of the priority conservation actions in this landscape (NJ DEP 2008). Furthermore, waterbirds were included as target ecosystem characteristics (TECs), measurable objectives for restoration in the Hudson/Raritan Estuary that relate to the ecosystem function and have societal and management value (Baron 2011). Difficulties associated with heron conservation in the NY/NJ Harbor are further aggravated by the challenges of maintaining healthy habitats in an industrialized and highly urbanized environment. It is critical to identify management issues for these birds and their habitats, both nesting and foraging, and to continue to track the health of their populations in the NY/NJ Harbor estuary.

Prall's Island was chosen as for this study conducted by Audubon and restoration by New York City Department of Parks and Recreation because of past use of the island for colonial nesting by the harbor herons, and its potential for habitat restoration. Furthermore, migratory studies conducted by NYCA in 1996 and 1997 demonstrated the importance of Prall's Island as a migratory stopover for passerine birds. Colonial wading birds form the highest level of the trophic pyramid in the estuarine ecosystem and are dependent upon marine resources and coastal habitats including bay islands, salt marshes, tidal creeks, and brackish water ponds. The number of nesting pairs of wading birds on Prall's Island has plummeted while other islands within the system have seen increases in their respective populations.

We are not certain why harbor herons abandoned Prall's Island, but it is clear that the island has sustained profound ecological perturbations in the last two decades, including the following:

- 1990: Prall's Island was at the epicenter of the Exxon Bayway oil spill and was the site in
- 1991 of extensive shoreline cleanup efforts
- 1991: An autumn nor'easter created 12 foot tidal storm surges that flooded much of the island with salt water
- 1992: NRG and NYC Audubon observed substantial decline and die-back of gray birch, a dominant canopy tree in the island's early successional forest and a major component of the harbor heron nesting habitat. In addition, the construction of a "box store" on Forest Avenue appears to have radically altered the hydrology of Goethals Bridge Pond, which, up to that time was a major foraging site for harbor herons nesting in the Arthur Kill, resulting in dramatically diminished water levels and avoidance by the Harbor Herons.
- 1993: Harbor Herons abandon Prall's Island
- 1993-2007: Gray birch regenerating
- 2007: Asian Long-Horned Beetle (ALB) discovered on Prall's Island, requiring state and federal authorities to remove more than 3,000 potential host trees, mostly gray birch that had regenerated since 1992. The tree removals radically altered the island's light regime. By removing the tree canopy, the ALB control measures released a suite of invasive species, including mile-a-minute vine, Asiatic bittersweet, and glossy buckthorn that quickly colonized the newly opened canopy gaps. At about the same time a deer herd reached Prall's Island by swimming from New Jersey burgeoned, and began exerting grazing pressure on native woody plants.

New York City Audubon's project is part of a joint initiative with New York City Department of Parks and Recreation Natural Resources Group. NYC Audubon's project addresses the harbor herons part of the U.S Army Corps of Engineer's Comprehensive Restoration Plan (CRP) Target Ecosystem Characteristics (TECs) Islands for Waterbirds and Maritime Forests.

New Jersey Audubon (NJA) and New York City Audubon (NYCA) have been working together to improve our knowledge of the use of urban wetland habitats and to advance the conservation of colonially breeding waterbirds in the NY Harbor. In 2008-2010, funding from several sources including NJ DEP's Conserve Wildlife Matching Grants and the Education Foundation of America, allowed NJA to investigate the connections between Harbor Heron breeding and non-breeding/foraging areas in NJ. We employed our birding volunteer force on a comprehensive study of foraging habitat use and feeding behaviors of these birds in the Hackensack Meadowlands and Raritan Bay as well as areas in the Upper Hackensack and Arthur Kill. Specifically, we developed protocols and training materials, and then recruited and trained volunteers to conduct baseline surveys of colonial waterbirds at wetland sites across the NY/NJ Harbor estuary.

This report summarizes 2012-2013 baseline conditions for bird populations on and near Prall's Island and is the first step in addressing larger issues about habitat restoration, carrying capacity, and mitigating limiting resources for harbor heron populations within the New York/New Jersey Harbor Estuary. In advance of attracting harbor herons back to the island to nest, we first needed to assess current conditions in terms of other (landbird) species during the breeding season and migration; evaluate the presence of potential nest predators on the island; test the methodology of using decoys to attract harbor herons to sites where they are not currently found; and to evaluate the surrounding area for a potential source of future harbor heron nesters by looking at nearby colonies, foraging site use, and roost sites used during fall migration. Each of those areas of research is presented as a separate project within this larger report (see Table of Contents).

**Objectives**

This study focused on five main objectives:

- To document pre-restoration baselines of identify landbird species that use Prall's Island as a stopover site during fall and spring migration, and to quantify their relative frequency;
- To document the presence of mammalian predators that could pose a threat to nesting aquatic birds attempting to re-colonize Prall's Island;
- To pilot a social attraction study by exploring the feasibility of using decoys to attract colonial wading birds to potential feeding habitats;
- To document the current pre-restoration distribution and abundance of nesting harbor herons and band them to track movement throughout the region;
- To increase the understanding of the ecology of harbor heron foraging in the surrounding region.

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## I. Landbird Use of Prall's Island During Migration and the Breeding Season

*A. Introduction, Study Area, and Period*

Prall's Island (40$^{o}$36' N, 74$^{o}$12' W) is an 80 acre (32 ha), uninhabited island located in the Arthur Kill between Staten Island, New York and New Jersey (Figure 1). During the early 1900s, thousands of tons of dredge spoils from the Arthur Kill were dumped on Prall's Island, and the island was extensively diked. This raised the island's maximum elevation by *ca* 2 m above the mean high tide level, and created a patchwork of substrates that support various plant communities that differ from one another depending on elevation, drainage, soil type, and other factors. During the 1980s, 1990s and the early-to-mid-2000s, the upland tree community on Prall's Island was characterized by patches of forest dominated by grey birch (*Betula populifolia*) averaging 4-7 m in height, which provided the main nesting habitat for colonial wading birds. Other prominent tree species included black cherry (*Prunus serotina*), pear (*Pyrus communis*), aspen (*Populus* sp.), and crabapple (*Malus sylvestris*). Parts of the island supported small grassy fields and sparsely-vegetated shrublands, which were gradually invaded and overgrown by sumac (*Rhus* sp.), sassafras (*Sassafras albidum*), black chokeberry (*Pyrus melanocarpa*), grey birch, black cherry, blackberry (*Rubus* sp.), multiflora rose (*Rosa multiflora*), bayberry (*Myrica* sp.), poison ivy (*Toxicodendron radicans*) and other trees, shrubs and vines (Parsons 1986, 1987; Kerlinger 1997a, 2003; Blanchard et al. 2001). By the mid-2000s, many of the grey birch trees that wading birds had used for nesting in previous decades had been knocked over by wind storms, or had weakened and fallen possibly as a result of leaf miner infestation, fungal infection, and/or saltwater intrusion (Kerlinger 2004; Elbin & Tsipoura 2010). In March 2007, more than 40 grey birches and several maple (*Acer* sp.) trees on Prall's Island were found to be infested with imported Asian longhorned beetles (*Anoplophora glabripennis*). This led to the clearcutting and chipping of more than 3,000 potential beetle host trees on the island by the Asian Longhorned Beetle Cooperative Eradication Team, comprising the U.S. Department of Agriculture Animal and Plant Health Inspection Service (USDA-APHIS), the New York State Department of Environmental Conservation (NYSDEC),

and other agencies (Bernick 2007, Elbin & Tsipoura 2010). Clearcut areas have since been colonized by mile-a-minute (*Persicaria perfoliata*), Asiatic bittersweet (*Celastrus orbiculatus*), multiflora rose (*Rosa multiflora*), glossy buckthorn (*Frangula alnus*), and callery pear (*Pyrus calleryana*) (Bernick & Craig 2008; personal observations).

Fieldwork on Prall's Island was conducted from 11 September to 2 November 2012, and from 30 April to 25 June 2013, coinciding with the fall and spring bird migration seasons, respectively, and including most of the 2013 nesting season.

*B. Methods and Materials*

Three different approaches were applied to documenting the use of Prall's Island by migrating and breeding landbirds: standard bird-watching methods (e.g., walking, "pishing" and "squeaking"), mist netting and banding, and point counts. All bird species observed during fieldwork on Prall's Island were noted. These included observations made during walks on the island taken for the express purpose of locating birds, and in the course of mist netting and banding.

Four mist nets (nylon, four pockets, 30 mm mesh, 2.6 m high, 6 m long, supported by 3 m aluminum poles) were deployed on Prall's Island during the fall 2012 and spring 2013 migration seasons. In spring 2013, all four mist nets had to be relocated *ca* 200 m north of their original positions because of fallen trees and wrack left by Hurricane Sandy, which struck the island on 29 October, 2012. All mist nets were oriented in an east-west direction perpendicular to the long axis of Prall's Island. Mist nets were opened only under non-raining skies. When opened, mist nets were inspected once every 10-20 minutes. Captured birds were carefully removed from the nets and transported in a cloth carrying bag to a makeshift banding station, where they were identified, banded and (if possible) sexed. Netted birds were also measured (culmen, wing chord and tarsus), weighed, and assessed for age and body fat condition except during periods of high capture rates, when rapid processing and release were necessary to minimize holding time and stress. The Master banding permit holder (Elbin, USFWS permit 21032, NYSDEC permit 81, NYC Parks and Recreation Permit 2012_13) was assisted by qualified personnel from New York City Audubon, the New York State Department of Environmental Conservation, and citizen scientist volunteers.

On some days, scheduled fieldwork on Prall's Island had to be canceled due to rain, high winds and/or unsafe boating conditions in the Arthur Kill. Even on days when the field team was able to reach the island, net opening was sometimes delayed, or nets were closed early due to rain or wind. Inclement weather in April and May reduced the number of netting days (three fewer ) and the total net-hours (21.4 fewer) in spring 2013 compared to fall 2012 (Tables 1 & 2).

Five-minute point counts (Ralph et al. 1993) were conducted at eight sites on 25 June 2013. Sites were at least 250 m apart. These same points can be sampled in future years for pre and post restoration comparison.

*C. Results*

Bird Species Observed on Prall's Island

This study documented 58 species of birds using Prall's Island during fall and spring migration and the breeding season (Table 3). With the exception of Great Blue Heron (*Ardea herodias*), Great Egret (*Ardea alba*) and Spotted Sandpiper (*Actitis macularius*), which were observed feeding along the

island's shoreline or in adjacent shallow water, and Canada Goose (*Branta canadensis*), all species recorded were landbirds.

The seasonal occurrence and breeding status of birds detected on Prall's Island in this study (Table 3) were determined through observation, and general knowledge of the habitat preferences, seasonal occurrence and breeding status of each species in the New York-New Jersey Harbor region and the habitat types present on the island. Species that inhabit Prall's Island throughout the year were classified as year-round residents (YRR, Table 3), while species whose occurrence was documented during spring migration and into June were classified as spring-summer residents (SSR). Birds that were observed during fall and/or spring migration but are not known to breed or winter in the New York-New Jersey Harbor region, or in the habitats present on Prall's Island, were classified as passage migrants only (PMO, Table 3). The study period did not include the wintering season, so some species were tentatively classified as possible winterers (PW) based on general knowledge of a species' winter occurrence in the New York-New Jersey Harbor region. Some populations that breed and/or winter on Prall's Island may be augmented by conspecifics that breed and winter elsewhere but migrate through the region and use Prall's Island as a stopover site. These transient birds are usually impossible to distinguish from breeding or wintering residents without marked individuals, or genetic or stable isotopic analysis, and were classified as passage migrants (PM) or possible passage migrants (PPM, Table 3).

In addition to the species listed in Table 3, several bird species were observed flying over Prall's Island that may use the island as a food source, a resting site, and for nesting in some cases. These included Turkey Vulture (*Cathartes aura*), Osprey (*Pandion haliaetus*), Bald Eagle (*Haliaeetus leucocephalus*), Cooper's Hawk (*Accipiter cooperii*), Red-tailed Hawk (*Buteo jamaicensis*), Rock Pigeon (*Columba livia*), Belted Kingfisher (*Megaceryle alcyon*), and Fish Crow (*Corvus ossifragus*). Aquatic birds seen in open water in the Arthur Kill close to Prall's Island included Gadwall (*Anas strepera*), Mallard (*Anas platyrhynchos*), Bufflehead (*Bucephala albeola*), Double-crested Cormorant (*Phalacrocorax auritus*), Laughing Gull (*Leucophaeus atricilla*), Ring-billed Gull (*Larus delawarensis*), Herring Gull (*Larus argentatus*), and Great Black-backed Gull (*Larus marinus*).

Mist Netting and Banding

Mist netting and banding were conducted on 13 different days (8 in fall 2012, 5 in spring 2013) on Prall's Island (Table 1). Mist nets were opened between 8:45 and 11:15 and were closed between 11:30 and 15:30 h (EDST), and were kept open for 2.2-5.7 (mean = 3.74) hours at a time.

A total of 209 birds (36 species) was netted on Prall's Island during this study, of which 188 (90%) were banded (Table 4). Twenty-one netted birds were not banded because they (a) escaped before or during removal from the net, (b) escaped while being extracted from the carrying bag at the banding station, or (c) showed signs of severe stress and were released.

Of the 36 species netted on Prall's Island in this study, only five (14%) were netted in both fall 2012 and spring 2013 (Tables 4 & 5). Twenty-one (58%) and 10 (28%) species were netted only in fall or spring, respectively (Tables 4 & 5; see Discussion below).

Tables 6 and 7 show the number of birds of each species netted on Prall's Island, the relative frequency (as a percentage of the total number of all birds netted) of each species, and the average number of birds captured per net-hour during fall 2012 and spring 2013, respectively (see Discussion below).

Point Counts and Breeding Bird Observations.

Breeding by a particular species on Prall's island was confirmed (CB, Table 3) by observations of (a) male territorial and singing behavior, (b) adults carrying nest-building materials, (c) active nests, (d) adults delivering food items to nests or fledged offspring, or (e) newly-fledged juveniles. Species that were present during the breeding season (SSR) but were not confirmed to nest on Prall's Island were classified as likely (LB) or possible (PB) breeders (Table 3).

D. *Discussion*

It is evident that Prall's Island provides important habitat for a wide variety of birds that make their homes there year-round or seasonally, or use the island as a stopover site during migration (Table 3). Passerines dominated the list of species recorded in this study, accounting for 47 (81%) of the 58 species encountered. Thirteen species (22.4%) were confirmed breeding (CB) on Prall's Island, with an additional 14 (24.1%) species that are likely to breed (LB) or may possibly breed (PB) on the island. Thirty-one species (53.5%) do not or are very unlikely to breed on Prall's Island, although some may overwinter (Table 3).

Mist netting was chosen as the preferred approach to sampling landbirds on Prall's Island, and to quantifying the relative abundance of each species during migration, because it has certain advantages over point counts and other sampling methods. Previous studies have shown that mist netting out-performs point counts in detecting small and/or secretive species, particularly those that inhabit dense vegetation, such as sparrows, warblers, vireos, and wrens, as well as rare species (Wang & Finch 2002). During migration in particular, mist netting may be more reliable than point counts because (a) there is rapid turnover of species and individuals at stopover sites, (b) habitat specificity is usually less pronounced during migration than in the breeding and wintering seasons, and (c) many migrants are food-deprived, ranging widely and foraging very actively during stopover, so they are less likely to be detected in by point counts (Loria & Moore 1990, Wang & Moore 1993, Moore et al. 1995, Johnson & Geupel 1996, Wang & Finch 2002). Finally, this study relied heavily on volunteer field assistants with variable bird detection and identification skills. Mist netting minimizes the need for highly trained and experienced observers (DeSante et al. 1993, Peach et al. 1996), which are crucial in point count surveys. On the other hand, mist netting tends to exclude or under-sample aerial-feeding birds (swifts, swallows) and larger landbirds, such as galliforms, raptors and crows (Wang & Finch 2002).

Although the spread in netting dates between the first and last days was similar in both seasons (36 and 33 days in fall and spring, respectively, see Tables 1 & 2), there were three fewer netting days (-37.5%) and 21.4 fewer net-hours (-21.7%) in spring compared to fall (Table 2). However, quantitative differences in netting effort and results do not fully explain a 42% drop in the number of species and a 62% drop in the total number of individuals from fall to spring (Table 2). The number of species netted per netting day was only 0.25 (-7.7%) lower in spring than in fall, although the number of species netted per net-hour was 0.07 (-26.5%) lower in spring than in fall (Table 2). The number of individuals netted per netting day was 7.28 (-38.6%) lower in spring compared to fall, while the number of individuals netted per net-hour was 0.78 (-50.9%) lower in spring than in fall (Table 2). Larger population sizes augmented by hatch-year birds after the breeding season (Lack 1966, Johnson & Geupel 1996, Chase et al. 1997) may partly explain the higher number of individuals netted in fall compared to spring.

Of the 36 species netted on Prall's Island in this study, only five (14%) were netted in both fall 2012 and spring 2013 (American Robin, Gray Catbird, Common Yellowthroat, Song Sparrow and American Goldfinch; see Tables 4 and 5). All five of these species were confirmed breeding (CB) on the island,

although eight other CB species were netted only in spring (Downy Woodpecker, Willow Flycatcher, Brown Thrasher, Yellow Warbler, Common Grackle, Baltimore Oriole) or were not netted at all (Wild Turkey, Brown-headed Cowbird). This seemingly wide divergence between the fall and spring avifauna could prove to be smaller once more information is gathered on the likely (LB) and possible (PB) breeding species detected on the island (see Table 3).

Of the 12 species (excluding Wild Turkey, which is unlikely to be captured in the nets used) that were confirmed breeding (CB) on Prall's Island, five (41.7%) were netted in fall, and accounted for 18 (11.9%) of the 151 total individuals netted, and 11 (91.7%) were netted in spring, accounting for 54 (93.1%) of the 58 total individuals netted (Tables 4-7). The much greater prominence of CB species in spring compared to fall is not surprising, because spring migration broadly overlaps with the early part of the breeding season. No Brown-headed Cowbirds were netted in spring even though they were common on the island.

Of the 14 species that were designated as passage migrants only (PMO) on Prall's Island (Table 3), 11 were captured in mist nets (Tables 4-7). None of these species was netted in both seasons; 10 (90.9%) were netted in fall, while one (9.0%) was netted in spring (Tables 4-7). Of the total number of PMO individuals netted in both seasons combined (n = 105), 104 (99.0%) were netted in fall and one (1.0%) was netted in spring. Of the 26 species of birds netted on Prall's Island in fall 2012, 10 (38.5%) were PMO species, and accounted for 104 (68.9%) of the 151 total individuals netted (Tables 4-6). One species alone, Myrtle Warbler, accounted for 93 (61.6%) of the 151 total individuals netted in fall. In contrast, of the 15 species of birds netted on Prall's Island in spring 2013, only one (6.7%) was a PMO species, accounting for only one (1.7%) of the 58 total individuals netted (Tables 4, 5 &7). The relative scarcity of PMO species and individuals netted in spring compared to fall may reflect a real phenomenon, whereby more species and individuals use Prall's Island as a migration stopover site in fall than in spring. Alternatively, it may reflect biases engendered by differences in netting effort (Tables 1 & 2), or the timing of netting in relation to migration chronology in fall and spring.

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## II. Documenting the Presence of Mammalian Predators on Prall's Island

### *A. Introduction*

As summarized in the Harbor Herons Conservation Plan (Elbin and Tsipoura, 2010), predators are major threat to the nesting success of wading birds and has influenced the evolution of colonial nesting as a predator deterrent (Burger 1982, Wittenberger and Hunt 1985). Different species respond differently to aerial or ground predators, and even a small number of predators can destroy large colonies (Rodgers 1987).

An understanding of existing predators is important to determine management options for reducing predator pressure on nesting populations (Parnell, et al. 1988, Erwin et al., 2001). The presence of predators were documented to determine the potential threats to nesting success at the study site.

### *B. Methods and Materials*

Two trail cameras (Bushnell HD Trophy Cam model 119437) that operate by motion detection were set up on Prall's Island in October 2012 and during May-June 2013. Each camera was secured to the base of a tree 30-40 cm above ground level with an adjustable strap and oriented to cover a clearing *ca* 15 m in diameter. Canned cat food of various "fishy" flavors was set out as bait, with the lid partly open and peeled back to expose the contents; the bait was secured by a length of nylon twine tied to a nearby

tree. The cameras' memory cards and bait were replaced as needed.

C. *Results and Discussion*
The trail cameras were set up for 34 days (total camera-hours = 1,508), yielding a total of 11,682 photographs. Most of these (>98%) were triggered by breezes and winds and moving foliage in the field of view and showed no animals. One camera was located inland, at the banding station. The second camera was located closer to the shore.

Four species of mammals and six avian species were photographed by the trail cameras (Table 8). White-tailed deer, raccoons and striped skunks were already known to occur on Prall's Island (Kerlinger 1997b, Blanchard et al. 2001, Bernick 2007, Bernick & Craig 2008), and the trail camera images provide documentation. At least one white-tailed deer fawn was photographed on several occasions, strongly suggesting that the species breeds on the island.

The presence of mesopredators (raccoons, striped skunks and opossums) poses serious challenges to any plan to re-establish harbor heron nesting colonies on Prall's Island. Raccoons in particular are known to prey on adults, chicks and eggs of ground-nesting (gulls, terns and skimmers) and tree-nesting (herons, egrets, storks and ibises) colonial waterbird species, which can ultimately lead to colony abandonment (Hjertaas 1982, Rodgers 1987, Parnell et al. 1988, Frederick & Collopy 1989, Coulter & Bryan 1995, Erwin et al. 2001, Ellis et al. 2007). Restoring colonial wading bird colonies to Prall's Island will require effective anti-predator measures, such as trapping and removal of predators, and the predator-proofing of potential nesting trees with sheet metal flashing (Hjertaas 1982, von Duyke 2009).

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**III. Social attraction pilot: using Decoys to Attract Colonial Wading Birds to Potential Feeding Habitats**

*A. Introduction *
Decoys are an important research tool that has been used to study various aspects of colonial water behavior (Crozier and Gawlick, 2003). Tufted Puffin decoys have been used extensively in puffin conservation, to attract individual birds to previously unoccupied nesting habitat (Kress, 1998). The vegetation on Prall's Island is not yet ready to support a colony of nesting herons and egrets, so Decoys were used in this study as a way to potentially attract herons to restored habitat and observe their response to conspecifics.

*B. Study Sites*
The study sites were located in Parsippany-Troy Hills Township in Morris County, New Jersey, within 275 m of Lake Hiawatha (40°52'43.37"N, 74°22'15.97"W), a small remnant wetland in the floodplain of the Rockaway River in a suburban residential area (Figure 2). Two sites (A and B) were located along a small, shallow, channelized side stream of the Rockaway River that flows into Lake Hiawatha, while a third site (C) was located in a rock-lined stormwater drainage ditch that flows directly into the Rockaway River. All three sites were within 170-380 m of one another (Figure 2). These sites were chosen for their close proximity to Lake Hiawatha, where Great Blue Herons, Great Egrets and Green Herons (*Butorides virescens*) congregate to feed during August-September (personal observations).

*C. Materials and Methods*

Decoys were plastic "pink flamingo" lawn ornaments painted white, which have been shown to be effective in past studies (Crozier & Gawlik 2003, Heath & Frederick 2003, Herring et al. 2008). Decoys stood 70 cm tall and were placed in water 10-20 cm deep.

Observations were made using a modified form of "instantaneous sampling" (Altmann 1974).

Each site was scanned once every 15 minutes by an observer walking from one site to another in a consistent, repetitive sequence, yielding four samples per hour at each site. For each sample, the presence or absence of wading birds was recorded. Samples taken with a decoy in place at the site were matched by an equal number of samples with no decoy present as a control. Observations were made from 24 August through 12 September, 2013 (Table 8), under non-raining skies between 8:00 and 18:00 h (EDST).

*D. Results*

A total of 512 instantaneous samples were obtained over the course of 128 observation hours, which were equally divided between decoy present (D) and no decoy (ND) conditions (Table 9). No more than one heron was present in any sample, and any heron observed in the course of sampling is recorded only once in Table 9, regardless of the length of time that it remained at the site. A heron (Green Heron or Great Blue Heron) was present in 14 (2.7%) of the 512 total samples. Of these, a heron was present in 11 samples with a decoy present and in three samples with no decoy, yielding a statistically significant difference using the chi-square goodness-of-fit test ($\chi^2$= 4.58, df= 1, $P < 0.05$). Sample sizes were too small to test the significance of differences for each species, but a Green Heron was present in seven samples with a decoy present and one sample with no decoy, while a Great Blue Heron was present in four samples with a decoy present and two samples with no decoy (Table 9).

*E. Discussion*

The scientific literature on the role of social attraction in the feeding ecology of colonial-nesting wading birds is voluminous (e.g., Kushlan 1977), but relatively few studies have ever examined the use of artificial decoys to attract herons, egrets and ibises to potential foraging habitats (see Master 1992, Gawlik 2003, Heath & Frederick 2003, Green & Leberg 2005, Herring et al. 2008). Our short pilot study demonstrated that herons can be attracted to feeding sites in the region by using decoys. Thus, decoys can be a valuable management tool to attract wading birds to suitable feeding sites that are currently underused, to fish-rearing ponds created specifically to provide food for wading birds (Coulter et al. 1987), and possibly to newly-restored or artificial wetlands. The first steps in restoring colonial-nesting wading birds to Prall's Island may include the use of decoys to attract birds to suitable foraging areas near the island. The use of vocalizations along with the decoys will certainly enhance the attraction of the decoys to birds as they select their nest sites (Clark, et al. 2012).

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## IV. Documenting the Current Distribution and Abundance of Nesting Harbor Herons, 2012-2013

A. *Introduction*

New York City Audubon’s Harbor Herons nesting surveys are part of a long-term database, and have been taking place for 28 consecutive years. The primary objective of the surveys is to monitor the population status of wading birds (i.e. herons, egrets, ibis) and other colonial waterbirds on select islands in New York/New Jersey (NY/NJ) Harbor and surrounding waterways, while also noting the presence of other nesting bird species and current nesting habitat. If nests can easily accessed by the

observer from the ground (using a mirror pole), then nest contents are observed and recorded.

Since 2004, New York City Audubon has shifted from an annual to a triennial schedule, and in intervening years to conduct interim surveys on islands where nesting occurred in the prior year. An interim nest survey was done in 2012; a comprehensive nest survey was conducted in 2013.

This section summarizes nesting activity of the harbor herons, cormorants, gulls, and terns observed on selected islands, aids to navigation and at one mainland colony documented during the 2013 field season, between 20 and 31 May. The objectives of these surveys is to: (1) monitor the population status of harbor herons cormorants, and gulls on selected islands; (2) document nesting habitat used by harbor herons and cormorants; and (3) record the presence of other important nesting or migratory bird species.

Monitoring long-term trends and short-term conditions in harbor heron and other harbor heron nesting populations in NY/NJ Harbor provides both an estimate of the relative health and stability of local colonial waterbird populations, and a valuable indicator of the overall health of the region's natural resources. For the purposes of the Prall's Island study, we focus in this report on the nesting activity closest in proximity to Prall's: the three Arthur Kill/Kill van Kull islands as well as Hoffman and Swinburne Islands to the north and east of Staten Island. This section of the report included excerpted sections of the 2012 and 2013 Harbor Heron's Nesting Survey Reports, drafted by Elizabeth Craig for NYC Audubon. The complete report for 2012 and 2013 can be found in Appendices A and B.

*B. Methods*

The 2013 survey followed field methods designed for previous Harbor Herons Project nesting surveys [Katherine Parsons (1986-1995), Paul Kerlinger (1996-2004)] and the standard protocol of the New York State Department of Environmental Conservation's Long Island Colonial Waterbird and Piping Plover Survey (Litwin et al. 1993). All counts were conducted between 6:00AM and 4:00PM, and under clear conditions without rainfall, high winds (>8 knots), or temperatures above 80°F. Counts were conducted once from 20 through 31 May 2013.

Islands surveyed in 2012 and 2013 (Table 10, Figure 2) included two in the Lower New York Harbor (Hoffman and Swinburne islands); four in the East River/Western Long Island Sound area (U Thant, Mill Rock, and North and South Brother islands); and two in the Hutchinson River/Long Island Sound area (Goose and Huckleberry islands). Partial colonial waterbird estimates were conducted on four islands in Jamaica Bay: Canarsie Pol, Elders Point Marsh East, Little Egg Marsh, and Subway Island. Additionally, observations of (1) Double-crested Cormorant nests near Shooters Island and on aids to navigation (i.e., channel markers and beacons) in the Kill Van Kull, Arthur Kill and northwestern Raritan Bay, (2) Yellow-crowned Night-Heron nesting at a mainland colony, and (3) Common Terns nesting on Governor's Island, are also presented in this report.

Each island was surveyed by a research team consisting of the author, volunteers from New York City Audubon and other organizations, and staff from New York City Department of Parks and Recreation (NYCDPR). Double-crested Cormorant counts were conducted by the author with Susan Elbin and numerous volunteers (see island accounts for details) as part of an ongoing study of cormorant population dynamics, habitat use, and foraging ecology in NY Harbor. Surveys at Goose and Huckleberry islands were conducted jointly with David Künstler (NYCDPR, Van Cortlandt & Pelham Bay Parks Administrators' Office). Don Riepe of the American Littoral Society/Jamaica Bay Guardian/NYC Audubon provided additional information on colonial waterbird activity in Jamaica

Bay.

Surveys were conducted by one or two teams of researchers, led by the author and trained volunteers. Groups quickly and systematically searched for nests on each island, initially focusing effort on areas occupied by nesting birds in previous years. Depending on the colony size, each team was composed of two counters (i.e. one person using a telescopic mirror pole to examine contents of nests up to five meters from the ground, and another to record data), and from one to three spotters, who moved slightly ahead to direct the counters to nests and keep multiple teams from re-sampling the same nests. A nest was deemed active if it contained eggs or young, if there was evidence of recent construction (e.g. fresh twigs or vegetation in nest) or use (e.g. a layer of fresh feces underneath a nest), or by direct observation of adults on or within one meter of a nest with the above characteristics. Whenever possible, nests were identified to species by the presence of young, eggs and clearly discernible nest structure. Nests beyond the reach of the mirror pole were examined with binoculars. If nest contents could not be confirmed, but other evidence suggested recent activity (e.g. feces, new nest construction), nesting species was noted as 'unknown'. Old or unused nests were noted in the count as 'inactive, but not included in the final tally of active nests. Nesting vegetation (i.e., tree, shrub, or vine species) was recorded for all species whenever possible by observers skilled in plant identification.

Double-crested Cormorant surveys were conducted by direct observation within colonies (as detailed above). After all the nests were counted in a given tree, the tree was tagged with forestry flagging tape. Boat counts were conducted on Shooter's and U Thant islands, where nests were counted with binoculars from a boat no more than 20 meters away from the colony. In addition, observations of nesting activity on aids to navigation were made from distances of up to 20 meters.

Adult counts of Great Black-backed Gulls and Herring Gulls were conducted at all surveyed colonies. In addition, nest counts were made whenever possible. Both adult counts and nest counts are presented in this report. When adults were counted in the vicinity of selected colonies, a nest was assumed present for each adult observed, as one-half of adults are assumed to be foraging away from the nesting colony during daytime (see Litwin et al. 1993; Kerlinger 2004).

Study Site

The nesting survey occurs across all islands of the New York Harbor. For the purposes of this project, we are most interested in the nesting activity in the lower part of the harbor: Hoffman and Swinburne Islands, and the islands of the Arthur Kill and Kill van Kull (Shooter's, Prall's, and Isle of Meadows). Island descriptions are available in the Nesting Survey full report (Appendix A and B)

*C. Results*

2012. Overview: Species summary for all islands surveyed. Eight species of harbor herons nested on eight islands in New York Harbor. These species, hereafter collectively referred to as waders, included Black-crowned Night-Heron, Great Egret, Snowy Egret, Glossy Ibis, Yellow-crowned Night-Heron, Little Blue Heron, Tricolored Heron and Great Blue Heron (observed nesting in the New York Harbor for the first time in 2011). Black-crowned Night-Herons continued to be the numerically dominant nesting species in most mixed-species colonies. The Tricolored and Little Blue herons continued to nest at low numbers. Cattle Egret and Green Heron, observed in small numbers in previous years, have not been observed nesting in New York Harbor since 2010. A total of 1,389 Double-crested Cormorant nests were observed, exhibiting very little population growth since 2011. Gull nesting activity was observed on all surveyed islands. Hoffman, Swinburne, and the Arthur Kill Islands were surveyed in 2012, but not all islands were.

Overview: Island summaries. The largest species diversity was observed in Jamaica Bay on Subway Island this year (2012, seven wader species) as opposed to Canarsie Pol as in previous years. The greatest total number of nests was observed on Hoffman Island as in recent years, despite the incomplete nature of the survey conducted on this island in 2012. Nesting activity in Jamaica Bay was concentrated on Subway Island and Elder's Point Marsh East, where wader populations experienced moderate increases. Nesting activity declined drastically on Canarsie Pol (by -97%) in Jamaica Bay, and to a lesser extent on South Brother Island (by -9%). Wader nesting activity on Huckleberry Island continued to persist at low levels.

Nearby Islands (near Prall's) (Table 11).
The three islands in the Arthur Kill and Kill Van Kull (Shooters Island, Prall's Island, and Isle of Meadows) continued to exhibit no signs of wader nesting activity in 2012. Shooter's Island supported 17 Double-crested Cormorant nests.

Hoffman Island: The greatest total number of nests was observed on Hoffman Island (n=527). There were 400 Double-crested Cormorant nests.
Swinburne Island: No wading birds were nesting on Swinburne this year. There were 426 Double-crested Cormorant nests.

2013 Overview: Species summary for all islands surveyed. Seven species of harbor herons nested on seven islands in New York Harbor. These species, hereafter collectively referred to as waders, included Black-crowned Night-Heron, Great Egret, Snowy Egret, Glossy Ibis, Yellow-crowned Night-Heron, Little Blue Heron, and Tricolored Heron. Overall, the total number of wader nests has decreased by 26% since the last comprehensive survey in 2010. This includes decreases in Black-crowned Night-Herons (-27%), the numerically dominant nesting species in most mixed-species colonies, Great Egrets (-15%), Snowy Egrets (-24%), and Glossy Ibis (-45%). The Tricolored and Little Blue herons continued to nest at low numbers. Great Blue Heron, Cattle Egret and Green Heron, observed in small numbers in previous years, were not observed nesting in New York Harbor in 2013. A total of 1,596 Double-crested Cormorant nests were observed, continuing the slow but steady population increase exhibited since 2004. Gull nesting activity was observed on all surveyed islands. Tern nesting activity was observed in Joco Marsh and on Governor's Island.

Overview: Island summaries. The greatest species diversity was observed in Jamaica Bay on Subway Island this year (six wader species) as opposed to Canarsie Pol as in previous years. The greatest total number of nests was observed on Hoffman Island as in recent years, although this island exhibited a 19% decline in total nests since 2010. Nesting activity in Jamaica Bay was concentrated on Subway Island and Elder's Point Marsh East, where wader populations experienced substantial increases (163% and 250% respectively), while nesting activity on Canarsie Pol was entirely absent for the first time in the fourteen years this island has been surveyed. South Brother Island exhibited substantial declines in nesting activity (-37%) since the last comprehensive survey in 2010. Goose Island exhibited substantial nesting activity during the 2013 breeding season, but had been recently abandoned, likely due to a combination of human disturbance and nest predation, one or two days prior to the survey. Wader nesting activity on Huckleberry Island continued at very low levels. Recently inactive islands, including the three islands in the Arthur Kill and Kill Van Kull (Shooters Island, Pralls Island, and Isle of Meadows) and North Brother Island, continued to exhibit no signs of wader nesting activity in 2013. Mainland nesting of Yellow-crowned Night-Herons has increased after reported predation pressure reduced the breeding colony at the Redfern Houses in Far Rockaway in 2010. Double-crested

Cormorants nested on seven islands throughout the harbor. Additional cormorant nests were observed near Shooters Island and on aids to navigation in the Kill Van Kull, Arthur Kill and northwestern Raritan Bay.

Nearby Islands (near Prall's) (Table 11).
The three islands in the Arthur Kill and Kill Van Kull (Shooters Island, Prall's Island, and Isle of Meadows) continued to exhibit no signs of wader nesting activity in 2013. Shooter's supported 10 nests.

Hoffman Island: The greatest total number of nests was observed on Hoffman Island (n=507). There were 611 Double-crested Cormorant nests, an increase of 52% compared to 2012 (n= 426 nests).

Swinburne Island: No wading birds were nesting on Swinburne this year. There were 336 Double-crested Cormorants nesting on the island, a decrease of 20% since 2012. Superstorm Sandy drastically changed the landscape on Swinburne, eliminating many of the trees as well as all but one wall of the built structures. Cormorants selected to nest in trees on Hoffman.

*D. Discussion*
Wading birds occur in the harbor in the vicinity of Prall's Island, although they have not nested there in any sizeable numbers since 2005. Hoffman Island could possibly provide a source of waders, to nest on Prall's post-restoration. If cormorants continue to increase their nesting numbers on Hoffman, they may start to compete for space with the wading birds. If this happens, these displaced wading birds could serve as pioneers to (re)start the colony on Prall's.

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**V. Banding Great Egrets and Other Waterbirds in the New York Harbor**
Lead author for this section: Susan Elbin

*A. Introduction*
Individual identification is an important part of evaluating where individual egrets spend their time and how far/where they spend their time in the region. Since 2006, Elbin has been color-banding waterbirds in the harbor. She and her team have banded nearly 2,000 birds: Glossy Ibis (n=47), Snowy Egret (n=29), Great Egret (n=184), Herring Gull (n=35), Great Black-backed Gull (n=103), Double-crested Cormorant (n=1,425). Of those birds banded, there were 76 individuals that were re-sighted (4%) from live birds or band returns (dead birds).

In the past (2009-2010), New York City Audubon deployed VHF radio transmitters on Great Egrets, to track them in the Harbor. This technique proved to be problematic. Signals were difficult to pinpoint for many reasons, including interference from the surrounding built structures. Aerial tracking was prohibitive because of flight restrictions for small craft in the air space surrounding La Guardia and JFK Airports. And tracking by land was difficult because of the maze of waterways and highways that would need to be crossed (Elbin, personal communication). We hypothesized that the number of re-sightings for live birds would increase if the band were more obvious to bird watchers and citizen science volunteers.

Birds banded three or more years ago may be returning as adults to breed in the harbor. Also, as those birds fledge from the nesting colony, they may be seen by the many observers taking part in the

foraging surveys. Wing tags need to be used with caution, however, as some researchers have found a correlation between wing tags and failure to return to a natal colony (Curtis et al. 1983, Kinkel 1989).

*B. Methods*

In 2012 we started a banding program to use patagial tags (wing tags) on Great Egrets (Figure 4). Wing tags have been used on a variety of species in the past (Anderson 1963). We modeled our program after a successful banding program run by the Canadian Wildlife Service in Ontario, Canada, to attached wing tags to Great Egrets (D.V. Chip Weseloh, personal communication).

Tag Construction

Tags were made of yellow heavy-gauge, color-fast flexible plastic material. Each tag was numbered with a unique 3-digit code, e.g. C10, 20A. Tags were 21.5 cm long and shaped like a barbell. Each end of the tag was rounded (6.5 cm across x 10 mm long) and connected by a 3 cm x 2cm narrow band. The rounded ends were both marked with the same unique ID. Tags were situated on the wing such that one end was on the outside of the wing and one end was on the underside of the wing. The ID number could be read from either side of the wing.

Tag Attachment

Pre-fledged Great Egrets were hand-captured on or near their nests, placed gently in pillowcases, and carried out of the colony to the banding site nearby. Each bird was banded with a USFWS metal band. Birds with blood feathers (remiges) were not tagged with wing tags. Those birds were given metal bands and color bands only. We used small rivets to pierce the patagium and attach the tags to the wings. The bird was then returned to the pillowcase. All tagged birds were then carried back to the point of capture and released. We watched the bird for approximately 20 seconds after release.

In 2012, pre-fledged Great Egrets were tagged on the 11 June on Elder's Marsh in Jamaica Bay. Birds were tagged on 19 June and 7 July on Hoffman Island in the lower harbor. In 2013, pre-fledged Great Egrets were tagged and banded on Elder's Marsh on 21 June and 8 July. The nesting trees were severely impacted by salt water from Superstorm Sandy, providing little screening or protection for the nestling. Therefore, we did not band any birds on Hoffman Island in 2013.

*C. Results and Discussion*

In 2012 we banded 116 birds, all banded at the natal colony before fledging: 25 Great Egret, 2 Glossy Ibis, 14 Herring Gulls, and 75 Double-crested Cormorant. In 2013 we banded 244 birds: 21 Great Egret and 223 Double-crested Cormorants (Table 12b). In addition to metal bands, ibis and cormorants received colored leg bands. Great Egrets received either colored leg bands or wing tags.

In addition to keen-eyed birders, the Harbor Herons foraging observers were also trained to look for color bands and wing tags on individuals. We also received observation data from the Bird Banding Laboratory in Patuxent, MD. Wing tags on Great Egrets greatly increased the number of sightings reported to us. After the use of wing tags, the rate of re-sighting newly fledged Great Egrets increased to 18-44% (Table 12a) as compared to 4 sightings from 142 Great Egrets banded with leg bands only (3%). Wing tags are the preferred method of marking for this project. They are quick and easy to apply, and easily seen and read from a distance.

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**VI. Ecology of Colonial Waterbirds in the NY/NJ Harbor: Harbor Heron Foraging Surveys**
Lead authors for this section: Nellie Tsipoura and Laura Stern

Note: The full report is attached at Appendix C. Some pertinent Tables have been copied into this report, but please refer to the full report for any figures.

*A. Introduction*

The assumption that successful breeding colonies reflect improved estuary health in the NY/NJ Harbor is implicit in breeding colony management goals. However, although these nesting islands provide rich, isolated habitats for breeding colonies, these sites provide little to no foraging habitat, and therefore, Harbor Herons depart from their colonies daily to forage elsewhere. Because Harbor Heron nesting sites are conspicuous with hundreds of nests, more is known about their breeding activities than their foraging habitats.

Through this work we identified sites of importance to the Harbor Herons and provided data to fill gaps in the biotics database on the threatened Black-crowned and Yellow-crowned Night-Heron as well as data on the special concern Snowy Egret and Great-Blue Heron. Although Black-crowned Night-Herons are the numerically dominant species on the nesting colonies (Craig 2012), Great Egrets and Snowy Egrets have been the two most common species observed foraging in the Meadowlands District and Raritan Bay, while Great Blue Heron, Black-crowned Night-Heron and Great Egret were the most common species observed at two North Hackensack River sites. For both Great and Snowy Egret, the average number of birds observed in foraging groups is greater in the Meadowlands than any other general area, including the Raritan Bay, and NY sites. During our surveys we found that habitat was an important factor in determining foraging sites used by Harbor Herons, with the greatest number of birds observed in sites with available open water habitats. A larger proportion of Great Egrets were recorded foraging in deeper water compared to Snowy Egrets, as would be expected based on their feeding behaviors. Also, more birds than expected were seen during mid-tides than at low or high tides, suggesting the importance of tidal cycle in determining Harbor Heron foraging site use.

In 2010 and 2011, we identified some interesting patterns in egret abundance and movements during the post-breeding period, with large increases in use at some sites and then rapid declines. Seasonal changes in the number of birds did not show the same temporal patterns among sites, with peaks in numbers at Meadowlands wetlands preceding those in the Raritan and Jamaica Bay. The number of birds we encountered seem to match approximately the number we would expect based on breeding colony counts, and we don't think that it reflects an influx of migrating birds, but that also warrants further study.

We received funding in 2011 from the New York-New Jersey Harbor & Estuary Program to conduct this study in conjunction with restoration activities at Prall's Island. Our results for 2012 are presented in this report. Surveys continue in 2013 until the end of October, so at this time we are still analyzing data.

*B. Objectives*

If Prall's Island provides nesting sites for Harbor Herons, increased use of NJ foraging sites will be observed as the birds move closer to NJ. Specific objectives of this portion of the project were: (1) to determine the baseline abundance of long-legged colonial waterbirds at specific sites in the NY/NJ

Harbor, especially later in the breeding season; (2) to collaborate with NYCA and correlate numbers and patterns of occurrence in foraging habitats to those in the breeding colonies; and (3) to mobilize and coordinate citizen scientists to conduct observations of these colonial waterbirds and thereby engage them in nature study and create stewards of the birds and their habitat. Below we describe the methods and results of objective (1) and (3). We continue to collaborate with NYCA to integrate the research results of their breeding surveys with the foraging study.

*C. Methods*

**Study Site/Survey Locations**

Surveys of foraging colonial wading birds focused on the Meadowlands and Raritan Bay areas of New Jersey with some additional sites in the Upper Hackensack River and in the Arthur Kill watershed. These focus areas were chosen based on previous flight line observations suggesting that birds breeding on North and South Brother Islands fly over Manhattan and the Hudson River to forage in the New Jersey's Meadowlands, while birds from Hoffman cross Staten Island to forage in Arthur Kill and the Raritan River basin (NYCA 2005). Selection of other sites throughout Northern New Jersey and Staten Island were based on volunteer suggestions and availability.

Specific survey locations in the Meadowlands were selected with help from NJMC staff, based on the presence of suitable habitat. Survey points were established in 2008 using aerial photographs in ArcGIS. Points were selected within suitable habitat to cover as much of the site as possible, while maintaining sufficient distance to minimize overlap in viewing area among points. Sites outside the Meadowlands District were selected based on discussions with birders and volunteers familiar with the areas, and by searching for wetland habitats that appeared productive with aerial maps. In 2012, sites were prioritized based on the number of herons and egrets observed during surveys in previous years.

In New York City, survey sites were selected by identifying suitable habitat on Google Earth Maps of the area. Staff and volunteers then visited the sites and determined whether or not they should be monitored.

Survey points were established at 13 sites within the Meadowlands region (Table 13a and Figure 1a), 3 sites along the Northern Hackensack (Table 13a and Figure 2a) and 1 site in northern New Jersey (Table 13a and Figure 2a). One to 11 points were established at each site, with a total of 73 survey points in the Meadowlands, 18 points at the Northern Hackensack sites and 7 points at the North Jersey site (Table 13a). Survey points were designated as optional if they were difficult to access. Survey points were established at 17 sites within the Raritan Bay/Raritan River area in New Jersey, hereafter referred to as 'Raritan' (79 points; Table 13b and Figure 4b), at 5 sites in the Arthur Kill Watershed area (37 points; Table 13b and Figure 5a), and at one site in southern New Jersey (6 points; Table 1b and Figure 2a). Figure 5a shows the location of all survey sites for each region, i.e. the Meadowlands, Northern Hackensack, Raritan, Arthur Kill Watershed, and North and South Jersey.

New York City Audubon survey points were established at a total of 21 sites in the New York City area: 4 sites in the Bronx (43 points; Table 14 and Figure 1c), 3 sites in Manhattan (18 points; Table 14 and Figure 1c), 2 sites in Queens (14 points; Table 14 and Figure 1c), 4 sites in the Brooklyn/Jamaica Bay area (25 points; Table 14 and Figure 1d), 6 sites on Staten Island (27 points; Table 14 and Figure 1d) and 2 sites on Long Island (17 points; Table 14 and Figure 1e). Figure 5b shows the location of all survey sites for each area, i.e. Bronx, Manhattan, Queens, Brooklyn/Jamaica Bay, Staten Island and Long Island. It should be noted that the NJA survey points established on Staten Island as part of the Arthur Kill Watershed region (Figure 1b) were established separately from, and are independent of the

NYCA Staten Island survey points (Figure 1d). Only the NYCA Staten Island sites are included in this report because the NJA Staten Island sites were not surveyed in 2012.

Individual site descriptions for the New Jersey and New York sites are given below. Raritan and Arthur Kill Watershed sites are not as well described, but we present descriptions of some of them below. Maps of individual survey sites are provided in the Appendices of full report, Appendix C.

**Site Descriptions –New Jersey**

Hackensack Meadowlands sites

Anderson Creek - is located along the eastern bank of the Hackensack River and is dominated by marsh, open water and mudflats. *Phragmites* has been removed and/or knocked down. The site is accessible only by boat. Two survey points were established but were not surveyed.

Harrier Meadow - is a restored tidal marsh surrounded by tidal mudflats on two sides and urban development and landfill on the remaining two sides. During restoration, three large, tidally influenced open-water areas surrounded by high-marsh and fringe-upland vegetation were created. This site is different than the other restored marsh sites in the Meadowlands because it was constructed on top of rubble and other hard materials. Survey points were revised in 2009, resulting in a total of eight survey points, one of which is optional.

Richard P. Kane Natural Area (Empire Tract) - is a historically diked marsh dominated by *Phragmites*. Access to the central portion of the site is limited. Three survey points were established, but only one point was surveyed during 2008. In 2012, Empire Tract was not surveyed due to limited volunteer availability.

Kearny Brackish Marsh - consists primarily of open water and emergent vegetation. Over the past ten years, emergent vegetation has been largely eliminated and replaced by open water, and tidal flows and hydrologic connections have been restricted due to surrounding development (U.S. Army Corps of Engineers 2004). We established two survey points along Belleville Turnpike. KBRM_02 was accessed by permission of the radio station WMCA. A third survey point was added in 2011.

Kearny Freshwater Marsh - is a freshwater impoundment, adjacent to the Keegan landfill, and dominated by *Phragmites*. Productivity of the marsh has declined due to rising water levels (U.S. Army Corps of Engineers 2004). We selected two survey points in 2008, accessible along the abandoned RR tracks along the northern portion of the site, and added a new point within Gunnell Oval park in 2009, but large portions of the site are not accessible from land and therefore could not be observed. This site was assigned in 2012 but no data was ever received from the volunteer.

Kingsland Impoundment (DeKorte Park) and Saw Mill Creek – these two sites are parts of the same wetland, consisting of open water interspersed and bordered by *Phragmites* stands and manmade berms. The sites receive tidal waters from both Saw Mill Creek and Kingsland Creek. Water levels are occasionally controlled for wildlife habitat and recreational uses. In 2009, the water level of Kingsland Impoundment was dramatically reduced to allow for renovations on the NJMC buildings in September and October, a point that may complicate our analysis. The sites are easily accessible via the Marsh Discovery and Saw Mill Creek Trails. Eleven survey points were established at Kingsland Impoundment and seven points, one of which is optional, at Saw Mill Creek. These points remained unmodified from 2008.

Mill Creek Marsh - was restored by NJMC in 1999. During restoration, dredge material was excavated, tidal flow reestablished, open water impoundments created, and the surface graded to provide low marsh and upland habitat. The site now contains low marsh habitats that are flushed daily with the tides, lowland scrub-shrub habitats, and open water. There is a 1.5-mile walking trail, along which we established ten survey points. An eleventh point, listed as optional, is accessed from a residential area west of the site at Huber Street.

Marsh Resources Meadowlands Mitigation Bank (MRI) - is a restored tidal marsh. The low marsh areas are dominated by smooth cordgrass (*Spartina alterniflora*), dwarf spike rush (*Eleocharis parvula*) and marsh fleabane (*Pluchea odorata*). The high marsh areas are dominated by saltmarsh hay (*Spartina patens*), spikegrass (*Distichlis spicata*) and groundseltree (*Baccharis halmifolia*). Access to this site was somewhat limited because it can only be surveyed during business hours. In 2008, we established 9 survey points at the site. MRI_08 is only accessible by boat and was not surveyed during 2012. Additionally, based on its limited visibility, MRI_01 was removed from the survey in 2009.

Riverbend Wetlands Preserve - consists of high saltmarsh vegetation, primarily *Spartina patens*, areas dominated by common reed (*Phragmites australis*), and open water. Riverbend is only accessible by boat. Two survey points were established, but were not surveyed.

Saw Mill Creek Wildlife Management Area - is a naturally functioning marsh dominated by *Spartina alterniflora* and a large contiguous expanse of mudflat. Recreational use at this site includes angling, canoeing, kayaking, and NJMC boat tours. Waterfowl hunting is also permitted during the regular hunting season. Nine survey points were established; all are accessible only by boat and in the past had only been surveyed by NJMC staff.

Secaucus High School Wetlands – is a recently restored site in which *Spartina* vegetation is still being established. Five survey points were established; three along the Secaucus High School Wetlands boardwalk and two along the southern portion of the site.

Skeetkill Creek Marsh - includes about 16 acres within the industrial section of Ridgefield. Before the NJMC acquired the site, it consisted largely of a dense monoculture of *Phragmites* with very little open water or tidal flow. Enhancement projects at the site included the creation of tidal channels, open water, low marsh habitat, and upland islands. The site is viewed along Pleasantview Terrace, where one survey point sufficiently covers the observable area of the marsh. Skeetkill Creek Marsh was not surveyed in 2012 due to limited volunteer availability.

Overpeck Creek – is a tributary of the Hackensack River, approximately 8 miles (13 km) long, in Bergen County in northeastern New Jersey in the United States. The lower broad mouth of the creek is part of the extended tidal estuary of the lower Hackensack and of the adjacent New Jersey Meadowlands. Like the other tributaries of the Hackensack in the Meadowlands, the creek has suffered from severe pollution in the 20th century during the era of heavy industrialization. During the 1950s, tide gates were installed on the creek that largely cut off the tidal flow into the surrounding wetlands. The restoration of the surrounding wetlands has been an ongoing project of several state and private agencies.

*Raritan sites*

Cheesequake - is a 1,274-acre state park located in Old Bridge Township, Middlesex County. Not only is it situated in the middle of the urban north and the suburban south, it lies in a transitional zone

between two different ecosystems. The park's lowlands consist of freshwater and saltwater marsh and a tidal estuary near the mouth of Cheesequake Creek on the Raritan Bay. It also includes hills of Northeastern hardwood forest, open fields, and a white cedar swamp. It includes a small parcel of Atlantic coastal pine barrens consisting of pine forest in sandy soil, an isolated section of the much larger New Jersey Pine Barrens. The marshes here hold nesting Green Heron, foraging Great and Snowy Egrets, Black-crowned Night-Heron, Osprey, Clapper Rail, and Marsh Wren. Rough-legged Hawk and Short-eared Owl have made winter visits to these marshes.

Compton Creek - is one of three tidal waterways located in the north portion of Middletown Township, Monmouth County, NJ that empty to the Sandy Hook Bay. Compton Creek and Ware Creek to the east are situated in the Belford section of Middletown and Pews Creek to the west is situated in the Port Monmouth section of Middletown. The southern, upstream reaches of Compton's Creek are comprised of a 10-30 feet wide channel routed through phragmites-dominated floodplain. Compton's Creek along with Pews Creek and Ware Creek are natural open-space areas that provide benefits to the bayshore including floodwater control, habitat for wildlife and all the benefits of coastal wetlands

Pews Creek and Ware Creek have been surveyed in the past but were not surveyed in 2012.

Edmund's Ave. (Conaskonk Pt.) - is an area of salt marsh and beach, in Union Beach on Raritan Bay between Sandy Hook and South Amboy. It is a favorite among birders for the diverse species of bay and estuary birds that can be sighted here. Best access to the site is from Edmund's Ave. so it is sometimes called by that name.

Laurence Harbor - is home to Laurence Harbor Waterfront Park which consists of a new boardwalk which was completed in 2002. It extends approximately one mile from the Old Bridge Police substation south, to the border of Cliffwood Beach. This area is very popular for fishing as three jetties extend into the Raritan.

Natco Lake - is located on the border of Hazlet Township and Union Beach. The National Fireproofing Company (Natco) mined clay here for bricks in the 1930's. Eventually the mining equipment hit underground springs and the lake filled in. A ditch was dug in an attempt to drain off the water into a nearby tidal creek. The ditching brought in salt water and made the lake brackish, as it remains today. Natco's mix of habitat, along with its location on the bayshore, makes it a great place for birds.

Raritan Center – is a large, privately owned industrial complex in Edison Township, which includes approximately 930 acres of emergent wetlands, ponds, and tidal creeks. These wetlands provide essential habitat for waterfowl, shorebirds, colonial water birds (including the state threatened Black-crowned and Yellow-crowned Night-Heron), raptors, passerines, furbearers, and anadromous fish in a highly urbanized area. Historically this site was known as Raritan Arsenal, and was used by the U.S. Army primarily for storage of munitions and equipment. Remaining hazards include unexploded ordnance, contamination and derelict buildings. The remaining wetland habitat is in imminent danger of destruction from numerous unauthorized fills and degradation of adjacent wetlands from erosion of fill material. Due to hazards at the site and private property issues, our survey area was limited to the roads throughout the site, which cover only a small portion of the total habitat, leaving large areas of suitable habitat not surveyed.

Sandy Hook - is a 2,044 barrier beach peninsula located in an urban landscape at the northern tip of New Jersey's shoreline. It is designated as a Gateway National Recreation Area (NRA) and is administered by the National Park Service. Sandy Hook is also designated as a globally significant

IBA by National Audubon Society for its ability to support Piping Plovers. New Jersey Department of Environmental Protection designated Sandy Hook a Natural Heritage Priority Site, one of the state's most significant natural areas. The site contains a variety of habitats including sandy beaches, extensive vegetated dune habitat, tidal mudflats, tidal salt marsh and two tracts of maritime forest, one of which is the largest remaining tract in NJ. Sandy Hook has been surveyed by students at the MAST school since 2008. The students also use their data for their senior thesis.

South Amboy Meadows - Collectively referred to by birders as "South Amboy," the area encompassed by Raritan Bay Waterfront Park in South Amboy and the mudflats/uplands of the Morgan section of Sayreville Township contain an array of habitat types and bird species in a small physical area. The creation of the waterfront park and renewed interest in birding in the area has contributed many modern bird records of note, and shows how this urban oasis is important for many migratory and nesting species. Diverse habitats include waters of Raritan Bay, open beach and dune, mudflats, tidal creeks, salt marsh, freshwater wetlands and pond, pitch pine woods, red maple-tupelo swamp, and oak forest.

Washington Canal - This site is located along the Washington Canal in the western portion of Sayreville, between Popowski Avenue and the canal, which feeds into the Raritan River. The site includes forested, shrub-dominated, and riverfront access, with views of Washington Canal and extensive marshes across the canal. Washington Canal was not surveyed in 2011 due to limited volunteer availability.

*Arthur Kill Watershed sites*

Bayonne Waterfront – Hudson River Waterfront Walkway is a paved path which wends its way along the waterfront, sandwiched between the Bayonne Golf Club and South Cove. There is some marsh, the cove itself, which, depending on tide can host a variety of different birds, the golf course edges, and, at the end of the trail, a view out over New York Harbor.

Elizabeth River – is a roughly 312 acre linear park consisting of salt marsh, wetland, woodland, and riparian habitats within Elizabeth, Union and Hillside. The Elizabeth River Parkway, acquired in the 1930s as a mostly passive use park, is an important link in a chain of historically important parks that form a greenway along the Elizabeth River watershed and serves as a key "corridor" for travelling wildlife. The Elizabeth River is 11 miles long, much of it channelized for flood control purposes. Land uses in the Rahway and Elizabeth Watersheds are mainly residential, commercial and industrial.

Liberty State Park – Located in densely populated and almost completely built-up Hudson County, and surrounded by development except where it fronts on Upper New York Bay, Liberty State Park is a green oasis in the middle of metropolitan northern New Jersey. Liberty State Park comprises 1,212 acres and is as well known for its premier birding (239 species identified). The salt marsh, one of the few remaining tidal marshes of the Hudson River supports a variety of foraging wading and shorebirds.

**Survey Protocol**

Protocols and datasheets to record site, habitat use, and foraging behavior observations were developed in 2008 and reevaluated and modified as needed in the 2009 and 2010 survey season. Volunteers visit their assigned sites twice per month during the survey season, once during the first half of the month and again during the second half. In 2008, the survey season ran from June 15th to October 31st. In 2009 and 2010, we were able to launch the survey earlier and begin on May 1st and again end on October 31sr.

Beginning in 2011 and continuing into 2012, we used a simplified protocol because we wanted to obtain more bird count data than foraging behavior observations. NJA volunteers were asked to conduct surveys weekly from July 15th to September 30th and twice per month in June and October. NYCA volunteers were asked to survey weekly from May through October To maximize the number of visits, we assigned multiple volunteers to each survey site whenever possible. Volunteers assigned to the same site were asked to coordinate their survey visits with each other so that they did not survey on the same day.

During each site visit, volunteers visited all of the mapped survey points and collected information on 1) date, time of day, tidal cycle, habitat, and weather, 2) total numbers of birds of each species and each age group (when possible). Date, time of day, tidal cycle, weather and habitat were recorded at each point even when no birds were present. Point habitat was categorized as: mudflat, open water above the knee, open water below the knee, open water (depth not recorded), high marsh, low marsh, *Phragmites* marsh, scrub/shrub, forest, or manmade (Appendix 2). Volunteers recorded habitat by either selecting the predominant habitat at the site (easier) or entering the percentage of each habitat (more challenging). Tide was established by recording the time of the nearest low tide. At each point, volunteers recorded the total number of birds of each species observed.

The survey protocol and datasheet are provided in the full report (Appendix C).

**Data Analysis**

The total number of colonial wading birds observed for each species, and the average number observed per site visit was calculated by general survey area and site. Within each general area, we estimated relative frequency at the site level, by calculating the number of sites at which a species was recorded divided by the total number of sites surveyed. We also calculated relative frequency at the point level for each general area, as the number of points at which a species was recorded divided by the total number of points surveyed. For each individual site, we calculated point frequency as the number of points at which a species was observed divided by the total number of points surveyed at that site. The time interval used for these analyses was June 16th to October 31st for both NJ and NY survey sites.

To investigate changes throughout the breeding/post-breeding season, the maximum number of birds observed during a single visit at each site was calculated for each two-week interval during the survey season. The June 16th to October 31st time interval was used for the NJ sites. Surveys were started earlier at the NY sites, so the May 1st to October 31st time interval was used for these sites in this analysis.

*D. Results*

Change in abundance throughout the survey season by site

Table 14a and Figure 9a show the maximum number of colonial water birds seen during a single site visit (across all species) by two-week (bi-monthly) intervals, for each site at the Meadowlands, Northern Hackensack and North Jersey. Maximum counts are shown in Table 14b and Figure 9b for the Raritan and Arthur Kill Watershed sites, and in Table 14c and Figure 9c for the New York sites. The same information was calculated for each of the three most common species; Great Egret (Tables 15a through 15c, Figures 10a through 10c), Snowy Egret (Tables 16a through 16c, Figures 11a through 11c), and Great Blue Heron (Tables 8a through 8c, Figures 12a through 12c). Tables 17a through 17c contain details regarding the number of site visits and number of points surveyed at each of the two-week intervals for the Meadowlands, Northern Hackensack and North Jersey sites, the Raritan and Arthur Kill Watershed sites, and the New York sites, respectively.

All Species

For all species combined (Table 14a, Figure 9a), the highest numbers of birds observed in a single visit in the Meadowlands occurred at Saw Mill Creek in early September (maximum = 83) and Harrier Meadow in early July (maximum = 74). There were also more than 60 birds observed in a single visit at Saw Mill Creek in early August (63), and at Kingsland Impoundment and Marsh Resources (67 and 70, respectively) in early September. The greatest numbers of birds observed in a single visit for the Raritan sites (Table 14b, Figure 9b) occurred at Raritan Center in late July (maximum = 60) and late August (maximum = 54). There were also 46 birds observed in a single visit in late September at Bayonne Waterfront in the Arthur Kill Watershed (Table 14b, Figure 9b). For the New York sites (Table 14c, Figure 9c), the greatest number of birds seen in a single visit occurred at Pelham Bay Park in late August (maximum = 52). There were also 40 or 41 birds observed in a single visit at Goethals in late July and early August, Pelham Bay Park in late September, and Jamaica Bay in late October.

Timing of the peak (highest maximum number) for all species combined varied widely across the Meadowlands sites. The earliest peak within a site was observed in early July at Harrier Meadow (maximum = 74), followed by late July at Mill Creek Marsh (24) and Secaucus High School (12) (however, these two sites were not surveyed in early August or September; see Table 12a in Appendix C), early August at Saw Mill WMA (47), and early September at Kingsland Impoundment (67), Marsh Resources (70), and Saw Mill Creek (83). The latest peak of the season was observed in late September at Kearny Brackish Marsh (43). For the Raritan sites, timing of the peak for all species combined also varied widely, from early July at Thorne Creek (maximum = 5) to late September at Compton Creek (30) and Sandy Hook (27). The distribution of the peak at the remaining 8 Raritan sites was as follows: late July for 3 sites, early August for one site, late August for one site, and early September for 3 sites. At 6 of the 9 New York sites, the peak occurred during July or August. The earliest peak was late May at Lower Bronx River (maximum = 6) and Clove Lakes Park (12), although Lower Bronx River was not surveyed during June or after mid-August (see Table 12c in Appendix C). The only site where the peak occurred after August was Jamaica Bay, in late October (41), although there were relatively high numbers of birds observed as early as late July (33) at this site.

*E. Discussion and Conclusions*

Great Egret and Snowy Egret were the two most common species observed in the Meadowlands and Raritan survey areas during 2012, similar to what we had reported for 2008 and 2009 (Tsipoura et al. 2009) and 2011. Great Egret and Great Blue Heron were the most common species observed at the Arthur Kill Watershed sites surveyed in 2012. Great Egret and Snowy Egret were the two most common species observed for the New York City Audubon sites. For both Great Egret and Snowy Egret, the average number observed per site visit in 2012 was greater in the Meadowlands (12.7 for Great Egret and 9.1 for Snowy Egret) than any other general area, including Raritan (3.3 and 1.1), Arthur Kill Watershed (4.8 and 1.1), and New York (3.2 and 3.3). Great Egrets were observed at 100% of all sites in all four general survey areas, and at 70% of points surveyed or greater in the Meadowlands (82%), Raritan (77%) and New York (70%). Snowy Egrets were observed at 100% of sites and 82% of points in the Meadowlands region, compared to 82% of sites and 44% of points in the Raritan region, and 67% of sites and 62% of points in New York.

In the Meadowlands, Kearny Marsh, Kingsland Impoundment, and Saw Mill Creek supported large numbers of Great Egrets, while Harrier Meadow and Marsh Resources supported more Snowy Egrets. In previous years, large numbers of Snowy Egrets were reported from Mill Creek Marsh. However, in 2012 numbers were lower because we were not able to conduct a full season of surveys at this site (the

volunteer who surveys that site had to stop the counts due to health issues). Saw Mill WMA supports relatively similar numbers of both species. Since the two species of egrets select different water depths (Tsipoura et al 2009) our results show that Harrier Meadow and Saw Mill WMA provide the tidal regimes and combination of water depths needed to accommodate both species.

Similarly, in Raritan most sites supported larger numbers of Great Egrets, with the largest number at Matawan Marsh, while only two sites, Edmund's Ave. and Raritan Center had both species of egrets in substantial numbers. The fact that the latter two sites are ones that are completely unmanaged and un-restored, yet provide a range of tidal heights and regimes appropriate for these species suggests that these two sites are important and should be considered carefully in any plans to develop or manage these sites in any manner.

In New York, Pelham Bay Park supported large numbers of Great Egrets and fewer, but still relatively substantial numbers of Snowy Egrets, while Goethals supported more Snowy Egrets. Jamaica Bay supported similar numbers of both species.

In terms of seasonal patterns, maximum numbers of Great Egrets are highest in the NJ Meadowlands from August through the beginning of October, coinciding with the time that the young fledge from the colonies (Figure 14a). Even though each site in the Meadowlands has a slightly different use pattern, the counts are driven by high peaks in biweekly counts at Kingsland Impoundment, Saw Mill WMA and Kearny Marsh, while some sites like Marsh Resources seem to have stable (but high) numbers from mid-August to late September (Figure 10a). At Raritan sites, the highest overall use was recorded earlier than in the Meadowlands, during the last two weeks of August. While the seasonal patterns in the Raritan are also driven by high peaks at two sites (Raritan Center and Matawan Marsh), the numbers of Great Egrets peak at several sites at the same time, although not to the scale that they do at Raritan Center and Matawan Marsh. At the New York sites, the highest overall use was recorded in the Bronx during the last two weeks of August, and again during the last two weeks of September, both driven by the high peaks at Pelham Bay Park. The Brooklyn/Jamaica Bay area showed the highest use during the last two weeks of October, resulting from the high peak at the Jamaica Bay site.

Snowy Egrets in the NJ Meadowlands showed two peaks in abundance, one in July and the second one coinciding with the peak of Great Egrets in early September. The two peaks were the result of a large number of individuals of this species seen at two sites; Harrier Meadow for the first peak and Marsh Resources for the second peak. At Raritan sites, the highest number of Snowy Egrets was seen in late July, and this was driven by counts at Raritan Center. At New York sites, the highest use was recorded for Staten Island from July through early August, driven by counts at the Goethals site.

Finally, although the seasonal patterns vary among the individual sites, overall numbers for Great Blue Herons across the Meadowlands are relatively steady, ranging between 9 and 12 from early July through early September. A peak in late August can be seen in the Arthur Kill. There are some productive estuarine marshes and mudflats at the mouth of the Rahway River which are inaccessible, and while we believe that these sites are likely to support good numbers of both species of egrets, we have not been able to establish their seasonal use patterns.

In addition to the surveys of foraging herons and egrets, in 2012 and 2013 we collected information on roosting sites in the NY/NJ Harbor. In collaboration with egret scientists from Canada, NJA and NYCA will coordinate a roost-blitz in September to identify sites that may be of importance to egrets in the region but have not been recognized because they are only used during the evening hours for

roosting.

Finally, an important part of analysis of 2011 and 2012 data will be combining the foraging survey results in NJ with those collected by NYCA in NY, and integrating the breeding colony data to understand the connections between breeding and foraging site use.

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Tables and Figures

Table 1. Number of mist nets deployed and total net-hours per netting day on Prall's Island, fall 2012 and spring 2013. Number of days from first to last netting days were 36 and 33 d in fall and spring, respectively.

| Fall 2012 | | | Spring 2013 | | |
|---|---|---|---|---|---|
| Date | No. of Nets | Total Net-Hours | Date | No. of Nets | Total Net-Hours |
| 2012.09.21 | 3 | 6.17 | - | - | - |
| 2012.09.25 | 3 | 9.92 | - | - | - |
| 2012.10.02 | 3 | 7.65 | - | - | - |
| 2012.10.05 | 3 | 10.34 | 2013.05.03 | 4 | 18.00 |
| 2012.10.11 | 3 | 16.60 | 2013.05.13 | 4 | 18.17 |
| 2012.10.12 | 4 | 15.17 | 2013.05.14 | 4 | 14.00 |
| 2012.10.15 | 4 | 17.25 | 2013.05.17 | 4 | 12.00 |
| 2012.10.26 | 4 | 15.47 | 2013.06.04 | 4 | 15.00 |
| Total | - | 98.57 | Total | - | 77.17 |

Table 2. Comparison of mist netting effort and results on Prall's Island in fall 2012 and spring 2013.

| Parameter | Fall | Spring | Difference | |
|---|---|---|---|---|
| Number of netting days[1] | 8 | 5 | -3 | -37.5% |
| Spread of first-to-last netting days (d)[1] | 36 | 33 | -3 | -8.3% |
| Total net-hours[1] | 98.57 | 77.17 | -21.40 | -21.7% |
| | | | | |
| Total species netted[2,3] | 26 | 15 | -11 | -42.3% |
| Total species netted/Number of netting days | 3.25 | 3.0 | -0.25 | -7.7% |
| Total species netted/Total net-hours | 0.264 | 0.194 | -0.07 | -26.5% |
| | | | | |
| Total individuals netted[2,3] | 151 | 58 | -93 | -61.6% |
| Total individuals netted/Number of netting days | 18.88 | 11.60 | -7.28 | -38.6% |
| Total individuals netted/Total net-hours[3] | 1.532 | 0.752 | -0.780 | -50.9% |

[1] Source: Table 1

[2]Sources: Tables 4-5

[3]Sources: Tables 6-7

Table 3. Species of birds observed and their status on Prall's Island. YRR = Year-Round Resident, PM = Passage Migrant, PMO = Passage Migrant Only, PPM = Possible Passage Migrant, SSR = Spring-Summer Resident, PW = Possible Winterer, CB = Confirmed Breeder, LB = Likely Breeder, PB = Possible Breeder, NB = Not Breeding (see text).

| Species | Status | |
|---|---|---|
| | Occurrence | Breeding |
| Wild Turkey (*Meleagris gallopavo*) | YRR | CB |
| Downy Woodpecker (*Picoides pubescens*) | YRR | CB |
| Willow Flycatcher (*Empidonax traillii*) | SSR, PPM | CB |
| American Robin (*Turdus migratorius*) | SSR, PM, PW | CB |
| Gray Catbird (*Dumetella carolinensis*) | SSR, PM | CB |
| Brown Thrasher (*Toxostoma rufum*) | SSR, PPM | CB |
| Common Yellowthroat (*Geothlypis trichas*) | SSR, PM | CB |
| Yellow Warbler (*Setophaga petechia*) | SSR, PPM | CB |
| Song Sparrow (*Melospiza melodia*) | SSR, PM, PW | CB |
| Common Grackle (*Quiscalus quiscula*) | SSR, PM | CB |
| Brown-headed Cowbird (*Molothrus ater*) | SSR, PPM | CB |
| Baltimore Oriole (*Icterus galbula*) | SSR, PPM | CB |
| American Goldfinch (*Spinus tristis*) | YRR, PPM | CB |
| Canada Goose (*Branta canadensis*) | YRR, PPM | LB |
| American Woodcock (*Scolopax minor*) | SSR, PM | LB |
| Mourning Dove (*Zenaida macroura*) | YRR | LB |
| Eastern Phoebe (*Sayornis phoebe*) | SSR, PPM | LB |
| Black-capped Chickadee (*Poecile atricapillus*) | YRR | LB |
| European Starling (*Sturnus vulgaris*) | YRR | LB |
| Northern Cardinal (*Cardinalis cardinalis*) | YRR | LB |
| Spotted Sandpiper (*Actitis macularius*) | SSR, PPM | PB |
| Yellow-shafted Flicker (*Colaptes a. auratus*) | YRR | PB |
| House Wren (*Troglodytes aedon*) | SSR | PB |
| Red-eyed Vireo (*Vireo olivaceus*) | SSR, PM | PB |
| Blue Jay (*Cyanocitta cristata*) | YRR | PB |
| Tree Swallow (*Tachycineta bicolor*) | SSR, PPM | PB |
| Hermit Thrush (*Catharus guttatus*) | SSR, PM | PB |

(Table 3 continued on next page)

Table 3 (continued)

| Species | Status | |
|---|---|---|
| | Occurrence | Breeding |
| Great Blue Heron (*Ardea herodias*) | SSR | NB |
| Great Egret (*Ardea alba*) | SSR, PPM | NB |
| Yellow-bellied Sapsucker (*Sphyrapicus varius*) | PM, PW | NB |
| Peregrine Falcon (*Falco peregrinus*) | SSR, PPM | NB |
| Blue-headed Vireo (*Vireo solitarius*) | PMO | NB |
| Philadelphia Vireo (*Vireo philadelphicus*) | PMO | NB |
| Barn Swallow (*Hirundo rustica*) | SSR, PPM | NB |
| Red-breasted Nuthatch (*Sitta canadensis*) | PM, PW | NB |
| White-breasted Nuthatch (*Sitta carolinensis*) | PM, PW | NB |
| Brown Creeper (*Certhia americana*) | PM, PW | NB |
| Golden-crowned Kinglet (*Regulus satrapa*) | PM, PW | NB |
| Ruby-crowned Kinglet (*Regulus calendula*) | PM, PW | NB |
| Veery (*Catharus fuscescens*) | PMO | NB |
| Gray-cheeked Thrush (*Catharus minimus*) | PMO | NB |
| Swainson's Thrush (*Catharus ustulatus*) | PMO | NB |
| Cedar Waxwing (*Bombycilla cedrorum*) | PM, WR | NB |
| Black-and-white Warbler (*Mniotilta varia*) | PMO | NB |
| Mourning Warbler (*Geothlypis philadelphia*) | PMO | NB |
| American Redstart (*Setophaga ruticilla*) | SSR, PPM | NB |
| Magnolia Warbler (*Setophaga magnolia*) | PMO | NB |
| Blackpoll Warbler (*Setophaga striata*) | PMO | NB |
| Palm Warbler (*Setophaga palmarum*) | PMO | NB |
| Myrtle Warbler (*Setophaga c. coronata*) | PMO | NB |
| Eastern Towhee (*Pipilo erythrophthalmus*) | PMO | NB |
| Seaside Sparrow (*Ammodramus maritimus*) | PMO | NB |
| Swamp Sparrow (*Melospiza georgiana*) | PMO | NB |
| White-throated Sparrow (*Zonotrichia albicollis*) | PM, PW | NB |
| Slate-colored Junco (*Junco h. hyemalis*) | PM, PW | NB |
| Purple Finch (*Haemorhous purpureus*) | PM, PW | NB |
| House Finch (*Haemorhous mexicanus*) | PM, PW | NB |
| Pine Siskin (*Spinus pinus*) | PM, PW | NB |

Table 4. Total (T) numbers of birds netted and banded (B) or not banded (NB) on Prall's Island, fall 2012 and spring 2013.

| Species | Fall 2012 | | | Spring 2013 | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | B | NB | T | B | NB | T | B | NB | T |
| Downy Woodpecker | - | - | - | 1 | 0 | 1 | 1 | 0 | 1 |
| Yellow-shafted Flicker | 2 | 1 | 3 | - | - | - | 2 | 1 | 3 |
| Willow Flycatcher | - | - | - | 0 | 1 | 1 | 0 | 1 | 1 |
| Eastern Phoebe | 4 | 0 | 4 | - | - | - | 4 | 0 | 4 |
| Blue-headed Vireo | 0 | 1 | 1 | - | - | - | 0 | 1 | 1 |
| Philadelphia Vireo | 1 | 0 | 1 | - | - | - | 1 | 0 | 1 |
| Red-eyed Vireo | 0 | 1 | 1 | - | - | - | 0 | 1 | 1 |
| Tree Swallow | - | - | - | 1 | 0 | 1 | 1 | 0 | 1 |
| Barn Swallow | - | - | - | 1 | 0 | 1 | 1 | 0 | 1 |
| Black-capped Chickadee | 1 | 0 | 1 | - | - | - | 1 | 0 | 1 |
| Brown Creeper | 1 | 0 | 1 | - | - | - | 1 | 0 | 1 |
| Ruby-crowned Kinglet | 2 | 0 | 2 | - | - | - | 2 | 0 | 2 |
| Hermit Thrush | 2 | 0 | 2 | - | - | - | 2 | 0 | 2 |
| American Robin | 1 | 1 | 2 | 12 | 0 | 12 | 13 | 1 | 14 |
| Gray Catbird | 9 | 1 | 10 | 17 | 0 | 17 | 26 | 1 | 27 |
| Brown Thrasher | - | - | - | 2 | 0 | 2 | 2 | 0 | 2 |
| Cedar Waxwing | 1 | 0 | 1 | - | - | - | 1 | 0 | 1 |
| Black-and-white Warbler | 1 | 0 | 1 | - | - | - | 1 | 0 | 1 |
| Mourning Warbler | 1 | 0 | 1 | - | - | - | 1 | 0 | 1 |
| Common Yellowthroat | 3 | 0 | 3 | 0 | 1 | 1 | 3 | 1 | 4 |
| Magnolia Warbler | - | - | - | 1 | 0 | 1 | 1 | 0 | 1 |
| Yellow Warbler | - | - | - | 8 | 0 | 8 | 8 | 0 | 8 |
| Blackpoll Warbler | 1 | 0 | 1 | - | - | - | 1 | 0 | 1 |
| Palm Warbler | 1 | 1 | 2 | - | - | - | 1 | 1 | 2 |
| Myrtle Warbler | 84 | 9 | 93 | - | - | - | 84 | 9 | 93 |
| Eastern Towhee | 0 | 1 | 1 | - | - | - | 0 | 1 | 1 |

(Table 4 continued on next page)

Table 4 (continued)

| Species | Fall 2012 | | | Spring 2013 | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | B | NB | T | B | NB | T | B | NB | T |
| Seaside Sparrow | 1 | 0 | 1 | - | - | - | 1 | 0 | 1 |
| Song Sparrow | 2 | 0 | 2 | 1 | 0 | 1 | 3 | 0 | 3 |
| Swamp Sparrow | 0 | 2 | 2 | - | - | - | 0 | 2 | 2 |
| White-throated Sparrow | 11 | 1 | 12 | - | - | - | 11 | 1 | 12 |
| Slate-colored Junco | 1 | 0 | 1 | - | - | - | 1 | 0 | 1 |
| Northern Cardinal | - | - | - | 1 | 0 | 1 | 1 | 0 | 1 |
| Common Grackle | - | - | - | 4 | 0 | 4 | 4 | 0 | 4 |
| Baltimore Oriole | - | - | - | 5 | 0 | 5 | 5 | 0 | 5 |
| Purple Finch | 1 | 0 | 1 | - | - | - | 1 | 0 | 1 |
| American Goldfinch | 1 | 0 | 1 | 2 | 0 | 2 | 3 | 0 | 3 |
| Total | 132 | 19 | 151 | 56 | 2 | 58 | 188 | 21 | 209 |

Table 5. Number of each species netted on Prall's Island in fall 2012 and spring 2013. Species designated as passage migrants only (PMO, Table 3) are indicated with an asterisk.

| Species | Fall | Spring | Species | Fall | Spring |
|---|---|---|---|---|---|
| American Robin | 2 | 12 | Palm Warbler* | 2 | - |
| Gray Catbird | 10 | 17 | Myrtle Warbler* | 93 | - |
| Common Yellowthroat | 3 | 1 | Eastern Towhee* | 1 | - |
| Song Sparrow | 2 | 1 | Seaside Sparrow* | 1 | - |
| American Goldfinch | 1 | 2 | Swamp Sparrow* | 2 | - |
| Yellow-shafted Flicker | 3 | - | White-throated Sparrow | 12 | - |
| Eastern Phoebe | 4 | - | Slate-colored Junco | 1 | - |
| Blue-headed Vireo* | 1 | - | Purple Finch | 1 | - |
| Philadelphia Vireo* | 1 | - | Downy Woodpecker | - | 1 |
| Red-eyed Vireo | 1 | - | Willow Flycatcher | - | 1 |
| Black-capped Chickadee | 1 | - | Tree Swallow | - | 1 |
| Brown Creeper | 1 | - | Barn Swallow | - | 1 |
| Ruby-crowned Kinglet | 2 | - | Brown Thrasher | - | 2 |
| Hermit Thrush | 2 | - | Magnolia Warbler* | - | 1 |
| Cedar Waxwing | 1 | - | Yellow Warbler | - | 8 |
| Black-and-white Warbler* | 1 | - | Northern Cardinal | - | 1 |
| Mourning Warbler* | 1 | - | Common Grackle | - | 4 |
| Blackpoll Warbler* | 1 | - | Baltimore Oriole | - | 5 |

Table 6. Number of birds of each species netted on Prall's Island in fall 2012, relative frequency (as a percentage of total birds netted) of each species, and average number captured per net-hour (n = 98.57 net-hours, Table 1). Species designated as passage migrants only (PMO, Table 3) are indicated with an asterisk.

| Species | Number Netted | Relative Frequency (%) | Average Number per Net-Hour |
|---|---|---|---|
| Myrtle Warbler* | 93 | 61.59 | 0.943 |
| White-throated Sparrow | 12 | 7.94 | 0.122 |
| Gray Catbird | 10 | 6.62 | 0.101 |
| Eastern Phoebe | 4 | 2.65 | 0.041 |
| Yellow-shafted Flicker | 3 | 1.99 | 0.030 |
| Common Yellowthroat | 3 | 1.99 | 0.030 |
| Ruby-crowned Kinglet | 2 | 1.32 | 0.020 |
| Hermit Thrush | 2 | 1.32 | 0.020 |
| American Robin | 2 | 1.32 | 0.020 |
| Palm Warbler* | 2 | 1.32 | 0.020 |
| Song Sparrow | 2 | 1.32 | 0.020 |
| Swamp Sparrow* | 2 | 1.32 | 0.020 |
| Blue-headed Vireo* | 1 | 0.66 | 0.010 |
| Philadelphia Vireo* | 1 | 0.66 | 0.010 |
| Red-eyed Vireo | 1 | 0.66 | 0.010 |
| Black-capped Chickadee | 1 | 0.66 | 0.010 |
| Brown Creeper | 1 | 0.66 | 0.010 |
| Cedar Waxwing | 1 | 0.66 | 0.010 |
| Black-and-white Warbler* | 1 | 0.66 | 0.010 |
| Mourning Warbler* | 1 | 0.66 | 0.010 |
| Blackpoll Warbler* | 1 | 0.66 | 0.010 |
| Eastern Towhee* | 1 | 0.66 | 0.010 |
| Seaside Sparrow* | 1 | 0.66 | 0.010 |
| Slate-colored Junco | 1 | 0.66 | 0.010 |
| Purple Finch | 1 | 0.66 | 0.010 |
| American Goldfinch | 1 | 0.66 | 0.010 |
| | 151* | 99.94** | 1.532*** |

* Total

** Note: percentages do not add up to 100% due to rounding.

*** 151 birds netted/98.57 total net-hours = 1.532 birds captured per net-hour.

Table 7. Number of birds of each species netted on Prall's Island in spring 2013, relative frequency (as a percentage of total birds netted) of each species, and average number captured per net-hour (n = 77.17 net-hours, Table 1). Species designated as passage migrants only (PMO, Table 3) are indicated with an asterisk.

| Species | Number Netted | Relative Frequency (%) | Average Number per Net-Hour |
|---|---|---|---|
| Gray Catbird | 17 | 29.31 | 0.220 |
| American Robin | 12 | 20.69 | 0.156 |
| Yellow Warbler | 8 | 13.79 | 0.104 |
| Baltimore Oriole | 5 | 8.62 | 0.065 |
| Common Grackle | 4 | 6.90 | 0.052 |
| Brown Thrasher | 2 | 3.45 | 0.026 |
| American Goldfinch | 2 | 3.45 | 0.026 |
| Downy Woodpecker | 1 | 1.72 | 0.013 |
| Willow Flycatcher | 1 | 1.72 | 0.013 |
| Tree Swallow | 1 | 1.72 | 0.013 |
| Barn Swallow | 1 | 1.72 | 0.013 |
| Common Yellowthroat | 1 | 1.72 | 0.013 |
| Magnolia Warbler* | 1 | 1.72 | 0.013 |
| Song Sparrow | 1 | 1.72 | 0.013 |
| Northern Cardinal | 1 | 1.72 | 0.013 |
| | 58* | 99.97* | 0.752** |

* Total

** Note: percentages do not add up to 100% due to rounding.

*** 58 birds netted/77.17 total net-hours = 0.752 birds captured per net-hour.

Table 8. Mammals and birds photographed with trail cameras on Prall's Island, 2012-2013 (see text).

| Mammals: |
| --- |
| White-tailed Deer (*Odocoileus virginianus*) |
| North American Raccoon (*Procyon lotor*) |
| North American Opossum (*Didelphis virginiana*) |
| Striped Skunk (*Mephitis mephitis*) |
| Birds: |
| Canada Goose (*Branta canadensis*) |
| Wild Turkey (*Meleagris gallopavo*) |
| Mourning Dove (*Zenaida macroura*) |
| American Robin (*Turdus migratorius*) |
| Gray Catbird (*Dumetella carolinensis*) |
| Common Grackle (*Quiscalus quiscula*) |

Table 9. Number of instantaneous scans at each study site with decoy (D) or no decoy (ND) present, and number of Great Blue Herons (GBH) and Green Herons (GH) observed at each site, August-September 2013.

| | Number of Scans | | | | | | Herons Observed | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Study Sites | | | | | | Study Sites | | | | | |
| | A | | B | | C | | A | | B | | C | |
| | D | ND | D | ND | D | ND | D | ND | D | ND | D | ND |
| 24 August | 0 | 16 | 0 | 16 | 0 | 16 | 0 | 1 GBH | 0 | 0 | 0 | 0 |
| 25 August | 16 | 0 | 0 | 16 | 16 | 0 | 0 | 0 | 0 | 0 | 1 GBH | 0 |
| 27 August | 0 | 16 | 0 | 16 | 0 | 16 | 0 | 0 | 0 | 1 GH | 0 | 1 GBH |
| 28 August | 16 | 0 | 0 | 16 | 16 | 0 | 1 GBH | 0 | 0 | 0 | 1 GH | 0 |
| 29 August | 8 | 8 | 8 | 0 | 8 | 8 | 0 | 0 | 1 GH | 0 | 0 | 0 |
| 31 August | 8 | 8 | 8 | 0 | 8 | 8 | 1 GBH | 0 | 1 GH | 0 | 0 | 0 |
| 3 September | 8 | 8 | 8 | 0 | 8 | 8 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 September | 8 | 8 | 8 | 0 | 8 | 8 | 0 | 0 | 1 GH | 0 | 1 GH | 1 GH |
| 6 September | 8 | 8 | 8 | 0 | 8 | 8 | 1 GBH | 0 | 0 | 0 | 0 | 0 |
| 7 September | 0 | 8 | 8 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 September | 8 | 0 | 8 | 0 | 8 | 0 | 0 | 0 | 1 GH | 0 | 0 | 0 |
| 9 September | 0 | 8 | 8 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 September | 8 | 0 | 8 | 0 | 8 | 0 | 1 GH | 0 | 0 | 0 | 0 | 0 |
| 11 September | 0 | 8 | 0 | 8 | - | - | 0 | 0 | 0 | 0 | - | - |
| 12 September | 8 | 0 | 0 | 0 | - | - | 0 | 0 | 0 | 0 | - | - |
| Total | 96 | 96 | 72 | 72 | 88 | 88 | 1 GH<br>3 GBH | 1 GBH | 4 GH | 1 GH | 2 GH<br>1 GBH | 1 GH<br>1 GBH |

Table 10. List of islands, location and ownership for wader, cormorant and gull surveys. The islands closest to Prall's are marked with an *. They are Shooter's, Prall's, Isle of Meadows, Hoffman, and Swinburne.

| Location Surveyed | Ownership |
|---|---|
| *Long Island Sound* | |
| Goose Island | NYC DPR |
| Huckleberry Island | Huckleberry Indians, Inc. |
| | |
| *East River* | |
| North Brother Island | NYC DPR |
| South Brother Island | NYC DPR |
| Mill Rock | NYC DPR |
| U Thant | NYC DPR |
| | |
| *Arthur Kill-Kill Van Kull* | |
| *Shooter's Island | NYC DPR |
| *Prall's Island | NYC DPR |
| *Isle of Meadows | NYC DPR |
| | |
| *Lower New York Bay* | |
| *Swinburne Island | NPS |
| *Hoffman Island | NPS |
| | |
| *Upper New York Bay* | |
| Governor's Island | NY State, NPS |
| | |
| *Jamaica Bay* | |
| Elders Point Marsh | NPS |
| Canarsie Pol | NPS |
| Subway Island | NPS |
| Little Egg Marsh | NPS |
| | |
| *Mainland – Far Rockaway* | |
| Redfern Houses | NYC Housing Authority |

Table 11. Number of nesting pairs of wading birds and cormorants on Hoffman Island, Swinburne Island, and the islands of the Arthur Kill/Kill van Kull in 2012 and in 2013.

Hoffman Island

| Species | Number of Nests in 2012 | Number of Nests in 2013 |
|---|---|---|
| Black-crowned Night-Heron | 275 | 219 |
| Great Egret | 94 | 203 |
| Snowy Egret | 56 | 52 |
| Glossy Ibis | 100 | 29 |
| Little Blue Heron | 0 | 2 |
| Yellow-crowned Night-Heron | 2 | 0 |
| Double-crested Cormorant | 400 | 611 |

Swinburne Island

| Species | Number of Nests in 2012 | Number of Nests in 2013 |
|---|---|---|
| Wading Birds | 0 | 0 |
| Double-crested Cormorant | 426 | 336 |

Shooter's Island

| Species | Number of Nests in 2012 | Number of Nests in 2013 |
|---|---|---|
| Wading Birds | 0 | 0 |
| Double-crested Cormorant | 17 | 10 |

Prall's Island and Isle of Meadows had 0 pairs of nesting waterbirds.

Table 12a. Great Egret banding and wing-tag returns. Hoffman Island is in the lower harbor. Elder's Marsh is part of Jamaica Bay. Number Tagged (yr) is the number of Great Egrets tagged with wing tags during the year in parentheses. Number Resighted is the number of tagged Great Egrets that were seen. Percent Resighted is the percent of tagged birds that were seen in a given year. Location is where the bird was seen. All observations were made during the hatching year, before the bird migrated south.

| Tagging Location | # Tagged (yr) | # Resighted (yr) | % Resighted (yr) | Location |
|---|---|---|---|---|
| Hoffman Island | 7 ('12)<br>-----<br>0 ('13) | 2 ('12)<br>-----<br>- | 29 ('12)<br>-----<br>- | Barnegat Bay, NJ<br><br>Wyoming, DE |
| Elder's Marsh East | 18 ('12)<br>------<br>17 ('13)<br>+4 birds were banded and not tagged ('13) | 8 ('12)<br>------<br>3 ('13) | 44 ('12)<br>------<br>18 ('13) | Brooklyn, NY<br><br>Kingston, NY<br>Meadowlands, NJ<br><br>Tinicum, PA<br>Lewisbury, PA<br>Rivière des Mille Iles, Quebec<br>Saratoga, NY |

Table 12b. All waterbirds banded in the NY Harbor.

| Species | # banded 2012 | # banded 2013 |
|---|---|---|
| Great Egret | 25 | 21 |
| Glossy Ibis | 2 | 0 |
| Herring Gull | 14 | 0 |
| Double-crested Cormorant | 75 | 223 |
| Total | 116 | 244 |

Table 13a. 2012 Heron Survey Sites in the NJ Meadowlands, Northern Hackensack and North Jersey. Includes number of points established and number of surveys conducted (June 16 – October 31) and entered into the online database.

| | | | Established points | | Data received | | |
|---|---|---|---|---|---|---|---|
| **Code** | **Site** | **Area** | **Regular** | **Optional** | **Visits** | **Points** | **Surveys** |
| ANCR | Anderson Creek | Meadowlands | 2 | 0 | - | - | - |
| HAME | Harrier Meadow | Meadowlands | 7 | 1 | 11 | 7 | 68 |
| KANE | Kane Natural Area (Empire Tract) | Meadowlands | 3 | 0 | - | - | - |
| KBRM | Kearny Brackish Marsh | Meadowlands | 3 | 0 | 11 | 3 | 33 |
| KFWM | Kearny Freshwater Marsh | Meadowlands | 3 | 0 | - | - | - |
| KING | Kingsland Impoundment (DeKorte) | Meadowlands | 11 | 0 | 19 | 11 | 207 |
| MRI | Marsh Resources (MRI) | Meadowlands | 7 | 1 | 33 | 8 | 235 |
| MCMA | Mill Creek Marsh | Meadowlands | 10 | 1 | 6 | 10 | 60 |
| RBWP | Riverbend Wetland Preserve | Meadowlands | 2 | 0 | - | - | - |
| SACR | Saw Mill Creek | Meadowlands | 6 | 1 | 28 | 7 | 196 |
| SAWM | Saw Mill Wildlife Management Area | Meadowlands | 9 | 0 | 19 | 9 | 167 |
| SEHS | Secaucus High School | Meadowlands | 5 | 0 | 4 | 5 | 20 |
| SKMA | Skeetkill Marsh | Meadowlands | 1 | 0 | - | - | - |
| **Meadowlands Total** | | | **69** | **4** | **131** | **60** | **986** |
| LIPA | Lincoln Park | N. Hackensack | 6 | 0 | - | - | - |
| ORAD | Oradell Reservoir | N. Hackensack | 5 | 0 | - | - | - |
| OVCR | Overpeck Creek | N. Hackensack | 7 | 0 | 1 | 6 | 6 |
| **Northern Hackensack Total** | | | **18** | **0** | **1** | **6** | **6** |
| CEFA | Celery Farm | Misc. North Jersey Sites | 7 | 0 | 9 | 7 | 62 |
| **Misc. North Jersey Sites Total** | | | **7** | **0** | **9** | **7** | **62** |

Table 13b. 2012 Heron Survey Sites in the Raritan and Arthur Kill Watershed regions.

Includes number of points established and number of surveys conducted (June 16 – October 31) and entered into the online database.

| | | | Points mapped | | Data received | | |
|---|---|---|---|---|---|---|---|
| **Code** | **Site** | **Area** | **Regular** | **Optional** | **Visits** | **Points** | **Surveys** |
| CHQU | Cheesequake | Raritan | 3 | 3 | 26 | 5 | 48 |
| CLCR | Claypit Creek | Raritan | 1 | 0 | - | - | - |
| COCR | Compton Creek | Raritan | 3 | 0 | 12 | 3 | 36 |
| CRRO | Creek Road | Raritan | 1 | 0 | - | - | - |
| EACR | East Creek | Raritan | 2 | 0 | 9 | 2 | 18 |
| EDAV | Edmund's Ave (Conaskonk Pt.) | Raritan | 3 | 0 | 9 | 3 | 27 |
| KEYP | Keyport | Raritan | 2 | 1 | - | - | - |
| LAHA | Laurence Harbor | Raritan | 5 | 4 | 28 | 6 | 57 |
| MAWA | Matawan Marsh | Raritan | 4 | 4 | 16 | 7 | 67 |
| NALA | Natco Lake | Raritan | 2 | 2 | 15 | 2 | 30 |
| PECR | Pews Creek | Raritan | 5 | 0 | - | - | - |
| RACE | Raritan Center | Raritan | 7 | 2 | 14 | 6 | 84 |
| SAHO | Sandy Hook | Raritan | 7 | 0 | 39 | 7 | 142 |
| SOAM | South Amboy Meadows | Raritan | 6 | 1 | 6 | 6 | 32 |
| THCR | Thorne Creek | Raritan | 1 | 1 | 15 | 1 | 15 |
| WACR | Ware Creek | Raritan | 3 | 0 | - | - | - |
| WACA | Washington Canal | Raritan | 6 | 0 | - | - | - |
| **Raritan Total** | | | **61** | **18** | **189** | **48** | **556** |
| ARKI | Arthur Kill | Arthur Kill Watershed | 10 | 0 | - | - | - |
| SI | Staten Island | Arthur Kill Watershed | 5 | 0 | - | - | - |
| BAYO | Bayonne Waterfront | Arthur Kill Watershed | 5 | 0 | 12 | 4 | 48 |
| ELRI | Elizabeth River | Arthur Kill Watershed | 1 | 0 | - | - | - |
| LISP | Liberty State Park | Arthur Kill Watershed | 8 | 2 | 8 | 5 | 40 |
| **Arthur Kill Watershed Total** | | | **35** | **2** | **20** | **9** | **88** |
| WRPO | Wreck Pond | Misc. South Jersey Sites | 6 | 0 | - | - | - |
| **Misc. South Jersey Sites Total** | | | **6** | **0** | **-** | **-** | **-** |

Table 14a. Maximum number of colonial wading birds observed during a single site visit for the Meadowlands, Northern Hackensack and North Jersey sites, by two-week intervals in 2012 (June 16 – October 31). Meadowlands sites include Harrier Meadow (HAME), Kearny Brackish Marsh (KBRM), Kingsland Impoundment (KING), Marsh Resources (MRI), Mill Creek Marsh (MCMA), Saw Mill Creek (SACR), Saw Mill WMA (SAWM), and Secaucus High School (SEHS). The Northern Hackensack site is Overpeck Creek (OVCR) and the North Jersey site is Celery Farm (CEFA).

| Date Range | Maximum Number Observed (All Species) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Meadowlands | | | | | | | | North Hacken. | North Jersey |
| | HAME | KBRM | KING | MRI | MCMA | SACR | SAWM | SEHS | OVCR | CEFA |
| June 16-30 | 14 | | | 8 | | 11 | 26 | | | |
| July 1-15 | 74 | 3 | 17 | 38 | 3 | 29 | 36 | 3 | | |
| July 16-31 | 59 | 11 | 34 | 25 | 24 | 21 | 44 | 12 | 2 | |
| Aug 1-15 | 27 | 25 | 48 | 23 | | 63 | 47 | | | 5 |
| Aug 16-31 | 42 | 24 | 53 | 54 | 6 | 53 | 36 | 6 | | 5 |
| Sept 1-15 | 45 | 30 | 67 | 70 | | 83 | 27 | | | 4 |
| Sept 16-30 | 31 | 43 | 38 | 56 | | 46 | 37 | | | 3 |
| Oct 1-15 | 1 | | 41 | 20 | 4 | 55 | 17 | | | 3 |
| Oct 16-31 | | | | 9 | 0 | 8 | 13 | | | |

Table 14b. Maximum number of colonial wading birds observed during a single site visit for the Raritan and Arthur Kill Watershed sites, by two-week intervals in 2012 (June 16 – October 31).

Raritan sites include Cheesequake (CHQU), Compton Creek (COCR), East Creek (EACR), Edmund's Avenue (EDAV), Laurence Harbor (LAHA), Matawan Marsh (MAWA), Natco Lake (NALA), Raritan Center (RACE), Sandy Hook (SAHO), South Amboy Meadows (SOAM) and Thorne Creek (THCR). Arthur Kill Watershed sites include Bayonne Waterfront (BAYO) and Liberty State Park (LISP).

| Date Range | Maximum Number Observed (All Species) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raritan | | | | | | | | | | | Arthur Kill Watershed | |
| | CHQU | COCR | EACR | EDAV | LAHA | MAWA | NALA | RACE | SAHO | SOAM | THCR | BAYO | LISP |
| June 16-30 | 6 | | 2 | 10 | 3 | | 1 | | 6 | | 2 | 12 | |
| July 1-15 | 6 | 4 | 3 | 7 | 8 | 18 | 3 | 8 | 9 | 0 | 5 | 8 | |
| July 16-31 | 14 | 14 | 4 | 18 | 16 | 17 | 1 | 60 | 8 | 1 | 2 | 9 | 10 |
| Aug 1-15 | 14 | 3 | 2 | 7 | 26 | 12 | 2 | 9 | 12 | 0 | 3 | 19 | 11 |
| Aug 16-31 | 23 | 10 | 2 | 7 | 11 | 29 | 2 | 54 | 12 | 1 | 0 | 28 | 8 |
| Sept 1-15 | 7 | 6 | 2 | 13 | 10 | 38 | 7 | 10 | 7 | 3 | 2 | 18 | 9 |
| Sept 16-30 | 11 | 30 | | | 1 | 18 | 2 | 10 | 27 | 0 | 1 | 46 | 12 |
| Oct 1-15 | 2 | 1 | | | 1 | 33 | 0 | 1 | 8 | | 0 | 16 | 7 |
| Oct 16-31 | 5 | 1 | 2 | 2 | 2 | | 1 | | 5 | | 1 | | |

Table 14c. Maximum number of colonial wading birds observed during a single site visit for the New York sites, by two-week intervals in 2012 (May 1 – October 31). Bronx sites include Lower Bronx River/Soundview Park (LOBR) and Pelham Bay Park East (PEBP); Manhattan sites include Inwood Hill (INWO) and Randall's Island (RAND); Brooklyn/Jamaica Bay sites include Gerritsen Beach (GEBE), Jamaica Bay (JABA) and Spring Creek (SPCR); and Staten Island sites include Clove Lakes Park (CLLA) and Goethals (GOET).

| Date Range | Maximum Number Observed (All Species) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Bronx | | Manhattan | | Brooklyn/Jamaica Bay | | | Staten Island | |
| | LOBR | PEBP | INWO | RAND | GEBE | JABA | SPCR | CLLA | GOET |
| May 1-15 | 2 | 8 | 0 | 7 | 6 | | 12 | 5 | 2 |
| May 16-31 | 6 | 16 | 0 | 5 | 2 | 18 | 7 | 12 | 11 |
| June 1-15 | | 13 | 0 | 11 | 10 | 9 | 12 | 12 | 4 |
| June 16-30 | | 21 | 1 | 9 | 8 | 18 | 26 | 4 | 18 |
| July 1-15 | 3 | 14 | 3 | 3 | 7 | 8 | 25 | 5 | 29 |
| July 16-31 | 2 | 19 | 1 | 15 | 3 | 33 | 30 | 2 | 40 |
| Aug 1-15 | 2 | 5 | 1 | 4 | 9 | 16 | 27 | 1 | 41 |
| Aug 16-31 | | 52 | 1 | 3 | 12 | 30 | 27 | 1 | 11 |
| Sept 1-15 | | 37 | | 3 | 4 | | 25 | 1 | 15 |
| Sept 16-30 | | 41 | 0 | 3 | 8 | 28 | 29 | 1 | 17 |
| Oct 1-15 | | 19 | 0 | 1 | 4 | 37 | 22 | 2 | 18 |
| Oct 16-31 | | 8 | | 2 | 0 | 41 | 1 | 2 | 5 |

Table 15a. Maximum number of Great Egrets observed during a single site visit for the Meadowlands, Northern Hackensack and North Jersey sites, by two-week intervals in 2012 (June 16 – October 31).

Meadowlands sites include Harrier Meadow (HAME), Kearny Brackish Marsh (KBRM), Kingsland Impoundment (KING), Marsh Resources (MRI), Mill Creek Marsh (MCMA), Saw Mill Creek (SACR), Saw Mill WMA (SAWM), and Secaucus High School (SEHS). The Northern Hackensack site is Overpeck Creek (OVCR) and the North Jersey site is Celery Farm (CEFA).

| Date Range | Maximum Number of Great Egrets Observed | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Meadowlands | | | | | | | | North Hacken. | North Jersey |
| | HAME | KBRM | KING | MRI | MCMA | SACR | SAWM | SEHS | OVCR | CEFA |
| June 16-30 | 5 | | | 4 | | 5 | 9 | | | |
| July 1-15 | 10 | 3 | 15 | 29 | 1 | 17 | 19 | 0 | | |
| July 16-31 | 6 | 8 | 22 | 11 | 7 | 9 | 15 | 7 | 0 | |
| Aug 1-15 | 9 | 22 | 36 | 6 | | 35 | 26 | | | 0 |
| Aug 16-31 | 17 | 19 | 40 | 26 | 0 | 33 | 12 | 0 | | 1 |
| Sept 1-15 | 10 | 24 | 58 | 18 | | 57 | 12 | | | 1 |
| Sept 16-30 | 12 | 42 | 32 | 21 | | 32 | 28 | | | 1 |
| Oct 1-15 | 0 | | 33 | 16 | 1 | 40 | 13 | | | 1 |
| Oct 16-31 | | | | 8 | 0 | 4 | 4 | | | |

Table 15b. Maximum number of Great Egrets observed during a single site visit for the Raritan and Arthur Kill Watershed sites, by two-week intervals in 2012 (June 16 – October 31).

Raritan sites include Cheesequake (CHQU), Compton Creek (COCR), East Creek (EACR), Edmund's Avenue (EDAV), Laurence Harbor (LAHA), Matawan Marsh (MAWA), Natco Lake (NALA), Raritan Center (RACE), Sandy Hook (SAHO), South Amboy Meadows (SOAM) and Thorne Creek (THCR). Arthur Kill Watershed sites include Bayonne Waterfront (BAYO) and Liberty State Park (LISP).

| Date Range | Maximum Number of Great Egrets Observed | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raritan | | | | | | | | | | | Arthur Kill Watershed | |
| | CHQU | COCR | EACR | EDAV | LAHA | MAWA | NALA | RACE | SAHO | SOAM | THCR | BAYO | LISP |
| June 16-30 | 4 | | 2 | 6 | 1 | | 1 | | 2 | | 1 | 1 | |
| July 1-15 | 2 | 1 | 3 | 4 | 5 | 6 | 2 | 7 | 6 | 0 | 3 | 5 | |
| July 16-31 | 8 | 7 | 4 | 5 | 10 | 6 | 0 | 26 | 4 | 1 | 1 | 5 | 5 |
| Aug 1-15 | 10 | 1 | 2 | 2 | 16 | 7 | 1 | 8 | 3 | 0 | 1 | 4 | 6 |
| Aug 16-31 | 20 | 8 | 1 | 4 | 2 | 22 | 2 | 41 | 1 | 0 | 0 | 5 | 1 |
| Sept 1-15 | 7 | 3 | 0 | 8 | 2 | 36 | 5 | 8 | 3 | 2 | 1 | 4 | 7 |
| Sept 16-30 | 7 | 17 | | | 1 | 10 | 1 | 6 | 3 | 0 | 1 | 17 | 5 |
| Oct 1-15 | 1 | 1 | | | 1 | 20 | 0 | 1 | 2 | | 0 | 5 | 2 |
| Oct 16-31 | 0 | 0 | 1 | 1 | 0 | | 0 | | 2 | | 0 | | |

Table 15c. Maximum number of Great Egrets observed during a single site visit for the New York sites, by two-week intervals in 2012 (May 1 – October 31).

Bronx sites include Lower Bronx River/Soundview Park (LOBR) and Pelham Bay Park East (PEBP); Manhattan sites include Inwood Hill (INWO) and Randall's Island (RAND); Brooklyn/Jamaica Bay sites include Gerritsen Beach (GEBE), Jamaica Bay (JABA) and Spring Creek (SPCR); and Staten Island sites include Clove Lakes Park (CLLA) and Goethals (GOET).

| Date Range | Maximum Number of Great Egrets Observed | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Bronx | | Manhattan | | Brooklyn/Jamaica Bay | | | Staten Island | |
| | LOBR | PEBP | INWO | RAND | GEBE | JABA | SPCR | CLLA | GOET |
| May 1-15 | 0 | 2 | 0 | 3 | 5 | | 3 | 1 | 0 |
| May 16-31 | 4 | 11 | 0 | 4 | 0 | 4 | 1 | 3 | 0 |
| June 1-15 | | 9 | 0 | 1 | 8 | 3 | 5 | 1 | 3 |
| June 16-30 | | 15 | 1 | 5 | 5 | 4 | 8 | 2 | 2 |
| July 1-15 | 2 | 10 | 2 | 0 | 4 | 2 | 6 | 1 | 2 |
| July 16-31 | 1 | 13 | 1 | 1 | 3 | 5 | 8 | 0 | 2 |
| Aug 1-15 | 0 | 3 | 1 | 0 | 6 | 2 | 9 | 0 | 3 |
| Aug 16-31 | | 31 | 1 | 0 | 4 | 9 | 6 | 0 | 3 |
| Sept 1-15 | | 16 | | 0 | 1 | | 3 | 0 | 3 |
| Sept 16-30 | | 27 | 0 | 0 | 4 | 11 | 8 | 0 | 4 |
| Oct 1-15 | | 10 | 0 | 0 | 2 | 12 | 7 | 0 | 4 |
| Oct 16-31 | | 6 | | 0 | 0 | 20 | 0 | 0 | 1 |

Table 16a. Maximum number of Snowy Egrets observed during a single site visit for the Meadowlands, Northern Hackensack and North Jersey sites, by two-week intervals in 2012 (June 16 – October 31).

Meadowlands sites include Harrier Meadow (HAME), Kearny Brackish Marsh (KBRM), Kingsland Impoundment (KING), Marsh Resources (MRI), Mill Creek Marsh (MCMA), Saw Mill Creek (SACR), Saw Mill WMA (SAWM), and Secaucus High School (SEHS). The Northern Hackensack site is Overpeck Creek (OVCR) and the North Jersey site is Celery Farm (CEFA).

| Date Range | Maximum Number of Snowy Egrets Observed | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Meadowlands | | | | | | | | North Hacken. | North Jersey |
| | HAME | KBRM | KING | MRI | MCMA | SACR | SAWM | SEHS | OVCR | CEFA |
| June 16-30 | 1 | | | 3 | | 1 | 12 | | | |
| July 1-15 | 46 | 0 | 2 | 12 | 1 | 7 | 21 | 0 | | |
| July 16-31 | 46 | 1 | 11 | 16 | 17 | 5 | 22 | 3 | 0 | |
| Aug 1-15 | 16 | 2 | 18 | 19 | | 19 | 8 | | | 0 |
| Aug 16-31 | 20 | 5 | 17 | 27 | 5 | 13 | 16 | 4 | | 0 |
| Sept 1-15 | 26 | 3 | 7 | 54 | | 15 | 4 | | | 0 |
| Sept 16-30 | 12 | 2 | 7 | 34 | | 9 | 13 | | | 0 |
| Oct 1-15 | 0 | | 7 | 2 | 2 | 3 | 1 | | | 0 |
| Oct 16-31 | | | | 0 | 0 | 0 | 0 | | | |

Table 16b. Maximum number of Snowy Egrets observed during a single site visit for the Raritan and Arthur Kill Watershed sites, by two-week intervals in 2012 (June 16 – October 31).

Raritan sites include Cheesequake (CHQU), Compton Creek (COCR), East Creek (EACR), Edmund's Avenue (EDAV), Laurence Harbor (LAHA), Matawan Marsh (MAWA), Natco Lake (NALA), Raritan Center (RACE), Sandy Hook (SAHO), South Amboy Meadows (SOAM) and Thorne Creek (THCR). Arthur Kill Watershed sites include Bayonne Waterfront (BAYO) and Liberty State Park (LISP).

| Date Range | Maximum Number of Snowy Egrets Observed | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raritan | | | | | | | | | | | Arthur Kill Watershed | |
| | CHQU | COCR | EACR | EDAV | LAHA | MAWA | NALA | RACE | SAHO | SOAM | THCR | BAYO | LISP |
| June 16-30 | 1 | | 0 | 4 | 2 | | 0 | | 2 | | 0 | 1 | |
| July 1-15 | 0 | 1 | 0 | 3 | 4 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | |
| July 16-31 | 0 | 0 | 0 | 11 | 6 | 1 | 0 | 31 | 1 | 0 | 0 | 0 | 3 |
| Aug 1-15 | 0 | 0 | 0 | 4 | 6 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 4 |
| Aug 16-31 | 0 | 0 | 0 | 3 | 7 | 5 | 0 | 13 | 6 | 0 | 0 | 0 | 5 |
| Sept 1-15 | 2 | 0 | 0 | 5 | 7 | 0 | 1 | 6 | 4 | 1 | 0 | 0 | 1 |
| Sept 16-30 | 0 | 0 | | | 0 | 2 | 0 | 1 | 3 | 0 | 0 | 0 | 3 |
| Oct 1-15 | 0 | 0 | | | 0 | 3 | 0 | 0 | 1 | | 0 | 0 | 3 |
| Oct 16-31 | 0 | 0 | 0 | 0 | 0 | | 0 | | 0 | | 0 | | |

Table **16**c. Maximum number of Snowy Egrets observed during a single site visit for the New York sites, by two-week intervals in 2012 (May 1 – October 31).
Bronx sites include Lower Bronx River/Soundview Park (LOBR) and Pelham Bay Park East (PEBP); Manhattan sites include Inwood Hill (INWO) and Randall's Island (RAND); Brooklyn/Jamaica Bay sites include Gerritsen Beach (GEBE), Jamaica Bay (JABA) and Spring Creek (SPCR); and Staten Island sites include Clove Lakes Park (CLLA) and Goethals (GOET).

| Date Range | Maximum Number of Snowy Egrets Observed | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Bronx | | Manhattan | | Brooklyn/Jamaica Bay | | | Staten Island | |
| | LOBR | PEBP | INWO | RAND | GEBE | JABA | SPCR | CLLA | GOET |
| May 1-15 | 0 | 5 | 0 | 0 | 2 | | 6 | 0 | 0 |
| May 16-31 | 0 | 3 | 0 | 0 | 2 | 2 | 5 | 0 | 10 |
| June 1-15 | | 2 | 0 | 3 | 2 | 1 | 1 | 0 | 3 |
| June 16-30 | | 3 | 0 | 3 | 1 | 3 | 3 | 0 | 15 |
| July 1-15 | 0 | 1 | 0 | 0 | 2 | 0 | 2 | 0 | 25 |
| July 16-31 | 0 | 2 | 0 | 5 | 0 | 16 | 4 | 0 | 37 |
| Aug 1-15 | 0 | 0 | 0 | 0 | 3 | 8 | 3 | 0 | 35 |
| Aug 16-31 | | 17 | 0 | 2 | 6 | 16 | 4 | 0 | 7 |
| Sept 1-15 | | 18 | | 2 | 3 | | 2 | 0 | 13 |
| Sept 16-30 | | 10 | 0 | 0 | 3 | 6 | 5 | 0 | 11 |
| Oct 1-15 | | 7 | 0 | 0 | 0 | 19 | 6 | 0 | 13 |
| Oct 16-31 | | 0 | | 0 | 0 | 14 | 0 | 0 | 3 |

Figure 1. Map of Prall's Island. Google Earth image from 2010. Prall's Island is situated in the Arthur Kill, between Linden New Jersey and Staten Island, New York.

Figure 2. Map of social attraction sites. Sites A, B, and C occur along a small, shallow, channelized side stream of the Rockaway River that flows through Lake Hiawatha, NJ, near the Rockaway River. A community swimming pool is visible between Sites B and C.

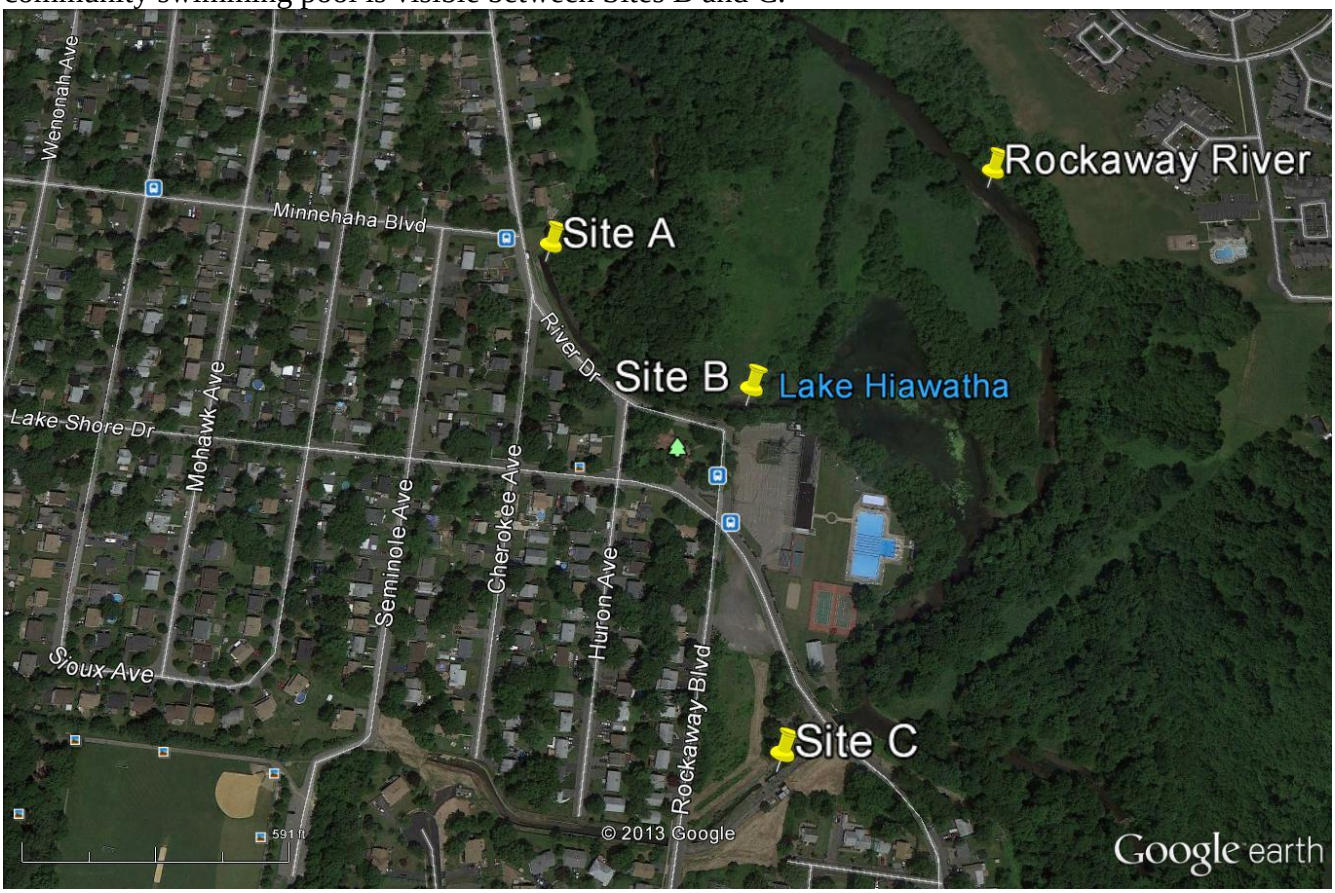

Figure 3. Current and former nest sites in NY/NJ Harbor for waders, cormorants, and gulls. Map modified by authors from OasisNYC.

Figure 4. Great Egret, tagged as a pre-fledged chick, is seen at XXX. The yellow wing tag (C18) is visible from a distance.