

**ECOLOGY OF COLONIAL WADING BIRDS FORAGING IN THE
MEADOWLANDS DISTRICT:
2009 FINAL REPORT**

Submitted to:

New Jersey Meadowlands Commission
One DeKorte Park Plaza
Lyndhurst, NJ 07071

Submitted by:

Nellie Tsipoura, Ph.D.
Kristin Mylecraine, Ph.D.
Kate Ruskin
New Jersey Audubon Society

March 22, 2010

TABLE OF CONTENTS

<i>Background</i>	4
<i>Objectives</i>	6
<i>Methods</i>	6
Study Site/Survey Locations	6
Survey Protocol	8
Citizen Scientist Recruitment and Training	9
Breeding colony studies	10
Data Analysis	10
<i>Results</i>	11
Volunteer participation	11
Sites and points surveyed	11
Abundance and frequency of occurrence of birds seen	12
Egret banding and tracking	14
<i>Discussion and Conclusions</i>	15
<i>Plans for 2010</i>	16
<i>Literature Cited</i>	16

Tables and Figures

Table 1. 2009 Heron Survey Sites in the Meadowlands and Northern Hackensack.	18
Table 2. 2009 Heron Survey Sites outside of the Meadowlands and Northern Hackensack.....	19
Table 3. Total number of birds seen during 2009 surveys in the Meadowlands and Northern Hackensack.	20
Table 4. Average number of birds seen during 2009 surveys in the Meadowlands and Northern Hackensack.....	21
Table 5. Average number of birds seen during 2009 surveys outside of the Meadowlands and Northern Hackensack.....	22
Table 6. Relative site frequency of birds seen during 2009 surveys, by general area..	23
Table 7. Relative point frequency of birds seen during 2009 surveys, by general area.	24
Table 8. Relative point frequency of birds seen during 2009 surveys in the Meadowlands and Northern Hackensack.	25
Figure 1. Map of Meadowlands Survey Points.....	26
Figure 2. Map of all New Jersey Survey Points	27
Figure 3. Average number of the five most common colonial wading bird species observed per visit in 2009, by general survey area.	28
Figure 4. Total number of birds observed at Meadowlands and Northern Hackensack survey sites in 2009.....	29
Figure 5. Average number of birds observed per visit at Meadowlands and Northern Hackensack survey sites in 2009.	30

Figure 6. Relative site frequency of colonial wading birds observed at sites during 2009, by survey area..	31
Figure 7. Relative point frequency of colonial wading birds observed at survey points during 2009, by general area..	32
Figure 8. Relative frequency of colonial wading birds observed at Meadowlands and Northern Hackensack sites during 2009	33

Appendices

Appendix 1. 2009 Heron Survey Protocol.....	34
Appendix 2. 2009 Heron Survey Datasheet.....	42
Appendix 3. Individual maps of Meadowlands Heron Survey Sites	43

ECOLOGY OF COLONIAL WATERBIRDS FORAGING IN THE MEADOWLANDS DISTRICT

Background

Hérons, egrets, and ibises started nesting on small islands of the Greater NY/NJ Harbor in the early 1950s, and this complex of mixed wading bird colonies, locally known as “Harbor Herons”, has been a flagship for biodiversity in the Harbor Bight region ever since. 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 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 species of conservation concern, and the two night-herons are listed as NJ State threatened. Harbor Herons are currently breeding on Hoffman Island, Canarsie Pol, Elder’s Point West, and South Brother Island; they have previously nested on Shooter’s, Prall’s Islands and Isle of Meadows in the Arthur Kill, and on North Brother Island. The assumption that successful breeding colonies reflect improved estuary health in the NY/NJ Harbor is implicit in breeding colony management goals. For this reason, Harbor Heron colonies have been monitored through the efforts of New York City Audubon (NYCA) since 1985.

Though 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. Additionally, some difficulties associated with heron conservation are specific to protecting waterbird non-breeding / foraging sites and are further aggravated by the challenges of maintaining healthy habitats in an industrialized and highly urbanized environment. In 2008, New Jersey Audubon Society (NJAS) initiated a joint project with NYCA to study habitat use of the ‘Harbor Herons’ in New Jersey. We launched this project with the purpose of collecting information on foraging habitat use in the Meadowlands District and in Raritan Bay that can be shared with state and federal agencies involved in managing wetlands in this region.

Because Harbor Heron nesting sites are conspicuous with hundreds of nests, more is known about their breeding activities and behavior than is known about their foraging habitats. Previous NYCA research on ‘Harbor Herons’ includes flight line observations of the birds as they leave the breeding colony. The results of these surveys suggest that NY Harbor’s herons forage in New Jersey. For example, it appears that birds from North and South Brother Islands flew over Manhattan and the Hudson River, which would take them to foraging grounds in the

tidal mudflats of New Jersey's Meadowlands, while birds from Hoffman Island have been observed crossing Staten Island most likely to forage in Arthur Kill and the Raritan River basin (NYCA 2005). In fact, based on birding observations, Harbor Herons seem especially abundant in the New Jersey Meadowlands and Raritan Bay during the breeding and post-breeding season.

A recent comprehensive 2-year survey of avifauna in the NJ Meadowlands District undertaken by NJAS Research Department recorded over 100 individual sightings of the state listed Great Blue Heron and Black-crowned Night Heron, and over 500 sightings of Great and Snowy Egret (Mizrahi et al. 2007). While this survey was not designed specifically for monitoring herons and egrets, it provides strong evidence that the New Jersey Meadowlands wetlands are important habitats for these birds. Only the Yellow-crowned Night-Heron is known to breed in the District. The other Harbor Heron species travel daily from their nesting rookeries in the NY/NJ Harbor to feed and loaf in the Meadowlands wetlands.

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 (Bain et al. 2007). It is critical to identify management issues for these birds and their NY/NJ Harbor habitats, both nesting and foraging and to continue to track the health of their populations in the greater NY Metropolitan area.

New Jersey Audubon Society (NJAS) and New York City Audubon (NYCA) are working together on this project to advance the conservation of colonially breeding waterbirds in the NY Harbor and to instill in local citizens an appreciation for these birds and their habitats. The results of the research will fill gaps in knowledge identified by the Harbor Heron Conservation Plan, a plan slated for release in spring 2009 and jointly written by governmental, non-governmental, and university members of the Harbor Heron subcommittee of the Harbor Estuary Program. In addition, it will provide information needed for management of wetlands in the Meadowlands District, assess their significance to the larger, regional population of waterbirds and showcase the successes of the New Jersey Meadowlands Commission (NJMC) in creating and restoring habitats and attracting herons and egrets to them. This in turn will help ensure persistence of these charismatic birds in the NY/NJ Harbor Bight, of which the Meadowlands District is one of the most critical parts.

In 2008, funding from the NJ Meadowlands Commission, The Education Foundation of America, and NJ DEP's Conserve Wildlife Matching Grants allowed NJAS and NYC Audubon to complete a pilot project to study the connections between Harbor Heron breeding and non-breeding/foraging areas. Building on the strengths of past and ongoing restoration, management, and research activities of the NJMC, and NJAS's expertise on New Jersey avifauna and citizen science, we employed our birding volunteer force on a comprehensive study of Herons and Egrets in the Meadowlands. NJAS developed methods and training materials, recruited and trained volunteers and conducted baseline surveys at sites that are used extensively by colonial waterbirds nesting in the Harbor colonies. NYC Audubon initiated a banding and radio tracking

project in conjunction with volunteer observations of tagged birds. In 2009, NJAS continued the Harbor Heron survey in the Meadowlands, with funding provided by the NJ Meadowlands Commission, and also continued surveys outside of the Meadowlands District.

In addition to providing the important ecological information on the natural resources needed for appropriate management decisions, this project raises awareness and engages the public in understanding and more actively conserving wildlife. The involvement of citizen scientists in wildlife research exposes them to the natural areas of the Meadowlands and serves to promote the management successes of the Meadowlands Commission.

Objectives

Specific objectives of this project are: (1) to determine the abundance and distribution of long-legged colonial waterbirds at various sites and habitats and identify areas used as foraging grounds; and (2) to mobilize and coordinate citizen scientists to conduct observations of colonial waterbirds, thereby engaging them in nature study and creating stewards of the birds and habitat of the Meadowlands District.

Methods

Study Site/Survey Locations

Surveys of foraging colonial wading birds focused on the Meadowlands and Raritan Bay areas of New Jersey. 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 chosen with help from NJMC staff, based on the presence of suitable habitat, and were prioritized based on the number of herons and egrets observed during the NJAS avian abundance study in the District (Mizrahi et al. 2007). Survey points were established 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.

Survey points were established at 13 sites within the Meadowlands region (Figure 1; Table 1) and 2 sites along the Northern Hackensack. One to 11 points were established at each site, with a total of 72 survey points in the Meadowlands and 12 points at the Northern Hackensack sites (Table 1). Survey points were designated as optional if they were difficult to access. Survey points were also established within the Raritan Bay area (79 points), the NJ/NY Harbor (including Arthur Kill and Staten Island, 26 points), other areas of northern (6 points; Figure 2),

and southern New Jersey (6 points). A total of 118 points at 23 sites were established outside of the Meadowlands and Northern Hackensack region (Table 2).

Individual site descriptions are given below for all Meadowlands sites, and maps of individual survey sites are provided in Appendix 5.

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 and surveyed by NJMC staff.

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 2009, 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.

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, but large portions of the site are not accessible from land and therefore could not be observed.

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 Sawmill 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 Sawmill Creek Trails. Eleven survey points were established at Kingsland Impoundment and seven points, one of which is optional, at Sawmill 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 2008 or 2009. 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 in 2008 or 2009.

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 were surveyed by NJMC staff.

Secaucus High School Wetlands – This 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. Due to renovation of the boardwalk scheduled for early summer 2009, SEHS_01 and SEHS_02 were inaccessible for much of the 2009 survey season.

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.

Survey Protocol

Citizen scientists collected baseline data on colonial waterbird numbers and habitat use of Meadowlands and Raritan Bay wetlands during the 2008 breeding and post-breeding season. These procedures were reevaluated and when appropriate, slightly modified for the 2009 survey season. Volunteers were asked to 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, we were able to launch the survey earlier and begin on May 1st and again end on October 31st.

During each site visit, volunteers visited all of the mapped survey points and collected information on 1) date, time of the day, tidal cycle, habitat, and weather, 2) total numbers of birds of each species and each age group (when possible), and 3) behavioral activity.

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. Behavioral observations were then conducted on individual focal birds. If more than 5 birds were present at a point, volunteers randomly selected 5 focal birds to conduct detailed behavioral observations. Surveyors conducted 3-minute behavioral observations for each focal bird and recorded: species, age (adult or juvenile), tag color and number (if applicable); specific habitat in which the individual was observed (may be different from the general site habitat); foraging success (number of strikes and successes) if the bird is involved in foraging activity; time spent in various activities (foraging, preening, loafing/standing, other behavior); closest neighbor and distance to other neighbors; and aggressive interactions (yes or no).

The survey protocol (Appendix 1) and datasheet (Appendix 2) are provided in this report. Abbreviated protocols and datasheets were developed in 2008 for volunteers who could not attend the training sessions, but all volunteers were trained in the full survey in 2009, eliminating the need for an abbreviated survey. The abbreviated version was similar to the regular protocol, but did not include behavioral information other than foraging success and did not include information about neighbors or aggression.

To maximize the number of visits and achieve good representation of all tides and times of day, we assigned multiple volunteers to each survey site, whenever possible. For sites with multiple volunteers, Google calendars (<http://www.google.com/calendar/hosted/njaudubon.org>) were created for volunteers to use to coordinate surveys at different times of day. Volunteers were asked to access the calendar online and sign up for a specific day and tide window. Additionally, in 2009, NJAS staff emphasized establishing contact among volunteers surveying the same site so they could coordinate their surveys via email and phone.

Citizen Scientist Recruitment and Training

We conducted volunteer recruitment for 2009 in March through postings at NJAS Centers, the NJAS website, and bulk emails to the membership and area birders. The project was also cross promoted via posts on the Meadowlands blog and to volunteers working on other citizen science projects such as the NJAS Grasslands survey.

In 2009, 28 of 33 volunteers trained in 2008 returned to the project, 15 new volunteers were trained, and four volunteers who conducted abbreviated surveys in 2008 because they could not attend training were trained for the full survey. Consequently, all 47 volunteers in 2009 conducted complete surveys of their sites, maximizing the richness of data collected.

Training workshops were held April 20th and May 30th at NJMC, and May 9th at Cheesecake State Park. Training workshops consisted of three basic modules: project background and goals, species identification, survey methodology. The portion of the training devoted to project background teaches volunteers about diverse aspects of the program, including: the history, benefits, and uses of citizen science; the history, ecology, and current population status of herons in the New York/New Jersey Harbor; and local heron conservation research. The heron identification segment of the training workshop consists of teaching the field marks for each local heron species. Excerpts and illustrations from *The Sibley Field Guide to Birds* are supplemented by photographs. Problematic species are compared and distinguished to familiarize even novice birders with species identification. Most volunteers are accomplished birders, however, and the training session serves as a refresher. The longest and most detailed portion of the training session is the survey methodology segment due to the rigors of the project's data collection protocol. NJAS staff review the data collection process step-by-step, from arrival at a survey point to entering data online. Minor problematic issues, such as how to record a bird that moves out of sight during the survey are addressed and materials distributed (Appendix 1 and 2) are reviewed. Due to the detail provided in the training workshops, relatively few issues are raised during the survey season, allowing for more reliable data.

Additionally, NJAS staff take the opportunity of meeting with volunteers in person to discuss, learn about, and finalize the survey points at various survey sites. Because the majority of volunteers were veterans to the project, the site workshopping was minimal in 2009. Volunteers meet the other surveyors at their site and encouraged to work together to coordinate coverage and in some cases, for a veteran volunteer to orient a new recruit to the site and project. These aspects of the training workshops were particularly successful in 2009, with volunteers getting to know each other and working together to the benefit of the project and enrichment of their own experience.

Breeding colony studies

In concert with the citizen science survey efforts of NJAS, New York City Audubon (NYCA) conducted a banding and radio telemetry survey effort to investigate connections between breeding colonies in New York City and foraging habitats in New Jersey. Great Egret and Glossy Ibis young were caught at nesting colonies on Hoffman (Staten Island, NY) and South Brother Islands (Bronx, NY) and tagged to identify individuals observed foraging at NJAS survey sites.

Data Analysis

For the purposes of this report, we summarized 2009 survey results for all sites within the Meadowlands and Northern Hackensack regions. We also include data collected outside of this area (North Jersey, NY/NJ Harbor, Raritan Bay, and South Jersey; Figure 2) as a comparison and indication of Harbor Heron use outside of this focal region. The total number of colonial wading birds observed of 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 within the Meadowlands and Northern Hackensack area, 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.

Data collection in 2009 also included information on habitat, tide, and behavioral observations. Future analyses will include detailed examination of these project components, as a comprehensive analysis including results from both 2008 and 2009.

Results

Volunteer participation

A total of 18 trained volunteers were assigned survey sites in the Meadowlands region, including 13 veteran volunteers who were trained in 2008. An additional two veteran volunteers were assigned to Northern Hackensack sites. To date, 18 out of the 20 volunteers have submitted data for 2009, either into the online data entry system or via datasheets (90% collection).

Outside of the Meadowlands and Northern Hackensack regions, 28 volunteers were assigned sites in North Jersey, the NY/NJ Harbor area, Raritan Bay, and South Jersey, including 18 veteran volunteers who were either trained or conducted abbreviated surveys in 2008. To date, 22 of these volunteers have submitted data for 2009 (79% collection).

Sites and points surveyed

All Meadowlands sites were surveyed in 2009, with the exception of Riverbend Wetland Preserve and Kane Natural Area (Empire Tract). A total of 53 points at 9 sites have been entered into the online database. Data from 128 full surveys have been entered as of March 2010, ranging from 6 surveys at Kearny Freshwater Marsh to 24 surveys at Sawmill Creek (Table 1). This does not include any data for two sites that were known to have been surveyed (Anderson Creek and Sawmill Wildlife Management Area); therefore, the amount of data received is an underestimate of the amount of data collected in 2009. Twenty-eight visits were made to Northern Hackensack sites, including 22 to Overpeck Creek and 6 to Oradell Reservoir (Table 1). Across all 11 Meadowlands and Northern Hackensack sites, the average number of visits per site was 14.

Outside of the Meadowlands and Northern Hackensack regions, data have been entered for 16 (70%) of the 23 mapped sites in 2009. A total of 86 points were surveyed. Volunteers entered 298 total site visits, and the number of visits per site ranged from three at Liberty State Park to 42 at Laurence Harbor (Table 2). While these additional data do not reflect bird use at the Meadowlands, we include them in the analysis for comparison purposes.

Abundance and frequency of occurrence of birds seen

Observers made 1,222 observations of colonial wading birds during 128 site visits to the Meadowlands, and 104 observations of these target species during 28 visits to sites along the Northern Hackensack in 2009 (Table 3). By comparison, observers made 86 observations during 35 visits to NY/NJ Harbor sites, 1061 observations during 257 visits in the Raritan Bay region, and 12 observations during 6 visits to South Jersey sites.

The total numbers of each species observed at sites within the Meadowlands District and Northern Hackensack region are displayed in Table 3 and Figure 4. The two most common species in the Meadowlands District were Great Egret (695 observations) and Snowy Egret (425 observations). Other species observed include Great Blue Heron (60), Black-crowned Night-Heron (39), Glossy Ibis (1), Yellow-crowned Night-Heron (1), and Green Heron (1). Little Blue Heron and Tricolored Heron were not observed during the 2009 survey. The greatest number of Great Egret observations were from Kingsland Impoundment (237 observations), followed by Saw Mill Creek (163 observations). The largest number of Snowy Egret observations were at Mill Creek Marsh (104 observations), followed by Harrier Meadow (104 observations). At Northern Hackensack sites, Great Blue Heron was the most common species observed (38 observations), followed by Black-crowned Night-Heron (35 observations), Great Egret (28 observations), and Green Heron (4 observations). Snowy Egret, Yellow-crowned Night-Heron, Little Blue Heron, Tricolored Heron, and Glossy Ibis were not recorded at Northern Hackensack sites in 2009. These numbers represent the total number of observations, and do not take into account the number of survey visits or the number of points surveyed. Specifically, some sites may be over-represented in these data because easy access allowed the volunteers to undertake multiple surveys during each survey period.

More colonial wading birds were observed per visit in the Meadowlands than any other survey area. An average of 9.5 birds were observed per site during each visit, compared to 4.1 at Raritan sites, 3.7 at Northern Hackensack sites, 2.5 in the NY/NJ Harbor, and 2.0 in South Jersey (Tables 4 and 5). On average, 5.4 Great Egrets and 3.3 Snowy Egrets were observed per site visit to Meadowlands sites; and 1.0 Great Egrets were observed per visit to Northern Hackensack sites. By comparison, an average of 2.3 Great Egrets and 0.9 Snowy Egrets were observed per visit in the Raritan Bay area (Figure 3).

The average number of birds seen at each individual site is displayed in Table 4 and Figure 5 for Meadowlands and Northern Hackensack sites and Table 5 for sites outside of these regions. Per visit, more Great Egrets were seen at Kearny Brackish Marsh than any other site in the Meadowlands (mean = 16.0), followed by Kingsland Impoundment (mean = 11.9). Mill Creek Marsh had the highest number of Snowy Egrets observed per visit (8.7), followed by Harrier Meadow (5.1). By comparison, the largest number of Great Egrets per visit to sites outside the Meadowlands was 4.2 at Cheesequake, and the greatest mean number of Snowy Egrets was 3.0 at Raritan Center.

The frequencies of occurrence for individual species at the site level (number of sites in which a species was seen divided by the total number of sites) are displayed in Table 6 and Figure 6, by general survey area. South Jersey, had only one surveyed point, and therefore is not included in

Figure 6. In the Meadowlands, site frequency of occurrence was 1.0 for Great Egret, meaning that this species was seen at all sites. Frequency of occurrence also approached 1.0 for Snowy Egrets (0.9), suggesting that Snowy Egrets were seen at nearly all sites (8 out of 9 sites surveyed). Great Blue Heron was seen at a frequency of 0.8 (7 out of 9 sites). Black-crowned Night-Heron, Glossy Ibis, Green Heron, and Yellow-crowned Night-Heron occurred at a smaller number of sites. Little Blue Heron and Tricolored Heron were not observed at any Meadowlands sites in 2009. Four species were observed at both Northern Hackensack sites (relative site frequency = 1.0): Great Egret, Black-crowned Night-Heron, Great Blue Heron, and Green Heron. Snowy Egret, Yellow-crowned Night-Heron, Little Blue Heron, Tricolored Heron, and Glossy Ibis were not observed at these two sites. By comparison, frequency of occurrence was 1.0 for Great Egrets, 0.9 for Snowy Egret and Great Blue Herons, 0.6 for Yellow-crowned Night-Heron, and 0.4 for Black-crowned Night-Heron and Green Heron in the Raritan Bay area. Little Blue Heron, Tricolored Heron, and Glossy Ibis were each seen at one site in the Raritan region (frequency = 0.1). Within the NY/NJ Harbor region, Great Egret was seen at all four sites (frequency = 1.0); Snowy Egret, Black-crowned Night-Heron, and Yellow-crowned Night-Heron were seen at a frequency of 0.8 (3 sites); Great Blue Heron was seen at 2 sites (frequency = 0.5); and Green Heron and Little Blue Heron were seen at one site (frequency = 0.25).

Frequency of occurrence for individual species at the point level (number of points in which a species was seen divided by the total number of points surveyed) are displayed in Table 7 and Figure 7, by general survey area. Within the Meadowlands District, Great Egret had the highest frequency of occurrence (0.9), followed by Snowy Egret (0.8); Great Egrets were observed at 85% (45 out of 53) of surveyed points, and Snowy Egrets were observed at 83% (44 out of 53). Less frequent species observed in the Meadowlands included Great Blue Heron (49% of all points), Black-crowned Night-Heron (23%), Yellow-crowned Night-Heron (2%), Green Heron (2%), and Glossy Ibis (2%). Within the Northern Hackensack sites, Great Egret had the highest point frequency, occurring at 67% of all surveyed points, followed by Great Blue Heron (58%), Black-Crowned Night-Heron (42%), and Green Heron (17%). Great Egret, the primary focal species, occurred at the same point frequency in the Meadowlands and Raritan Bay (0.9). By comparison, frequency of occurrence of Great Egrets was 0.7 in the Northern Hackensack area (12 total points surveyed), 0.5 at NY/NJ Harbor sites (25 points), and 0.3 at South Jersey sites (6 total points surveyed). Snowy Egret occurred at a greater frequency of points in the Meadowlands (0.8) than any other survey area. Snowy Egrets were seen at 83% of points in the Meadowlands, compared to 62% of points in the Raritan Bay area (34 out of 55 points surveyed), 28% of points in the NY/NJ Harbor (7 out of 25 points), and 17% of points at the South Jersey site (1 out of 6 points; Table 7).

Table 8 and Figure 8 display frequency of occurrence for each individual site in the Meadowlands and Northern Hackensack regions, calculated as number of points in which a species was seen divided by the total number of points surveyed at that particular site. The three species with the greatest frequency of occurrence at Meadowlands sites were Great Egret, Snowy Egret and Great Blue Heron. Frequency of occurrence of Great Egrets was 1.0 at six of the nine sites surveyed: Harrier Meadow, Kearny Brackish Marsh, Kingsland Impoundment, Saw Mill Creek, Secaucus High School, and Skeetkill Marsh. This focal species was observed at all points surveyed at those sites. Frequency of occurrence was greater than 0.7 at Mill Creek Marsh, 0.5 at Kearny Freshwater Marsh, and 0.4 at Marsh Resources. For Snowy Egrets, frequency of

occurrence was 1.0 at Harrier Meadow, Saw Mill Creek, and Skeetkill Marsh; 0.9 at Mill Creek Marsh; 0.8 at Kingsland Impoundment and Secaucus High School; 0.7 at Marsh Resources; and 0.5 at Kearny Brackish Marsh. Snowy Egret was not observed at either of the Kearny Freshwater Marsh survey points in 2008 (Tsipoura et al. 2009) or 2009. Great Blue Heron frequency was 1.0 at Harrier Meadow, occurring at all surveyed points; ; 0.9 at Saw Mill Creek; 0.5 at Kearny Brackish Marsh, Kearny Freshwater Marsh, and Kingsland Impoundment;; 0.4 at Secaucus High School; and 0.3 at Mill Creek Marsh. Black-crowned Night-Herons were observed at nearly all points at Harrier Meadow (7 out of 8 points), 57% of points at Saw Mill Creek, and 9% of points at Kingsland Impoundment. Less frequent species included Yellow-crowned Night-Heron, observed at 14% of points at Saw Mill Creek, Green Heron, observed at 9% of points at Kingsland Impoundment, and Glossy Ibis, occurring at 13% of points at Harrier Meadow (Table 8; Figure 8). Within the Northern Hackensack region, Great Egrets had the highest point frequency (71% at Overpeck Creek and 60% at Oradell Reservoir), followed by Great Blue Heron (71% at Overpeck and 40% at Oradell). Black-crowned Night-Heron occurred at 43% of survey points at Overpeck Creek and 40% at Oradell Reservoir; and Green Heron occurred at 14% of points at Overpeck points and 20% at Oradell (Table 8; Figure 8).

Egret banding and tracking (NYCA)

In the 2008 pilot season, NYCA staff fit 17 Great Egret near-fledged young with aluminum (United States Fish and Wildlife Service) bands and leg-mounted VHF radio transmitters (Sirtrack). Birds were captured at their nesting colonies on Hoffman Island (Staten Island, NY) and South Brother Island (Bronx, NY). Radio telemetry surveys were conducted by NYCA staff from the ground at various NJAS foraging sites, including Harrier Meadow, Sawmill Creek, Kingsland Impoundment, and the Arthur Kill, with mobile and stationary radio receivers (ATS). Surveys were also conducted at the nesting colonies using the stationary unit. A Great Egret fledgling fit with a radio transmitter was observed in Kingsland Impoundment by an NJAS citizen scientist volunteer on July 6, 2008. The Great Egret fledgling tagged “AL” was detected from Erie Landfill at NJMC on July 25, 2008.

In 2009, NYCA staff fit 9 Great Egret near-fledged young with aluminum United States Fish and Wildlife Service bands and leg-mounted VHF radio transmitters. Birds were captured at their nesting colonies on Hoffman Island (Staten Island, NY) and South Brother Island (Bronx, NY). Radio telemetry surveys were again conducted by NYCA staff from the ground at various NJAS foraging sites. Additionally, NYCA staff conducted aerial surveys over nesting colonies and foraging habitats in both New York City and New Jersey, including NJAS foraging sites spanning from the NJMC to Sandy Hook. Aerial surveys were conducted through the generosity and coordination of LightHawk. Ground and aerial surveys were conducted with a mobile radio receiver, and a stationary unit was deployed at the nesting colonies (ATS). Due to the success of NJAS citizen scientist sightings of NYCA-tagged birds in 2008, NYCA incorporated color banding of Great Egret nestlings into the project in 2009. NYCA staff fit 40 Great Egret nestlings that were, at the time of capture, too small to hold radio transmitters, with aluminum (United States Fish and Wildlife Service) and colored (Haggie) leg bands.

In 2008 and 2009, NYCA staff fit 27 Glossy Ibis nestlings with aluminum (United States Fish and Wildlife Service) and colored (Pro-touch) leg bands. Birds were captured at their nesting

colonies on Hoffman Island (Staten Island, NY). On August 8, 2008, the Glossy Ibis fledgling tagged "011" was observed on the Susquehanna River near Lancaster, PA.

Additionally, NYCA launched a citizen science survey program in 2009, based on the protocol developed by NJAS staff. 16 volunteers were recruited, trained, and deployed to survey sites spanning Manhattan, Staten Island, Brooklyn, Queens, and Long Island. Sites were diverse, incorporating a range of size, vegetation, and urban development. NYCA researchers will analyze and compare the data collected by its volunteers in a similar manner to the NJAS analysis to examine the NY Harbor system in a complete, comprehensive way.

Discussion and Conclusions

Great Egret and Snowy Egret were the two most common species observed in the Meadowlands District during 2008 (Tsipoura et al. 2009) and 2009 surveys. Great Blue Heron, Black-crowned Night-Heron and Great Egret were the most common species observed at the two Northern Hackensack sites. For both Great Egret and Snowy Egret, the average number observed per site visit in 2009 was greater in the Meadowlands (5.4 for Great Egret and 3.2 for Snowy Egret) than any other general area, including the Raritan Bay area (2.3 Great Egrets and 0.9 Snowy Egrets), NY/NJ Harbor (0.9 and 0.3), South Jersey (0.7 and 0.2), and the Northern Hackensack (1.0 and 0.0). Great Egrets were observed at 100% of all sites and 85% of points surveyed in both the Meadowlands and Raritan Bay areas. Great Egrets were also observed at all sites in remaining three survey areas (Northern Hackensack, NY/NJ Harbor, and South Jersey), but occurred at a lower frequency of points within these regions. Snowy Egrets were observed at 89% of sites and 83% of points in the Meadowlands region, compared to 92% of sites and 62% of points in the Raritan Bay area; 75% of sites and 28% of points in the NY/NJ Harbor, and 17% of points in South Jersey (only one site surveyed). Snowy Egrets were not observed at either site along the Northern Hackensack.

Preliminary analyses conducted in 2008 suggest that habitat and tide cycle are important factors in determining use by Harbor Herons (Tsipoura et al. 2009), as has been reported for these species in the literature (e.g. Burger 1983, Maccarone and Parsons 1994, Maccarone and Brzorad 2002). The largest numbers of colonial wading birds were observed in open water habitats, both in the Meadowlands and outside the Meadowlands region. These preliminary data also suggested that a larger proportion of Great Egrets forage in deeper water than Snowy Egrets, which may be attributable to differences in foraging behavior (McCrimmon et al 2001, Parsons and Master 2000). The abundance of Snowy Egrets at Meadowlands sites was higher than that at other sites, possibly because of the existence of wetlands of various (and varying with the tides) depths in the District. Also in 2008, more birds than expected were seen during mid-incoming tides in the Meadowlands and during mid-outgoing tides in the Raritan Bay area, suggesting the importance of tidal cycle in determining Harbor Heron use of non-breeding sites. In future analyses, we plan to examine habitat and tide effects in more detail for the 2009 season, and compare these with 2008 results.

Plans for 2010

- Continue proofing 2009 data entry
- Repeat survey in 2010 and focus on volunteer retention and recruitment of new volunteers
- Continue to try to get more volunteers per site and increase coordination to get better coverage of all tides and times of day.

Literature Cited

- Bain, M., J. Lodge, D.J. Suszkowski, D. Botkin, R. Diaz, k. Farley, J.S. Levinton, F. Steimle and P. Wilber. 2007. Target Ecosystem Characteristics for the Hudson Raritan Estuary: Technical Guidance for Developing a Comprehensive Ecosystem Restoration Plan. A report to the Port Authority of NY/NJ. Hudson River Foundation, New York, NY. 106 pp.
- Burger, J. 1983. Jamaica Bay Studies. II. Effect of tidal, temporal and weather variables on distribution of ibises, egrets and herons on a coastal estuary. *Acta Ecolog.* 4: 289-297.
- Maccarone, A. D. and J. N. Brzorad. 2002. Foraging Patterns of Breeding Egrets at Coastal and Interior Locations. *Waterbirds* 25: 1-7.
- Maccarone, A. D. and K. C. Parsons. 1994. Factors affecting the use of freshwater and estuarine foraging habitats by breeding wading birds in New York City. *Colonial Waterbirds* 17:60–68.
- Mccrimmon, Jr., D. A., J. C. Ogden and G. T. Bancroft. 2001. Great Egret (*Ardea alba*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: <http://bna.birds.cornell.edu.bnaproxy.birds.cornell.edu/bna/species/570>
- Mizrahi, D., N. Tsipoura, K. Witkowski, and M. Bisignano. 2007. Avian Abundance and Distribution in the New Jersey Meadowlands District: The Importance of Habitat, Landscape, and Disturbance. Final report to the New Jersey Meadowlands Commission. 108pp.
- New Jersey Department of Environmental Protection, Division of Fish and Wildlife (DFW). 2008. New Jersey Wildlife Action Plan for Wildlife of Greatest Conservation Need. Trenton, NJ.
- New York City Audubon. 2005. Harbor Herons Monitoring Program – 2005. New York City Audubon. <http://www.nycaudubon.org/projects/harborherons/2005MonitoringReport.pdf>.
- Parsons, K. C. and T. L. Master. 2000. Snowy Egret (*Egretta thula*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: <http://bna.birds.cornell.edu.bnaproxy.birds.cornell.edu/bna/species/489>
- Tsipoura N., D. Mizrahi, and J. Yacabucci. 2007. Contaminant Levels in Birds Breeding in the Hackensack Meadowlands and their Effects. A Draft Interim Report Submitted to New Jersey Meadowlands Commission. 42 pp.

- Tsipoura N., J. Burger, R. Feltes, D. Mizrahi, and J. Yacabucci, C. Jeitner, and M. Gochfeld. 2008. Metal concentrations in three species of passerine birds breeding in the Hackensack Meadowlands of New Jersey. *Environ Res.* 107: 218-228.
- Tsipoura, N., K. Mylecraine, and K. Ruskin. 2009. Ecology of colonial wading birds foraging in the Meadowlands District: 2008 Final Report. Submitted to New Jersey Meadowlands Commission.

Table 1. 2009 Heron Survey Sites in the Meadowlands and Northern Hackensack, including number of points established and number of surveys entered into the online database.

Code	Site	Established Points		Data Received	
		Regular	Optional	Visits	Points
ANCR	Anderson Creek	2	0	0	0
HAME	Harrier Meadow	7	1	17	8
KANE	Kane Natural Area (Empire Tract)	3	0	-	-
KBRM	Kearny Brackish Marsh	2	0	7	2
KFWM	Kearny Freshwater Marsh	3	0	6	2
KING	Kingsland Impoundment (DeKorte)	11	0	20	11
MCMA	Mill Creek Marsh	10	1	12	10
MRI	Marsh Resources (MRI)	7	1	14	7
RBWP	Riverbend Wetland Preserve	2	0	-	-
SACR	Saw Mill Creek	6	1	24	7
SAWM	Saw Mill WMA	9	0	0	0
SEHS	Secaucus High School	5	0	23	5
SKMA	Skeetkill Marsh	1	0	5	1
Meadowlands Total		68	4	128	53
OVCR	Overpeck Creek	7	0	22	7
ORAD	Oradell Reservoir	5	0	6	5
Northern Hackensack Total		12	0	28	12

Table 2. 2009 Heron Survey Sites outside of the Meadowlands and Northern Hackensack regions, including number of points established, number of surveys conducted, and number of visits entered into the online database.

Code	Site	Area	Points mapped		Data received	
			Regular	Optional	Visits	Points
CEFA	Celery Farm	Misc. North Jersey Sites	7	0	-	-
Misc. North Jersey Sites Total			7	0	-	-
ARKI	Arthur Kill	NY/NJ Harbor	10	0	6	8
SI	Staten Island	NY/NJ Harbor	5	0	22	5
ELRI	Elizabeth River	NY/NJ Harbor	1	0	4	1
LISP	Liberty State Park	NY/NJ Harbor	8	2	3	11
NY/NJ Harbor			24	2	35	25
CHQU	Cheesequake	Raritan	3	3	33	5
CLCR	Claypit Creek	Raritan	1	0	-	-
COCR	Comptons Creek	Raritan	3	0	-	-
CRRO	Creek Road	Raritan	1	0	-	-
EACR	East Creek	Raritan	2	0	12	2
EDAV	Edmund's Ave (Conaskonk Pt.)	Raritan	3	0	22	3
KEYP	Keyport	Raritan	2	1	23	2
LAHA	Laurence Harbor	Raritan	5	4	42	5
MAWA	Matawan Marsh	Raritan	4	4	26	8
NALA	Natco Lake	Raritan	2	2	20	2
PECR	Pews Creek	Raritan	5	0	-	-
RACE	Raritan Center	Raritan	7	2	21	9
SAHO	Sandy Hook	Raritan	7	0	14	5
SOAM	South Amboy Meadows	Raritan	6	1	12	6
THCR	Thorne Creek	Raritan	1	1	20	2
WACR	Ware Creek	Raritan	3	0	-	-
WACA	Washington Canal	Raritan	6	0	12	6
Raritan Total			61	18	257	55
WRPO	Wreck Pond	Misc. South Jersey Sites	6	0	6	6
Misc. South Jersey Sites Total			6	0	6	6

Table 3. Total number of observations of colonial waterbirds during 2009 surveys in the Meadowlands and Northern Hackensack.

	Visits	Points	Total Number Observed									
			GREG	SNEG	BCNH	YCNH	GBHE	GRHE	LBHE	TRHE	GLIB	Total
Anderson Creek	-	-	-	-	-	-	-	-	-	-	-	-
Harrier Meadow	17	8	118	87	21	0	25	0	0	0	1	252
Kane Natural Area (Empire Tract)	-	-	-	-	-	-	-	-	-	-	-	-
Kearny Brackish Marsh	7	2	112	13	0	0	1	0	0	0	0	126
Kearny Freshwater Marsh	6	2	5	0	0	0	1	0	0	0	0	6
Kingsland Impoundment	20	11	237	69	9	0	8	1	0	0	0	324
Marsh Resources (MRI)	14	7	11	33	0	0	0	0	0	0	0	44
Mill Creek Marsh	12	10	20	104	0	0	4	0	0	0	0	128
Riverbend Wetland Preserve	-	-	-	-	-	-	-	-	-	-	-	-
Saw Mill Creek	24	7	163	58	9	1	14	0	0	0	0	245
Saw Mill WMA	-	-	-	-	-	-	-	-	-	-	-	-
Secaucus High School	23	5	27	56	0	0	7	0	0	0	0	90
Skeetkill Marsh	5	1	2	5	0	0	0	0	0	0	0	7
Total (All Meadowlands Sites)	128	53	695	425	39	1	60	1	0	0	1	1222
Overpeck Creek	22	7	15	0	30	0	31	2	0	0	0	78
Oradell Reservoir	6	5	12	0	5	0	7	2	0	0	0	26
Total Northern Hackensack	28	12	27	0	35	0	38	4	0	0	0	104

Table 4. Average number of birds observed per visit, during 2009 surveys in the Meadowlands and Northern Hackensack.

	Visits	Points	Average Number Observed per Visit									
			GREG	SNEG	BCNH	YCNH	GBHE	GRHE	LBHE	TRHE	GLIB	Total
Anderson Creek	-	-	-	-	-	-	-	-	-	-	-	-
Harrier Meadow	17	8	6.9	5.1	1.2	0.0	1.5	0.0	0.0	0.0	0.1	14.8
Kane Natural Area (Empire Tract)	-	-	-	-	-	-	-	-	-	-	-	-
Kearny Brackish Marsh	7	2	16.0	1.9	0.0	0.0	0.1	0.0	0.0	0.0	0.0	18.0
Kearny Freshwater Marsh	6	2	0.8	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	1.0
Kingsland Impoundment	20	11	11.9	3.5	0.5	0.0	0.4	0.1	0.0	0.0	0.0	16.2
Marsh Resources (MRI)	14	7	0.8	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1
Mill Creek Marsh	12	10	1.7	8.7	0.0	0.0	0.3	0.0	0.0	0.0	0.0	10.7
Riverbend Wetland Preserve	-	-	-	-	-	-	-	-	-	-	-	-
Saw Mill Creek	24	7	6.8	2.4	0.4	0.0	0.6	0.0	0.0	0.0	0.0	10.2
Saw Mill WMA	-	-	-	-	-	-	-	-	-	-	-	-
Secaucus High School	23	5	1.2	2.4	0.0	0.0	0.3	0.0	0.0	0.0	0.0	4.0
Skeetkill Marsh	5	1	0.4	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4
Total Meadowlands	128	53	5.4	3.3	0.3	0.0	0.5	0.0	0.0	0.0	0.0	9.5
Overpeck Creek	22	7	0.7	0.0	1.4	0.0	1.4	0.1	0.0	0.0	0.0	3.5
Oradell Reservoir	6	5	2.0	0.0	0.8	0.0	1.2	0.3	0.0	0.0	0.0	4.3
Total Northern Hackensack	28	12	1.0	0.0	1.3	0.0	1.4	0.1	0.0	0.0	0.0	3.7

Table 5. Average number of birds seen during 2009 surveys outside of the Meadowlands and Northern Hackensack regions.

	Visits	Points	Average Number Observed per Visit									Total
			GREG	SNEG	BCNH	YCNH	GBHE	GRHE	LBHE	TRHE	GLIB	
Arthur Kill	6	8	3.2	0.5	0.3	0.5	0.3	0.0	0.0	0.0	0.0	4.8
Staten Island	22	5	0.2	0.2	0.7	0.1	0.0	0.0	0.7	0.0	0.0	1.9
Elizabeth River	4	1	0.3	0.0	0.5	0.5	0.0	0.3	0.0	0.0	0.0	1.5
Liberty State Park	3	11	2.0	0.7	0.0	0.0	0.3	0.0	0.0	0.0	0.0	3.0
Total NY/NJ Harbor	35	25	0.9	0.3	0.5	0.2	0.1	0.0	0.5	0.0	0.0	2.5
Cheesequake	33	5	4.2	0.3	0.4	0.0	0.3	0.0	0.0	0.0	0.0	5.2
Claypit Creek	-	-	-	-	-	-	-	-	-	-	-	-
Comptons Creek	-	-	-	-	-	-	-	-	-	-	-	-
Creek Road	-	-	-	-	-	-	-	-	-	-	-	-
East Creek	12	2	0.7	0.0	0.0	0.4	0.1	0.0	0.0	0.0	0.3	1.5
Edmund's Ave (Conaskonk Pt)	22	3	3.1	2.2	0.0	0.0	0.2	0.2	0.0	0.0	0.0	5.8
Keyport	23	2	0.8	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
Laurence Harbor	42	5	0.8	0.3	0.0	0.0	0.1	0.0	0.0	0.0	0.0	1.2
Matawan Marsh	26	8	3.8	1.9	0.1	0.6	0.6	0.0	0.0	0.0	0.0	7.1
Natco Lake	20	2	2.9	0.2	0.0	0.2	0.5	0.0	0.0	0.0	0.0	3.7
Pews Creek	-	-	-	-	-	-	-	-	-	-	-	-
Raritan Center	21	9	3.0	3.0	0.0	0.0	0.8	0.2	0.0	0.0	0.0	7.0
Sandy Hook	14	5	2.6	0.4	7.8	0.5	0.1	0.1	0.1	0.1	0.0	11.6
South Amboy Meadows	12	6	2.8	0.9	0.1	0.0	0.2	0.0	0.1	0.0	0.0	4.1
Thorne Creek	20	2	1.0	0.1	0.0	0.3	0.1	0.1	0.0	0.0	0.0	1.4
Washington Canal	12	6	0.4	0.8	0.0	0.2	0.7	0.0	0.0	0.0	0.0	2.1
Total Raritan	257	55	2.3	0.9	0.5	0.1	0.3	0.0	0.0	0.0	0.0	4.1
Wreck Pond	6	6	0.7	0.2	0.0	0.0	1.0	0.2	0.0	0.0	0.0	2.0
Total South Jersey	6	6	0.7	0.2	0.0	0.0	1.0	0.2	0.0	0.0	0.0	2.0

Table 6. Relative site frequency of birds seen during 2009 surveys, by general area. Frequency was calculated as the number of sites in which a species was observed divided by the total number of sites surveyed.

General Area	# of Sites	Frequency (# of sites observed/total # of sites)								
		GREG	SNEG	BCNH	YCNH	GBHE	GRHE	LBHE	TRHE	GLIB
Meadowlands	9	1.00	0.89	0.33	0.11	0.78	0.11	0.00	0.00	0.11
Northern Hackensack	2	1.00	0.00	1.00	0.00	1.00	1.00	0.00	0.00	0.00
NY/NJ Harbor	4	1.00	0.75	0.75	0.75	0.50	0.25	0.25	0.00	0.00
Raritan	12	1.00	0.92	0.42	0.58	0.92	0.42	0.08	0.08	0.08
Misc. South Jersey Sites	1	1.00	1.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00

Table 7. Relative point frequency of birds seen during 2009 surveys, by general area. Frequency was calculated as the number of points in which a species was observed divided by the total number of points surveyed.

General Area	# of Points	Frequency (# of points observed/total # of points)								
		GREG	SNEG	BCNH	YCNH	GBHE	GRHE	LBHE	TRHE	GLIB
Meadowlands	53	0.85	0.83	0.23	0.02	0.49	0.02	0.00	0.00	0.02
Northern Hackensack	12	0.67	0.00	0.42	0.00	0.58	0.17	0.00	0.00	0.00
NY/NJ Harbor	25	0.52	0.28	0.16	0.16	0.08	0.04	0.08	0.00	0.00
Raritan	55	0.85	0.62	0.13	0.27	0.51	0.15	0.04	0.02	0.02
Misc. South Jersey Sites	6	0.33	0.17	0.00	0.00	0.50	0.17	0.00	0.00	0.00

Table 8. Relative point frequency of birds seen during 2009 surveys in the Meadowlands and Northern Hackensack. Frequency was calculated as the number of points in which a species was seen on at least one survey divided by the total number of points surveyed.

Site	Points Surveyed	Frequency (# of points observed/total # of points)								
		GREG	SNEG	BCNH	YCNH	GBHE	GRHE	LBHE	TRHE	GLIB
Anderson Creek	-	-	-	-	-	-	-	-	-	-
Harrier Meadow	8	1.00	1.00	0.88	0.00	1.00	0.00	0.00	0.00	0.13
Kane Natural Area (Empire Tract)	-	-	-	-	-	-	-	-	-	-
Kearny Brackish Marsh	2	1.00	0.50	0.00	0.00	0.50	0.00	0.00	0.00	0.00
Kearny Freshwater Marsh	2	0.50	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00
Kingsland Impoundment	11	1.00	0.82	0.09	0.00	0.45	0.09	0.00	0.00	0.00
Marsh Resources (MRI)	7	0.43	0.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mill Creek Marsh	10	0.70	0.90	0.00	0.00	0.30	0.00	0.00	0.00	0.00
Riverbend Wetland Preserve	-	-	-	-	-	-	-	-	-	-
Saw Mill Creek	7	1.00	1.00	0.57	0.14	0.86	0.00	0.00	0.00	0.00
Saw Mill Wildlife Management Area	-	-	-	-	-	-	-	-	-	-
Secaucus High School	5	1.00	0.80	0.00	0.00	0.40	0.00	0.00	0.00	0.00
Skeetkill Marsh	1	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Meadowlands	53	0.85	0.83	0.23	0.02	0.49	0.02	0.00	0.00	0.02
Overpeck Creek	7	0.71	0.00	0.43	0.00	0.71	0.14	0.00	0.00	0.00
Oradell Reservoir	5	0.60	0.00	0.40	0.00	0.40	0.20	0.00	0.00	0.00
Total Northern Hackensack	12	0.67	0.00	0.42	0.00	0.58	0.17	0.00	0.00	0.00

Figure 1: 2009 Heron Survey - Meadowlands Sites

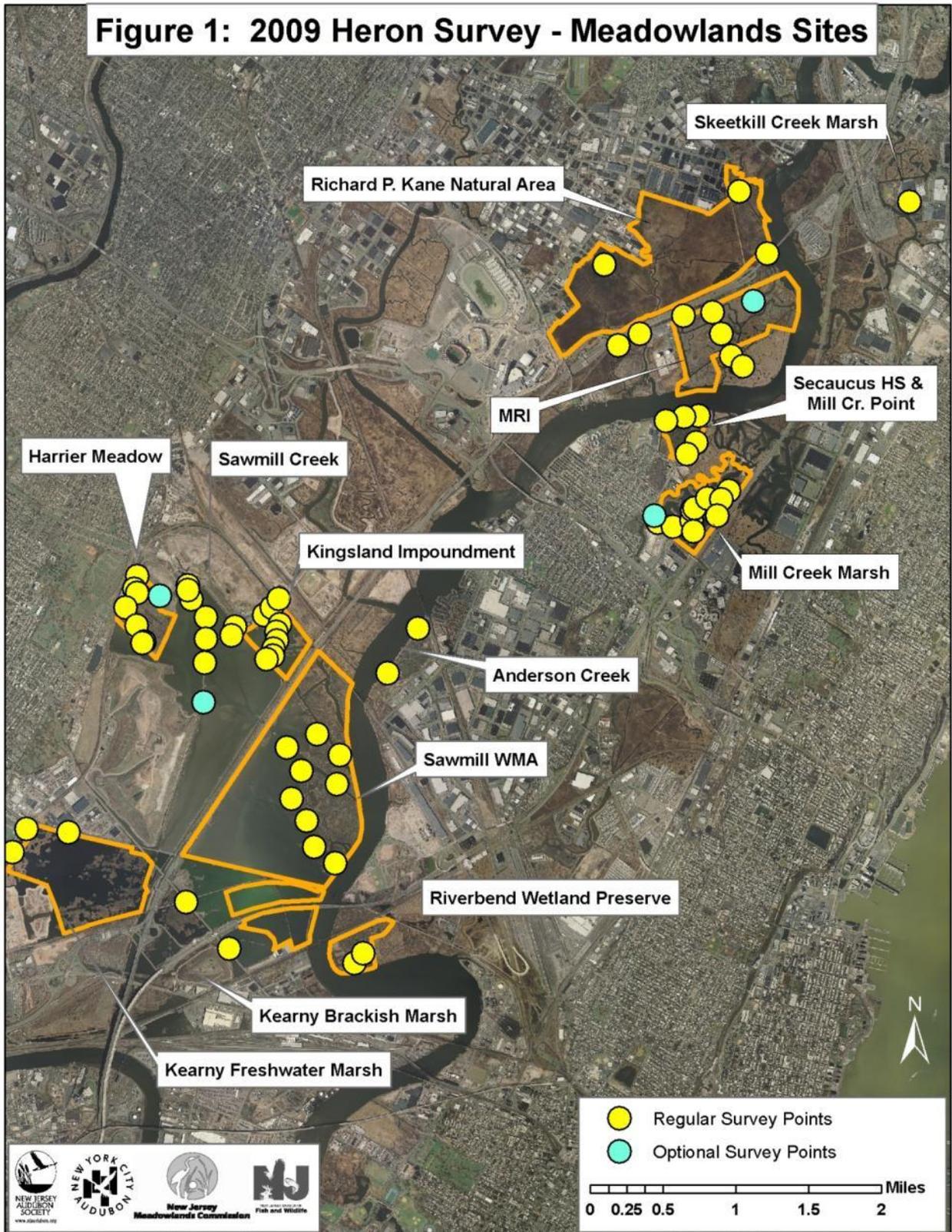


Figure 2: 2009 Heron Survey - All Survey Sites

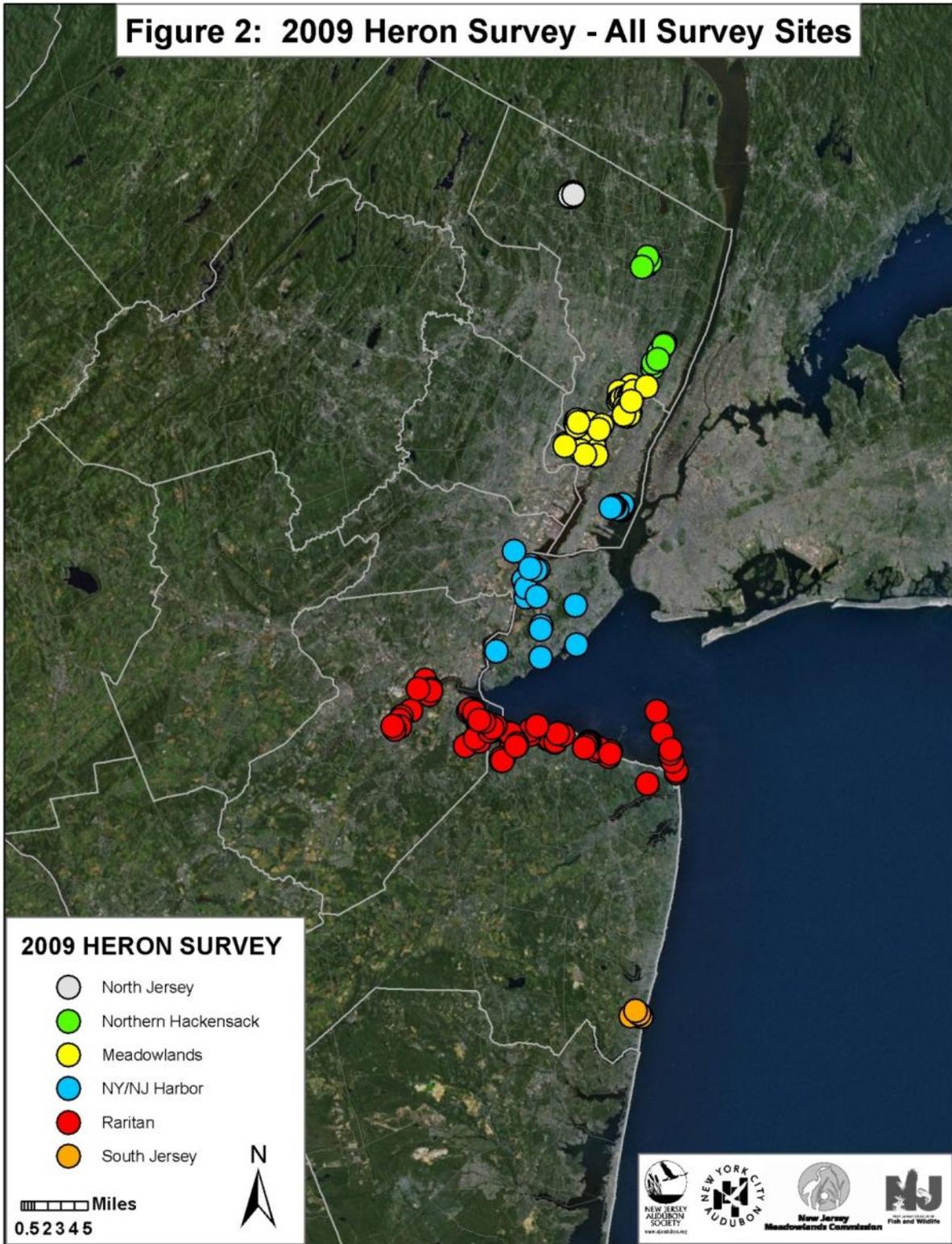


Figure 3. Average number of the five most common colonial wading birds observed per visit in 2009, by general survey area.

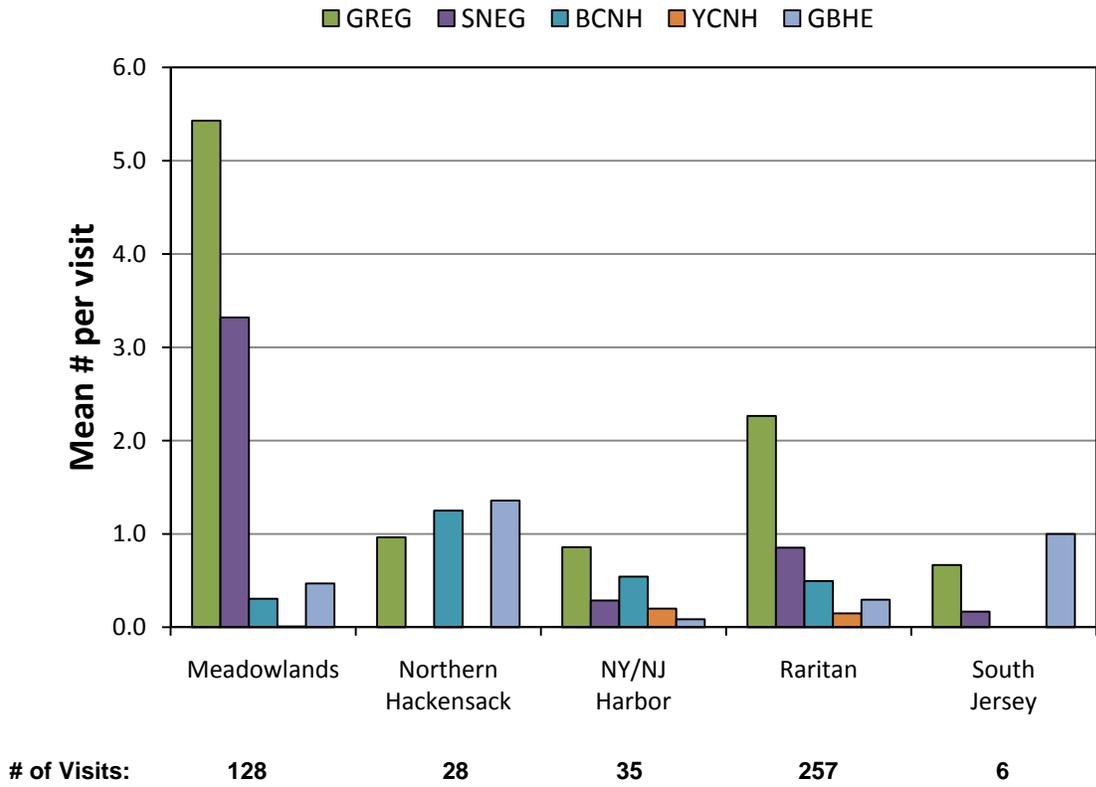


Figure 4. Total number of colonial wading birds observed at Meadowlands and Northern Hackensack survey sites in 2009. Meadowlands sites include Harrier Meadow (HAME), Kearny Brackish Marsh (KBRM), Kearny Freshwater Marsh (KFWM), Kingsland Impoundment (KING), Marsh Resources (MRI), Mill Creek Marsh (MCMA), Saw Mill Creek (SACR), Secaucus High School (SEHS), and Skeetkill Marsh (SKMA). Northern Hackensack sites include Overpeck Creek (OVCR), and Oradell Reservoir (ORAD).

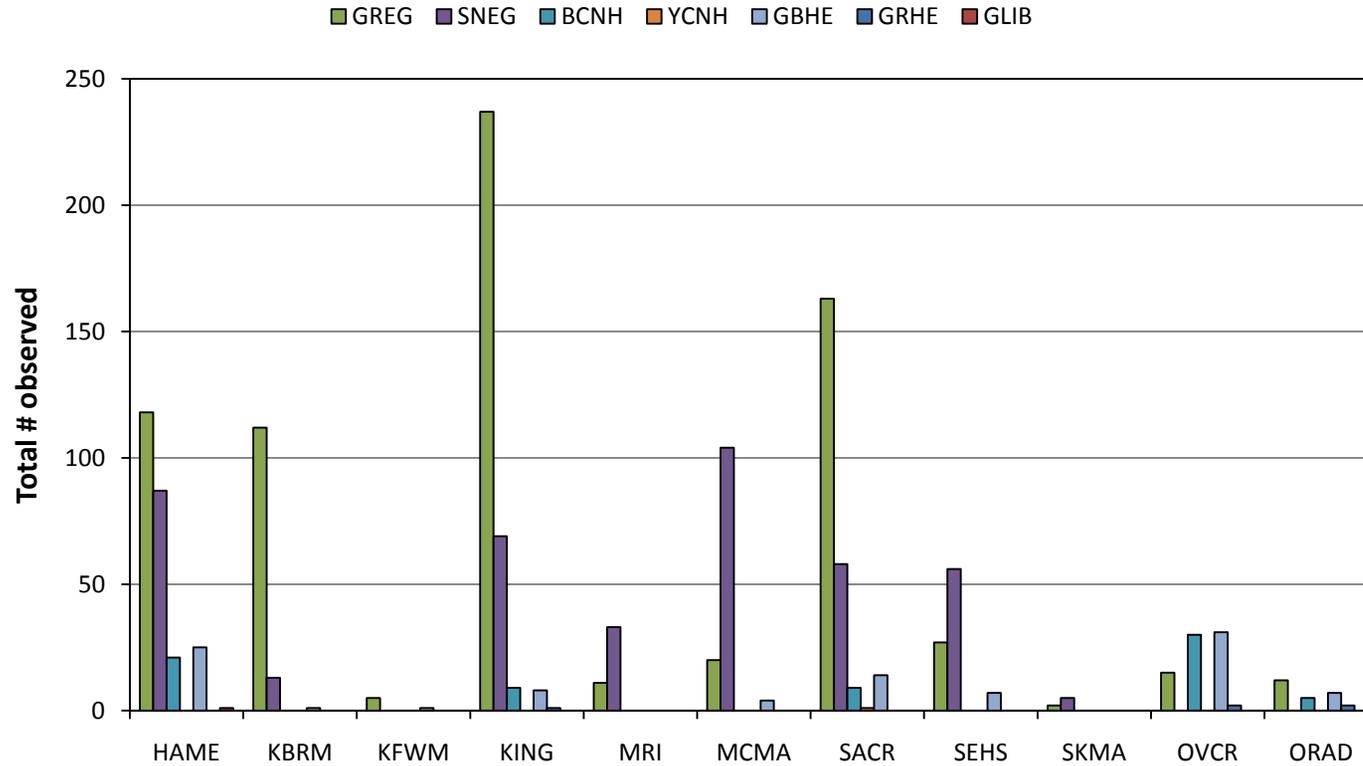


Figure 5. Average number of colonial wading birds observed per visit at Meadowlands and Northern Hackensack survey sites in 2009. Meadowlands sites include Harrier Meadow (HAME), Kearny Brackish Marsh (KBRM), Kearny Freshwater Marsh (KFWM), Kingsland Impoundment (KING), Marsh Resources (MRI), Mill Creek Marsh (MCMA), Saw Mill Creek (SACR), Secaucus High School (SEHS), and Skeetkill Marsh (SKMA). Northern Hackensack sites include Overpeck Creek (OVCR), and Oradell Reservoir (ORAD)

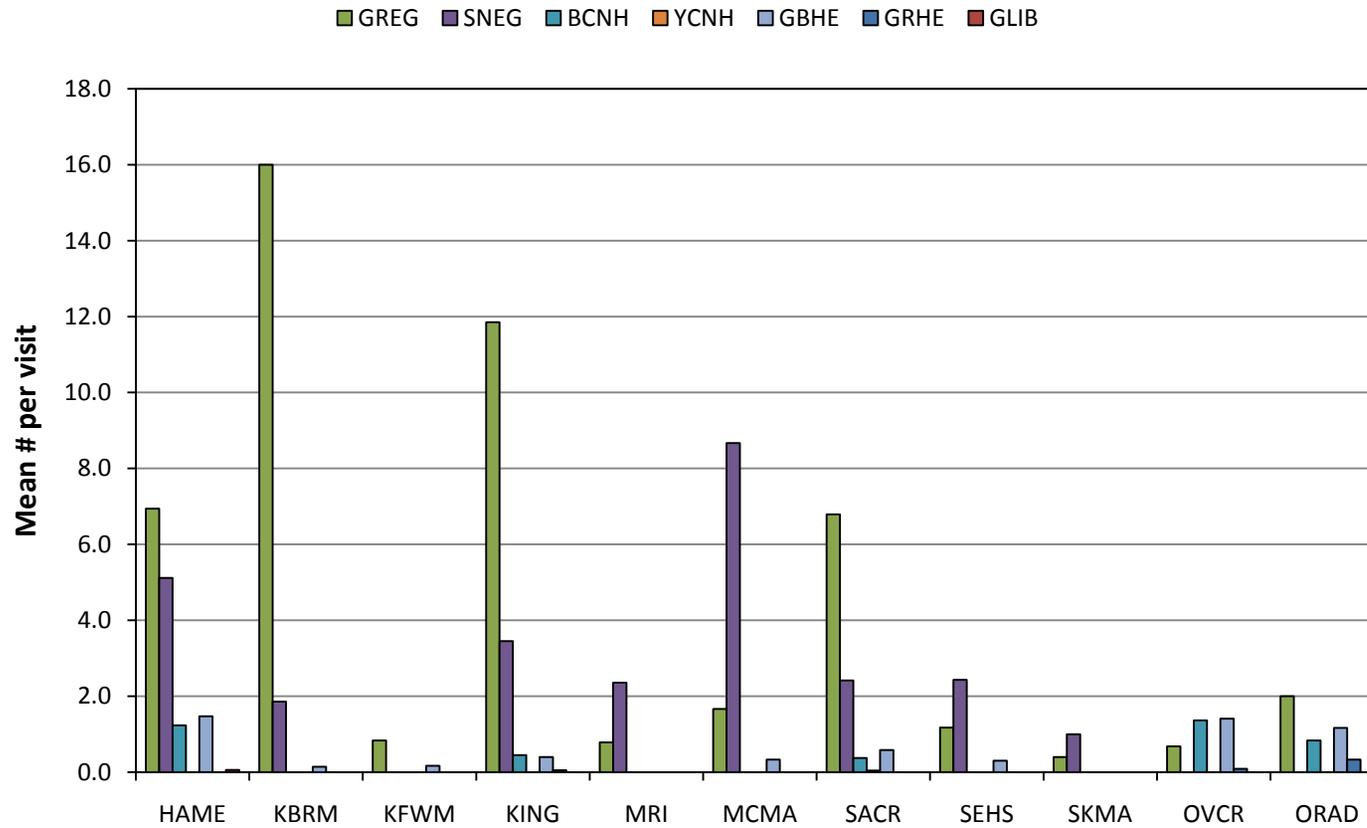


Figure 6. Relative frequency of colonial wading birds observed at sites during 2009, by general survey area. Relative frequency was calculated as the number of sites at which a species was observed divided by the total number of sites surveyed.

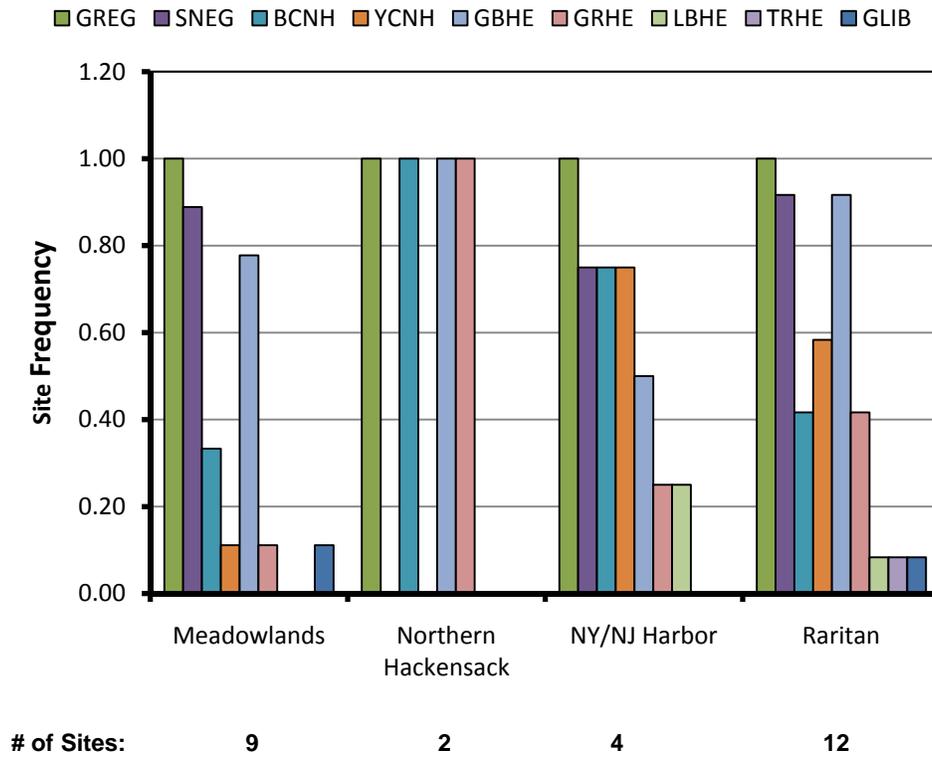


Figure 7. Relative frequency of colonial wading birds observed at survey points during 2009, by general area. Relative frequency was calculated as the number of points at which a species was observed divided by the total number of points.

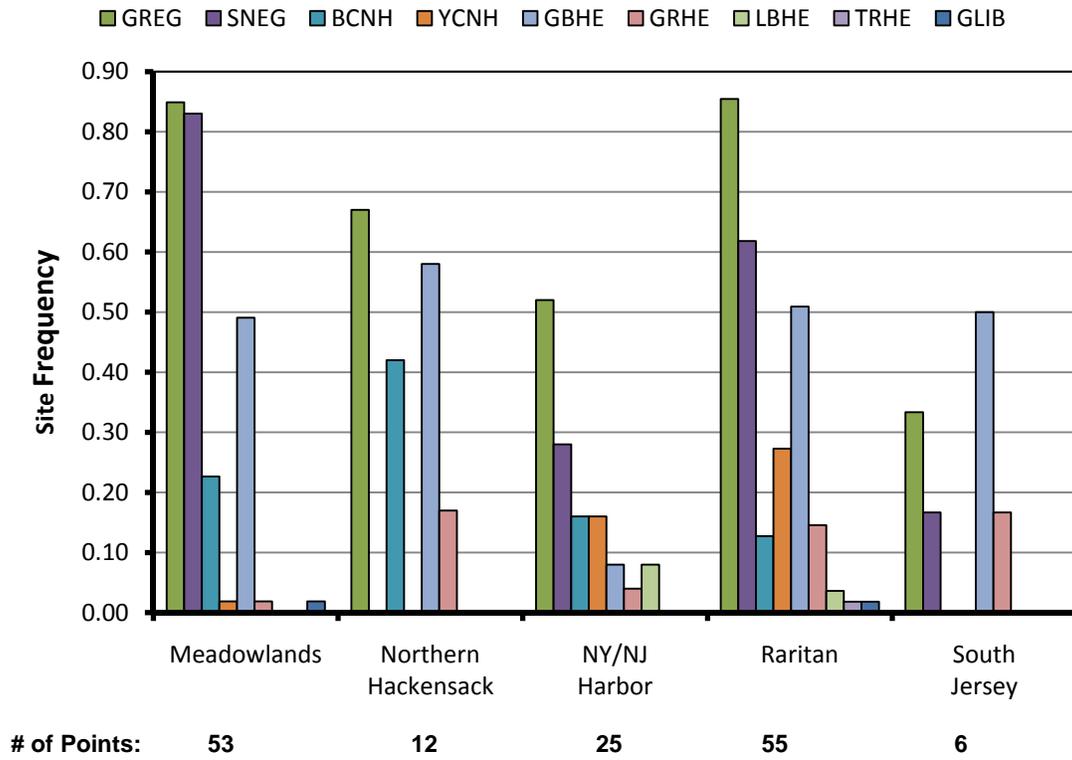
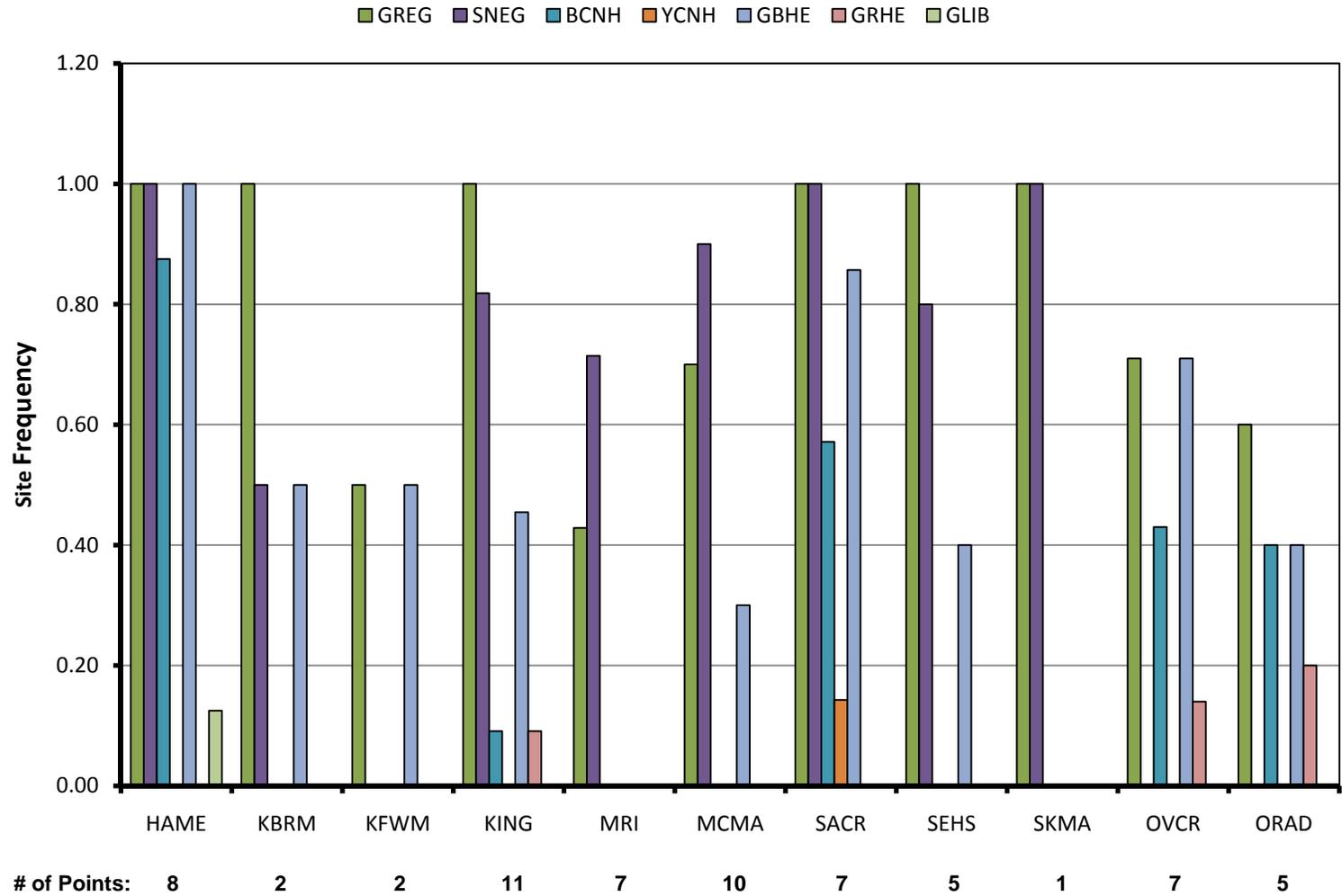


Figure 8. Relative frequency of colonial wading birds observed at Meadowlands and Northern Hackensack sites during 2009. Relative frequency was calculated as the number of points at which a species was observed on at least on survey divided by the total number of points surveyed. Meadowlands sites include Harrier Meadow (HAME), Kearny Brackish Marsh (KBRM), Kearny Freshwater Marsh (KFWM), Kingsland Impoundment (KING), Marsh Resources (MRI), Mill Creek Marsh (MCMA), Saw Mill Creek (SACR), Secaucus High School (SEHS), and Skeetkill Marsh (SKMA). Northern Hackensack sites include Overpeck Creek (OVCR), and Oradell Reservoir (ORAD)





HARBOR HERON SURVEY PROTOCOL -- 2009

Nellie Tsipoura and Kate Ruskin, New Jersey Audubon Society

Survey dates: May 1st – October 31st

Submit all data by: November 30th, 2009

Time of day to conduct surveys: Anytime

Number of visits per site:	12	Twice per month
Number of points per site	1-10	Depending on site and bird use
Number of volunteers per site	3-6	Sign up for specific weeks and times
Habitat surveys	12	During each bird survey

All citizen scientists are required to attend a training workshop. During this workshop, survey sites will be assigned and corresponding maps will be handed out. We make every attempt to match volunteers to their preferred areas. Volunteers are asked to survey their site at least 12 times over a 6 month period. Do not try to be too ambitious and take on more than you can handle. If you feel that you are not able to survey that many times, please let us know and we can combine surveys with those of other volunteers.

2009 Harbor Heron Foraging Survey

Developed by Nellie Tsipoura, Kristin Mylecraine and Kate Ruskin, New Jersey Audubon Society and Susan Elbin, New York City Audubon

INTRODUCTION

The goal of this project, a collaborative effort of New Jersey Audubon Society (NJAS) and New York City Audubon (NYCA), is to advance the conservation of colonially breeding waterbirds in the NY/NJ Harbor and to instill in local citizens an appreciation for these birds and their habitats. This project will fill gaps in knowledge identified by the New Jersey Wildlife Action Plan (WAP) for coastal areas in the Hackensack Meadowlands and the Raritan Bay conservation zones of the Piedmont Plains. In addition, it will provide information needed for the Harbor Heron Conservation Plan, which in turn will help ensure persistence of these charismatic birds. In addition to the important ecological information on the status of a natural resource to allow for appropriate management decisions, this project will raise awareness and engage the public in understanding and more actively conserving wildlife.

Since 1985, nine wading bird species have bred on island colonies in the NY/NJ Harbor: Great Egret, Snowy Egret, Cattle Egret, Glossy Ibis, Black-crowned Night-Heron, Yellow-crowned Night-Heron, Little Blue Heron, Green Heron, and Tri-colored Heron. All of these species are NJ species of greatest conservation concern (SGCN), and the two night-herons are NJ listed as state threatened. These birds currently breed on several islands in the harbor, including Hoffman Island, Canarsie Pol, and South and North Brother Islands. Continued monitoring is essential to track the health of the metropolitan populations, assess their significance to the larger, regional population of waterbirds, and to identify management issues for both the birds and their habitats.

Because waterbird breeding colonies are conspicuous with hundreds of nests, more is known about their breeding behavior than is known about their foraging habitats and activities. Flight line observations performed during a previous study showed that NY Harbor-breeding herons extensively use New Jersey wetlands to forage. For example, birds from North and South Brother Islands fly over Manhattan and the Hudson River to forage in the tidal mudflats of New Jersey's Meadowlands, while birds from Hoffman were observed crossing Staten Island to forage in Arthur Kill and the Raritan River basin (NYCA unpublished data). Recently, the NJAS Research Department completed a 2-year comprehensive survey of avifauna in the NJ Meadowlands District. This survey recorded over 100 individual sightings of the state listed Black-crowned Night Herons, and over 500 sightings of Great and Snowy Egrets.

Continued monitoring is essential to track the health of the populations of these birds in the greater NY Metropolitan area, assess their significance to the larger, regional population of waterbirds, and identify management issues for both the birds and their harbor island habitats. New Jersey Audubon Society (NJAS) and New York City Audubon (NYCA) are working together in this project to advance the conservation of colonially breeding waterbirds in the NY Harbor and to instill in local citizens an appreciation for these birds and their habitats. This in

turn will help ensure persistence of these charismatic birds in the NY/NJ Harbor Bight, of which the Meadowlands District is one of the most critical parts.

In 2008, funding from the NJ Meadowlands Commission, The Education Foundation of America, and NJ DEP's Conserve Wildlife Foundation allowed NJAS and NYC Audubon to complete a pilot project to study the connections between Harbor Heron breeding and non-breeding/foraging areas. NJAS developed methods and training materials, recruited and trained volunteers and conducted baseline surveys at sites that are used extensively by colonial waterbirds nesting in the Harbor colonies. NYC Audubon initiated a banding and radio tracking project in conjunction with volunteer observations of tagged birds. We continue this survey in 2009 to determine the abundance and distribution of long-legged colonial waterbirds at various sites and habitats, identify areas used as foraging grounds, and explore foraging success and behavioral interactions of these birds away from their breeding colonies.

PROCEDURE

Volunteer Time Reporting

All volunteer hours spent performing heron surveys must be recorded on the provided timesheet. This includes scouting, habitat assessments, bird surveys, data entry, etc. Also be sure to record the miles traveled during each survey.

It is essential for volunteers to record all this information for every field visit and return the time log to NJAS with data sheets at the end of the field season. Thank you.

Scouting

During your first survey, expect to spend a little extra time at your site because you must initially determine site suitability and accessibility. This first visit must take place sometime between the workshops and May 25th for people attending the April or May 9th workshops, or June 15th for people attending the May 30th workshop. **PLEASE LET US KNOW (Kate.ruskin@njudubon.org) about any sites that are inaccessible or that you have difficulty reaching the point, and we will work with you to resolve access issues.** If you decide after the first visit that you would prefer another area, also please let us know. We prefer not to re-assign sites, but we will if necessary.

We have selected approximately 30 different survey sites, all of which are appropriate for heron and egret use, and we anticipate that they are used by these birds sometime during the breeding season. Some of these may be used by large numbers of birds and during each survey while others may not be used as extensively. However, for determining utilization of different habitats and areas, studies at lesser used sites are also needed. In addition, bird use may change through the season. Therefore, the negative data and continuing visits to sites that do not produce birds on the first visit are critical.

Survey Frequency, Timing, and General Guidelines

The survey period spans from May 1st to October 31st, 2009. We ask volunteers to visit their sites twice a month for the duration of the survey. In other words, perform one count between

May 1st and May 15th, one count between May 16th and May 31st, one count between June 1st and June 15th, etc. Counts should be conducted at least 5 days apart. For example, do not survey for the first window on May 15th, and then for the second on May 17th.

We will provide bird identification training to all participants. We recommend you use a good field guide for visual identification during your surveys if you are still uncomfortable after the workshop.

Counting can be done from a car or a boat or from a stationary point. **Absolutely no method of coaxing birds should be used during surveys.** This includes "spishing", tape playbacks, or any other method of enticing a bird to sing, call, or make itself visible. It is crucial that all surveys be done consistently. **In all situations, avoid biasing the data by disturbing the birds. Walk out of your car quietly, approach the survey point cautiously, avoid unnecessary movements, and try to blend in as much as possible.**

It is desirable to count the whole site from a single vantage point to minimize disturbance and the possibility of counting birds twice. For sites that a single vantage point is not possible, we have divided the site into multiple survey points that are defined by the features and accessibility of the site. Survey points are subject to change based on input from volunteers. **If after scouting your points or during the field season, you find that our locations are not as effective for counting birds, please let us know and we can decide together whether we should modify the points.** Because each site will be surveyed by several observers, we need to make sure that there is consistency among all in how and where the birds are being counted.

Data Collection

General Information

- For each survey point, use a separate datasheet and record:
- NAME
- DATE
- START TIME FOR THAT POINT
- SITE AND SURVEY POINT.

Record this information even if no herons are present.

- WEATHER: Temperature should be recorded in °F. Sky code should be recorded using the categories listed on the datasheet: 0 – clear or few clouds; 1 – partly cloudy; 2 – cloudy or overcast; 4 – fog or smoke; 5 – drizzle; 8 – showers. Record this information even if no birds were recorded. Remember the absence of birds is important data!
- TIDES: We will provide time tables for stations close to your survey site. We will also do our best to provide the time difference for each specific site if significantly different from the tide station. Please provide feedback if the tide tables do not seem to reflect tidal levels at your site.

Please enter the time of the closest low tide at your site. We will use this information to calculate at what part of the tidal cycle your survey was conducted.

- HABITAT:
 - Record the site habitat characteristics during the initial visit and at each subsequent visit if possible since vegetation characteristics may change through the season. Please record habitat information, even if no birds are seen. If you record habitat information during the first visit and the habitat does not change in

subsequent visits, you can refer to the habitat entered during the first visit in later datasheets. However, we would prefer for each data sheet to include this information.

- Habitat can be recorded in two ways; 1) circle the predominant habitat at the site (easier); 2) enter the percentage of each habitat surrounding your survey point (more detailed).
- Habitat codes are as follows: Mudflat (MF); Open Water (OW); Open Water - below knee (OWB); Open Water above knee (OWA); High Marsh (HM); Low Marsh (LM); *Phragmites* marsh (PH); Scrub/Shrub (SC); Forest (FO); Man-made (MM).
 - Mudflats and open water are common un-vegetated habitats in tidal wetlands, especially in and along channels and in the impoundments. Depending on the tide cycle, a point may have lots of open water and other times it may be mostly mudflat. We ask that you record water depth when birds are present by recording whether it is above or below the bird's knee. If the water depth is unknown, simply put down 'open water'.
 - Marshes are open habitats that in the survey area are typically dominated by *Spartina* or *Phragmites*. Low marsh is dominated by *Spartina alterniflora*, the most typical cordgrass, with flat, tall leaves. Low marsh is less than one foot in height and is primarily flooded throughout. High marsh is dominated by *Spartina patens* and the ground height is 1 foot to 3 feet, therefore it only floods at the higher tides. *S. patens* has stems that are softer, finer, and paler green than *S. alterniflora*. Later in the season the stems flatten on the ground and look "wavy". *Phragmites australis* is a taller grass than the *Spartina* and can grow in very thick stands. *Phrag.* sports densely packed seed heads that often persist well into the season from the previous fall.
 - Forest and Scrub/shrub are habitats that consist of at least 25% woody vegetation. If the average height of the stand is at least 20 feet, it is defined as a forest while if it is less than 20 feet, it falls within the Scrub/shrub category.
 - Man-made habitats include artificial structures and/or substrates (e.g. docks, buildings, nest boxes, tires and other discarded materials). We do not consider restored wetlands as man-made habitat, unless they are in the early stages of completion and dominated by human made structures.

Reporting Birds

To report waterbird abundance, count individuals of each species present at each survey point/site. Record all herons and egrets seen at your survey site/location by writing the total number observed after each species name. We do not anticipate that numbers will be large enough in any of our sites (ie hundreds of birds at a site) to make it necessary to estimate numbers. Binoculars and/or a spotting scope mounted on a tripod can be used to locate, identify, and count birds, depending on distance from the observer.

If more than a few birds are seen at a site, pan with binoculars or spotting scope across the area occupied by the birds. Starting at say the left hand side of the flock, count how many are in one field of view, then move the view to the right and continue counting for each view until the

entire flock has been recorded. When possible, counts should be repeated several times and another observer's opinion obtained on the number of birds before it is recorded to ensure accuracy.

Observers should avoid walking (or canoeing) directly towards the birds as this might make them fly. In addition, observers should not walk along the "skyline" as they will be silhouetted and this might scare the birds. Observer should try to blend in with the environment as much as possible, and remain quiet and avoid sudden movements that scare the birds.

Hérons and egrets observed outside of your assigned site can be reported in a separate datasheet, indicating the location of the site where they were seen. Please provide as much specific information as possible on the sightings and the site, so we can potentially include it in future surveys.

Three-minute Behavioral Observations

Once all you have recorded all the general site information and the total number of birds seen, we ask that you do a three minute observations for each waterbird. Do 3-minute focal bird observations for each heron and egret you see at your site/location if fewer than 5-10 birds are seen at your site/location. If more than 5-10 birds are seen at a site, choose a random subset of 5-10 birds to observe.

Use more than one datasheet per site if needed!

For each individual long-legged waterbird at your site/location, record:

1. Species (code): Black-crowned Night Heron (BCNH), Yellow-crowned Night-Heron (YCNH), Great Blue Heron (GBHE), Glossy Ibis (GLIB), Great Egret (GREG), Snowy Egret (SNEG), Green Heron (GRHE), Little Blue Heron (LBHE), Tricolored Heron (TRHE).
2. The age of the bird: Adult (A) or Juvenile (J). Note: In most cases you will not be able to age the birds. That is OK, you can just leave this box blank.
3. Tag color and number (if tagged). Note: It is uncommon to see tagged birds. That is OK, you can just leave this box blank. However, keep scanning at every survey. And if you see any tagged birds, please let us know immediately!
4. Record the habitat in which each focal bird is recorded. This not the general habitat of the site that you recorded at the top of your data sheet. This is an important distinction. For example, if the habitat is dominated by *Phragmites*, but there is a small mudflat (or open water area) and birds are recorded only in the mudflat (or open water area) this is important information to use in determining specific habitat use at the site.
5. Using a stop-watch record the focal bird's behavior -- time spent in various activities in 3 minutes.
 - a. This can be done in a few different ways. An easy way is to record the activity in which the bird is initially involved and then record the time (within the 3-minute period) when it switches behavior. For example, if a bird is foraging when your observation starts, enter 0 under feeding. If at 2 minutes and 15 seconds it starts preening, enter 2:15 under preening. If the bird after preening for 30 seconds

- starts loafing, that is at 2:45 minutes during the observation it roosts, enter 2:45 under roosting.
- b. Another way to do this is to count the specific time involved in each activity. **This seems to be the method most used by citizen scientists in the 2008 field season.** This may be easier to do if the bird is involved in one activity for most of the 3-minute survey, but does something else for a brief time. For example, if a bird is foraging throughout the entire survey, but spends 5-10 seconds preening, it may be easier to record how many seconds it was involved in the latter behavior (10 sec) and subtract that from 180 sec (3-minutes) to derive the amount of time spend foraging (170 sec).
 - c. If birds are involved in ‘other behavior’, record the type of behavior (aggression, flying, etc) – this can be recorded either in the behavior part of the data sheet, or in comments.
6. If the focal bird is engaged in foraging during its 3-minute observation period, record the feeding success by counting the number of times it strikes for prey and the number of times it successfully captures the prey. **Be sure to record 0 for either of these categories if applicable.**
 7. Neighbors
 - a. **Count the other waterbirds seen in the proximity of the ‘focal’ bird by species and distance.**
 - b. Record:
 - i. Species (by code)
 - ii. Distance to focal bird in 10 m increment brackets (0-10 meters, 10-20 meters, 20-30 meters, and greater than 30 meters).
 - iii. Number of individuals of this species at this distance bracket
 - iv. Record any aggressive interactions that occur between the focal bird and its nearest neighbor within the focal bird’s 3-minute observation period.
 - v. The best way to estimate distance is to use Great Egret height as a measure – Great Egrets stand at about 1 meter tall, so you can estimate how many GREGs away the neighboring bird is. If no GREGs are present, you can estimate based on another species, and we can make the calculation. Snowy Egrets stand at about 65 cm tall, so a bird that is 10 SNEGs away is about 6.5 GREGs away, or about 6.5 meters.
 - c. **Repeat this process for each focal bird’s heron neighbors within 30 meters, using a row for each individual.**

Data Submission

We are in the process of developing a data entry system that will be available by early June. Volunteers will be asked to register online with a login ID and password and enter their own data. We are using a pull-down menu entry based on the format of the data sheet and developed with input from one of our citizen scientists, so we hope it will be a smooth process! We will do our best to guide you through the data entry process. Please let us know if any issues arise.

After data have been entered, submit your data sheets to:

Kristin Mylecraine

New Jersey Audubon Society

Scherman-Hoffman Wildlife Sanctuary
11 Hardscrabble Road
P.O. Box 693
Bernardsville, NJ 07924

Please enter your data and submit your datasheets for the first survey as soon as possible. For the rest of the season, you can submit your datasheets monthly. Send datasheets via mail, fax, or email. Please keep copies of your datasheets in case questions arise as data is entered. If you are unable to enter your data, please send us your data sheets promptly so we can do the data entry ourselves and produce our yearly report in a timely fashion.

PLEASE MAIL ALL DATA SHEETS BY NOVEMBER 30th, 2008

Please do not hesitate to contact us with any questions about your surveys. Thank you for your assistance and good luck with all of your surveys!

NJAS/NYCA Heron Foraging Survey 2009

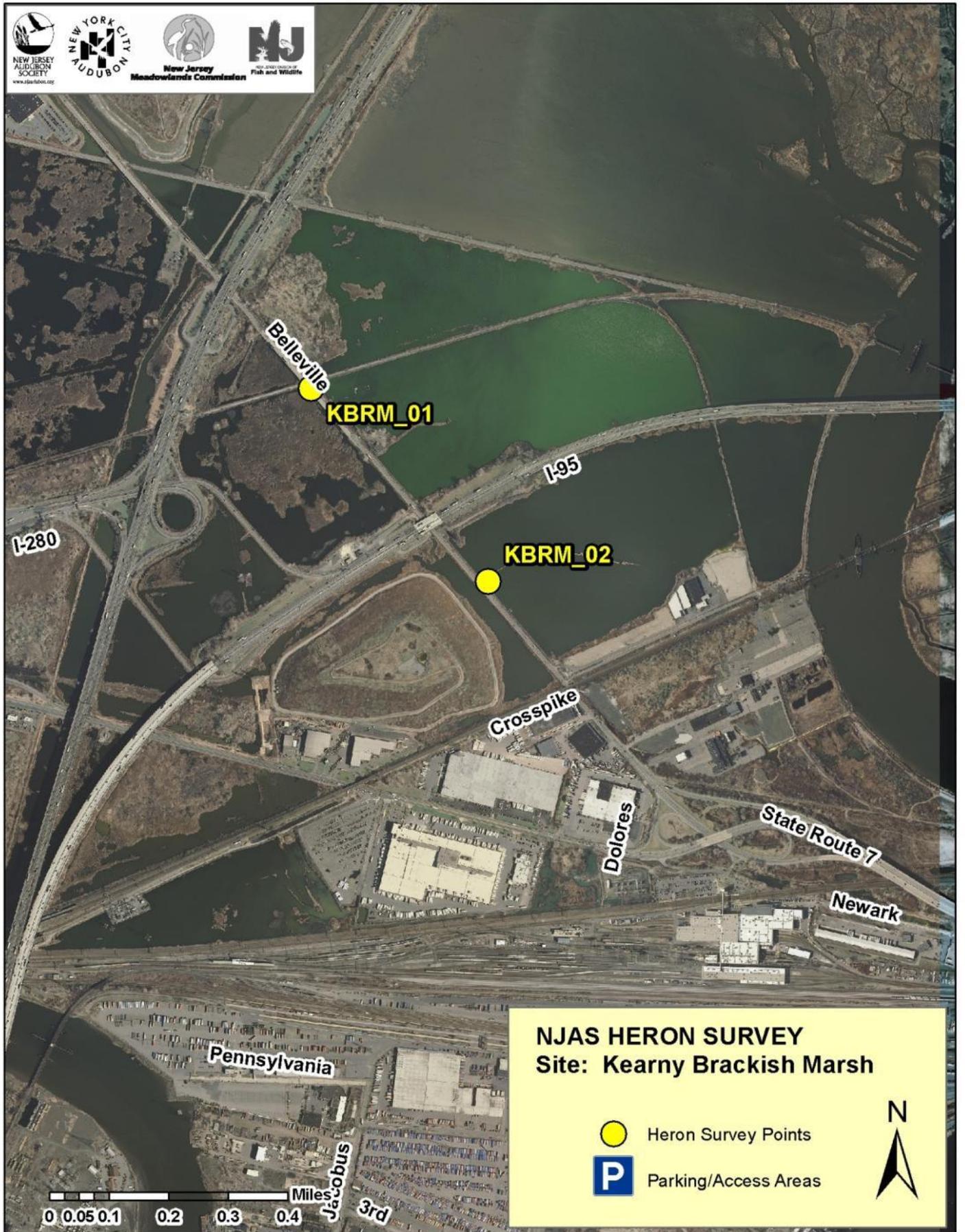
Site Name:		HABITAT:				SPECIES COUNT:												
Survey Point:		(Predominant at site or % each): Mudflat (MF)____ Open Water (OW)____ Open Water Below Knee (OWB)____ Open Water Above Knee (OWA)____ Low Marsh (LM)____ High Marsh (HM)____ Phragmites (PH)____ Scrub-Shrub (SC)____ Forest (FO)____ Manmade (MM)____ Other (please specify)____				Great Egret (GREG)____ Snowy Egret (SNEG)____ Black-crowned Night Heron (BCNH)____ Yellow-crowned Night Heron (YCNH)____ Great Blue Heron (GBHE)____ Green Heron (GRHE)____ Little Blue Heron (LBHE)____ Tricolored Heron (TRHE)____ Glossy Ibis (GLIB)____												
Observer:																		
Date:																		
Time:																		
WEATHER:		Temp: _____°F; Weather : _____ 0: clear 4: fog or smoke 1: partly cloudy 5: drizzle 2: cloudy/overcast 8: showers																
TIDES:																		
Time of nearest Low Tide: _____																		
<input type="checkbox"/> Non-tidal																		
Time	Species	AGE		Tagged Color Number	Habitat	Time spent in various activities during 3-minute period (seconds)				Foraging success in 3 min			Heron neighbors (0-10m, 10-20m, 20-30m, >30m)					
						feeding	preening	loafing	other	#strikes	#captures	N/A	Species	Distance	Count	Aggression		
		A	J														Y	N
		A	J														Y	N
		A	J														Y	N
		A	J														Y	N
		A	J														Y	N
		A	J														Y	N
		A	J														Y	N
		A	J														Y	N
Comments:																		
Submit datasheets to: Kristin Mylecraine, New Jersey Audubon Society, Scherman-Hoffman Wildlife Sanctuary, 11 Hardscrabble Rd., Bernardsville, NJ 07924																		

Appendix 3. Individual site maps for 2009 Meadowlands Harbor Heron survey









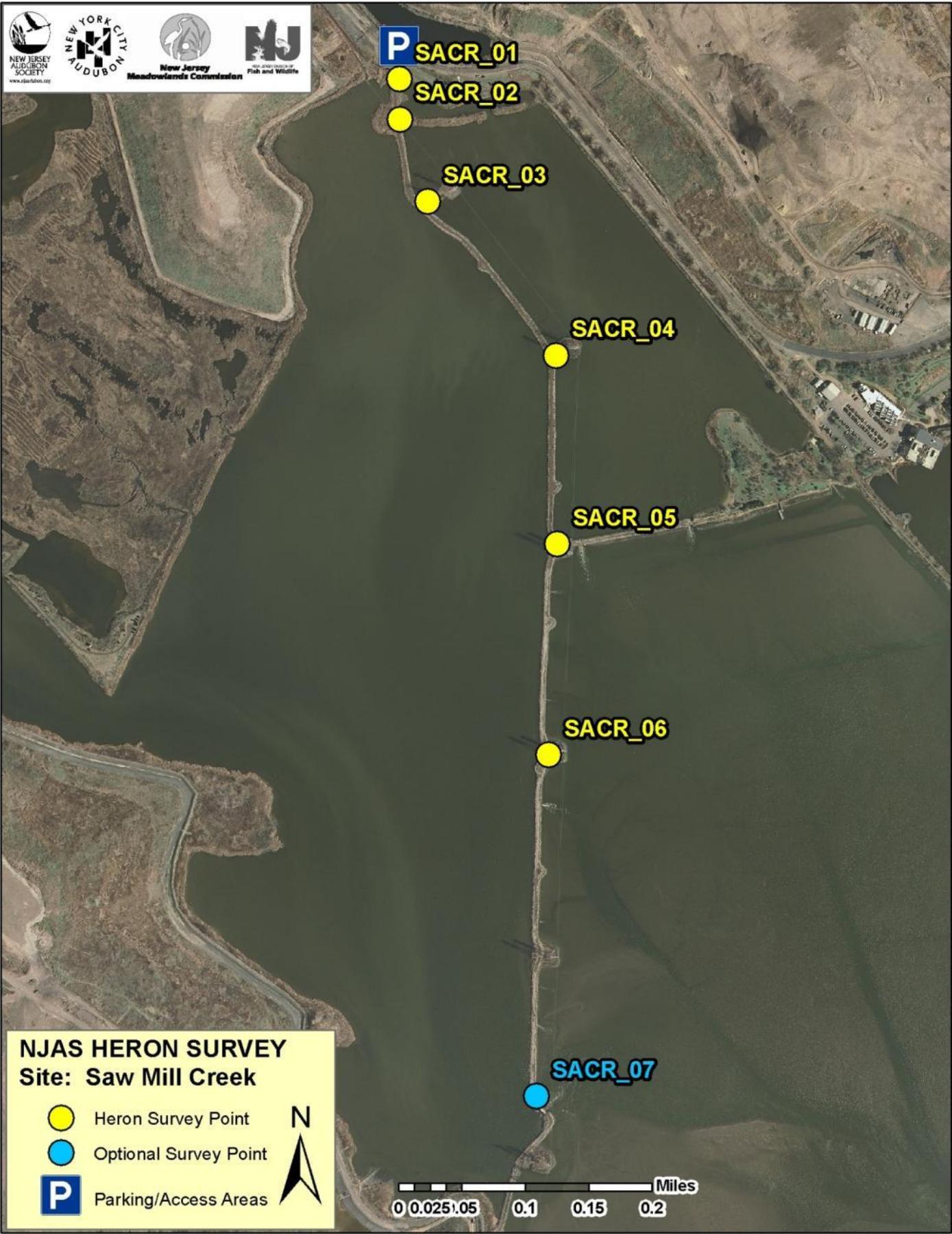


**NJAS HARBOR HERON SURVEY
Site: Kearny Freshwater Marsh**

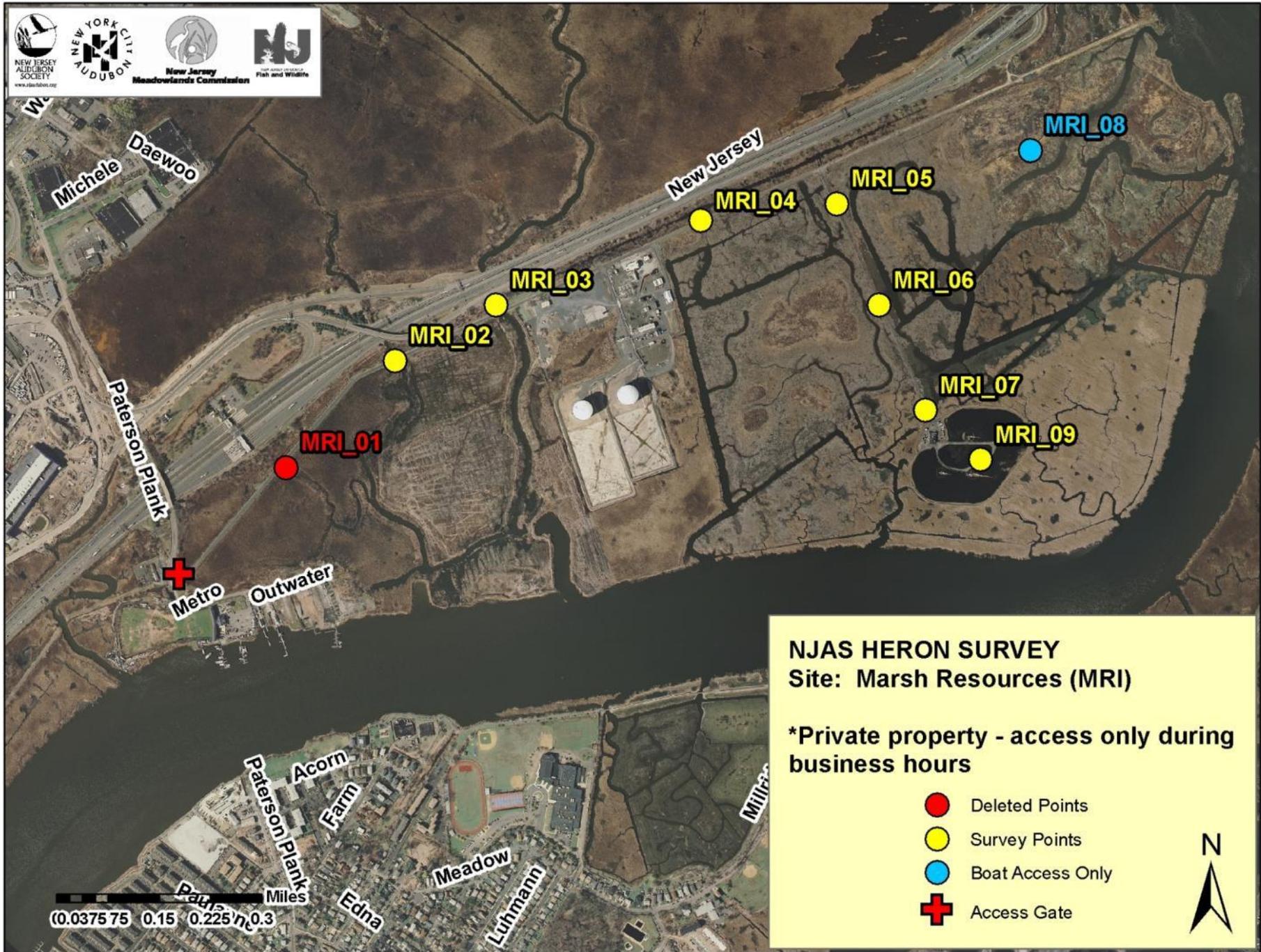
-  Heron Survey Points
-  Parking/Access Areas

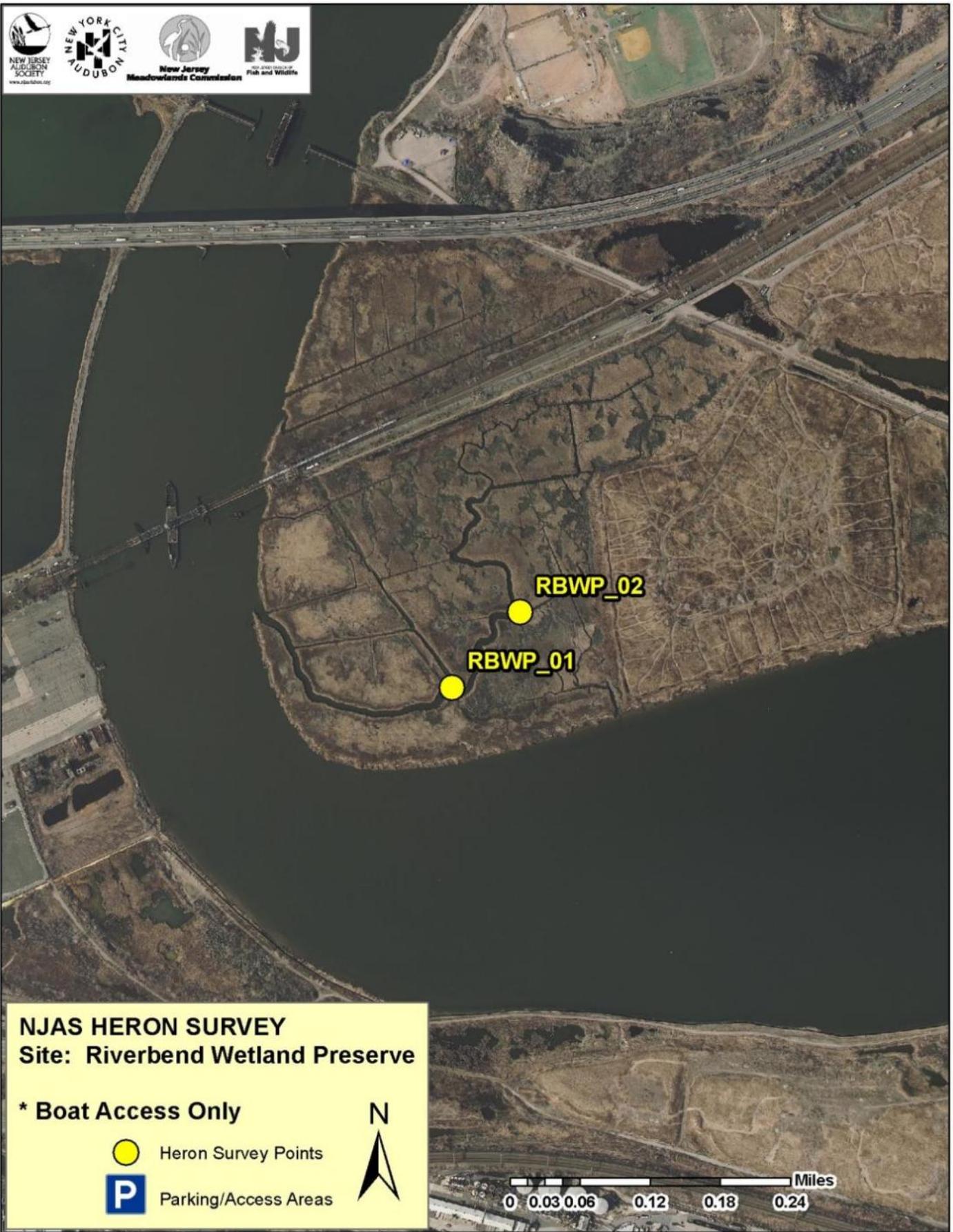








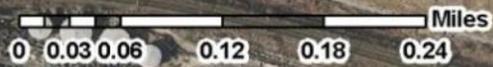


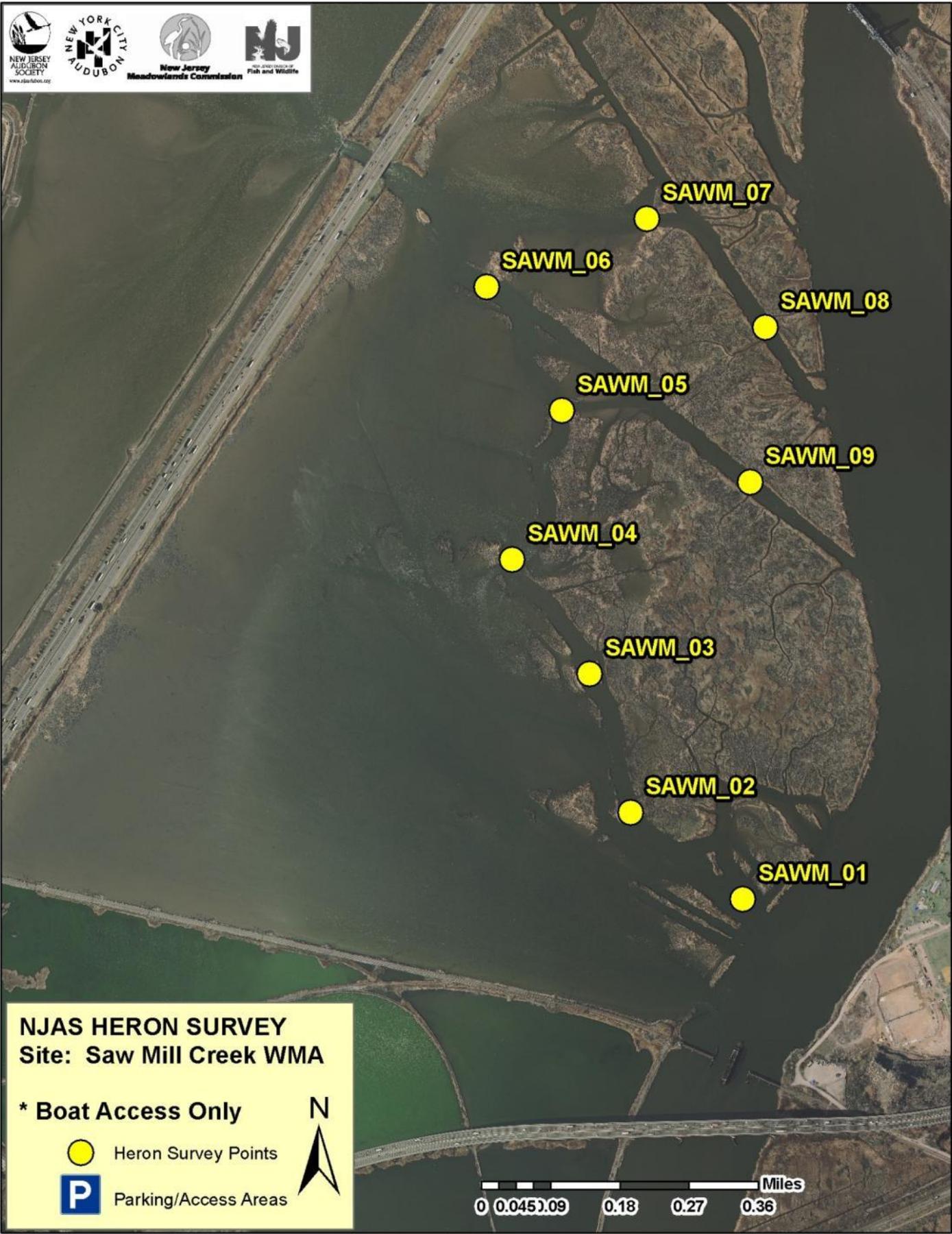


NJAS HERON SURVEY
Site: Riverbend Wetland Preserve

*** Boat Access Only**

-  Heron Survey Points
-  Parking/Access Areas





NJAS HERON SURVEY
Site: Saw Mill Creek WMA

- * **Boat Access Only**
-  Heron Survey Points
-  Parking/Access Areas







**NJAS HERON SURVEY
Site: Skeetkill Creek Marsh**

-  Heron Survey Points
 -  Parking/Access Areas
- 

