Avian Abundance and Distribution in the New Jersey Meadowlands District: The Importance of Habitat, Landscape, and Disturbance

A Final Report
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EXECUTIVE SUMMARY

The Meadowlands is a diverse mosaic of habitats that include tidal, brackish, and freshwater emergent wetlands, forested wetland, upland deciduous forest and early successional habitats. The resources of this area are under the jurisdiction of the New Jersey Meadowlands Commission (NJMC). In 2004, the NJMC contracted New Jersey Audubon Society to systematically conduct two full years of avian surveys in the Meadowlands District, from August 2004 to September 2006. The goal of the project was to collect baseline data about the species present, and their abundance and distribution in different sites and habitats. These data will allow NJMC to evaluate avian responses to any habitat modifications, predict changes in the bird community resulting from habitat alteration, and develop effective management strategies for avian species. All avian surveys followed protocols outlined in the U.S. Fish and Wildlife Service's wildlife inventory and monitoring procedure guidelines for birds that conform to widely used simple point count methodology. Data were analyzed to produce summary information on the occurrence, relative abundance and relative species diversity of species across all survey locations.

We reported on the first year of the study that took place from August 2004 to August 2005 in an earlier document (Tsipoura et al. 2006). In brief, during the first year of the study we surveyed 118 points at 28 sites. Of these, 69 points at 17 sites were used for the secretive marsh bird callback surveys, during which taped calls of target species were used to elicit vocal responses from birds that are typically difficult to detect visually. We recorded 80,261 individuals of 175 bird species, including 1,191 individuals of 29 State endangered, threatened or species of concern. During the second year of the study, three more sites with two points each were added and two points were eliminated due to construction. A final set of 122 points at 31 sites were surveyed from September 6, 2005 through September 5, 2006. A total of 71,801 individual birds of 173 species were observed in the Meadowlands District during the second year of the avian surveys. A total of 25 species not observed during the first year of the study were seen, increasing the Hackensack Meadowlands avifauna list to 200 species for the entire study. These included 753 individuals of 29 state endangered, threatened or species of concern.

The most commonly seen endangered species was the Northern Harrier (*Circus cyaneus*), recorded at 59% of the survey points over the two years of the survey. The most commonly seen threatened species were Osprey (*Pandion haliaetus*), Savannah Sparrow (*Passerculus sandwichensis*), and Black-crowned Night-Heron (*Nycticorax nycticorax*), each recorded at more than 30% of the points. Red-winged Blackbird (*Agelaius phoeniceus*), Song Sparrow (*Melospiza melodia*), and European Starling (*Sturnus vulgaris*) were the most common and most abundant passerine species. Herring (*Larus argentatus)*, Ring-billed (*L. delawarensis*), and Great Black-backed Gull (*L. marinus*) were the most common colonial water birds, while Mallards (*Anas platyrhynchos*) and Canada Geese (*Branta canadensis*) were the most common waterfowl. Finally, the most common raptor seen was the Red-tailed Hawk (*Buteo jamaicensis*). Semipalmated Sandpiper (*Calidris pusilla*) and Ruddy Duck (*Oxyura jamaicensis*) were the birds seen in highest numbers. There were some differences in total numbers of birds seen between years, for example more Ruddy Duck and Gadwall were counted in larger numbers during the second survey year, while more shorebird, gull, and raptor species seen during the first survey

year. We believe that these differences are not biologically significant but rather that they are a reflection of flock movements during migration and winter through the District. Long-legged waterbird and passerine numbers were not significantly different between years.

Common Moorhen was the most widespread and abundant secretive marsh species, recorded at 25% of the points surveyed and accounting for over 50% of all secretive marsh birds recorded. Clapper Rail was the second most abundant species recorded, found at 16% of the points surveyed and accounting for about 30% of recorded secretive marsh birds. Virginia Rail (*Rallus limicola*), and Least Bittern (*Ixobrychus exilis*) were also recorded during the surveys. There were no significant differences between years in the numbers of secretive marshbirds recorded.

Usage patterns by avian species in the District differed between species. Shorebirds such as Semipalmated and Least Sandpipers (*C. minutilla*) utilize the Meadowlands District mostly as a stop over area during their southbound migration. Waterfowl species such as Ruddy Duck and Green-winged Teal (*Anas crecca*) are found almost exclusively and in greatest abundance during the winter, while others such as Canada Geese, Mallard and Gadwall (*Anas strepera*) occur year round. For these species, patterns of use within the District remained similar between the two years. Herring Gull and Ring-billed Gulls also are present throughout the year and peak in the late fall and winter, while Laughing Gulls (*Larus atricilla*) present only during late summer and fall. The District is also important for foraging wading birds. Seasonal patterns of use also differ among passerines. Some species such as Red-winged Blackbirds, European Starlings, and Song Sparrows occur year-round, while others such as Marsh Wren (*Cistothorus palustris*), Barn Swallows (*Hirundo rustica*) and Tree Swallows (*Tachycineta bicolor*) can be observed only in spring and summer when they breed in the Meadowlands.

The number of species recorded varied by habitat with the highest number of species observed for both years combined in shrub/scrub (122 species), followed by open water (91 species), high marsh (87 species) and *Phragmites* (81 species). The highest numbers of individuals for both years were observed in association with open water, followed by shrub/scrub and then mudflat habitats. Forest and scrub/shrub habitat are limited in the Meadowlands District and in the NY/NJ Harbor at large and existing patches of habitat may act as an attractive oasis for birds in the region. Results of the species/area curve analysis reveals that this type of habitat supports a high level of species diversity in the Meadowlands District.

Red-winged Blackbird was the species with the highest breeding density across the entire survey area followed by Marsh Wren and Song Sparrow. Red-winged Blackbird occurred and had significantly higher density at sites with sufficient marsh and/or scrub/shrub upland vegetation, while Marsh Wren, another marsh species, had higher density at sites that have a higher percentage of low marsh dominated by *Spartina*. Finally, other species, such as American Robin, Common Yellowthroat, and Song Sparrow, had higher density at sites with sufficient forest or scrub/shrub vegetation.

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BACKGROUND

The Meadowlands and its expansive wetlands have long been recognized as a critical resource for wildlife, especially birds. Given its location amidst a highly urbanized landscape, its importance as an oasis for wildlife cannot be overlooked. The U.S. Fish and Wildlife Service designated the Meadowlands/Hudson River Complex as part of New Jersey's North Atlantic Coast Waterfowl Focus Area. New Jersey's Division of Fish and Wildlife maintains Sawmill Creek Wildlife Management Area, a 741-acre wetland complex within the Meadowlands District that supports large numbers of waterfowl and shorebirds during migration. Conservation non-profit organizations like New Jersey Audubon Society (NJAS), Hackensack Riverkeeper, American Littoral Society, and Natural Resources Defense Council, have worked diligently over the last three decades to raise public and government agency awareness of the incredible resource value of the Meadowlands. Finally, the New Jersey Meadowlands Commission (NJMC), recognizing the District's value to wildlife, has made preservation and restoration of open space one of its high priorities in its Master Plan.

The Meadowlands consists of a diverse mosaic of habitats that include tidal, brackish, and freshwater emergent wetlands, forested wetland, upland deciduous forest and early successional habitats (e.g., deciduous scrub/shrub). A diversity of habitats usually results in a diversity of avian species, and the Meadowlands are no exception. The District is home to many breeding species, several of which, like Pied-billed Grebe (*Podilymbus podiceps*), American Bittern (*Botaurus lentiginosus*), Yellow-crowned Night-Heron (*Nycticorax violaceus*), Black-crowned Night-Heron (*Nycticorax nycticorax*), and Northern Harrier (*Circus cyaneus*), are listed as "endangered" or "threatened" by the state of New Jersey. The District also hosts more than 150 bird species during the migration and winter seasons. Waterfowl, long-legged wading birds (i.e., herons, egrets), raptors, shorebirds, and migrant songbirds, all find refuge and respite in the Meadowlands during passage between their breeding and wintering grounds. For many species, the District is their winter home.

NJMC in its Natural Environment System Plan has articulated a clear set of objectives for meeting its goal of promoting suitable land use practices that are compatible with preserving and enhancing wetlands and other valuable natural resources and open space in the Meadowlands. All of the objectives, however, are dependent on information about the abundance and distribution of wildlife, especially high priority species identified by New Jersey Division of Fish and Wildlife. We report here on a comprehensive, two-year avian inventory conducted by NJAS to provide the NJMC with information needed to set site acquisition priorities, and direct management and restoration activities related to reducing fragmentation among the District’s habitats (e.g., trail placement), improving targeted habitats that support wildlife related activities (e.g., breeding, foraging), and establishing habitats that are more beneficial to wildlife. Results of the first year of study were reported elsewhere (Tsipoura et al 2006). Here we present the results of the second year of study, combine the data for the entire study period, and make some comparisons between the two years. We also present some information on habitat use by birds not presented in the Tsipoura et al. 2006 report.

GOALS AND OBJECTIVES

The goal of this project is to collect and evaluate information on birds of the Meadowlands District to assist the New Jersey Meadowlands Commission realize the environmental and land use goals described in its Master Plan. Specifically, our objectives are to (1) determine the abundance and distribution of avian species occurring throughout the annual cycle in the various habitats of the District, (2) investigate habitat, landscape, and disturbance characteristics that underlie avian abundance and distribution patterns, (3) determine avian behavior patterns associated with different habitat and disturbance characteristics, and (4) test hypotheses regarding bird use of wetland habitats dominated by common reed (*Phragmites australis*).

METHODS

Data Collection

We followed avian survey protocols outlined in standard wildlife inventory and monitoring procedure guidelines for birds (Ralph et al.1995). Avian surveys were conducted from point locations approximately every two weeks during migration and the breeding season, and once per month during the non-breeding season. We also conducted "callback" surveys designed to detect the presence of secretive marsh species (e.g., rails, bitterns), which followed standard protocols describe by Conway (2004).

Site and Survey Point Selection

The Meadowlands District is a mosaic of open space, and residential and industrial development. Although our efforts focused on natural areas, there were some opportunities to conduct surveys in developed sites that support birds (e.g., landfills). Because of the District's fragmented nature and its diversity of habitats, we took a stratified rather than a random approach to site selection.

The site boundaries for Hackensack Meadowlands areas were obtained as ArcInfo® GIS export files from the NJMC MERI website. These boundaries were imported into ArcView® 3.2. and overlaid onto 1997 NJ land use/land cover data available from the New Jersey GIS website, http://www.state.nj.us/dep/gis/lulc95shp.html. We used Animal Movement, Version 2 (Hooge and Eichenlaub1997), a software program that can generate a series of random survey points for individual polygons (i.e., site) and latitude/longitude coordinates for each point (see Appendix 1). Survey points were located at least 250 m apart to minimize possible double counting and also were at least 25 meters from adjacent non-contiguous habitats to avoid possible edge effects caused by ecotones. These attributes satisfied recommended survey protocol requirements (Ralph et al. 1995). To select sites we used the MESIC report (USACE 2004) to select a number of sites representative of the existing management regimes in the Meadowlands District and then consulted with the NJMC Natural Resource staff to determine which sites would be best to survey in terms of accessibility and NJMC needs.

Initial random points were field verified to determine accessibility. For various reasons, particularly on marsh sites, some points were inaccessible (e.g., impenetrable vegetation, no road access, no boat access). When possible, inaccessible points were moved to the closest accessible locations within the same tract (see Appendix 1). Some inaccessible points were moved to locations that provide expansive and unobstructed views of large portions of survey sites. This approach allows us to generate better estimates of abundance, and a better assessment of waterfowl, wading bird, and shorebird distributions with respect to habitat availability.

Some surveys focused on the Hackensack River and its tributaries as habitat. Under certain conditions, e.g., deep water, high tide, the Hackensack Riverkeeper provided boat service. Under shallow water or low tide conditions surveys were conducted from canoe, kayak or flat bottom boat with a small outboard motor. We moved inaccessible water points to randomly selected traversable waterways, again following suggested minimum distance criteria (Ralph et al. 1995). Points that could not be relocated were dropped from the survey. Information on the points surveyed during the first year of the survey can be found in the project first year report (Tsipoura et al. 2006).

During the first year of the study, 118 points distributed over 28 sites were surveyed. Two survey points at each of three additional sites were added during the second year of the study: Empire Tract 2, Resources Metro Marsh 2 and Secaucus High School Marsh. In addition, two points were dropped during the first year of the survey. A final set of 122 points at 31 sites were surveyed during the second year of the study, from early September 2005 until early September 2006 (see Tables 1 and 2, and Appendix 1). Of these, 69 points at 17 sites (Table 2) were used for the marsh bird callback survey. Latitude and longitude coordinates for all points surveyed (Appendix 1) were acquired using a hand-held Garmin 12L GPS (global positioning system) unit, and the location was marked if possible. Maps of all the survey sites and points can be seen in Appendices 2-8. A total of 19 point count surveys were conducted at each point during the second year of the study. Some points could not be accessed during the winter so fewer than 19 surveys were done there.

Number of point count surveys conducted

The maximum number of surveys conducted at any one point during the first year of the study was 19. Some points were surveyed fewer than 19 times due to access issues (see Appendix 1, Table 2). For example, points that are accessible by boat only were not surveyed during the winter surveys. All points at Bellemeade Mitigation site, Eastern Brackish Marsh, Western Brackish Marsh, Lyndhurst Riverside and Riverbend Marsh, and some points at Mill Creek and Resources Metro Marsh were surveyed only 13 times. Some points at Oritani Marsh, Sawmill Creek WMA were surveyed 15 times. Hackensack River points were surveyed 14 times except for one point, RIVR32, which was missed once due to weather factors and unavailability of a boat. Kearny Fresh Water Marsh has 4 points that could not be accessed during the winter. For winter surveying only, 4 additional points were established that correspond to existing points, and are represented with a W after their numeric code. Furthermore, surveys at some sites started later due to permit and access issues and have fewer than 19 surveys. For example, there

are 17 and 16 surveys from Teterboro Woods, and Landfill 1A respectively. Two points were dropped during the year of the survey: one at Oritani Marsh because access was denied by transit security and one at Laurel Hill Upland because it was altered due to construction.

During the second year of the study once again the maximum number of surveys conducted at any one point was 19. A final set of 122 survey points, at 31 sites were surveyed during the second year of the study, from September 6, 2005 to September 5, 2006. Surveys were conducted over a period of 2-3 weeks, the survey 'cycle'. Of these, 64 were surveyed during every survey cycle (53%). Some points were surveyed fewer than 19 times due to access issues (see Appendix 1, Table 2). For example, points that are accessible by boat only *were not* surveyed during the winter surveys. All points at Bellemeade Mitigation, Western Brackish Marsh, Lyndhurst Riverside and Riverbend Marsh were surveyed only 11 times. All points at Eastern Brackish Marsh were surveyed 11 times, except for EABM01, which was surveyed nine times. Some points at Oritani Marsh and Sawmill Creek WMA were surveyed only 12 times. Hackensack River points were surveyed 10 times during the survey period due to lack of winter access. Kearny Freshwater Marsh has four points that could not be accessed during the winter. For winter surveying only, four additional points were established that correspond to existing points, and are represented with a W at the end of their alpha-numeric point code. The points surveyed during the second year of the survey were the same as the points surveyed during the first year, except at the following three sites: Secaucus High School Marsh points, which were surveyed 17 times because the site was added during the third cycle of the second survey year (cycle 22), and two points each at Empire Tract and Marsh Resources Mitigation Bank that were surveyed 16 times because these sites were added during the fourth survey cycle of the second survey year (cycle 23).

Survey methodology

Point counts

Bird surveys began at sunrise and continued for approximately four hours, following point count survey protocol established by Ralph et al. (1995). Surveys were conducted during suitable weather conditions, avoiding steady precipitation or winds greater than 10 mph. Each point location was surveyed as many as 19 times during each year of the survey. Each point count was a total of ten minutes long. During that period data were collected during three time segments, 0-3 minutes, 4-5 minutes, and 5-10 minutes following standard protocols that will allow comparison with similar surveys conducted in other locations. Data were recorded for each of these segments, but birds heard during a previous segment were not recorded again during subsequent segments. For every bird detected aurally, we recorded whether it occurred within 0-50 meters, between 50 and 100 meters, or greater than 100 meters of the survey location. Observers recorded the distance of visually detected individual(s) using a Bushnell Laser Range Finder Yardage Pro 500, and their direction (i.e., relative to North) by using a digital compass. The habitat in which each bird (or group of birds) occurred also was recorded.

Marsh Bird Callbacks

Callback surveys for secretive marsh birds during the second year of the study, as in the first year, focused on the breeding season and as such were conducted May 22 - July 3, 2006 following methodology outlined by Conway (2007). Two separate surveys were conducted during that time. All callback surveys began 30 minutes before sunrise and concluded approximately four hours after sunrise. The same weather condition protocols as the point count surveys were followed. Each of the 69 callback points was surveyed twice during the study period. No evening call back surveys were conducted, as Conway's (2007) survey protocol recommends either a dawn or dusk survey and evening surveys were deemed especially difficult and potentially dangerous in the Meadowlands study area.

We used taped calls of target species to elicit vocal responses from birds that are typically difficult to detect visually. Calls of eight marsh bird species were played at 69 survey points in the following order: Common Moorhen (*Gallinula chlorpus*), American Coot (*Fulica Americana*), Clapper Rail (*Rallus longirostris*), Virginia Rail (*Rallus limicola*), Black Rail (*Laterallus jamaicensis*), Pied-billed Grebe (*Podilymbus podiceps*), American Bittern (*Botaurus lentiginosus*), Least Bittern (*Ixobrychus exilis*).

At each callback survey point, data first were recorded during an initial five minute passive listening period. Then we played species-specific calls, each approximately 30 seconds long. Interspersed between each call was 30 seconds of silence. Detected birds were recorded only once, either during the 5 minutes passive listening period or the call-playback period. For every detected bird, we also recorded the approximate distance and direction at which it was heard.

Data Analysis

Point count data

We included all birds observed in the analysis of bird abundance and frequency of occurrence. While birds flying over a certain site may not be associated with that particular site at that specific time, we decided to include those observations in our general calculations, given the fact that appropriate habitats are limited within the broader NY/NJ Harbor area, and that the Meadowlands may provide the only potential habitat for these species.

We determined the number of points and number of sites where each species was observed and calculated relative frequency of occurrence for each species observed using the following equations: (1) number of point locations species *x* was observed/total number of point locations surveyed, and (2) number of sites where a species was observed/number of sites surveyed. We also determined the total number of individuals of a given species seen over the entire study period, across all surveys cycles and all sites and points. We calculated the relative abundance of each species observed using the equation: total number of individuals of species *x* observed/total number of individuals of all species observed.

Birds counted in species groupings were included only once in developing our species list totals. For example, we assumed that peeps (unidentified small sandpipers) were Semipalmated Sandpiper or Least Sandpiper and were not counted as a separate species. However, there is a slight possibility that within these groupings there were additional species (for example a Baird's Sandpiper within peeps). In addition, information on species grouping is presented in our abundance and frequency distribution analyses. Similarly, we aged raptors where possible, and include some information on ages of individuals seen in our summaries. Finally in comparisons between years, we re-analyzed the first year's data on total species numbers based on the criteria above to maintain consistency.

Furthermore, we include information on the maximum number of each species seen at all points during one cycle, which represents the maximum number counted as present in the Meadowlands District at one time. We considered this metric because it is likely a more realistic measure of abundance than total count of individuals. The probability that many individuals were observed during more than one survey cycle is high during the breeding and winter season.

Finally, we compared number of birds seen in the two years for some subsets of species (waterfowl, gulls, colonial waterbirds) using Chi-square distribution tests (Zar 1999). These were not meant to be exhaustive analyses that included all possible comparisons between years, but a sampling of possible ways to look at the extensive data depending on the question one is trying to answer.

Marsh bird callback survey

We calculated total numbers of secretive marsh birds recorded during the five minute passive listening period (5 minute pre-survey), and the callbacks for each of the two surveys conducted each year and for both years of the study. We also calculated percentage of points where secretive marsh birds were seen. Finally, we ran comparisons between years and between surveys using a Chi-square test.

Habitat and Bird Diversity Analysis

We combined the data from both years of the survey to investigate habitat effects on bird diversity. We analyzed these data in several different ways. First, we explored habitat and bird diversity relationships using the habitat codes assigned to each individual bird observation during the field survey. This specifically refers to the specific habitat where each bird was observed and not the survey point itself, and thus may not be representative of the dominant habitat characteristics of the area surrounding the point. We tabulated total number of species in every habitat category as recorded during the field observations. We used a X^2-test (Zar 1999) to determine differences between years and among habitats in the number of species recorded. In addition, we used habitat information obtained through GIS analysis to derive the number of species per acre for every habitat surveyed. We used the 2002 NJ land use/land cover data available from the New Jersey GIS website, http://www.state.nj.us/dep/gis/lulc95shp.html, level III/IV, to classify the existing habitat within an area of 100m around each survey point. We used

the habitat classification from Anderson (1976) as modified by NJDEP (2006) to calculate total number of hectares as well as the percentage of each habitat at each point. While these data are older and may have not been ground truthed effectively, this is the best source of habitat information in the Meadowlands to the best of our knowledge. Then, we divided the number of species seen in each habitat based on the field observations by the calculated total acreage of each habitat in the 100m circle around each point. One of the weaknesses of this analysis is that some of our field habitat codes such as mudflat, and habitats consisting of a combination of marsh and open water could not be assigned to any of the NJ land use land cover classifications. We therefore did not include these habitats in the number of species per hectare calculations. However, based on current existing information on habitat distribution in the Meadowlands District habitats, we believe that this was the most effective way to calculate the number of species per hectare for each habitat.

We used multivariate regression (SAS 2005) to explore relationships between the percentage of different habitats at a point and two metrics of bird use, bird abundance and total numbers of species. This analysis used a different approach, one that did not include the habitat assigned to each observation during the field survey, rather habitat assignments based on the NJ land use land cover classifications. We included only counts from birds recorded within the 100m area around each point, excluding birds flying over, to match bird data with mapped habitat at each point. Where there was statistical significance in a multivariate regression, we used SAS PROC REG with option SELECTION=RSQUARE to determine what percentage of variance each variable contributed to the model (Hatcher and Stepansky 1994). To correct for unequal number of surveys conducted at different points we used average numbers rather than total numbers of birds recorded at each point. We also explored differential use of habitats by several species, including Red-winged Blackbird, Marsh Wren, Tree Swallow and Northern Harrier, by regressing the average number of individuals counted of these species against percentage of each habitat at points where these birds were recorded.

Finally, we used the program **EstimateS8**, http://viceroy.eeb.uconn.edu/EstimateS, to model expected species accumulation (species-area) curves with 95% confidence intervals using the analytical formulas of Colwell et al. (2004), and Gotelli & Colwell (2001). This approach did not include the habitat assigned to each observation during the field survey, but the habitat assignments based on the NJ land use land cover classifications. First, using the NJ land use/land cover data, we assigned each point a 'dominant' habitat category based on which habitat type made up 40% or greater of its vegetation cover. Then, using **EstimateS8** we determined the cumulative number of unique species in each habitat type (along with confidence intervals) as survey points of that habitat type are added, up to the total number of points surveyed. If more than one habitat constituted greater than 40% of the habitat cover at a point, we modeled species/area curves for both habitat types at that point. We then compared curves between habitats based on overlap of 95% confidence interval curves. Since observed species richness within habitats is dependent on sample size, this modeling approach allows for standardization of comparisons and provides a visual output to illustrate the habitat differences.

We developed species curves for low marsh, *Phragmites* marsh, open water, forest, and

scrub/shrub habitats. We did not run analyses for some habitat categories because the definitions were not clear-cut, or because the habitats were likely to be in flux even during the period of our surveys, such as human-altered lands. Furthermore, while a large number of species occur in high marsh proportionately to the extent of this habitat, none of the survey points consisted of 40% or greater high marsh and this habitat dropped out of our analysis.

Breeding bird density

We used DISTANCE 5.0, a software program designed for the analysis of distance sampling data (Thomas et al. 2005), to estimate songbird breeding density while taking into account imperfect detection. We fit detection functions for uniform models with cosine and simple polynomial expansions, hazard-rate models with cosine and simple polynomial expansions and half-normal models with cosine and hermite polynomial expansions, as recommended by Buckland et al. (2001). We selected the best-fitting model based on Akaike's information criterion (AICc; Burnham and Anderson 2002). Because a minimum number of 60–100 detections are recommended to estimate density with a reasonable degree of accuracy using program DISTANCE, we estimated density for the most abundant species in our study. We pooled data across years to increase the number of detections, but included "year" as a covariate in some models to test the assumption that counts did not vary significantly between years. For species with longer breeding seasons we used the three highest counts for each of the two breeding seasons, while for species with shorter breeding seasons we used only one or two counts during each breeding season.

We modeled density for the entire study area and separately for each site. When only one point was surveyed at a site, we ran the site-specific model assuming Poisson distribution to calculate confidence intervals around the density estimates (Buckland et al. 2001). We modeled the density and detection probability including habitat, year, and bird behavior as covariates when there was a sufficiently large sample size to produce a model with a good fit. Because of the large number of sites, we did not have sufficiently large sample size to use site as a covariate. We compared mean densities for each site and species by examining 95% confidence intervals.

Mapping bird abundance and distribution

We created several different maps on bird distribution and abundance using a Geographic Information System (GIS), including maps of raptor and grassland bird occurrence and maps of abundance of common species such as Red-winged Blackbirds and Tree Swallows. Shapefiles were created using a GIS (ArcMap 9.1) by developing attribute tables based on the analyzed data. Analysis of the data was performed in Microsoft Excel, including calculations for frequency of occurrence, maximum total individuals observed, maximum total number of breeding individuals observed and total maximum number of non-breeding individuals observed. Information regarding "safe breeding dates" for species was obtained from The Handbook for The Atlas of New Jersey's Breeding Birds (April 1993). Generation of shapefile attribute tables for both individual and groups of species provides a visual representation of the data. Mapping the location of bird observations on aerial photographs of the Meadowlands landscape provides

examples of how the data can be represented graphically, and are based only on a subset of our data.

RESULTS AND DISCUSSION

Point Count Survey

A total of 80,261 individual birds of 175 species were counted in the Meadowlands District during the first year of surveys, of which seven were new for the Meadowlands species list (see Table 3, Appendix 9). During the second year of surveys, a total of 71,801 individual birds of 173 species were counted. Therefore, during the entire survey over 150,000 bird sightings were reported (Appendix 10). Total number of birds recorded was about 10% lower in the second year than the first, but approximately the same numbers of species were recorded during both years of the study. Given between year variability in timing of surveys and weather patterns, and the patchy distribution of some flocking species of birds (for example, shorebird, ducks, sparrows) we believe that the second survey year numbers, although lower, do not represent a decline in bird use of the area. A total of 17 species that were not recorded during the first year of the survey were reported during the second year, including Hudsonian Godwit (*Limosa haemastica*), Bonaparte's (*Larus Philadelphia*) and Glaucous Gull *(Larus hyperboreus*), Red-shouldered Hawk (*Buteo lineatus*), Short-eared Owl (*Asio flammeus*), Horned Lark (*Eremophila alpestris*), and Seaside Sparrow (*Ammodramus maritimus*) (Table 3). In addition, seven (7) species were seen during the survey but outside the count periods, bringing the total number of bird species seen to 200.

Of the 200 species recorded during the two years of the survey, ten (10) were new for the Birds of the Meadowlands list provided by the Meadowlands Environmental Center (MEC) and sponsored by NJMC. Of these, seven (7) were reported during the first and three (3) were reported during the second year of the study. These new species were Boat-tailed Grackle (*Quiscalus major*), Cerulean Warbler (*Dendroica cerulea*), Common Raven (*Corvus corax*), Eurasian Wigeon (*Anas Penelope*), Grasshopper Sparrow (*Ammodramus savannarum*), Great Cormorant (*Phalacrocorax carbo*), Orchard Oriole (*Icterus spurius*), Red-bellied Woodpecker (*Melanerpes carolinus*), Semipalmated Sandpiper (*Calidris pusilla*), and Wild Turkey (*Meleagris gallopavo*). Some of these (Semipalmated Sandpiper, Red-bellied Woodpecker) are common species and were probably mistakenly left out of the MEC list. Others are new reports for the District. Additionally, based on observations in appropriate season and habitat, the status of several species on the list can be changed to probable nesting based on observations made during this study (Table 3). Finally, two hybrid species were recorded, a hybrid of Mallard (*Anas platyrhynchos*) and Black Duck (*Anas rubripes*) and a Brewster's Warbler (hybrid of Blue-winged Warbler, *Vermivora pinus* and Golden-winged Warbler, *Vermivora chrysoptera*).

The fifty most commonly encountered species during the second year of the project are listed in Table 4A and are arranged in order of frequency of occurrence -- that is based on the proportion of points where these species were recorded. We also provide a comparison of both years in Table 4B, which illustrates that the frequencies of occurrence for the top 30 species are very

similar between the two years. Total numbers of individuals of all species per site are provided in Appendix 10.

Waterfowl

During the first year of the study, Mallard (*Anas platyrhynchos*) and Canada Goose (*Branta canadensis*) were the most common waterfowl, seen at 86% and 81% of all points, respectively (Tsipoura et al. 2006, Table 4B). A total of 5,318 Mallards and 3,768 Canada Geese were recorded, making up approximately 11% of all individual birds counted during the survey. Among all waterfowl species, Ruddy Duck (*Oxyura jamaicensis*) had the highest maximum count for a single cycle (2,281) even though they were observed at only16% of all points. Green-winged Teal (*Anas crecca*) had the second-highest maximum count (1,991) but was more widespread, seen at 52% of the survey points. Although less abundant, Gadwall (*Anas streptera*) was recorded at 44% of the survey points and 20 of the 28 sites.

Waterfowl species comprised nearly 43% (30,477 records) of all avian sightings during the second year of the study. The most commonly observed waterfowl species in year two were again Mallard and Canada Goose which were recorded at 83% and 77% of all points, respectively (Table 4A). A total of 5,161 Mallards and 4,092 Canada Geese were counted during the second year of the survey. These two species accounted for approximately 13% of all individual birds counted during the year two survey. Both are known to breed in the District.

Among all waterfowl species, Ruddy Duck was again the species most recorded during the second survey year (11,699 total records) and had the highest maximum count for a single cycle (2,898) even though this species was observed at only 17% of all points. The vast majority of Ruddy Ducks were recorded at Merhof Pond (10,875 records) which accounted for 92% of all observation. This species occurred sporadically in the District, during the breeding season, especially at Kingsland Impound and Kearny Marsh, but the majority of records were of migrants utilizing Mehrhof Pond as a wintering site (Appendix 10). Therefore, the high number of 11,699 likely represents the same birds counted again during subsequent survey cycles, but provides a good indication of the heavy winter use of the area by this species. Another abundant species of migrant/wintering waterfowl was again Green-winged Teal, with 3,667 individuals recorded during year two of the surveys. This species was the second most abundant after Ruddy Duck, but was more widespread, being observed at 52% of the survey points. Although less abundant, Gadwall produced a total of 1,429 records and was recorded at 51% of the survey points and 21 of the 31 sites (68%).

Total number of waterfowl seen was different between the two years (X^2=11.2, $p<0.05$) and this difference was significant for all the most common waterfowl species except for Mallard and Northern Shoveler (*Anas clypeata*), ($p>0.05$). Some species were encountered in larger numbers during the first year of the study, for example Green-winged Teal at 6,011 recorded the first year versus 3,667 the second, while others were more abundant the second year of the survey. For example Ruddy Duck numbers were 8,148 in year one versus 11,699 observed in year two. Similarly, Gadwall was more abundant in year two (1,429) than in year one (1,024). These birds

tend to concentrate in flocks especially during the non-breeding season, and also tend to move around within the site, so flocks may have been missed during some surveys. Therefore, we do not think that the differences based on our point count surveys are biologically meaningful.

Colonial Waterbirds

During the first year of the study, Herring Gull (*Larus argentatus*), Ring-billed Gull (*L. delawarensis*), and Great Black-backed Gull (*L. marinus*) were the most common colonial waterbirds, seen at 88%, 83%, and 75% of points respectively (Tsipoura et al. 2006). A total of 3,917 Herring, 4,917 Ring-billed, and 846 Great Black-backed Gulls were counted during that period of the surveys, accounting for approximately 12% of all individual birds counted during the survey. Maximum counts of Ring-billed (655) and Herring Gulls (572) are among the highest for any species observed.

Double-crested Cormorant (*Phalacrocorax auritus*) was relatively widespread, recorded at 70% of survey points, and abundant colonial waterbird, with 2,930 total individuals recorded. This species also had the maximum count for a single cycle among all colonial waterbirds (1,189). Among long-legged colonial waterbirds (e.g, heron, egrets) Great Egret (*Ardea alba*), Snowy Egret (*Egretta thula*) and Great Blue Heron (*Ardea herodias*) were the most widespread during the first year of the survey (Tsipoura et al. 2006), occurring at 64%, 47% and 40% of the survey points respectively.

As was the case during the first year of the study, Herring Gull, Ring-billed Gull, and Great Black-backed Gull were the most common colonial waterbirds observed in the second year of the surveys. These three species were recorded at 85%, 78% and 64% of the points respectively (Table 4A). Frequency of occurrence for these three species is slightly lower than those recorded in year one (88%, 83%, and 75%). Maximum counts per single point for Herring (701) and Ring-billed Gulls (582) were again some the highest recorded for any species, and were higher than the maxima recorded during the first year of the study. A total of 2,813 Herring, 3,787 Ring-billed, and 556 Great Black-backed Gulls were counted during the second year of the survey, accounting for approximately 10% of all individual birds counted during the survey.

However, significantly lower total numbers of these three gull species were counted during the second year of the study compared to the first ($X^2 = 9.6$, $p<0.01$). These species are not known to breed in the District, but they are typically present throughout the year as individuals from other areas (i.e. Jamaica Bay) that utilize the District's various habitats for foraging and roosting. Differences in counts between years are likely the result of movement around the area and not a reflection of changing conditions in the Meadowlands District.

Double-crested Cormorant, which was recorded at 70% of survey points during the first survey year, was still relatively common during the second year of the survey, and was recorded at 60% of the survey points. A total of 1,130 individuals were observed, which is substantially lower than the 2,930 total individuals recorded in year one (difference of 1,800 individuals). Again, since this species occurs in large flocks, the discrepancy, while statistically significant ($X^2 = 7.7$,

$p<0.01$), is probably the results of local movement of the birds and an artifact of not seeing the larger flocks in year two of the survey.

Long-legged colonial waterbird species (e.g. heron and egrets) were well represented during the second year of the survey. Though only Yellow-crowned Night-Herons are known to breed within the District, these species utilize the various habitats in the Meadowlands as foraging sites during the breeding season. Great Egret, Snowy Egret and Great Blue Heron were again the most widespread during the second year of the surveys, occurring at 57%, 50% and 38% of the survey points respectively. Black-crowned Night-Herons were seen in 33% of the points, compared to 25% of the points during the first year of the survey. Total number of long-legged colonial waterbirds was not different between the two years ($X^2 = 3.9$, $p > 0.9$).

<u>Shorebirds</u>

During the first year of the study, Semipalmated Sandpiper numbers were the highest among all species (12,895), had the highest maximum count for a single cycle (11,579) and the highest maximum count for a single survey point with 4,000 birds recorded at Mill Creek Point MCMA02 (Table 4B, Tsipoura et al. 2006). Despite these impressive numbers, this species was only recorded at 24% of all survey points. Typically, they are observed in the highest numbers because they tend to concentrate in larger groups during fall migration. Least Sandpiper (*Calidris minutilla*) also was relatively common and abundant. This species was observed at 38% of the survey points and 1,118 individuals was the maximum number seen during a single survey cycle. Greater Yellowlegs (*Tringa melanoleuca*) and Lesser Yellowlegs (*Tringa flavipes*) were seen at 39% and 32%, respectively, of all points surveyed. Maximum numbers for these two species were 196 and 188 individuals respectively.

Semipalmated Sandpiper was the second most abundant species recorded during the second year study with 6,946 counted. However, this is only 46% of the total recorded for this species in year one of the survey (12,895 records). Kingsland Walkway produced 78% of the total number of Semipalmated Sandpipers observed (Appendix 10). Typically, they are observed in high numbers but are not species most frequently seen across the Meadowlands District (Tables 4A and 4B) because they concentrate in large groups at a few sites during fall migration. Though observed in smaller numbers in the second year of the study as compared to the first, Least Sandpiper was also fairly common and abundant (1,326 records). This species was observed at 26% of the survey points (Table 4A). The maximum number recorded at all 19 points during a survey cycle (cycle 33) was 728 individuals. Eastern Brackish Marsh produced the most records with 346 individuals recorded (Appendix 10).

‘Peeps’, a term used to describe the small *Calidris* sandpipers when identification is not possible, were relatively abundant and common. There were 3,282 records of ‘peeps’ during the year two survey. These accounted for 28% of all the small sandpiper observations, while Semipalmated Sandpipers made up 60% and Least Sandpipers made up 12%. Peeps were observed at 21% of all the survey points with Harrier Meadow Marsh producing the highest total number seen with 1,060 observations.

Greater (*Tringa melanoleuca*) and Lesser Yellowlegs (*Tringa flavipes*) were seen at 31% and 28% of all points surveyed during the second study year, respectively. A total of 480 Greater Yellowlegs were recorded during the survey, with Kingsland Walkway producing the highest count of 163 total individuals. Lesser Yellowlegs numbers totaled 160 observations. Both Kingsland Walkway and Kingsland Impoundment generated the highest totals for this species with 31 records each (Appendix 10). These shorebird species are all migrants and occur in the greatest numbers during fall southbound passage.

There were generally more shorebirds seen during the first year of the survey than the second year ($X^2 = 553$, $p<0.001$). As mentioned earlier, shorebirds use the Meadowlands habitats during migration and differences between the two years most likely reflect the complexity of counting shorebirds, species that move around in large flocks and may be missed depending on the tide cycles. Interestingly, similar numbers of Spotted Sandpipers, *Actitis macularia*, a species that breeds locally, were seen in both years (73 and 85 sightings respectively, $X^2 = 0.91$, $p>0.05$), and higher numbers were seen of another local breeder, the Killdeer (*Charadrius vociferus*) in the second year of the study (256 and 430 sightings respectively, $X^2 = 44.13$, $p<0.001$).

<u>Diurnal Raptors</u>

The most common diurnal raptor during the first year of the surveys was Red-tailed Hawk (*Buteo jamaicensis*), seen at 84 survey points (71%, Table 4B, Tsipoura et al. 2006). A total of 231 Red-tailed Hawks were counted. Several state listed diurnal raptors were observed during the first survey year, although in low numbers or at few sites (see Table 5). These included Bald Eagle (*Haliaetus leucocephalus*), Cooper's Hawk (*Accipiter cooperii*), Sharp-shinned Hawk (*Accipiter striatus*), Northern Goshawk (*Accipiter gentilis*), Peregrine Falcon (*Falco peregrinus*) and American Kestrel (*Falco sparverius*). Other species seen during the survey were Broad-winged Hawk (*Buteo platypterus*), Rough-legged Hawk (*Buteo lagopus*) and Merlin (*Falco columbarius*).

During the second year of the study Red-tailed Hawk was again the most commonly occurring diurnal raptor. This species was seen at 63 survey points (52%, Table 4A). A total of 149 Red-tailed Hawks were counted during the second year of surveys. Several state threatened, endangered and special concern raptor species were again observed during the year two survey. Most were recorded in relatively low numbers, with Northern Harrier being the most abundant (71 records), and observed at 35% of the survey points. Other state-listed diurnal raptors observed were: American Kestrel, Bald Eagle, Cooper's Hawk, Osprey (*Pandion haliaetus*), Peregrine Falcon, Sharp-shinned Hawk and Red-shouldered Hawk (*Buteo lineatus*). Table 5A provides additional information regarding state-listed species observed in year two, while Table 5B provides a year to year comparison of state-listed species.

Overall, numbers of raptors differed between the two years of the study ($X^2 = 16.5849$, $p<0.05$), but since the survey included the migration period this may simply represent a sampling effect. Furthermore, the numbers of the state-listed Northern Harrier, American Kestrel and Sharp-

shinned Hawk recorded were similar in both years ($X^2 = 2.0250$, 1.0 and 0.3 respectively, all $p>0.05$).

Passerines

During the first year of the study, a total of 17,587 individuals from 86 species in the order *Passeriformes* were recorded. Red-winged Blackbird (*Agelaius phoeniceus*), Song Sparrow (*Melospiza melodia*), and European Starling (*Sturnus vulgaris*) were the most common passerine species, seen at 99%, 84%, and 81% of the points and 100%, 96%, and 93% of the sites respectively (Table 4B). Red-winged Blackbird was also the most abundant passerine counted across all surveys (4,094 individuals, followed by European Starling (3,686 individuals) and Song Sparrow (860 individuals). These three species together accounted for approximately 10% of all individual birds counted during the survey. Red-winged Blackbird and European Starling also were the passerine species with the highest total count for a single survey cycle (i.e., the maximum count, 663 and 456 respectively). The next highest maximum counts recorded were for Bobolink (322, *Dolichonyx oryzivorus*), American Crow (180, *Corvus brachyrhynchos*) and Barn Swallow (178, *Hirundo rustica*).

A total of 16,016 individuals from 81 species in the order *Passeriformes* were recorded during the year two survey. As was the case in year one, Red-winged Blackbird was again the most abundant passerine observed across all 19 surveys (4,611 individuals), followed by European Starling (2,450 individuals) and American Robin (*Turdus migratorius*, 999 individuals; Table 4A). These three species together accounted for just over 11% of all individual birds counted during the year two survey. Red-winged Blackbird and Common Grackle (*Quiscalus quiscala*) were the passerine species with the highest total count for a single survey cycle (maximum count of 897 and 373 respectively). The next highest maximum counts recorded during a single cycle were: European Starling (339), American Robin (213) and Barn Swallow (198). Red-winged Blackbird was the most frequently encountered species, seen at 97% of the survey points. The other two most frequently occurring passerine species were Barn Swallow and Song Sparrow, which were recorded at 84% and 83% of the survey points respectively (Table 4).

We looked at differences between years for the most abundant species, those for which there were more than 500 individuals sighted during the two years of the survey. American Crows and Starlings were recorded in significantly lower numbers during the second survey year (485 vs. 716 and 2,450 vs. 3,636 respectively, $X^2 = 44.43$ and $X^2 = 231.11$, $p<0.001$), while other common species were seen in larger numbers during the second survey year. The total number of individual sightings of all common passerines summed together did not differ between the two years ($X^2 = 0.31$, $p>0.05$), suggesting that declines in some species are counterbalanced by increases in others.

Frequently Observed State-listed species

During the first year of the survey, a total of 1,191 individuals of 29 state endangered, threatened or species of concern were recorded in the Meadowlands District (Table 5B). Of these, seven

species, Northern Harrier (*Circus cyaneus*), Great Blue Heron, Spotted Sandpiper (*Actitis macularia*), Osprey (*Pandion haliaetus*), Savannah Sparrow (*Passerculus sandwichensis*), and Black-crowned Night-Heron (*Nycticorax nycticorax*) were seen at more than half the sites. The most commonly seen endangered species was the Northern Harrier, which occurred at 47% of the survey points, with 88 birds recorded during the first year of the survey. The most widespread threatened species were the Osprey, Savannah Sparrow, and Black-crowned Night-Heron, seen at 29%, 26% and 25% of points respectively. The endangered species seen in largest numbers during one survey cycle was Black Skimmer (*Rynchops niger*) with 21 birds seen between June 13 and July 5. Most abundant among threatened species were migrating Bobolink with 322 individuals seen between August 30 - September 14 and Savannah Sparrow with 70 individuals seen between September 29 and October 13, 2005.

A total of 753 individuals of 29 state endangered, threatened or species of concern (E/T/SC) were recorded in the Meadowlands District during the second year of the survey. Of these, six species were ones not recorded during the first survey year, bringing up the E/T/SC species total to 35. Data for all E/T/SC species can be found in Tables 5A and 5B. Four species were seen at more than half of the sites. Those species were Great Blue Heron (*Ardea herodias*), Northern Harrier (*Circus cyaneus*), Black-crowned Night-Heron (*Nycticorax nycticorax*) and Spotted Sandpiper (*Actitis maculata*).

The most frequently observed *endangered* species was Northern Harrier, recorded at 38% of survey points. Black-crowned Night-Heron was the most frequently observed *threatened* species being observed at 35% of the survey points. The most frequently observed *species of concern* was the Great Blue Heron, which occurred at 33% of the survey points. The most abundant *endangered* species was Northern Harrier with 71 total records, and a high count of nine individuals observed between the dates of December 23, 2005 – January 6, 2006 (cycle 26). Most abundant among *threatened* species was Black-crowned Night-Heron. This species had a total abundance of 109 individuals, with 22 sightings occurring between June 14 and July 3, 2006 (cycle 35). Great Blue Heron was the most abundant species of concern recorded. There were a total of 109 individuals recorded during the survey period, with 21 individual sightings from September 22, 2005 through October 10, 2005.

During the second year of the study we recorded 438 fewer E/T/SC species than in the first year (753 sightings vs. 1,191 sightings). Much of the difference can be attributed to the lower numbers of Bobolink (*Dolichonyx oryzivorus*) and Savannah Sparrow (*Passerculus sandwichensis*) recorded during fall migration in the second year at Landfill sites. A total of 235 Bobolink were seen at the Kingsland Landfill during the first year of the study and none were seen during the second year. Similarly, 98 Savannah Sparrows were seen at the Sawmill Landfill (1E Landfill) during the first year of the study and only two were recorded the second year. Changes in habitat composition at the landfill sites due to ongoing construction may explain the reduction in sightings of these birds. However, since these two species are migrant passerines that travel in flocks, the limited number of sightings may also be attributable to migratory dynamics or the result of missed migratory events during the second year of the study.

Marsh Bird Callback Surveys

Although the marsh bird callback surveys were conducted independently and targeted different suites of species, we conducted them at the same survey point locations, following the 10-minute point counts. As described previously, these surveys took place at a subset of 69 points and consisted of two periods: a 5-minute period of passive listening and a 5-minute period during which calls were played in an attempt to elicit responses.

During the first year of the survey, a total of 43 individuals of 4 species of secretive marshbirds were recorded. Of these, 35 individuals, including 21 Common Moorhens (*Gallinula chloropus*), 9 Clapper Rails (*Rallus longirostris*), 4 Virginia Rails (*Rallus limicola*) and 1 Least Bittern (*Ixobrychus exilis*) responded to the playbacks at 36% (25 of 69) callback survey points (Tables 7A, 7B). Only 8 individuals of secretive marsh birds were detected during the 5-minute passive listening period (Table 7B, Figure 1). Secretive marsh birds during the first survey year were encountered only at 10% of the points before playbacks, but responded to playbacks at 36% of the points (see Table 7A). Common Moorhen was the most widespread and abundant secretive marsh species we observed, recorded at 28% of the points surveyed and accounting for almost 60% of all secretive marsh birds at surveyed sites. Clapper Rail was recorded at 11 of 69 point locations or 16% of the points surveyed and accounted for 30% of secretive marsh birds (Tables 7A, 7B).

During the second year of the callback survey a total of 44 individuals of four secretive marsh bird species were recorded at 20 points (Tables 6 and 7A). Of these 33 responded to callbacks, including 17 Common Moorhens, 12 Clapper Rails, 3 Least Bitterns and 1 Virginia Rail. In addition, 11 individuals of secretive marsh bird species were recorded during the 5-minute passive listening period, including 4 Common Moorhens, 4 Clapper Rails, and 3 Least Bitterns. Secretive marsh birds were encountered only at 12% of the points before playbacks, but responded to playbacks at 25% of the points (see Table 7A). Common Moorhen was again the most widespread and abundant secretive marsh species recorded during the second year of the study, recorded at 13 points (combined passive listening and callbacks) or 19% of the points surveyed, and accounting for almost 50% of all secretive marsh birds at survey sites (Tables 6, 7B). Clapper Rail was the second most abundant species recorded, found at 8 of 69 point locations or 12% of the points surveyed, and accounting for about 35% of recorded secretive marsh birds (Tables 6, 7B, Figure 1). Kearny Freshwater Marsh and Sawmill WMA 1 were the most productive sites. During the surveys, 8 Common Moorhens and 6 Least Bitterns were recorded at Kearny Freshwater Marsh and 10 Clapper Rails and 7 Common Moorhens at Sawmill WMA 1 (Table 6). Of the other sites Resources Metro Marsh held two species (Common Moorhen and Virginia Rail), while Kearny Marsh 2, Lyndhurst Riverside and Riverbend Marsh produced one species each.

The 44 individual secretive marsh birds detected in Year 2 is comparable to the 43 individuals recorded during the first year of the survey (Table 7B, Figure 1). The abundance of the two most common species, Clapper Rail and Common Moorhen did not differ between the two survey periods or between years ($X^2 = 1.23$, $p>0.1$; Figure 1). More Least Bitterns were seen during the

second year of the study, with 6 sightings compared to only one during the first year. Secretive marsh birds were recorded at 27 points during the entire study, almost 40% of the points surveyed. Marsh birds were recorded at 14 survey points through passive listening and responded to callbacks at an additional 13 points. Virginia Rail was only detected responding to callbacks. Common Moorhen was recorded at twice as many points during callbacks than during the passive listening period (Table 7A). Furthermore, only about 30% of secretive marsh birds were detected without playbacks (Table 7B). The fact that additional locations and an increased number of birds were detected through callbacks in our study confirms the importance of this type of methodology to census secretive marsh birds.

Seasonal patterns of avian occurrence in the Meadowlands District

We present some information on seasonal abundance patterns of bird species in the Meadowlands District (Appendix 11, and Figures 2-7). This is not intended as a complete analysis of these patterns for all species seen during the survey. Rather, this brief review can serve as a starting point to produce more specific questions that can be addressed using the dataset collected during the two years of the survey. Since fewer points were visited during the winter surveys (Table 2, Appendix 12), we used the mean number of birds counted to correct for this variable. Average numbers of the most common species recorded throughout the second year of the survey are shown in Figures 2-7. These figures show the total number of birds of each species seen at all points visited during a survey cycle divided by the number of points surveyed during that cycle. In addition, we grouped related species for the graphs, and present them specifically as waterfowl, shorebirds and gulls, passerines, colonial water birds, and raptors. For long-legged colonial waterbirds we present the abundance on information in side-by-side graphs of the two years, as an example of another approach and way of examining the data (Figures 5 and 6).

Waterfowl

Our data suggest two seasonal abundance patterns for waterfowl (Figure 2), a pattern similar in both years of the study. Species like Ruddy Duck and Green-winged Teal are found in great abundance during the winter. Green-winged Teal are not known to breed in the District and consequently they occur in low numbers or not at all during the summer. Ruddy Duck is considered a rare breeder in the District. In contrast, Canada Goose, Mallard and Gadwall all be found year round. These three species are common breeders in the District and Mallards in particular show peaks in numbers during the breeding season. Canada Goose numbers peak in late fall as most migrants have arrived in the District. Their numbers diminish throughout the winter months as open water habitats become less available as freezing conditions set in. The northbound, spring migration of this species in March-April is evident as the mean number of birds observed at this time is lowest.

Colonial Waterbirds and Shorebirds

Seasonal abundance patterns of colonial nesting waterbirds such as Herring, Ring-billed and

Laughing Gulls during the two survey years are shown in Figure 3. Although none of these species breed in the District, they are a prominent part of its avifauna. Laughing Gulls are migrants that breed in NY/NJ Harbor, and are present only during the spring and summer. Herring Gull and Ring-billed Gull, in contrast are present throughout the year and peak in the late fall and winter.

The most abundant shorebirds were Semipalmated Sandpipers, Least Sandpipers and 'peeps', a name given to small sandpipers in the genus *Calidris* that are difficult to identify in the field. In the northeastern U.S, 'peeps' are usually either Semipalmated or Least Sandpipers. The greatest numbers of shorebirds were counted in July and August 2005 and 2006 (Figure 3) as these species migrate south and use the Meadowlands District as a stopover area. These species winter well to the south of the Meadowlands (Southeastern U.S. to South America), so there total absence from the District in winter is expected.

Among long-legged colonial waterbirds, Great Egret and Snowy Egret were most abundant during the post-breeding season (Figure 4). The numbers of these two species peaked from late-July until October during both years of the study. Black-crowned Night -Herons, a state threatened species, are less abundant but their numbers start to go up earlier in the season, as early as April in the first year of the study, and then decrease by mid-September (Figure 5).

Double-crested Cormorants are also present throughout the year, but are seen in greatest numbers in late summer and fall with especially high numbers during the fall 2004 season (Figure 5). This suggests that, like shorebirds, they use the District waterways as a fall migration staging site. Even though cormorant numbers were higher the first year of the survey, overall patterns were similar between the two survey years and the differences are most likely the result of missing a migratory peak during the second survey year.

Diurnal Raptors

The most common diurnal raptors, Red-tailed Hawk and Northern Harrier, exhibited similar patterns of seasonal abundance with number of records increasing during the late fall and winter (Figure 6). Red-tailed Hawks are resident species in New Jersey and their winter populations are increased through an influx of birds that breed further north and winter in this area. Similarly, coastal areas provide good wintering habitat for Northern Harriers. In contrast, for the less frequently seen species observations are spread out throughout the year. This is most likely the result of the rarity of these observations rather that an indication that these species exhibit no clear seasonal distribution patterns.

Passerines

Seasonal patterns among the District's most common passerines vary widely. American Robins and Red-winged Blackbirds breed in the District and are seen throughout the year; with their numbers peaking during fall migration, primarily in mid to late-November (Figure 7). Conversely, Song Sparrows are common breeders and year-round residents in the District, so

their numbers remain relatively constant throughout the year.

Migratory passerines that use the District for breeding activities are also fairly common, but typically vacate the area during the winter months. Three of the most common migratory breeding passerines were the Barn Swallow, Marsh Wren (*Cistothorus palustris*) and Tree Swallow (*Tachycineta bicolor*). These species are, however, migrants and winter primarily in the southern U.S., the Caribbean and Central America. Two of these species, Barn and Tree Swallow, are most commonly encountered during fall migration when large migratory flocks are easily observed. They do however display differing peaks in abundance during fall migration. Barn Swallows peak in early September, with virtually all residents gone by the end of the month. Tree Swallows peak at the end of September and are absent from the District by the middle of October. Contrastingly, the Marsh Wren exhibits no peak during its fall exodus. Seasonal distribution of these species is available in Figure 7. The return of these species in spring is evenly distributed across cycles during migration with no major peaks in numbers. Their numbers tend to remain relatively unchanged throughout the breeding season, as expected for territorial bird species.

Habitat and Bird Diversity Analysis

Species diversity indices are a function of total number of species observed and total number of individuals of each species recorded. Distilling information on species richness and abundance of individuals into an index does not take into consideration the species composition, their overall requirements, or specific habitat needs. Consequently, a diversity index may misrepresent the value of certain sites and habitats. For example, in the Meadowlands many of the birds we recorded, such as shorebirds and ducks, occur in large flocks or in great abundance in appropriate habitats throughout the District during certain times of year. This large concentration of individuals at a site can lower diversity index values, even if species richness is high or the species are vulnerable and their habitats limited. In addition, high diversity of birds in landfills, uplands, and *Phragmites* dominated sites may not imply that these are the best habitats in the District, but it may point out that the existing combination of habitats is attractive to avian species and maintaining this heterogeneity may be most beneficial to a diverse group of birds. Given these limitations, we decided not to calculate diversity indices for the second year of the study, choosing instead to look at number of species and abundance of individuals of each species occurring at different habitats.

As mentioned in the methods section, for our habitat analysis we took a dual approach. Data was collected during the field surveys on what habitat type each bird was recorded, directly providing information on habitat use. Based on this, we investigated species richness at each observed habitat type. Next, using existing NJ land use/land cover data we determined the percentage of each habitat type at each survey point (Appendix 13). We made these calculations to relate the habitat use information associated with each individual bird observation to the existing habitat types in the Meadowlands District. While the NJ land use land cover habitat information is not ground-truthed and habitat distribution may have changed since those maps were developed, they remain the best current source of information available for describing the habitat

distribution across the Meadowlands District. We used the NJ land use land cover data to calculate proportional use of the different habitats by bird species. In addition, we used these data to correlate bird abundance with habitat type and to develop species accumulation curves by habitat.

Species richness by observed habitat

Total number of species seen during the second year of the study was 173, compared to 175 species recorded during the first year. Number of species at each habitat type as coded during the field observations, differed among habitat types (X^2 =100.4, df =19, $p < 0.001$), but did not differ between years (X^2 =0.99, df =19, $p > 0.1$), therefore we combined the observations for both years in the habitat analysis. During the two years of the study, more than 80 species were seen in each of the following habitat types: shrub/scrub, open water, *Phragmites* marsh and high marsh (Figure 8, Table 8). The largest number of species (122) was recorded in shrub/scrub habitat. When corrected for the proportion in which these habitats occur (based on habitat distribution within the 100m radius around each survey point) and expressed as number of species per hectare (Figure 9, Table 8), high marsh habitat supported the most species (12 species per hectare), followed by shrub/scrub (over 6 species per hectare). Forest and low marsh habitats each supported approximately 2.9 species per hectare, while open water and *Phragmites* habitats supported fewer than 2 species per hectare.

Based on this analysis, the high species richness in open water and *Phragmites* is most likely due to the fact that these are the predominant habitats within the District. Scrub/shrub and high marsh habitats, even though not very extensive, are also home to a large number of bird species, and their importance becomes clear when species richness is considered on a species by hectare basis. These habitats, therefore, may be most critical in preserving avian biodiversity in the District and need to be taken into consideration as restoration is being planned.

Habitat use based on GIS habitat mapping

Regression analysis to explore the relationship between habitat and number of species revealed only one case of a significant effect, a weak negative relationship ($p<0.05$) between percentage of *Phragmites* habitat and total number of species. However, the contribution of the R-square of the model was only 0.24, and the contribution of the *Phragmites* habitat variable to the model was only 6%, so we do not think that this is a biologically meaningful effect. None of the other habitat types showed any correlation with number of species recorded.

Regression analysis of the average number of individuals of three wetland species, Red-winged Blackbird, Tree Swallow, and Marsh Wren against percentage of habitat types at each point where these birds were recorded revealed only one significant effect. Percentage of low marsh habitat was significantly correlated with numbers of Marsh Wrens recorded ($p < 0.001$) and explained much of the variation in their abundance (R-square = 0.65, Figure 10). This implies that more individuals of this species are seen at survey points dominated by low marsh vegetation, which typically in the Meadowlands District consists of *Spartina alterniflora*. This

is in agreement with our field observations that this species seems fairly abundant in low *Spartina* marsh and the initiation of breeding may even depend on the seasonal vegetative growth in this habitat (K. Spendiff pers com., N. Tsipoura & J. Yacabucci, pers. obs).

For all three of these species we also found a statistically significant but weak effect of percent open water on abundance. The effect was positive for Tree Swallows, implying that they are attracted to open water habitats, as would be expected for these aerial foragers. The effect was negative for Red-winged Blackbirds and Marsh Wrens, implying that they may be more dependent on the vegetation that the water portion of sites that they use. However, in all cases the R-square of the model was less that 0.15, therefore the contribution of this habitat characteristic in describing abundance was small and likely of minimal biological importance.

Species accumulation curves

Differences in species richness based on observed habitat use (Figures 8 & 9) were not reflected in the regression analysis of number of species against percentage of habitat at each point described above. Therefore, since that type of analysis did not separate sufficiently the contribution of each habitat type to species richness, to further explore these relationships, we used a modeling approach. Specifically, we developed habitat based species accumulation curves. Species accumulation curves are derived by cumulatively adding new species encountered as more survey points are included. To do this, we categorized each survey point by its 'dominant' habitat, the habitat that made up 40% or more at this point, and we determined how many new species were added as points of each specific habitat type were added.

There are some weaknesses in this analysis. First, using only 40% of the habitat to describe a point does not account for habitat heterogeneity or for the effects of the remaining habitat on species diversity at the point. In addition, high marsh habitat is so limited that it dropped out of our analysis altogether, as none of the points consisted of more than 40% of this habitat. However, we believe that species/area curve modeling in combination with other approaches can provide useful insights on species/habitat relationships in the Meadowlands.

Species accumulation curves of wetland and upland species can be seen in Figures 12 and 13. The *Phragmites* habitat accumulation curve was included on both graphs for comparison. In the upland habitats, scrub/shrub and forest accumulation curves are almost indistinguishable with overlapping confidence intervals. The *Phragmites* curve is slightly lower but not significantly different from the upland habitats. This implies that number of species increases with increasing habitat area in a very similar fashion for those three habitats. Similarly, in the wetland habitats, the open water and *Phragmites* habitat accumulation curves are not different from each other and neither are the low marsh and *Phragmites* accumulation curves. However, the low marsh species/area curve is significantly different and lower than the one for open water. Specifically, the low marsh curve levels off much faster than the *Phragmites* curve, and after five survey points are included it differs significantly from the open water curve. Figure 14 shows the scrub/shrub accumulation curve, which is steep and has the highest number of species, and the low marsh one, which is the lower and does not even overlap the other one.

The accumulation curves imply that low marsh habitat supports overall lower avian biodiversity than open water habitats. However, this does not necessarily indicate that low marsh is not a valuable habitat. It may be that species using low marsh habitat occupy a more specialized niche while open water may support a larger diversity of generalist species. Furthermore, *Phragmites* habitat also appears to support a diverse avifauna, with species accumulation curves that are not different from habitat types typically considered more valuable. In addition, even a limited area of scrub/shrub supports more species than low marsh habitat, and as more area is added, more species are also added in scrub/shrub than in low marsh habitats. The fact that upland habitats support higher species diversity is not surprising. Forest and scrub/shrub habitat is limited in the Meadowlands District as well as in the broader urban NY/NJ Harbor area. Any existing patches of this habitat type may act as an attractive oasis for birds in the region.

Results of the species/area curve analysis are consistent with the descriptive statistics obtained on total number of species per hectare, that also point to scrub/shrub habitat as supporting a high level of species diversity in the Meadowlands District. Based on our data this habitat is critical for bird diversity in the Meadowlands District and needs to be considered carefully in restoration plans.

Breeding bird density

We estimated breeding bird density for Red-winged Blackbird, American Robin, Marsh Wren, Song Sparrow, Common Yellowthroat (*Geothlypis trichas*), and Yellow Warbler (*Dendroica petechia*). The breeding density by site for these species, along with confidence intervals, can be seen in Tables 9A and 9B. For Red-winged Blackbird and Song Sparrow, the hazard rate simple polynomial base model had the best fit, for Marsh Wren the uniform cosine model had the best fit, and for American Robin and Common Yellowthroat the hazard rate cosine model had the best fit (Appendix 14). For Yellow Warbler both the hazard rate cosine and simple polynomial models were equal in their fit, and produced the same density estimates. Models including habitat, year, or behavior as covariates did not compete with the best performing base model for any species (Appendix 14) indicating that these factors did not significantly influence bird density.

Red-winged Blackbird occurred and had significantly higher density at sites with sufficient marsh and/or scrub/shrub upland vegetation such as the Empire Tract, Kearny Freshwater Marsh, Resources Metro Marsh, than at sites that are forested or have a higher percentage of open water, such as Teterboro Woods, Mehrhof Pond, the Sawmill Wildlife Management Area and points along the Hackensack River (Table 9A). Marsh Wren, another marsh species, also differed in density among wetland sites. Marsh Wren density was lower at sites typically dominated by *Phragmites*, such as the Empire Tract and Kearny Marsh, and higher at sites such as Resources Metro Marsh and Bellemeade mitigation, which have a higher percentage of low marsh dominated by *Spartina*. However, some sites dominated by *Phragmites*, such as Riverbend Marsh and Lyndhurst Riverside Marsh, also had high concentrations of this species (Table 9B).

Other species, such as American Robin, Common Yellowthroat, and Song Sparrow, had higher density at sites with sufficient forest or scrub/shrub vegetation. For example, American Robin was seen in significantly higher densities at Laurel Hill Upland, Kingsland Landfill, Teterboro Woods East, and Schmidt's Woods compared to densities estimated for Sawmill WMA and Oritani Marsh (Table 9A). Song Sparrow was seen more at landfills and wetlands with sufficient upland vegetation, as compared to Riverbend Marsh, Sawmill WMA and points along the Hackensack River, sites that have more open water and low marsh vegetation (Table 9A). We did not see any differences among sites for Yellow Warbler, most likely because of the low numbers of this species observed throughout the study area.

Red-winged Blackbird was the species with the highest breeding density across the entire survey area (X = 1.192 birds/ha, 95% CI = 1.016-1.398), followed by Marsh Wren (X = 0.971 birds/hectare, 95% CI = 0.631-1.492) and Song Sparrow (X = 0.510 birds/hectare, 95% CI = 0.342-0.760). Marsh Wren breeding density was not different from either Red-winged Blackbird or Song Sparrow, but those two species were different from each other. Yellow Warbler had the lowest breeding density of the species examined (X = 0.065 birds/hectare, 95% CI = 0.044-0.096), significantly different from all other species except for American Robin (X = 0.166 birds/hectare, 95% CI = 0.059-0.468).

Maps of bird distributions

In Appendices 15-25 we provide maps of bird distribution to illustrate other potential ways of presenting the data from our two year survey. Species specific maps allow us at a glance to see what sites are being used extensively by which species. Appendix 15 shows a comparison of Bobolink and Savannah Sparrow observations for both years of the study. In Appendix 16 we illustrate observations of grassland species in the District during the first year and in Appendix 17 the second year of the project. We produced two maps to illustrate temporal distribution and habitat use by raptor species; Appendix 18 shows raptor observations during the breeding season, while Appendix 19 illustrates raptor observations during the non-breeding season.

We also chose to create maps for individual species as a way to show areas favored by those species. This can be important for habitat management purposes as areas slated for habitat alteration can be compared to those sites that support high densities of species of interest. For example, Marsh Wrens (Appendices 20 and 21) were most abundant at Marsh Resources, Bellemeade Mitigation, Sawmill 2 and Riverbend Marsh. Red-winged Blackbirds (Appendices 22 and 23) were observed fairly consistently throughout the Meadowlands District. Tree Swallows (Appendix 24 and 25) tend to be very abundant around Kingsland Impoundment, Mill Creek Marsh and Kearny Freshwater Marsh. These maps are meant to illustrate ways in which the data can be presented and are not intended to provide all possible permutations of graphically presenting the data.

Avian behavior patterns and disturbance

Information on disturbance could not be collected in a systematic manner for this study. While disturbances did take place during the two years of the survey (e.g. landfill capping, mitigation work) they were not predictable and we were not able to collect data around those events in a manner that would allow analysis. However, we believe that the data we collected can be used as a baseline for future work on how management or disturbance in the Meadowlands District is impacting bird populations. At each managed and/or disturbed site we can look at these effects using a before-after-control-impact design (Block et al. 2001). The 2004-2006 surveys can serve as the 'before' conditions, to be followed by surveys at the same sites and using the same methodology to determine the 'after' conditions, allowing us to minimize the effects of site-specific confounding variables. As an example, we include a brief comparison of our results for Harrier Meadow Marsh to those of Seigel et al. (2005) which was undertaken with the purpose of comparing pre- and post-restoration avian communities, with surveys done in 1997, and in 2001, 2002 and 2003. Because of the study design of the Seigel et al. study, rigorous statistical analysis to compare the two studies is not possible, and the comparison we present is mostly qualitative (Appendix 26). However, the point count survey design that we have used incorporates distance sampling and allows for rigorous comparisons with future similarly designed studies.

Behavioral information was collected during the survey and on every single observation. Some of this information was incorporated into the breeding density analysis above. However, this behavioral information is relatively coarse and after discussion with NJMC staff we decided that more detailed behavioral research would be needed to answer the questions of relationships between habitat and behavioral patterns. The intense field schedule required to complete a survey of all points within a 2-3 week cycle throughout the year did not allow us to commit the time to doing additional behavioral work, however, we believe it would be a worthwhile future endeavor.

CONCLUSION

Rigorous surveys have allowed us to collect over 30,000 records of avian species use at 31 sites in the Meadowlands District over a two year period. While we present several ways in which this data set can be approached, the sheer number of observations and the systematic manner in which they were collected make it possible to analyze the data to answer other questions as they arise. The data can be manipulated and subjected to a variety of qualitative and quantitative analyses to address specific management needs. Furthermore, they provide an appropriate baseline for comparisons with bird use after management of sites has taken place.

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Table 1. Total number of species and birds detected per site in the Meadowlands District between August 30, 2004 to September 1, 2005 (Year 1) and September 6, 2005 to September 5, 2006 (Year 2). Table is arranged in alphabetical order by site. New survey sites are in a italics. Number of points in bold indicate change in total number from year 1 to year 2. Current number of points is in parentheses.

Site name	Number of points	Number of species year 1	Number of species year 2	Total number of birds recorded year 1	Total number of birds recorded year 2
1A Landfill	2	54	51	464	653
1D Landfill	2	52	42	500	469
Bellemeade Mitigation	2	31	29	491	297
Eastern Brackish Marsh	4	57	63	2996	2206
Empire Tract	8	73	72	1971	2027
Empire Tract 2	2	N/A	37	N/A	407
Hackensack River	12	74	67	3917	3393
Harrier Marsh	3	72	71	3895	3416
Kearny Freshwater Marsh	10	69	74	2611	2262
Kearny Marsh 1	3	49	47	1899	1926
Kearny Marsh 2	2	49	46	1912	1769
Kingsland Impoundments	3	62	69	2632	2265
Kingsland Landfill	5	65	58	2254	2049
Kingsland Walkway	3	59	55	11077	9310
Laurel Hill Upland	**4 (3)**	62	58	832	880
Losen Slote Forest	2	46	47	292	344
Lyndhurst Riverside	3	38	28	475	223
Mehrhof Pond	2	67	61	10999	14509
Mill Creek Marsh	5	78	70	9978	3569
Oritani Marsh	**6 (5)**	61	64	1068	1236
Resources Metro Marsh	8	71	72	3024	2577
Resources Metro Marsh 2	2	N/A	43	N/A	226
Riverbend Marsh	3	44	39	472	480
Sawmill Landfill 1E	6	69	74	4108	3576
Sawmill WMA 1	8	59	69	5673	5261
Sawmill WMA 2	3	49	56	4415	3608
Schmidt's Woods	1	34	29	191	282
Secaucus H.S. Marsh	2	N/A	39	N/A	555
Teterboro Woods East	3	45	44	392	503
Teterboro Woods West	2	49	51	395	575
Western Brackish Marsh	3	60	52	1328	948
Grand Total	**122**	**175**	**173**	**80261**	**71801**

Table 2. Numbers of species recorded and total number of birds detected during point count bird surveys conducted in the Meadowlands District between August 30, 2004 to September 1, 2005 (Year 1) and September 6, 2005 to September 5, 2006 (Year 2) by point. Table is arranged in alphabetical order by site. Total numbers of counts conducted at each point during the survey are shown, as well as why fewer than 19 counts were conducted at some points. Sites/points in italics were added in Year 2.

		YEAR 1			**YEAR 2**			**BOTH YEARS**			
Site	Point Name	Number of birds	Number of species	Number of counts	Number of birds	Number of species	Number of counts	Number of birds	Number of species	Comment	Callback surveys
1A Landfill	1ALF01	216	34	16	330	31	19	546	46	started late/permit issues	
1A Landfill	1ALF02	248	41	15	323	41	19	571	52	started late/permit issues	
1D Landfill	1DLF01	172	36	19	196	33	19	368	42		
1D Landfill	1DLF02	328	44	19	273	34	19	601	51		
Bellemeade Mitigation	BEMI1A	245	19	13	125	19	11	370	26	no winter access	yes
Bellemeade Mitigation	BEMI2A	246	28	13	172	20	11	418	32	no winter access	yes
Eastern Brackish Marsh	EABM01	140	30	8	221	33	9	361	41	no winter access	yes
Eastern Brackish Marsh	EABM02	727	33	13	495	32	11	1222	45	no winter access	yes
Eastern Brackish Marsh	EABM03	771	30	13	268	36	11	1039	41	no winter access	yes
Eastern Brackish Marsh	EABM04	1358	34	13	1222	33	11	2580	43	no winter access	yes
Empire Tract	EMP02A	235	38	19	243	32	19	478	47		yes
Empire Tract	EMP03A	338	37	19	279	28	19	617	41		
Empire Tract	EMP09A	202	32	19	201	23	19	403	38		yes
Empire Tract	EMP11A	270	31	18	286	30	19	556	43	not located first survey	yes
Empire Tract	EMP14A	191	31	19	209	30	19	400	42		
Empire Tract	EMP15A	313	37	18	227	34	19	540	47	not located first survey	yes
Empire Tract	EMPM06	238	38	18	298	38	19	536	48	not located first survey	yes
Empire Tract	EMPM18	184	29	18	284	28	19	468	40	not located first survey	yes
Empire Tract 2	*EMP201*	N/A	N/A	N/A	174	28	16	174	28	added during year 2	
Empire Tract 2	*EMP202*	N/A	N/A	N/A	233	30	16	233	30	added during year 2	
Hackensack River	RIVR01	816	26	14	470	27	10	1286	36	no winter access	
Hackensack River	RIVR03	416	27	14	338	27	10	754	34	no winter access	
Hackensack River	RIVR06	376	28	14	435	24	10	811	36	no winter access	
Hackensack River	RIVR07	464	25	14	577	29	10	1041	37	no winter access	
Hackensack River	RIVR09	280	28	14	144	20	10	424	33	no winter access	
Hackensack River	RIVR16	448	29	14	476	22	10	924	32	no winter access	
Hackensack River	RIVR18	172	21	14	116	19	10	288	26	no winter access	
Hackensack River	RIVR19	260	24	14	191	22	10	451	33	no winter access	
Hackensack River	RIVR21	240	32	14	227	22	10	467	39	no winter access	
Hackensack River	RIVR23	123	28	14	156	24	10	279	35	no winter access	
Hackensack River	RIVR24	115	19	14	113	23	10	228	26	no winter access	
Hackensack River	RIVR32	207	25	13	150	21	10	357	31	no winter access	

Table 2. Continued

		YEAR 1			YEAR 2			BOTH YEARS			
Site	Point Name	Number of birds	Number of species	Number of counts	Number of birds	Number of species	Number of counts	Number of birds	Number of species	Comment	Callback surveys
Harrier Marsh	HARR01	1564	51	19	1997	51	19	3561	66		yes
Harrier Marsh	HARR02	1489	48	19	606	47	19	2095	64		yes
Harrier Marsh	HARR3A	842	50	19	813	54	19	1655	67		yes
Kearny Freshwater Marsh	KFWM01	316	26	13	145	26	11	461	34	no winter access	yes
Kearny Freshwater Marsh	KFWM03	256	30	13	125	28	11	381	40		yes
Kearny Freshwater Marsh	KFWM04	483	40	13	213	35	11	696	51	no winter access	yes
Kearny Freshwater Marsh	KFWM07	257	32	13	252	30	11	509	44	no winter access	yes
Kearny Freshwater Marsh	KFWM1W	195	12	6	157	18	8	352	22	winter only	
Kearny Freshwater Marsh	KFWM4W	365	18	6	557	21	8	922	26	winter only	
Kearny Freshwater Marsh	KFWM6A	214	30	13	196	28	11	410	38	no winter access	yes
Kearny Freshwater Marsh	KFWM6W	129	20	6	117	17	8	246	23	winter only	
Kearny Freshwater Marsh	KFWM7W	68	22	6	198	26	8	266	32	winter only	
Kearny Freshwater Marsh	KFWM8A	328	35	13	302	32	11	630	47	no winter access	yes
Kearny Marsh 1	KYM11A	530	32	19	588	35	19	1118	46		yes
Kearny Marsh 1	KYM12A	848	34	19	1006	28	19	1854	38		yes
Kearny Marsh 1	KYM13A	521	24	19	332	26	19	853	32		yes
Kearny Marsh 2	KYM21A	1375	34	19	1287	38	19	2662	46		yes
Kearny Marsh 2	KYM23A	537	42	19	482	32	19	1019	46		
Kingsland Impound	KLIM2A	986	47	19	334	41	19	1320	57		yes
Kingsland Impound	KLIM3A	716	43	19	1218	44	19	1934	57		yes
Kingsland Impound	KLIM4A	930	42	19	713	45	19	1643	58		yes
Kingsland Landfill	KILF01	461	48	19	302	38	19	763	58		
Kingsland Landfill	KILF02	561	37	19	376	37	19	937	47		
Kingsland Landfill	KILF04	379	36	19	469	33	19	848	42		
Kingsland Landfill	KILF05	426	28	18	442	27	18	868	36		
Kingsland Landfill	KILF6A	427	38	19	460	33	19	887	46		
Kingsland Walkway	KIWA01	7307	37	19	3733	43	19	11040	51		yes
Kingsland Walkway	KIWA02	1461	39	19	4216	35	19	5677	47		yes
Kingsland Walkway	KIWA03	2309	39	19	1361	30	19	3670	42		yes
Laurel Hill Upland	LHUP01	149	32	15	N/A	N/A	N/A	149	32	6/3/05 deleted/construction	
Laurel Hill Upland	LHUP04	249	32	19	411	37	19	660	45		
Laurel Hill Upland	LHUP05	60	21	5	221	35	19	281	40	6/3/05 replaces LHUP01	
Laurel Hill Upland	LHUP3A	374	46	19	248	41	19	622	56		
Losen Slote Forest	LSCP01	125	31	19	187	35	18	312	47		
Losen Slote Forest	LSCP02	167	34	19	157	33	19	324	43		

Table 2. Continued

		YEAR 1			YEAR 2			BOTH YEARS			
Site	Point Name	Number of birds	Number of species	Number of counts	Number of birds	Number of species	Number of counts	Number of birds	Number of species	Comment	Callback surveys
Lyndhurst Riverside	LYRI1A	73	18	13	78	14	11	151	23	no winter access	yes
Lyndhurst Riverside	LYRI2A	136	23	13	85	20	11	221	32	no winter access	yes
Lyndhurst Riverside	LYRI3A	266	18	13	60	14	11	326	24	no winter access	yes
Mehrhof Pond	MEPO1A	468	45	19	443	38	19	911	53		
Mehrhof Pond	MEPO02	10531	41	19	14066	43	19	24597	49		
Mill Creek Marsh	MCMA02	5124	30	13	490	34	11	5614	41	no winter access	yes
Mill Creek Marsh	MCMA04	915	44	13	259	34	11	1174	52	no winter access	yes
Mill Creek Marsh	MCMA05	1348	38	19	1182	37	19	2530	49		yes
Mill Creek Marsh	MCMA1A	1428	42	19	1022	39	19	2450	51		yes
Mill Creek Marsh	MCMA3A	1127	43	19	616	41	19	1743	57		yes
Oritani Marsh	ORMA02	194	28	19	207	25	19	401	37		yes
Oritani Marsh	ORMA03	196	39	19	284	35	19	480	51		yes
Oritani Marsh	ORMA09	156	31	15	390	34	12	546	43	no winter access	yes
Oritani Marsh	ORMA10	241	29	15	209	28	12	450	39	no winter access	yes
Oritani Marsh	ORMA4A	249	30	18	146	32	19	395	40		yes
Oritani Marsh	ORMA6A	32	10	6	N/A	N/A	N/A	32	9	access denied/security	
Resources Metro Marsh	REM04A	440	37	19	449	41	19	889	53		yes
Resources Metro Marsh	REM05A	605	31	13	738	36	11	1343	47	no winter access	yes
Resources Metro Marsh	REM07A	552	35	19	406	38	19	958	49		yes
Resources Metro Marsh	REMM03	312	29	13	192	29	11	504	38	no winter access	yes
Resources Metro Marsh	REMM06	547	24	13	109	22	11	656	34	no winter access	yes
Resources Metro Marsh	REMM08	298	33	19	307	32	19	605	22		yes
Resources Metro Marsh	REMM09	137	29	13	139	25	11	276	37	no winter access	yes
Resources Metro Marsh	REMM11	133	26	12	237	24	11	370	37	no winter access	yes
Resources Metro Marsh 2	*REM201*	N/A	N/A	N/A	95	22	16	95	32	added during year 2	
Resources Metro Marsh 2	*REM202*	N/A	N/A	N/A	131	37	16	131	42	added during year 2	
Riverbend Marsh	RBMA02	181	25	13	213	27	11	394	34	no winter access	yes
Riverbend Marsh	RBMA04	160	25	13	146	21	11	306	33	no winter access	yes
Riverbend Marsh	RBMA1A	131	25	12	121	20	11	252	33	no winter access	yes
Sawmill Landfill 1E	SMLF02	453	40	19	405	46	19	858	55		
Sawmill Landfill 1E	SMLF08	546	33	19	669	33	19	1215	41		
Sawmill Landfill 1E	SMLF11	534	43	18	526	36	19	1060	51		
Sawmill Landfill 1E	SMLF4A	427	29	19	304	29	19	731	38		
Sawmill Landfill 1E	SMLF6A	1807	33	19	1400	34	19	3207	44		
Sawmill Landfill 1E	SMLF9A	341	31	19	272	35	19	613	43		

		YEAR 1			YEAR 2			BOTH YEARS			
Site	Point Name	Number of birds	Number of species	Number of counts	Number of birds	Number of species	Number of counts	Number of birds	Number of species	Comment	Callback surveys
Sawmill WMA 1	SAW109	270	24	15	274	25	12	544	30	no winter access	yes
Sawmill WMA 1	SAW110	485	32	19	727	27	19	1212	38		yes
Sawmill WMA 1	SAW112	192	29	15	259	27	12	451	36	no winter access	yes
Sawmill WMA 1	SW103A	282	29	15	210	28	12	492	37	no winter access	yes
Sawmill WMA 1	SW106A	1140	31	19	672	27	19	1812	37		yes
Sawmill WMA 1	SW107A	1108	31	15	472	32	12	1580	41	no winter access	yes
Sawmill WMA 1	SW113A	189	29	14	181	24	12	370	38	no winter access	yes
Sawmill WMA 1	SW114A	2007	16	19	2466	31	19	4473	36		yes
Sawmill WMA 2	SAW21A	1167	45	19	1327	38	19	2494	47		yes
Sawmill WMA 2	SAW23A	2131	44	19	884	34	19	3015	46		yes
Sawmill WMA 2	SAW24A	1117	35	19	1397	29	19	2514	41		yes
Secaucus H.S. Marsh	*SEHS01*	N/A	N/A	N/A	320	31	17	320	31	added during year 2	
Secaucus H.S. Marsh	*SEHS02*	N/A	N/A	N/A	235	26	17	235	26	added during year 2	
Schmidt's Woods	SCHM01	191	34	19	282	29	19	473	40		
Teterboro Woods East	TWEA02	114	29	17	173	31	19	287	40	started late/permit issues	
Teterboro Woods East	TWEA1A	182	33	17	136	28	19	318	40	started late/permit issues	
Teterboro Woods East	TWEA4A	96	29	17	194	29	19	290	37	started late/permit issues	
Teterboro Woods West	TWWE4A	206	37	17	242	42	19	448	54	started late/permit issues	
Teterboro Woods West	TWWE6A	189	37	16	333	40	19	522	47	started late/permit issues	
Western Brackish Marsh	WEBM01	846	39	13	613	33	11	1459	45	no winter access	yes
Western Brackish Marsh	WEBM02	295	39	13	196	39	11	491	50	no winter access	yes
Western Brackish Marsh	WEBM03	187	31	13	139	31	11	326	41	no winter access	yes

Table 3. Seasonal occurrence species list for the Meadowlands District, updated with results of point count bird surveys conducted in the Meadowlands District between August 30, 2004 and September 5, 2006. Table is arranged by species in alphabetical order. Species not previously on the exisitng species list but recorded during survey are shown in bold. Species whose nesting status was previously not acknowledged on the checklist but should be considered probable breeders are shown in italics. Species recorded in the second year only are in red, whiule species observed in te District but not recorded during the offcial counts are in blue.

Species	Winter	Spring	Summer	Fall	Breeding
American Bittern				U	
American Coot	U	U		C	
American Crow	C	C	U	C	U
American Golden Plover				R	
American Goldfinch	C	C	C	C	C
American Kestrel		U	U	U	
American Pipit		U			
American Redstart		U			
American Robin	R	C	C	C	C
American Wigeon	U	U			
American Woodcock	U	U			
Bald Eagle	U			U	
Baltimore Oriole		C	C	U	U
Bank Swallow		U		U	
Barn Swallow		C	C	C	C
Belted Kingfisher			U	C	
Black and White Warbler		U	U	U	
Black Duck	C	C	U	C	R
Blackpoll Warbler		U			
Black Skimmer			C		
Black-bellied Plover				U	
Black-billed Cuckoo			U	U	
Black-capped Chickadee	C	C	U	C	U
Black-crowned Night-Heron	U	C	C	C	U
Black-necked Stilt				R	
Black-throated Blue Warbler		U			
Black-throated Green Warbler		U			
Blue Grosbeak			U		U
Blue Jay	C	C	C	C	C
Blue-gray Gnatcatcher		U	U		
Blue-headed Vireo		U			
Blue-winged Teal		U		U	
Blue-winged Warbler		U			
Bobolink		U	U	U	
Boat-tailed Grackle		**U**			
Bonaparte's Gull				U	
Brant		U		U	
Brewster's Warbler		R			
Broad-winged Hawk				U	
Brown Creeper				U	
Brown Thrasher		U	U		U
Brown-headed Cowbird		C	U	C	U
Bufflehead	C	U		C	
Canada Goose	C	C	C	C	C
Canada Warbler			U	U	
Canvasback	C			U	

Table 3. Continued

Species	Winter	Spring	Summer	Fall	Breeding
Carolina Wren	U	C	C	C	C
Caspian Tern			U	U	
Cedar Waxwing		U	U	U	U
Cerulean Warbler				**R**	
Chestnut-sided Warbler			U	U	
Chimney Swift		C	U	C	U
Chipping Sparrow				C	
Clapper Rail		U	U	U	U
Cliff Swallow		R			
Common Goldeneye	U			U	
Common Grackle	U	C	C	C	C
Common Loon		U		U	
Common Merganser	U	C		C	
Common Moorhen		C	C	U	C
Common Raven		R		R	R
Common Tern				U	
Common Yellowthroat		C	C	C	C
Cooper's Hawk	U			U	
Dark-eyed Junco	C			C	
Double-crested Cormorant	U	C	C	C	
Downy Woodpecker	C	C	C	C	C
Dunlin	U	U		U	
Eastern Kingbird		U	C	U	U
Eastern Meadowlark		U			
Eastern Phoebe			U	U	U
Eastern Towhee		U	U	U	U
Eastern Wood Pewee		R	R	R	R
Eurasian Wigeon	R				
European Starling	C	C	C	C	C
Field Sparrow		U		U	
Fish Crow		U	U	U	U
Forster's Tern		U	C		
Fox Sparrow	U			U	
Gadwall	C	C	C	C	C
Glaucous Gull	R				
Golden-crowned Kinglet		R		U	
Grasshopper Sparrow				U	
Gray Catbird		C	C	C	C
Great Black-backed Gull	C	C	C	C	
Great Blue Heron	C	C	C	C	
Great Cormorant	U	U			
Great Crested Flycatcher		U			
Great Egret		C	C	C	
Greater Yellowlegs	R	C	C	C	
Green Heron		U	U	U	U
Green-winged Teal	C	C		C	
Hairy Woodpecker	U	U	U	U	U
Hermit Thrush				U	
Herring Gull	C	C	C	C	
Hooded Merganser	U	C		C	
Horned Lark	C	C			
House Finch	C	C	C	C	C
House Sparrow	C	C	C	C	C

Table 3. Continued

Species	Winter	Spring	Summer	Fall	Breeding
House Wren		U	U		U
Hudsonian Godwit				R	
Indigo Bunting		C	C	U	C
Killdeer	U	C	C	C	C
Laughing Gull			C	C	
Least Bittern		U	U	U	U
Least Flycatcher		U			
Least Sandpiper		C	C	U	
Least Tern		U	U		
Lesser Black-backed Gull	R				
Lesser Scaup				U	
Lesser Yellowlegs		C	C	C	
Lincoln's Sparrow				U	
Louisiana Waterthrush		U	U		
Magnolia Warbler		U			
Mallard	C	C	C	C	C
Mallard x Black Duck Hybrid	R	R		R	
Marsh Wren		C	C	C	C
Merlin	R	R	R		
Mourning Dove	C	C	C	C	C
Mute Swan	U	C	C	C	U
Nashville Warbler				U	
Northern Cardinal	C	C	C	C	C
Northern Flicker	U	C	C	C	C
Northern Goshawk				R	
Northern Harrier	C	C	R	C	R
Northern Mockingbird	C	C	C	C	C
Northern Parula		U			
Northern Pintail	U	U		C	
Northern Rough-winged Swallow		U	U	U	U
Northern Shoveler	U	U		C	
Northern Waterthrush			U		
Orange-crowned Warbler				R	
Orchard Oriole		U	U		U
Osprey		C	U	C	
Ovenbird		U		U	
Palm Warbler		C		C	
Pectoral Sandpiper			U	U	
Peregrine Falcon	R	R	R	R	
Pied Billed Grebe		U		U	R
Pine Siskin				R	
Prairie Warbler				U	
Purple Martin		R			
Red-bellied Woodpecker	C	C	C	C	C
Red-breasted Merganser	U	U		U	
Red-eyed Vireo		U			
Red-shouldered Hawk				R	
Red-tailed Hawk	C	U	U	C	U
Red-throated Loon	R				
Red-winged Blackbird	R	C	C	C	C
Ring-billed Gull	C	C	C	C	
Ring-necked Duck	U	U		U	
Ring-necked Pheasant	C	C	C	C	C

Table 3. Continued

Species	Winter	Spring	Summer	Fall	Breeding
Rock Pigeon	C	C	C	C	C
Rough-legged Hawk	U				
Ruby-crowned Kinglet	R	C		C	
Ruby-throated Hummingbird				U	
Ruddy Duck				C	R
Rusty Blackbird	R	R			
Saltmarsh Sharp-tailed Sparrow			U	U	U
Savannah Sparrow	U	C		C	
Scarlet Tanager		U			
Seaside Sparrow		R			
Semipalmated Plover		U	C	U	
Semipalmated Sandpiper		C	C	U	
Sharp-shinned Hawk	U			U	
Sharp-tailed Sparrow		U			
Short-billed Dowitcher		C	C	C	
Short-eared Owl				U	
Snow Bunting				U	
Snow Goose				U	
Snowy Egret		C	C	C	
Solitary Sandpiper				U	
Song Sparrow	C	C	C	C	C
Spotted Sandpiper		C	C	C	C
Swamp Sparrow	U	C	C	C	C
Tree Sparrow	C			C	
Tree Swallow		C	C	C	C
Tri-colored Heron			U		
Tufted Titmouse	C	C	C	C	C
Turkey Vulture	U	U		U	
Veery		U		U	
Virginia Rail		U	U		U
Warbling Vireo		C	C		C
Western Sandpiper			R	R	
White-breasted Nuthatch	U	U	U	U	U
White-crowned Sparrow				U	
White-rumped Sandpiper			U		
White-throated Sparrow	C	C		C	
Wild Turkey	**U**	**U**	**U**	**U**	
Willow Flycatcher		C	C	U	C
Wilson's Phalarope			R		
Wilson's Snipe		U		U	
Winter Wren	U			U	
Wood Duck	U	C	C	C	U
Wood Thrush		U		U	
Yellow Warbler		C	C	U	C
Yellow-bellied Sapsucker				U	
Yellow-crowned Night-Heron		U	U		U
Yellow-rumped Warbler	U	C		C	

Table 4A. Summary statistics for the 50 species most frequently observed during point count bird surveys conducted in the Meadowlands District between September 6, 2005 and September 5, 2006. Table is arranged in order of frequency of occurrence.

Species	Points observed	Frequency occurrence by point[a]	Sites observed	Frequency occurrence by site[b]	Total number of birds seen[c]	Relative abundance[d]	Maximum seen at point	Maximum total number seen in any one cycle	Total number of birds seen <100m	Relative abundance <100m	Percent birds seen <100 m
Red-winged Blackbird	118	0.97	31	1.00	4611	0.064	250	897	2453	0.09	53.20
Herring Gull	104	0.85	27	0.87	2813	0.039	150	440	697	0.03	24.78
Barn Swallow	102	0.84	26	0.84	951	0.013	40	198	645	0.02	67.82
Mallard	101	0.83	27	0.87	5161	0.072	122	771	1857	0.07	35.98
Song Sparrow	101	0.83	29	0.94	955	0.013	6	101	868	0.03	90.89
Ring-billed Gull	95	0.78	28	0.90	3787	0.053	250	566	1337	0.05	35.30
Canada Goose	89	0.73	24	0.77	4092	0.057	175	675	2139	0.08	52.27
European Starling	86	0.70	27	0.87	2450	0.034	150	339	1443	0.06	58.90
Tree Swallow	79	0.65	26	0.84	547	0.008	50	126	341	0.01	62.34
Great Black-backed Gull	78	0.64	24	0.77	556	0.008	36	70	187	0.01	33.63
American Robin	77	0.63	29	0.94	999	0.014	65	213	655	0.03	65.57
Double-crested Cormorant	73	0.60	23	0.74	1130	0.016	100	253	229	0.01	20.27
Mourning Dove	72	0.59	24	0.77	633	0.009	40	106	386	0.01	60.98
Common Grackle	69	0.57	29	0.94	797	0.011	150	373	317	0.01	39.77
Great Egret	69	0.57	22	0.71	624	0.009	74	167	155	0.01	24.84
Marsh Wren	64	0.52	18	0.58	505	0.007	2	106	465	0.02	92.08
Yellow-rumped Warbler	64	0.52	27	0.87	170	0.002	10	121	169	0.01	99.41
Killdeer	63	0.52	23	0.74	430	0.006	15	63	323	0.01	75.12
Red-tailed Hawk	63	0.52	29	0.94	149	0.002	2	27	44	0.00	29.53
Gadwall	62	0.51	21	0.68	1429	0.020	61	169	476	0.02	33.31
Common Yellowthroat	61	0.50	23	0.74	275	0.004	2	58	216	0.01	78.55
Snowy Egret	61	0.50	17	0.55	569	0.008	87	156	241	0.01	42.36
Swamp Sparrow	61	0.50	25	0.81	351	0.005	2	53	299	0.01	85.19
Green-winged Teal	55	0.45	19	0.61	3667	0.051	250	775	1801	0.07	49.11
Northern Flicker	52	0.43	26	0.84	115	0.002	3	25	77	0.00	66.96
Yellow Warbler	52	0.43	24	0.77	117	0.002	1	35	94	0.00	80.34
Northern Mockingbird	51	0.42	23	0.74	152	0.002	2	21	109	0.00	71.71
American Goldfinch	50	0.41	19	0.61	189	0.003	8	24	183	0.01	96.83
Gray Catbird	50	0.41	20	0.65	190	0.003	3	30	184	0.01	96.84
Willow Flycatcher	48	0.39	21	0.68	96	0.001	1	43	53	0.00	55.21

Table 4A. Continued

Species	Points observed	Frequency occurrence by point[a]	Sites observed	Frequency occurrence by site[b]	Total number of birds seen[c]	Relative abundance[d]	Maximum seen at one point	Maximum total number seen in any one cycle	Total number of birds seen <100m	Relative abundance <100m	Percent birds seen <100 m
Great Blue Heron	46	0.38	17	0.55	109	0.002	4	21	39	0.00	35.78
Black-capped Chickadee	44	0.36	22	0.71	160	0.002	6	24	154	0.01	96.25
Laughing Gull	41	0.34	16	0.52	425	0.006	22	161	116	0.00	27.29
Black-crowned Night-Heron	40	0.33	18	0.58	109	0.002	6	22	69	0.00	63.30
Forster's Tern	39	0.32	15	0.48	209	0.003	26	115	137	0.01	65.55
Northern Cardinal	39	0.32	19	0.61	124	0.002	5	15	84	0.00	67.74
Greater Yellowlegs	38	0.31	15	0.48	480	0.007	75	158	171	0.01	35.63
American Crow	36	0.30	14	0.45	485	0.007	40	118	142	0.01	29.28
Downy Woodpecker	36	0.30	20	0.65	132	0.002	2	13	115	0.00	87.12
Spotted Sandpiper	36	0.30	17	0.55	85	0.001	3	19	78	0.00	91.76
Black Duck	35	0.29	17	0.55	712	0.010	65	101	92	0.00	12.92
Lesser Yellowlegs	34	0.28	16	0.52	160	0.002	18	55	59	0.00	36.88
Ring-necked Pheasant	34	0.28	14	0.45	97	0.001	2	20	62	0.00	63.92
Rock Pigeon	33	0.27	21	0.68	314	0.004	75	89	87	0.00	27.71
Least Sandpiper	32	0.26	15	0.48	1326	0.018	250	728	746	0.03	56.26
Northern Harrier	31	0.25	17	0.55	43	0.001	2	6	14	0.00	32.56
Palm Warbler	29	0.24	20	0.65	58	0.001	8	29	56	0.00	96.55
Tree Sparrow	28	0.23	16	0.52	173	0.002	17	34	173	0.01	100.00
Mute Swan	27	0.22	8	0.26	593	0.008	27	86	193	0.01	32.55
Brown-headed Cowbird	26	0.21	14	0.45	148	0.002	25	25	112	0.00	75.68

[a]Number of points a species was observed/ total number of points surveyed
[b]Number of sites a species was observed/ total number of sites surveyed
[c]Total number of individuals of a given species seen over the study period
[d]Total individuals of a given species/ total individuals of all species

Table 4B. Summary statistics for the 50 species most frequently observed during point count bird surveys conducted in the Meadowlands District between August 30, 2004 to September 1, 2005 (Year 1) and September 6, 2005 to September 5, 2006 (Year 2). Table is arranged in order of frequency of occurrence for Year 2. Species in italics were not in the top 50 in both survey years.

	YEAR 1					YEAR 2				
Species	Points observed	Frequency occurrence by point[a]	Total number of birds seen	Relative abundance[d]	Maximum total number seen in any one cycle	Points observed	Frequency occurrence by point[a]	Total number of birds seen	Relative abundance[d]	Maximum total number seen in any one cycle
Red-winged Blackbird	117	0.99	4094	0.051	663	118	0.97	4611	0.064	726
Herring Gull	104	0.88	3917	0.049	572	104	0.85	2813	0.039	369
Barn Swallow	92	0.78	836	0.010	178	102	0.84	951	0.013	188
Mallard	101	0.86	5318	0.066	571	101	0.83	5161	0.072	445
Song Sparrow	99	0.84	860	0.011	86	101	0.83	955	0.013	69
Ring-billed Gull	98	0.83	4917	0.061	655	95	0.78	3787	0.053	498
Canada Goose	95	0.81	3768	0.047	398	89	0.73	4092	0.057	444
European Starling	96	0.81	3686	0.046	456	86	0.70	2450	0.034	317
Tree Swallow	76	0.64	447	0.006	116	79	0.65	547	0.008	107
Great Black-backed Gull	89	0.75	846	0.011	101	78	0.64	556	0.008	61
American Robin	77	0.65	834	0.010	124	77	0.63	999	0.014	112
Double-crested Cormorant	83	0.70	2930	0.037	1189	73	0.60	528	0.007	200
Mourning Dove	81	0.69	528	0.007	53	72	0.59	633	0.009	84
Common Grackle	58	0.49	458	0.006	145	69	0.57	797	0.011	373
Great Egret	76	0.64	560	0.007	87	69	0.57	624	0.009	124
Marsh Wren	56	0.47	438	0.005	100	64	0.52	505	0.007	50
Yellow-rumped Warbler	50	0.42	149	0.002	65	64	0.52	170	0.002	91
Killdeer	51	0.43	256	0.003	46	63	0.52	430	0.006	43
Red-tailed Hawk	84	0.71	231	0.003	34	63	0.52	149	0.002	23
Gadwall	52	0.44	1024	0.013	170	62	0.51	1429	0.020	120
Common Yellowthroat	66	0.56	247	0.003	51	61	0.50	275	0.004	46
Snowy Egret	56	0.47	556	0.007	124	61	0.50	569	0.008	140
Swamp Sparrow	61	0.52	346	0.004	47	61	0.50	351	0.005	33
Green-winged Teal	61	0.52	6042	0.075	1991	55	0.45	3667	0.051	636
Northern Flicker	40	0.34	106	0.001	15	52	0.43	115	0.002	17
Yellow Warbler	50	0.42	126	0.002	37	52	0.43	117	0.002	31
Northern Mockingbird	43	0.36	109	0.001	14	51	0.42	152	0.002	19
American Goldfinch	64	0.54	288	0.004	34	50	0.41	189	0.003	22
Gray Catbird	46	0.39	189	0.002	29	50	0.41	190	0.003	24
Willow Flycatcher	41	0.35	78	0.001	40	48	0.39	96	0.001	38

Table 4B. Continued

Species	YEAR 1 Points observed	YEAR 1 Frequency occurrence by point[a]	YEAR 1 Total number of birds seen	YEAR 1 Relative abundance[d]	YEAR 1 Maximum total number seen in any one cycle	YEAR 2 Points observed	YEAR 2 Frequency occurrence by point[a]	YEAR 2 Total number of birds seen	YEAR 2 Relative abundance[d]	YEAR 2 Maximum total number seen in any one cycle
Great Blue Heron	47	0.40	128	0.002	15	46	0.38	109	0.002	17
Black-capped Chickadee	N/A	N/A	N/A	N/A	N/A	44	0.36	160	0.002	23
Laughing Gull	42	0.36	1258	0.016	388	41	0.34	425	0.006	86
Black-crowned Night-Heron	30	0.25	100	0.001	19	40	0.33	109	0.002	20
Forster's Tern	N/A	N/A	N/A	N/A	N/A	39	0.32	209	0.003	99
Northern Cardinal	40	0.34	122	0.002	17	39	0.32	124	0.002	14
Greater Yellowlegs	46	0.39	705	0.009	196	38	0.31	480	0.007	153
American Crow	48	0.41	716	0.009	180	36	0.30	485	0.007	90
Downy Woodpecker	30	0.25	112	0.001	11	36	0.30	132	0.002	10
Spotted Sandpiper	42	0.36	73	0.001	21	36	0.30	85	0.001	18
Black Duck	47	0.40	876	0.011	154	35	0.29	712	0.010	80
Lesser Yellowlegs	38	0.32	398	0.005	188	34	0.28	160	0.002	50
Ring-necked Pheasant	31	0.26	105	0.001	20	34	0.28	97	0.001	19
Rock Pigeon	44	0.37	730	0.009	152	33	0.27	314	0.004	86
Least Sandpiper	45	0.38	2031	0.025	1118	32	0.26	1326	0.018	556
Northern Harrier	54	0.46	88	0.001	10	31	0.25	43	0.001	9
Palm Warbler	N/A	N/A	N/A	N/A	N/A	29	0.24	58	0.001	23
Tree Sparrow	N/A	N/A	N/A	N/A	N/A	28	0.23	173	0.002	32
Mute Swan	N/A	N/A	N/A	N/A	N/A	27	0.22	593	0.008	53
Brown-headed Cowbird	N/A	N/A	N/A	N/A	N/A	26	0.21	148	0.002	25

[a]Number of points a species was observed/ total number of points surveyed
[b]Number of sites a species was observed/ total number of sites surveyed
[c]Total number of individuals of a given species seen over the study period
[d]Total individuals of a given species/ total individuals of all species

Table 5A. Summary statistics for endangered, threatened and special concern species observed during point count bird surveys conducted in the Meadowlands District between September 6, 2005 and September 5, 2006. Table is arranged in order of frequency of occurrence by point. E= Endangered, T= Threatened, SC=Special Concern

Species	Points observed	Frequency occurrence by point[a]	Sites observed	Frequency occurrence by site[b]	Total number of birds seen[c]	Maximum seen at one site on the same day	Maximum total number seen in any one survey period
Great Blue Heron (SC)	46	0.38	17	0.55	109	7	21
Northern Harrier (E)	43	0.35	17	0.55	71	3	9
Black-crowned Night-Heron (T)	40	0.33	18	0.58	109	6	22
Spotted Sandpiper (SC)	36	0.30	17	0.55	85	6	19
Black Skimmer (E)	25	0.20	13	0.42	51	4	24
Peregrine Falcon (E)	18	0.15	10	0.32	27	3	7
Osprey (T)	16	0.13	10	0.32	23	2	6
Savannah Sparrow (T)	16	0.13	10	0.32	36	6	14
Sharp-shinned Hawk (SC)	12	0.10	8	0.26	16	3	6
American Kestrel (SC)	11	0.09	8	0.26	15	2	4
Least Tern (E)	10	0.08	6	0.19	26	4	10
Yellow-crowned Night-Heron (T)	9	0.07	6	0.19	10	1	3
Cooper's Hawk (T)	8	0.07	6	0.19	10	2	5
Bobolink (T)	6	0.05	5	0.16	37	25	30
Least Bittern (SC)	6	0.05	2	0.06	7	2	3
Pied-billed Grebe (E)	6	0.05	5	0.16	7	1	2
Horned Lark (SC)	5	0.04	3	0.10	86	34	40
Black-throated Green Warbler (SC)	4	0.03	3	0.10	6	3	4
Caspian Tern (SC)	4	0.03	4	0.13	4	1	1
Northern Parula (SC)	4	0.03	4	0.13	4	1	3
American Woodcock (SC)	3	0.02	3	0.10	3	1	1
Bald Eagle (E)	3	0.02	3	0.10	3	1	2
Winter Wren (SC)	2	0.02	2	0.06	2	1	2
American Bittern (E)	1	0.01	1	0.03	1	1	1
Cliff Swallow (SC)	1	0.01	1	0.03	1	1	1
Common Tern (SC)	1	0.01	1	0.03	1	1	1
Eastern Meadowlark (SC)	1	0.01	1	0.03	1	1	1
Red-shouldered Hawk (E/T)	1	0.01	1	0.03	1	1	1
Short-eared Owl (E)	1	0.01	1	0.03	1	1	1
TOTAL					**753**		

[a]Number of points a species was observed/ total number of points surveyed
[b]Number of sites a species was observed/ total number of sites surveyed
[c]Total number of individuals of a given species seen over the study period

Table 5B. Summary statistics for endangered, threatened and special concern species observed during point count bird surveys conducted in the Meadowlands District between August 30, 2004 to September 1, 2005 (Year 1) and September 6, 2005 to September 5, 2006 (Year 2). Table is arranged in order of frequency of occurrence for Year 2. Species in italics were not recorded in both survey years.

	YEAR 1+YEAR2			YEAR 1			YEAR 2		
Species	Points observed	Frequency occurrence by point[a]	Total number of birds seen[b]	Points observed	Frequency occurrence by point[a]	Total number of birds seen[b]	Points observed	Frequency occurrence by point[a]	Total number of birds seen[b]
Northern Harrier (E)	72	0.59	161	56	0.47	90	43	0.35	71
Great Blue Heron (SC)	65	0.53	237	47	0.40	128	46	0.38	109
Spotted Sandpiper (SC)	56	0.46	158	42	0.36	73	36	0.30	85
Black-crowned Night-Heron (T)	48	0.39	209	30	0.25	100	40	0.33	109
Osprey (T)	39	0.32	68	34	0.29	45	16	0.13	23
Savannah Sparrow (T)	39	0.32	244	31	0.26	208	16	0.13	36
Black Skimmer (E)	37	0.30	86	17	0.14	35	25	0.20	51
Peregrine Falcon (E)	26	0.21	41	13	0.11	14	18	0.15	27
Sharp-shinned Hawk (SC)	23	0.19	30	12	0.10	14	12	0.10	16
Bobolink (T)	21	0.17	455	19	0.16	418	6	0.05	37
American Kestrel (SC)	16	0.13	25	8	0.07	10	11	0.09	15
Cooper's Hawk (T)	13	0.11	17	7	0.06	7	8	0.07	10
Least Tern (E)	12	0.10	32	4	0.03	6	10	0.08	26
Yellow-crowned Night-Heron (T)	11	0.09	13	3	0.03	3	9	0.07	10
Bald Eagle (E)	10	0.08	4	8	0.07	1	3	0.02	3
Caspian Tern (SC)	9	0.07	13	5	0.04	9	4	0.03	4
Least Bittern (SC)	8	0.07	7	N/A	N/A	N/A	6	0.05	7
Pied-billed Grebe (E)	6	0.05	15	6	0.05	8	6	0.05	7
Horned Lark (SC)	5	0.04	86	N/A	N/A	N/A	5	0.04	86
Black-throated Green Warbler (SC)	5	0.04	7	1	0.01	1	4	0.03	6
Northern Parula (SC)	5	0.04	5	1	0.01	1	4	0.03	4
Cliff Swallow (SC)	5	0.04	7	4	0.03	6	1	0.01	1
Winter Wren (SC)	4	0.03	4	2	0.02	2	2	0.02	2
American Woodcock (SC)	3	0.02	4	1	0.01	1	3	0.02	3
American Bittern (E)	3	0.02	3	2	0.02	2	1	0.01	1
Canada Warbler (SC)	2	0.02	4	2	0.02	4	N/A	N/A	N/A
Common Tern (SC)	1	0.01	1	N/A	N/A	N/A	1	0.01	1
Eastern Meadowlark (SC)	1	0.01	1	N/A	N/A	N/A	1	0.01	1
Red-shouldered Hawk (E/T)	1	0.01	1	N/A	N/A	N/A	1	0.01	1
Short-eared Owl (E)	1	0.01	1	N/A	N/A	N/A	1	0.01	1
Broad-winged Hawk (SC)	1	0.01	1	1	0.01	1	N/A	N/A	N/A
Grasshopper Sparrow (T)	1	0.01	1	1	0.01	1	N/A	N/A	N/A
Least Flycatcher (SC)	1	0.01	1	1	0.01	1	N/A	N/A	N/A
Northern Goshawk (E)	1	0.01	1	1	0.01	1	N/A	N/A	N/A
Tri-colored Heron (SC)	1	0.01	1	1	0.01	1	N/A	N/A	N/A
TOTAL			**1944**			**1191**			**753**

[a]Number of points a species was observed/ total number of points surveyed
[b]Number of sites a species was observed/ total number of sites surveyed
[c]Total number of individuals of a given species seen over the study period

Table 6. Points where secretive marsh birds were recorded during callback surveys in the Meadowlands District between May 22, 2006 and July 3, 2006 (Year2). Table is arranged by site in alphabetical order.

		Clapper Rail		**Common Moorhen**		**Least Bittern**		**Virginia Rail**		**Total**	
Site name	Point name	Passive listening	Callback	Passive listening	Callback	Passive listening	Callback	Passive listening	Callback	Passive listening	Callback
Kearny Freshwater Marsh	KFWM01				1	1				1	1
	KFWM03			1		2				3	
	KFWM04				1		1				2
	KFWM07				1		2				3
	KFWM6A			1	2					1	2
Kearny Marsh 2	KYM21A				3						3
Lyndhurst Riverside	LYRI1A		1								1
Resources Metro Marsh	REM04A				1						1
	REM05A				1						1
	REMM06			1	1					1	1
	REMM08								1		1
Riverbend Marsh	RBMA02		2								2
	RBMA04	2								2	
	RBMA1A	1								1	
Sawmill WMA 1	SAW109		2								2
	SAW112		2								2
	SW103A		5		1						6
	SW106A				1						1
	SW113A	1			2					1	2
	SW114A			1	2					1	2
TOTAL		**4**	**12**	**4**	**17**	**3**	**3**	**0**	**1**	**11**	**33**

Table 7A. Summary statistics for secretive marshbirds observed during callback surveys conducted in the Meadowlands District between May 19, 2005 and July 5, 2005 (Year 1), and May 22, 2006 and July 3, 2006 (Year 2). Shown is the number of points where birds were detected through passive listening and through callbacks.

	Year 1				**Year 2**				**Total**			
	Passive listening		**Callbacks**		**Passive listening**		**Callbacks**		**Passive listening**		**Callbacks**	
	Number of points detected	Percent of points detected	Number of points detected	Percent of points detected	Number of points detected	Percent of points detected	Number of points detected	Percent of points detected	Number of points detected	Percent of points detected	Number of points detected	Percent of points detected
Clapper Rail	3	4.35%	8	11.59%	3	4.35%	5	7.25%	6	8.70%	10	14.49%
Common Moorhen	4	5.80%	15	21.74%	4	5.80%	12	17.39%	8	11.59%	17	24.64%
Least Bittern	0	0.00%	1	1.45%	2	2.90%	2	2.90%	2	2.90%	2	2.90%
Virginia Rail	0	0.00%	3	4.35%	0	0.00%	1	1.45%	0	0.00%	3	4.35%
Total	**7**	**10.14%**	**25**	**36.23%**	**8**	**11.59%**	**17**	**24.64%**	**14**	**20.29%**	**25**	**36.23%**

Table 7B. Summary statistics for secretive marshbirds observed during callback surveys conducted in the Meadowlands District District between May 19, 2005 and July 5, 2005 (Year 1), and May 22, 2006 and July 3, 2006 (Year 2). Total number of individuals was derived using the higher of the two counts at each point for each year to avoid double-counting birds. Table is arranged by species in alphabetical order.

	Year 1			**Year 2**		
	Total number of individuals					
	Passive listening	**Callbacks**	**Percent of total # recorded**	**Passive listening**	**Callbacks**	**Percent of total # recorded**
Clapper Rail	3	8	30.56%	4	9	35.14%
Common Moorhen	5	16	58.33%	4	14	48.65%
Least Bittern	0	1	2.78%	2	3	13.51%
Virginia Rail	0	3	8.33%	0	1	2.70%
Total	**8**	**28**		**10**	**27**	

Table 8. Number of species recorded in each habitat type during point count surveys conducted in the Meadowlands District bertween August 30 2004 and September 5, 2006. Table is arranged in

Habitat code	**Number of Species**	**Number of species per hectare**
Scrub/shrub	122	6.79
Open Water	91	0.58
High Marsh	87	11.99
Phragmites	81	1.13
Forest	66	2.98
Low Marsh	65	2.93
Mudflat	49	NA
High Marsh/Open Water	47	NA
ManMade	45	0.56
Low Marsh/Open Water	26	NA

Table 9A. Estimated breeding density in number of individuals per hectare of Red-winged Blackbirds, Song Sparrows, and American Robins recorded at Meadowlands District sites between August 30, 2004 and September 5, 2006. Table is arranged by site in alphabetical order. Density estimates were obtained using DISTANCE, which incorporates detection probabilites. Best fit model was hazard-rate simple polynomial for Red-winged Blackbird and Song Sparrow and hazard rate cosine for American Robin (see Appendix 14). Values in bold were significantly higher than values in red.

	Red-winged Blackbird			**Song Sparrow**			**American Robin**		
Site	**Density**	**Confidence interval**		**Density**	**Confidence interval**		**Density**	**Confidence interval**	
1A Landfill	2.225	*0.502*	*9.864*	0.562	*0.196*	*1.610*	0.196	*0.066*	*0.582*
1D Landfill	0.318	*0.010*	*9.783*	0.281	*0.104*	*0.759*	0.391	*0.132*	*1.164*
Bellemeade Mitigation	1.695	*1.335*	*2.153*	0.211	*0.038*	*1.180*	NA		
Eastern Brackish Marsh	0.768	*0.242*	*2.434*	1.300	*0.864*	*1.956*	0.078	*0.017*	*0.368*
Empire Tract	**1.836**	***1.394***	***2.418***	0.500	*0.263*	*0.950*	0.270	*0.087*	*0.835*
Hackensack River	**0.732**	***0.534***	***1.003***	0.211	*0.091*	*0.486*	0.157	*0.028*	*0.873*
Harrier Marsh	1.872	*0.928*	*3.776*	1.031	*0.568*	*1.871*	0.104	*0.034*	*0.320*
Kearny Freshwater Marsh	**1.695**	***1.403***	***2.048***	0.618	*0.306*	*1.249*	0.104	*0.023*	*0.473*
Kearny Marsh	1.007	*0.694*	*1.461*	0.225	*0.030*	*1.682*	NA		
Kingsland Impound	1.342	*0.478*	*3.765*	0.422	*0.226*	*0.786*	0.052	*0.003*	*0.794*
Kingsland Landfill	1.441	*1.084*	*1.914*	0.815	*0.522*	*1.272*	**0.470**	***0.155***	***1.423***
Kingsland Walkway	0.494	*0.053*	*4.622*	0.515	*0.180*	*1.476*	0.026	*0.002*	*0.397*
Laurel Hill Upland	0.787	*0.241*	*2.570*	0.321	*0.072*	*1.424*	**0.492**	***0.152***	***1.596***
Losen Slote Forest	0.159	*0.005*	*4.891*	NA			0.470	*0.132*	*1.671*
Lyndhurst Riverside	1.518	*0.629*	*3.667*	0.047	*0.002*	*1.372*	0.026	*0.002*	*0.397*
Mehrhof Pond	**0.742**	***0.435***	***1.264***	0.562	*0.260*	*1.215*	0.235	*0.069*	*0.800*
Mill Creek Marsh	1.420	*0.998*	*2.020*	1.687	*1.125*	*2.530*	0.063	*0.013*	*0.297*
Oritani Marsh	1.716	*1.324*	*2.225*	0.445	*0.196*	*1.009*	**0.031**	***0.007***	***0.148***
Resources Metro Marsh	**1.766**	***1.412***	***2.208***	0.500	*0.213*	*1.172*	0.070	*0.017*	*0.289*
Riverbend Marsh	0.918	*0.412*	*2.046*	0.094	*0.017*	*0.518*	NA		
Sawmill Landfill 1E	1.554	*1.032*	*2.340*	1.242	*0.708*	*2.179*	0.209	*0.071*	*0.615*
Sawmill WMA	**0.645**	***0.363***	***1.147***	0.064	*0.020*	*0.205*	**0.026**	***0.007***	***0.100***
Schmidt's Woods	NA			NA			**0.861**	***0.276***	***2.689***
Secaucus H.S. Marsh	2.119	*1.344*	*3.340*	NA			0.078	*0.013*	*0.474*
Teterboro Woods East	NA			NA			**0.574**	***0.207***	***1.592***
Teterboro Woods West	**0.577**	***0.322***	***1.056***	0.914	*0.474*	*1.763*	0.391	*0.141*	*1.083*
Western Brackish Marsh	1.201	*0.695*	*2.073*	0.843	*0.540*	*1.316*	0.052	*0.012*	*0.231*
TOTAL	**1.192**	*1.016*	*1.398*	**0.510**	*0.342*	*0.760*	**0.166**	*0.059*	*0.468*

Table 9B. Estimated breeding density in number of individuals per hectare of Marsh Wrens, Common Yellowthroats and Yellow Warblers recorded at Meadowlands District sites between August 30, 2004 and September 5, 2006. Table is arranged by site in alphabetical order. Density estimates were obtained using DISTANCE, which incorporates detection probabilites. Best fit was uniform cosine model for Marsh Wren, hazard rate cosine for Common Yellowthroat and hazard rate cosine and simple polynomial for Yellow Warbler (see Appendix 14). Values in bold were significantly higher than values in red.

	Marsh Wren			**Common Yellowthroat**			**Yellow Warbler**		
Site	**Density**	**Confidence interval**		**Density**	**Confidence interval**		**Density**	**Confidence interval**	
1A Landfill	NA			0.429	*0.173*	*1.066*	0.068	*0.013*	*0.364*
1D Landfill	NA			0.429	*0.173*	*1.066*	0.181	*0.080*	*0.411*
Bellemeade Mitigation	**3.825**	***2.584***	***5.663***	NA			0.068	*0.013*	*0.364*
Eastern Brackish Marsh	0.103	*0.008*	*1.379*	NA			0.190	*0.063*	*0.577*
Empire Tract	**0.165**	***0.050***	***0.548***	**0.885**	***0.352***	***2.222***	0.106	*0.042*	*0.268*
Hackensack River	1.147	*0.581*	*2.261*	**0.072**	***0.016***	***0.318***	0.034	*0.011*	*0.103*
Harrier Marsh	0.620	*0.057*	*6.722*	0.286	*0.066*	*1.245*	0.045	*0.008*	*0.243*
Kearny Freshwater Marsh	1.723	*0.997*	*2.979*	NA			NA		
Kearny Marsh	**0.165**	***0.028***	***0.979***	NA			0.027	*0.005*	*0.146*
Kingsland Impound	0.207	*0.026*	*1.621*	0.143	*0.024*	*0.847*	0.136	*0.045*	*0.410*
Kingsland Landfill	NA			0.697	*0.221*	*2.202*	0.091	*0.041*	*0.200*
Kingsland Walkway	0.207	*0.007*	*6.343*	0.143	*0.024*	*0.847*	NA		
Laurel Hill Upland	NA			0.245	*0.056*	*1.068*	0.121	*0.073*	*0.200*
Losen Slote Forest	NA			0.215	*0.036*	*1.270*	0.068	*0.013*	*0.364*
Lyndhurst Riverside	**2.206**	***1.498***	***3.247***	NA			0.045	*0.008*	*0.243*
Mehrhof Pond	NA			0.429	*0.098*	*1.869*	0.204	*0.068*	*0.615*
Mill Creek Marsh	0.414	*0.082*	*2.084*	NA			0.091	*0.027*	*0.302*
Oritani Marsh	0.662	*0.242*	*1.811*	0.524	*0.200*	*1.376*	0.091	*0.027*	*0.302*
Resources Metro Marsh	**3.515**	***2.244***	***5.507***	0.585	*0.205*	*1.671*	0.043	*0.015*	*0.125*
Riverbend Marsh	**3.722**	***2.413***	***5.740***	0.172	*0.029*	*1.016*	NA		
Sawmill Landfill 1E	NA			0.620	*0.243*	*1.578*	0.045	*0.010*	*0.199*
Sawmill WMA	1.635	*0.744*	*3.593*	NA			NA		
Secaucus H.S. Marsh	0.402	*0.114*	*1.424*	NA			NA		
Teterboro Woods East	NA			NA			0.045	*0.008*	*0.243*
Teterboro Woods West	NA			0.429	*0.173*	*1.066*	0.136	*0.100*	*0.184*
Western Brackish Marsh	1.999	*1.086*	*3.680*	0.286	*0.066*	*1.245*	0.102	*0.039*	*0.264*
TOTAL	**0.971**	*0.631*	*1.492*	**0.327**	*0.130*	*0.822*	**0.065**	*0.044*	*0.096*

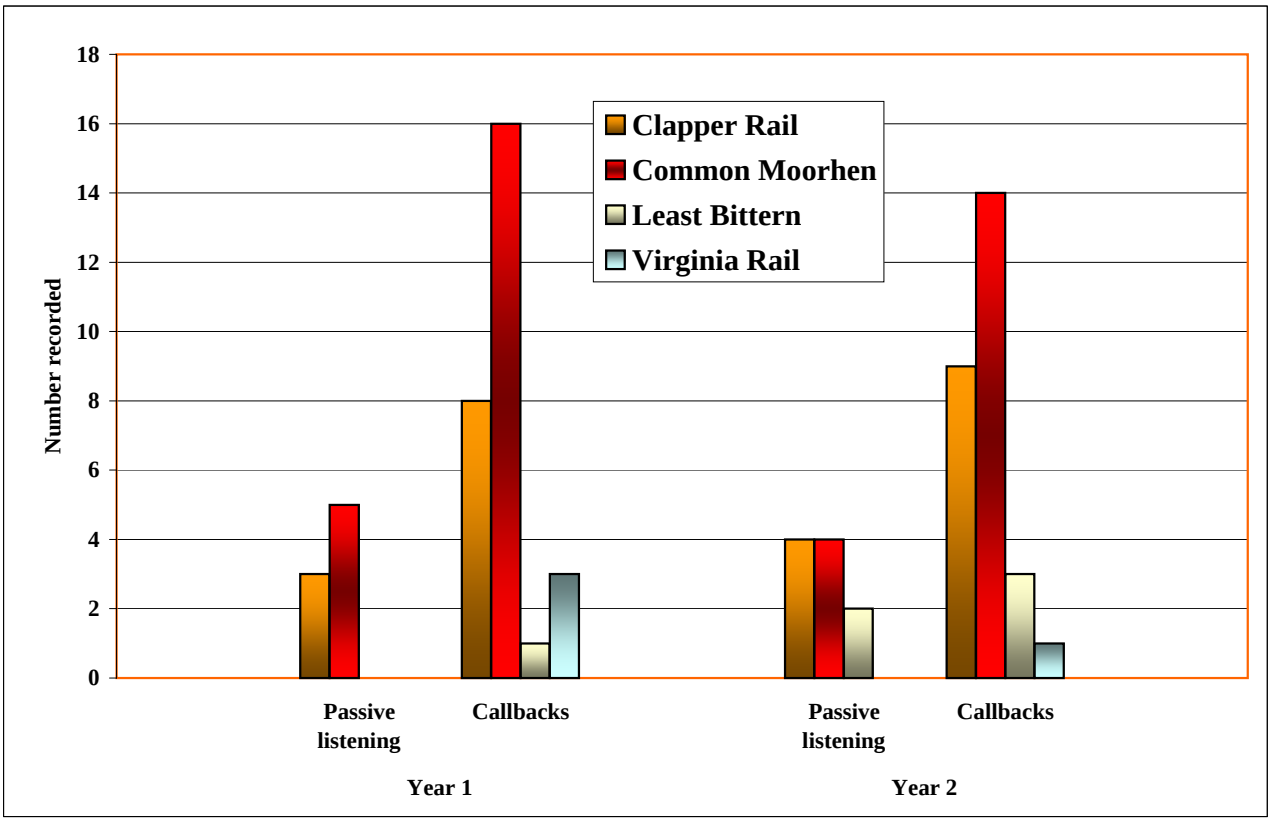


Figure 1. Yearly comparison of total numbers of marsh birds recorded during playbacks. There were no significant differences between years. Shown is the maximum number of birds seen at one time at each point.

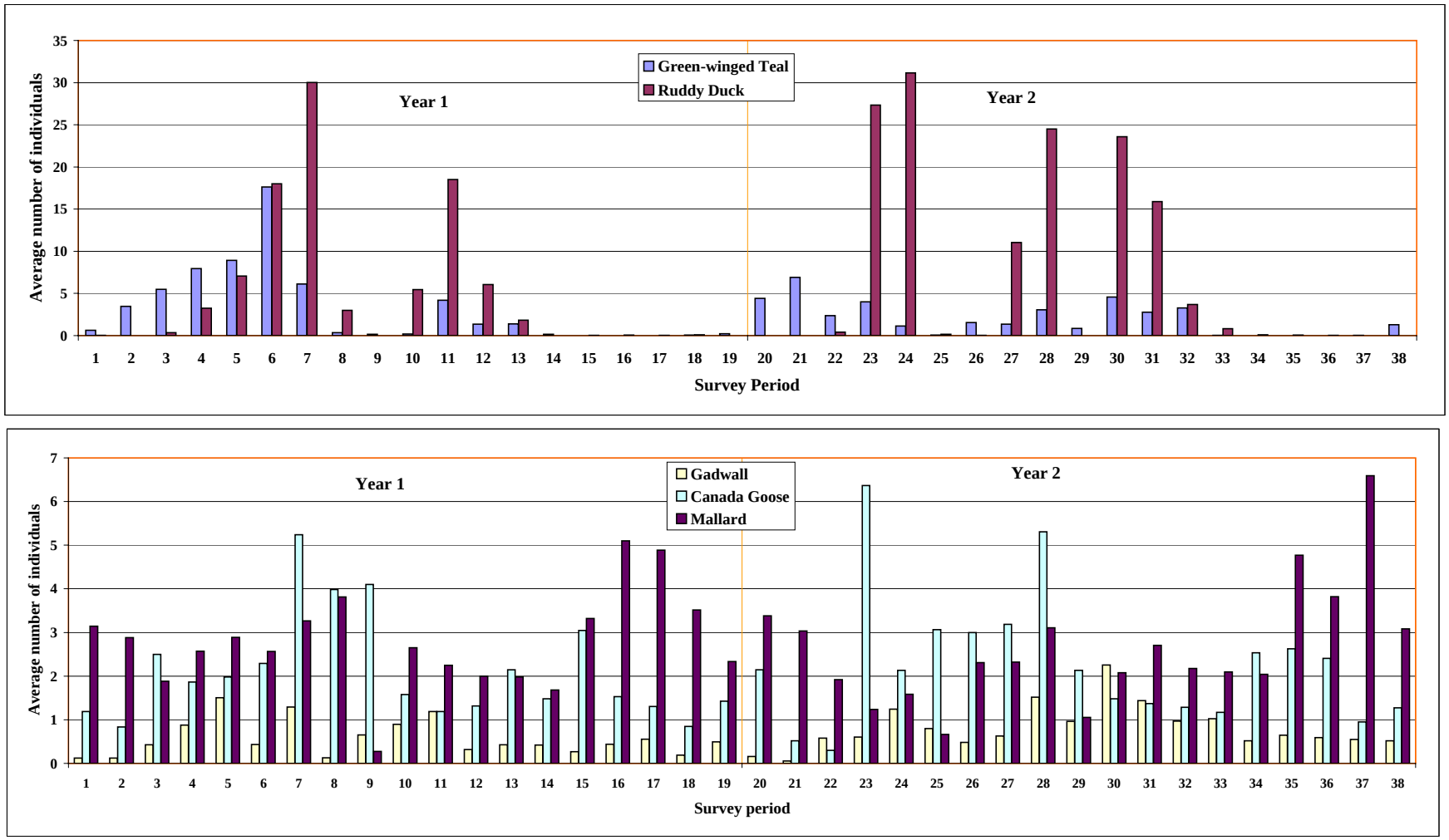
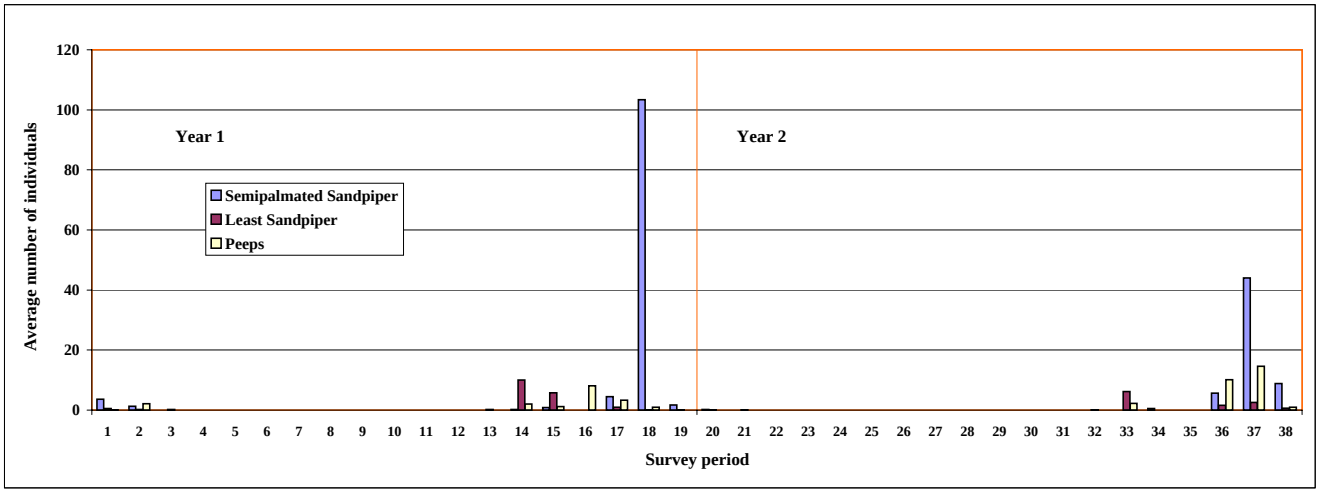


Figure 2. Seasonal distribution of three waterfowl species that breed and two migratory waterfowl species in the Meadowlands District . Average number of individuals is the total number seen during the survey cycle divided by the total number of points surveyed during that cycle. Data are shown for the 38 survey cycles conducted approximately two weeks apart between August 30, 2005 and September 5, 2006.

	Year 1						Year 2				
Cycle	Date	Cycle	Date	Cycle	Date	Cycle	Date				
1	8/30/2004-9/14/2004	8	12/29/2004-1/19/2005	14	5/4/2005-5/19/2005	20	9/6/2005-9/20/2005	27	1/12/2006-1/30/2006	33	5/1/2006-5/22/2006
2	9/15/2004-9/29/2004	9	1/22/2005-2/8/2005	15	5/19/2005-6/10/2005	21	9/21/2005-10/10/2005	28	2/1/2006-2/16/2006	34	5/22/2006-6/13/2006
3	9/29/2004-10/13/2004	10	2/9/2005-3/2/2005	16	6/13/2005-7/5/2005	22	10/11/200511/1/2005	29	2/19/2006-3/9/2006	35	6/13/2006-7/3/2006
4	10/18/2004-10/28/2004	11	3/14/2005-3/29/2005	17	7/7/2005-7/29/2005	23	11/3/2005-11/16/2005	30	3/13/2006-3/29/2006	36	7/5/2006-7/24/2006
5	11/1/2004-11/16/2004	12	3/30/2005-4/14/2005	18	8/1/2005-8/12/2005	24	11/17/2005-12/2/2005	31	3/30/2006-4/14/2006	37	7/24/2006-8/10/2006
6	11/17/2004-12/3/2004	13	4/18/2005-5/3/2005	19	8/15/2005-9/1/2005	25	12/5/2005-12/21/2005	32	4/14/2006-5/1/2006	38	8/13/2006-9/5/2006
7	12/6/2004-12/28/2004					26	12/22/2005-1/9/2006				



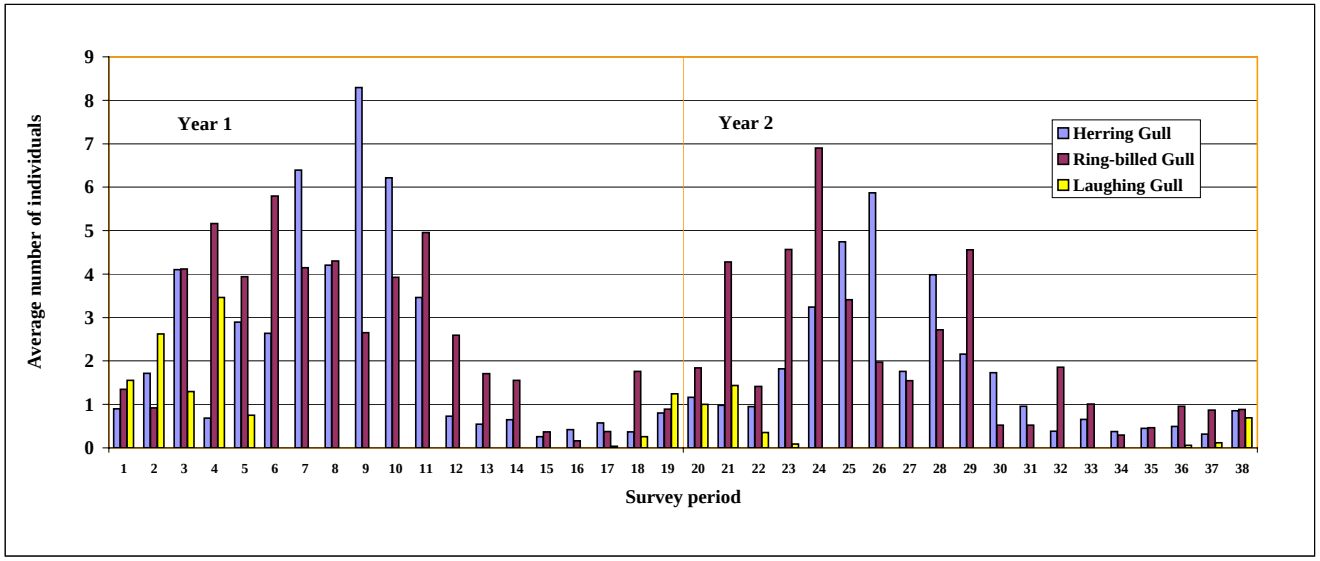
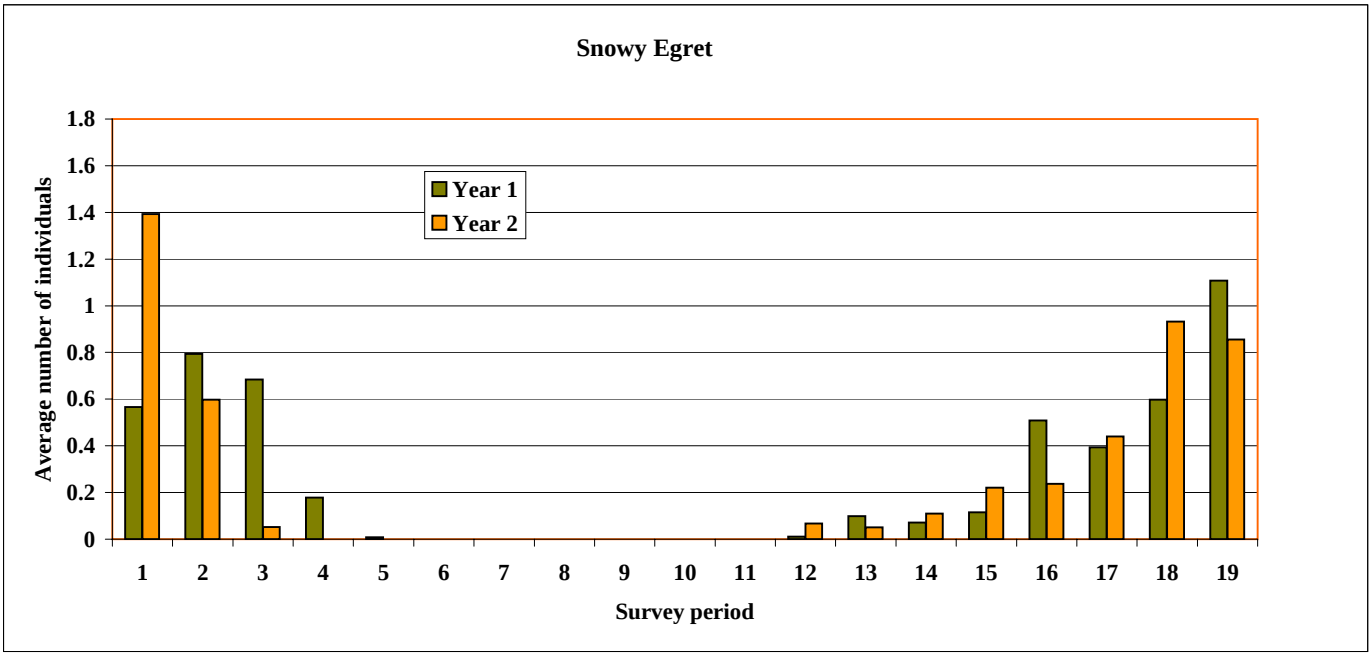


Figure 3. Seasonal distribution of two migratory shorebird species and three gull species recorded in the Meadowlands District. Average number of individuals is the total number seen during the survey cycle divided by the total number of points surveyed during that cycle. Data are shown for the 38 survey cycles conducted approximately two weeks apart between August 30, 2004 and September 5, 2006.

Year 1					
Cycle	Date	Cycle	Date	Cycle	Date
1	8/30/2004-9/14/2004	8	12/29/2004-1/19/2005	14	5/4/2005-5/19/2005
2	9/15/2004-9/29/2004	9	1/22/2005-2/8/2005	15	5/19/2005-6/10/2005
3	9/29/2004-10/13/2004	10	2/9/2005-3/2/2005	16	6/13/2005-7/5/2005
4	10/18/2004-10/28/2004	11	3/14/2005-3/29/2005	17	7/7/2005-7/29/2005
5	11/1/2004-11/16/2004	12	3/30/2005-4/14/2005	18	8/1/2005-8/12/2005
6	11/17/2004-12/3/2004	13	4/18/2005-5/3/2005	19	8/15/2005-9/1/2005
7	12/6/2004-12/28/2004				

Year 2					
Cycle	Date				
20	9/6/2005-9/20/2005	27	1/12/2006-1/30/2006	33	5/1/2006-5/22/2006
21	9/21/2005-10/10/2005	28	2/1/2006-2/16/2006	34	5/22/2006-6/13/2006
22	10/11/200511/1/2005	29	2/19/2006-3/9/2006	35	6/13/2006-7/3/2006
23	11/3/2005-11/16/2005	30	3/13/2006-3/29/2006	36	7/5/2006-7/24/2006
24	11/17/2005-12/2/2005	31	3/30/2006-4/14/2006	37	7/24/2006-8/10/2006
25	12/5/2005-12/21/2005	32	4/14/2006-5/1/2006	38	8/13/2006-9/5/2006
26	12/22/2005-1/9/2006				



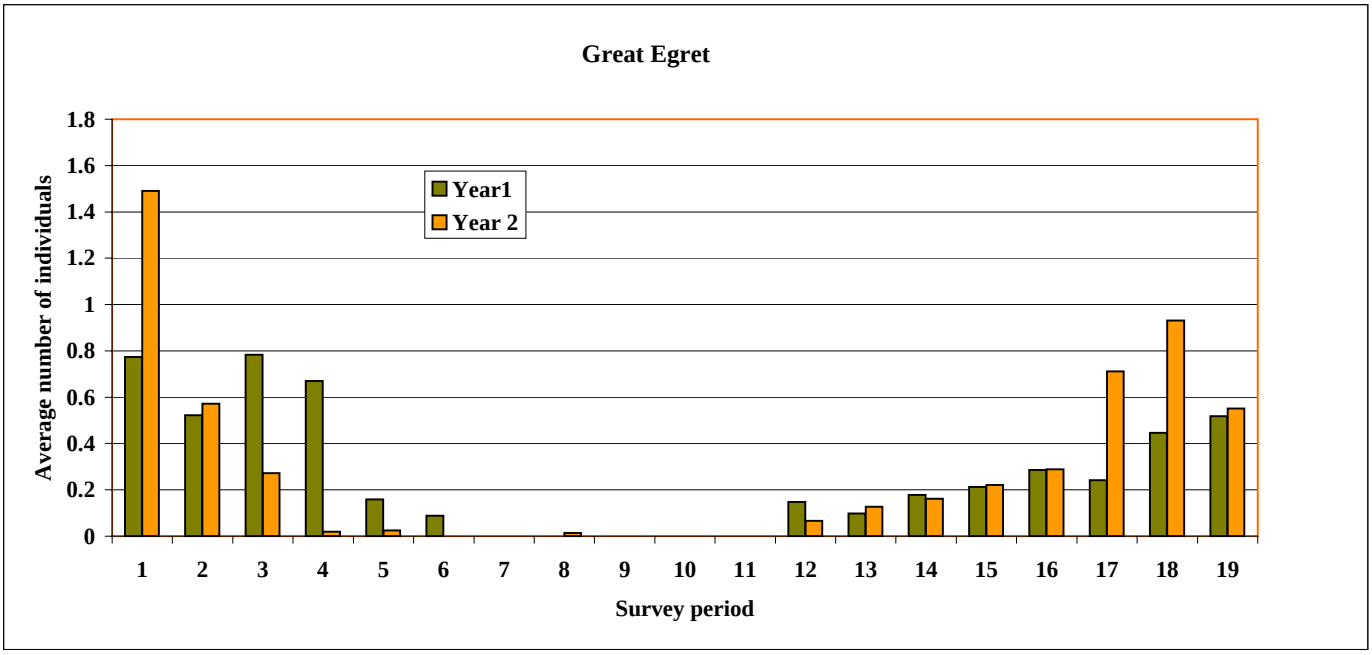
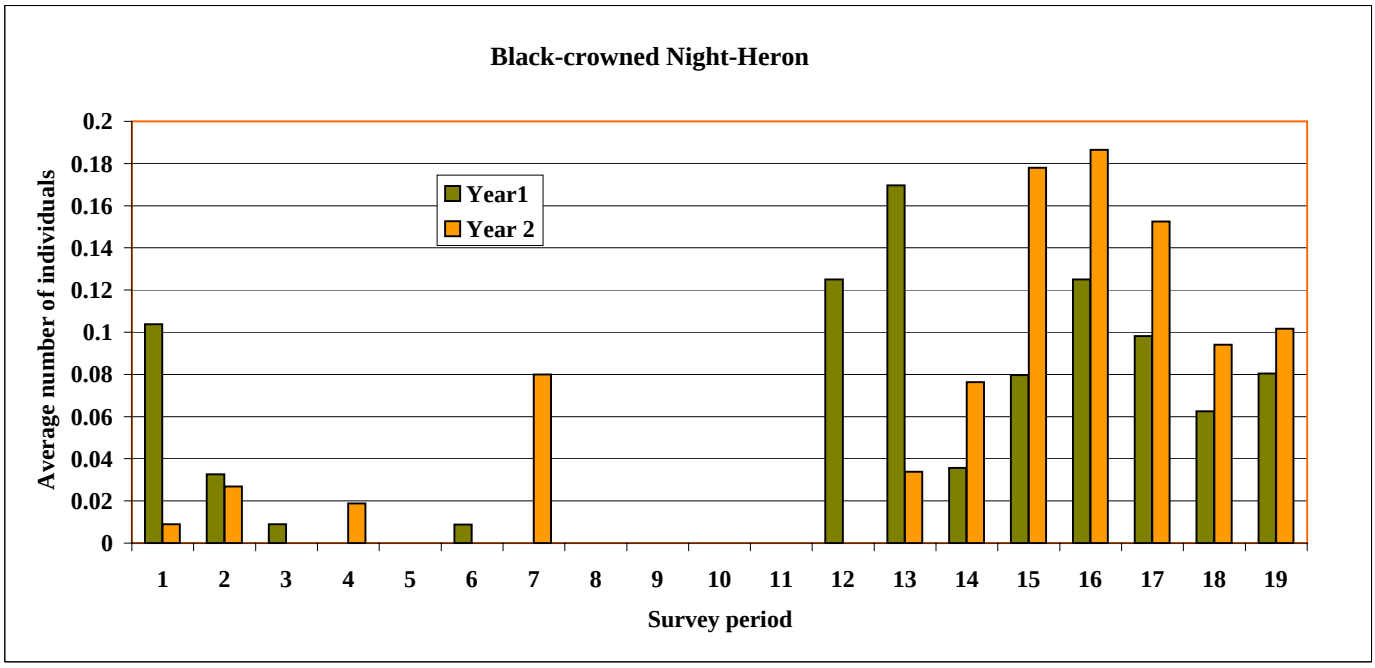


Figure 4. Seasonal distribution and interannual comparison of two long-legged colonial waterbirds recorded in the Meadowlands District. Data are shown for the 38 survey cycles, 19 each year conducted approximately two weeks apart between August, 2004 and September 5, 2006. There were no significant differences between the two years.

Year 1				Year 2			
Cycle	Date	Cycle	Date	Cycle	Date		
1	8/30/2004-9/14/2004	11	3/14/2005-3/29/2005	1	9/6/2005-9/20/2005	11	3/13/2006-3/29/2006
2	9/15/2004-9/29/2004	12	3/30/2005-4/14/2005	2	9/21/2005-10/10/2005	12	3/30/2006-4/14/2006
3	9/29/2004-10/13/2004	13	4/18/2005-5/3/2005	3	10/11/200511/1/2005	13	4/14/2006-5/1/2006
4	10/18/2004-10/28/2004	14	5/4/2005-5/19/2005	4	11/3/2005-11/16/2005	14	5/1/2006-5/22/2006
5	11/1/2004-11/16/2004	15	5/19/2005-6/10/2005	5	11/17/2005-12/2/2005	15	5/22/2006-6/13/2006
6	11/17/2004-12/3/2004	16	6/13/2005-7/5/2005	6	12/5/2005-12/21/2005	16	6/13/2006-7/3/2006
7	12/6/2004-12/28/2004	17	7/7/2005-7/29/2005	7	12/22/2005-1/9/2006	17	7/5/2006-7/24/2006
8	12/29/2004-1/19/2005	18	8/1/2005-8/12/2005	8	1/12/2006-1/30/2006	18	7/24/2006-8/10/2006
9	1/22/2005-2/8/2005	19	8/15/2005-9/1/2005	9	2/1/2006-2/16/2006	19	8/13/2006-9/5/2006
10	2/9/2005-3/2/2005			10	2/19/2006-3/9/2006		



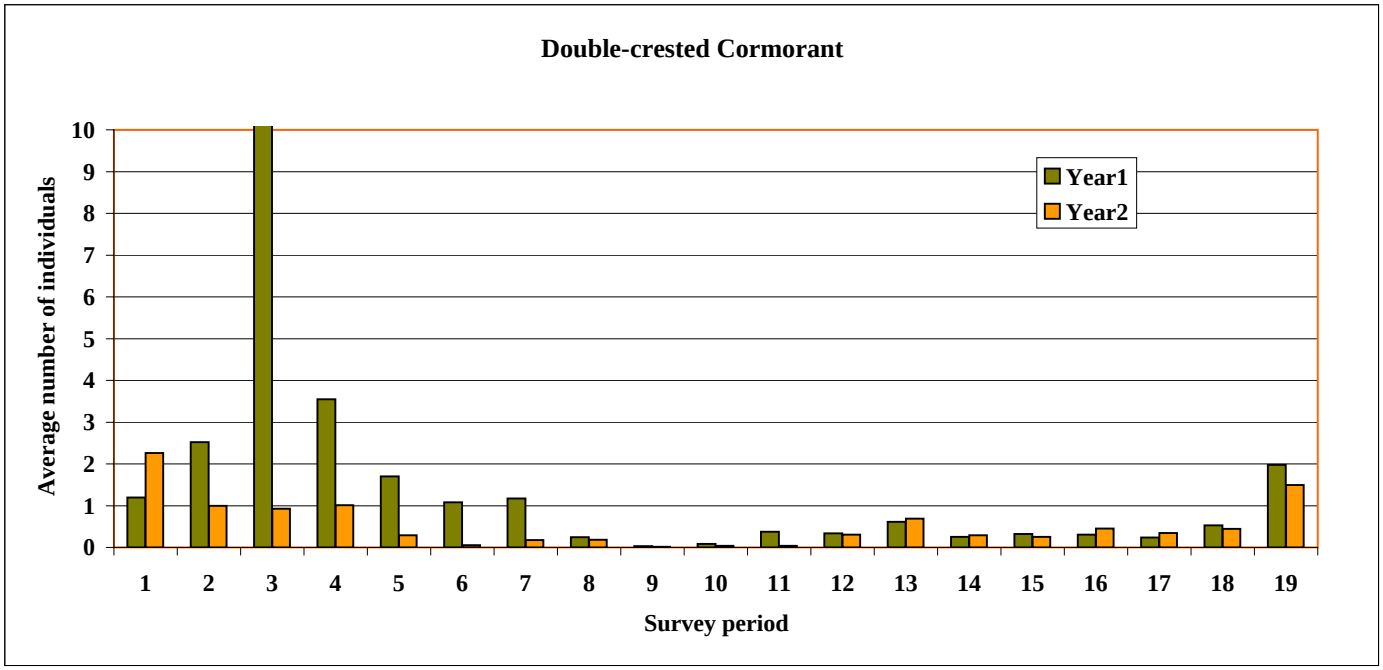
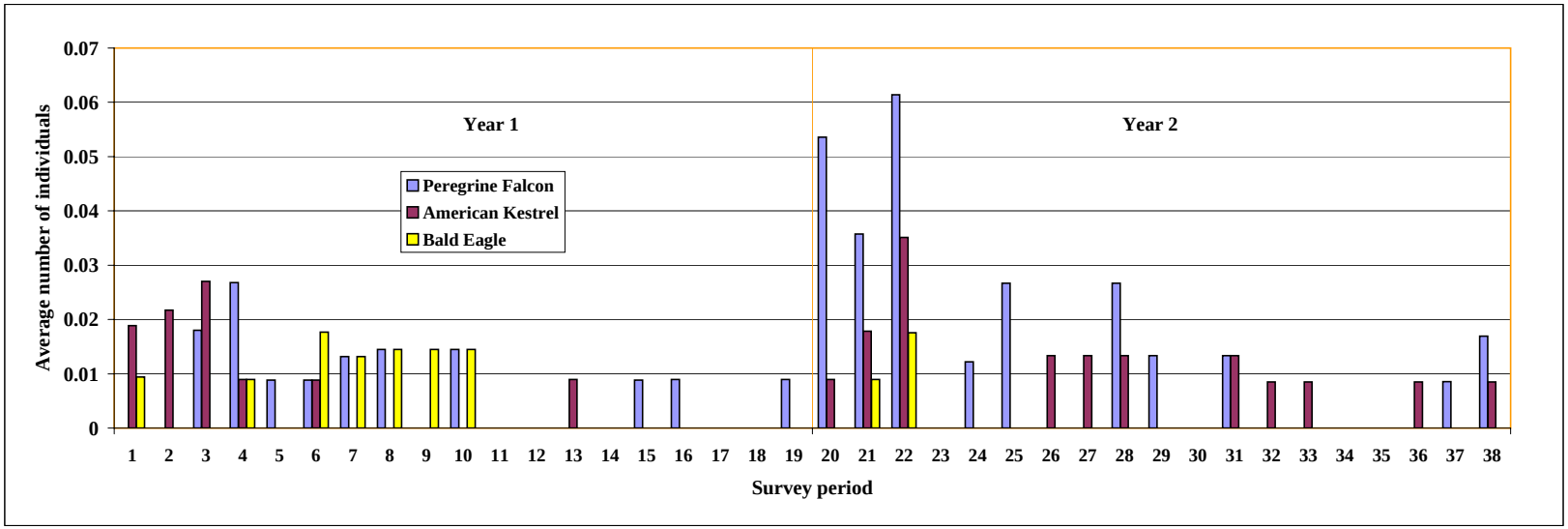


Figure 5. Seasonal distribution and interannual comparison of two colonial waterbirds recorded in the Meadowlands District. Data are shown for the 38 survey cycles, 19 each year conducted approximately two weeks apart between August, 2004 and September 5, 2006.

Year 1				Year 2			
Cycle	Date	Cycle	Date	Cycle	Date		
1	8/30/2004-9/14/2004	11	3/14/2005-3/29/2005	1	9/6/2005-9/20/2005	11	3/13/2006-3/29/2006
2	9/15/2004-9/29/2004	12	3/30/2005-4/14/2005	2	9/21/2005-10/10/2005	12	3/30/2006-4/14/2006
3	9/29/2004-10/13/2004	13	4/18/2005-5/3/2005	3	10/11/200511/1/2005	13	4/14/2006-5/1/2006
4	10/18/2004-10/28/2004	14	5/4/2005-5/19/2005	4	11/3/2005-11/16/2005	14	5/1/2006-5/22/2006
5	11/1/2004-11/16/2004	15	5/19/2005-6/10/2005	5	11/17/2005-12/2/2005	15	5/22/2006-6/13/2006
6	11/17/2004-12/3/2004	16	6/13/2005-7/5/2005	6	12/5/2005-12/21/2005	16	6/13/2006-7/3/2006
7	12/6/2004-12/28/2004	17	7/7/2005-7/29/2005	7	12/22/2005-1/9/2006	17	7/5/2006-7/24/2006
8	12/29/2004-1/19/2005	18	8/1/2005-8/12/2005	8	1/12/2006-1/30/2006	18	7/24/2006-8/10/2006
9	1/22/2005-2/8/2005	19	8/15/2005-9/1/2005	9	2/1/2006-2/16/2006	19	8/13/2006-9/5/2006
10	2/9/2005-3/2/2005			10	2/19/2006-3/9/2006		



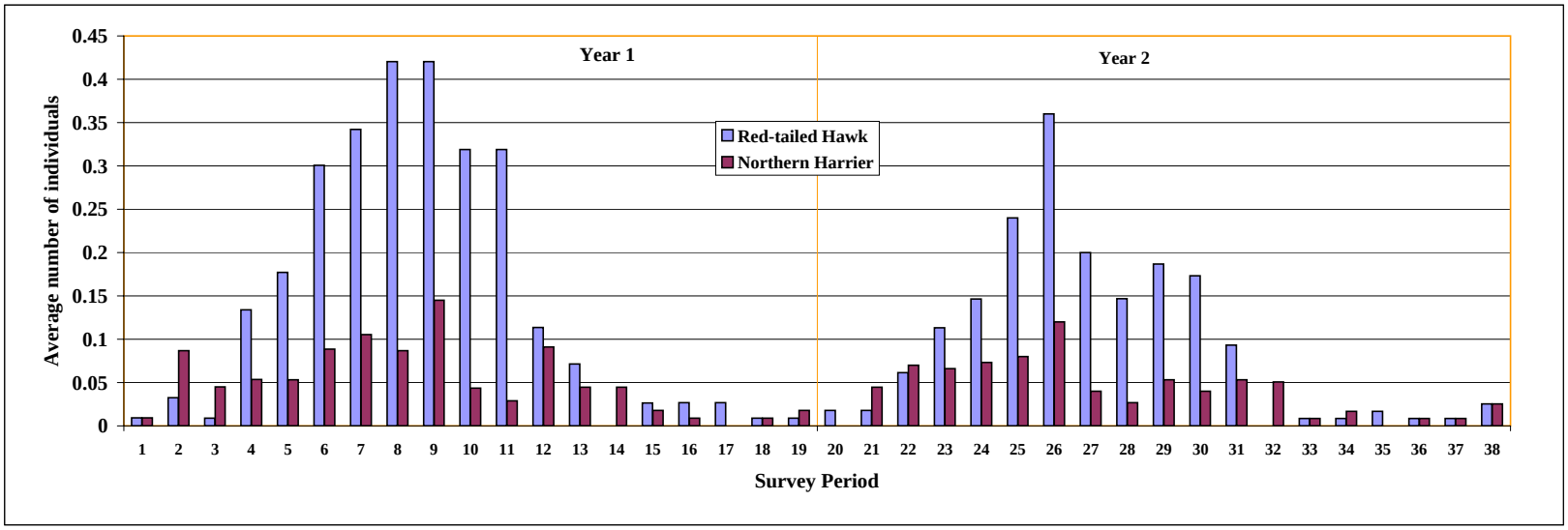


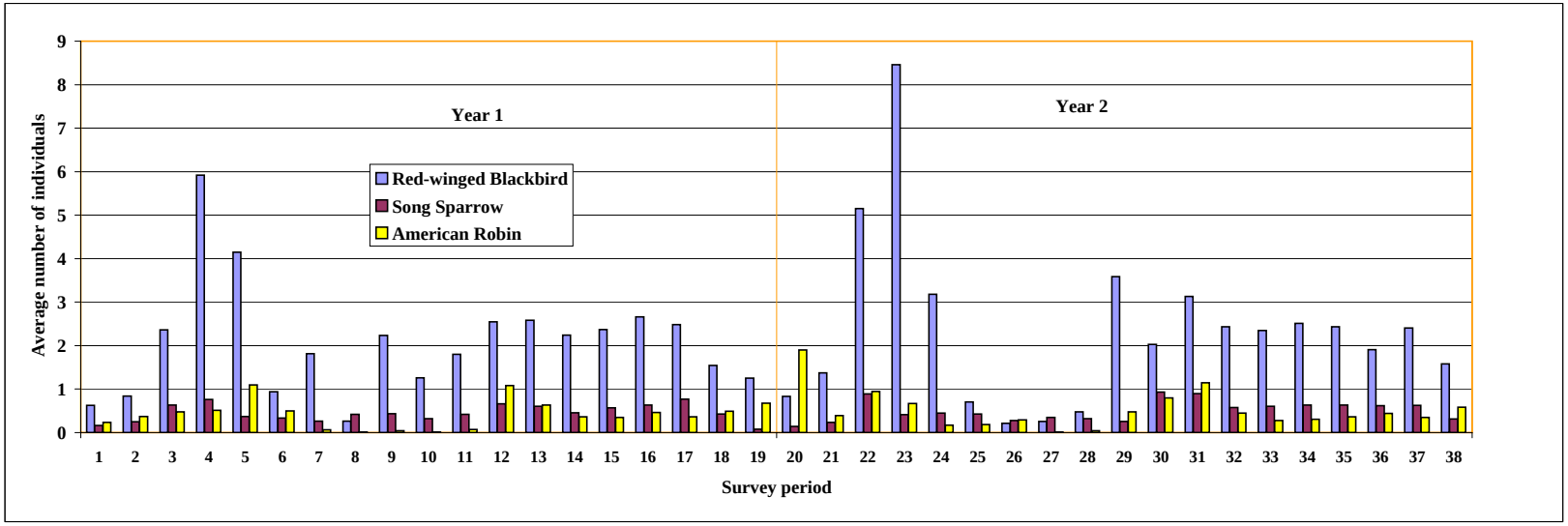
Figure 6. Seasonal distribution of five raptor species recorded in the Meadowlands District. Data are shown for the 38 survey cycles, 19 each year, conducted approximately two weeks apart between August, 2004 and September 5, 2006.

Year 1

Cycle	Date	Cycle	Date	Cycle	Date
1	8/30/2004-9/14/2004	8	12/29/2004-1/19/2005	14	5/4/2005-5/19/2005
2	9/15/2004-9/29/2004	9	1/22/2005-2/8/2005	15	5/19/2005-6/10/2005
3	9/29/2004-10/13/2004	10	2/9/2005-3/2/2005	16	6/13/2005-7/5/2005
4	10/18/2004-10/28/2004	11	3/14/2005-3/29/2005	17	7/7/2005-7/29/2005
5	11/1/2004-11/16/2004	12	3/30/2005-4/14/2005	18	8/1/2005-8/12/2005
6	11/17/2004-12/3/2004	13	4/18/2005-5/3/2005	19	8/15/2005-9/1/2005
7	12/6/2004-12/28/2004				

Year 2

Cycle	Date				
20	9/6/2005-9/20/2005	27	1/12/2006-1/30/2006	33	5/1/2006-5/22/2006
21	9/21/2005-10/10/2005	28	2/1/2006-2/16/2006	34	5/22/2006-6/13/2006
22	10/11/200511/1/2005	29	2/19/2006-3/9/2006	35	6/13/2006-7/3/2006
23	11/3/2005-11/16/2005	30	3/13/2006-3/29/2006	36	7/5/2006-7/24/2006
24	11/17/2005-12/2/2005	31	3/30/2006-4/14/2006	37	7/24/2006-8/10/2006
25	12/5/2005-12/21/2005	32	4/14/2006-5/1/2006	38	8/13/2006-9/5/2006
26	12/22/2005-1/9/2006				



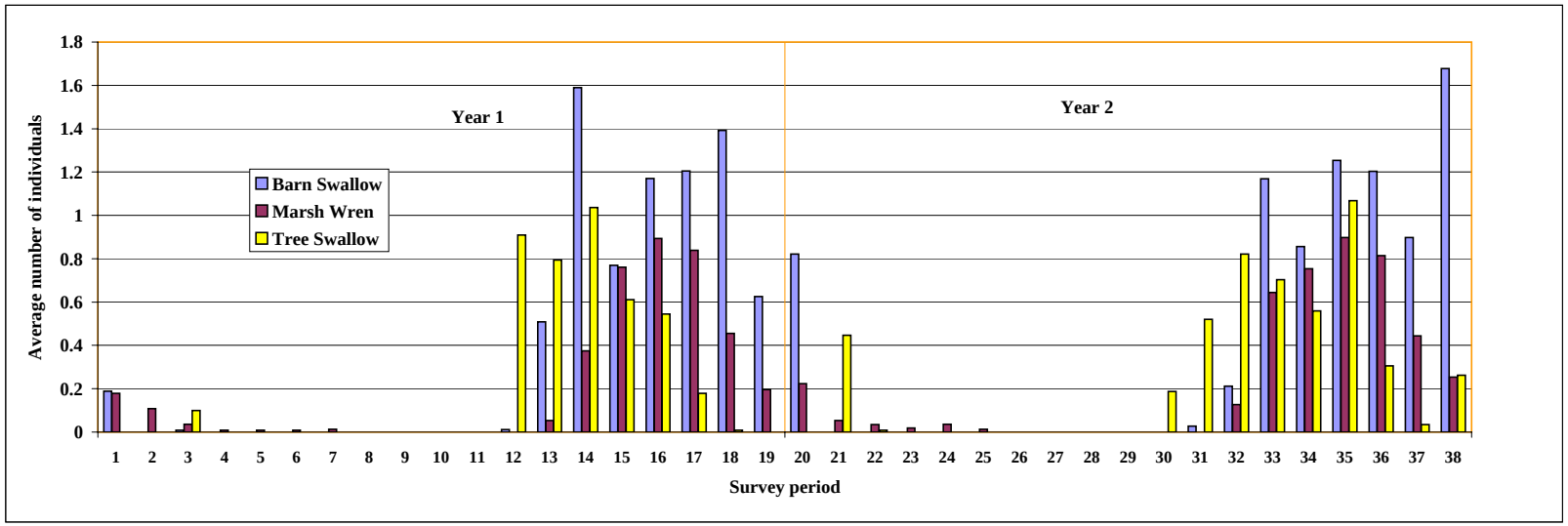


Figure 7. Seasonal distribution of the three most common year-round resident and three most common migratory passerine species in the Meadowlands District. Data are shown for the 38 survey cycles conducted approximately two weeks apart between August 2004 and September 2006.

Year 1					
Cycle	Date	Cycle	Date	Cycle	Date
1	8/30/2004-9/14/2004	8	12/29/2004-1/19/2005	14	5/4/2005-5/19/2005
2	9/15/2004-9/29/2004	9	1/22/2005-2/8/2005	15	5/19/2005-6/10/2005
3	9/29/2004-10/13/2004	10	2/9/2005-3/2/2005	16	6/13/2005-7/5/2005
4	10/18/2004-10/28/2004	11	3/14/2005-3/29/2005	17	7/7/2005-7/29/2005
5	11/1/2004-11/16/2004	12	3/30/2005-4/14/2005	18	8/1/2005-8/12/2005
6	11/17/2004-12/3/2004	13	4/18/2005-5/3/2005	19	8/15/2005-9/1/2005
7	12/6/2004-12/28/2004				

Year 2					
Cycle	Date				
20	9/6/2005-9/20/2005	27	1/12/2006-1/30/2006	33	5/1/2006-5/22/2006
21	9/21/2005-10/10/2005	28	2/1/2006-2/16/2006	34	5/22/2006-6/13/2006
22	10/11/200511/1/2005	29	2/19/2006-3/9/2006	35	6/13/2006-7/3/2006
23	11/3/2005-11/16/2005	30	3/13/2006-3/29/2006	36	7/5/2006-7/24/2006
24	11/17/2005-12/2/2005	31	3/30/2006-4/14/2006	37	7/24/2006-8/10/2006
25	12/5/2005-12/21/2005	32	4/14/2006-5/1/2006	38	8/13/2006-9/5/2006
26	12/22/2005-1/9/2006				

Figure 8
Species Richness by Habitat Type

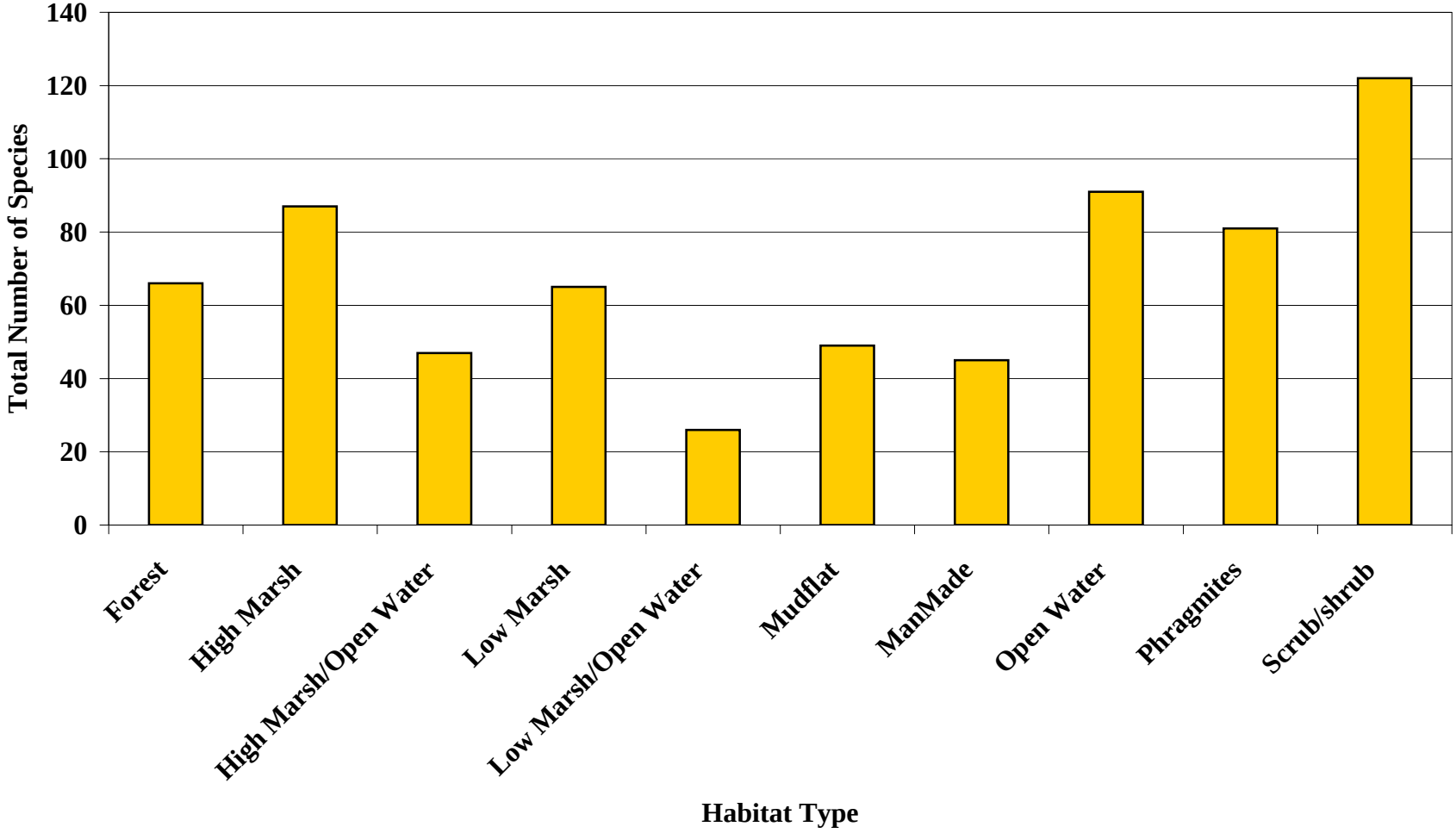


Figure 9
Species Richness by Habitat Area in hectares

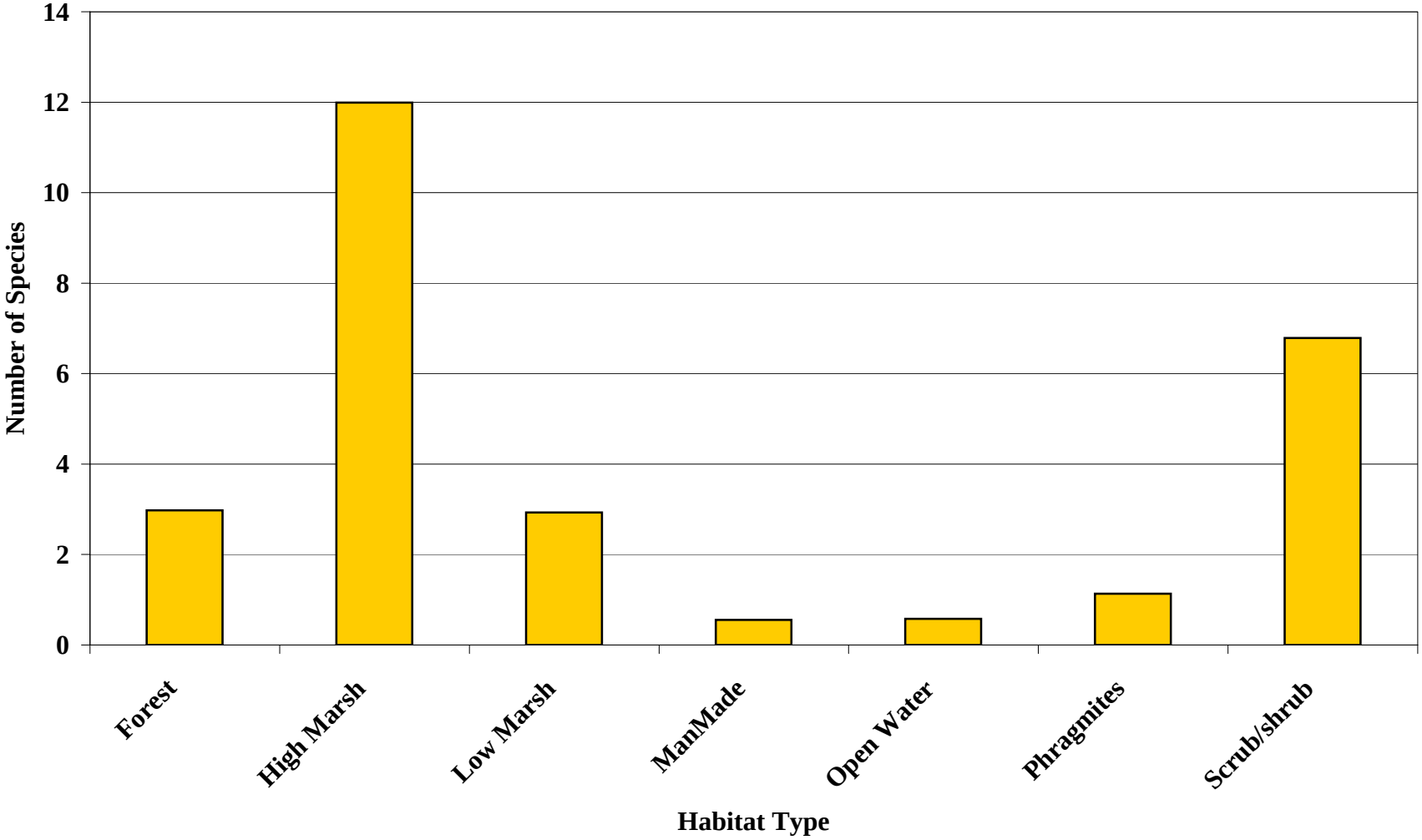


Figure 10.
Correlation Between Low Marsh Habitat and Marsh Wren Observations

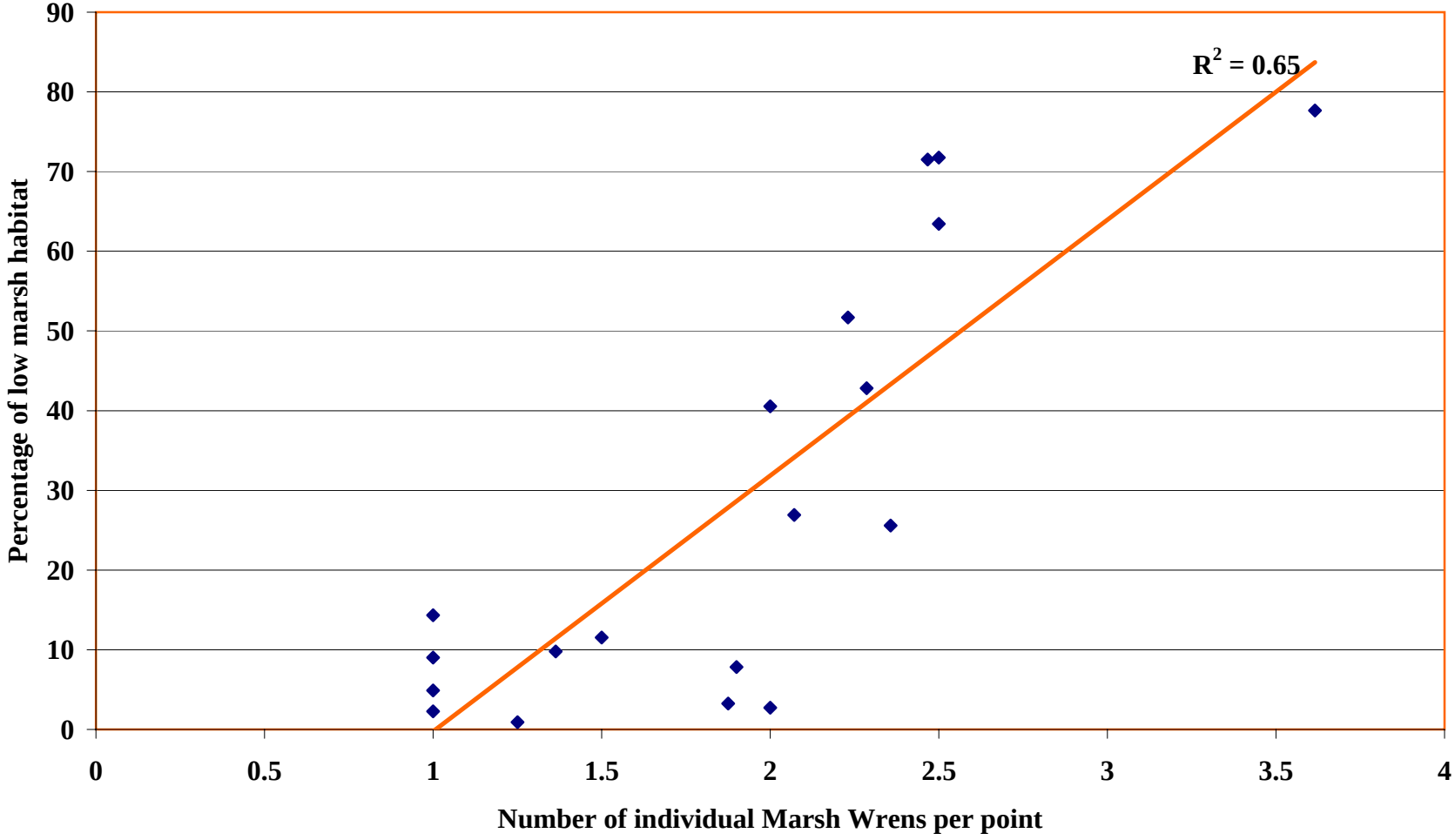


Figure 11.
Species Accumulation Curves for upland points and *Phragmites* habitats, with 95% confidence intervals

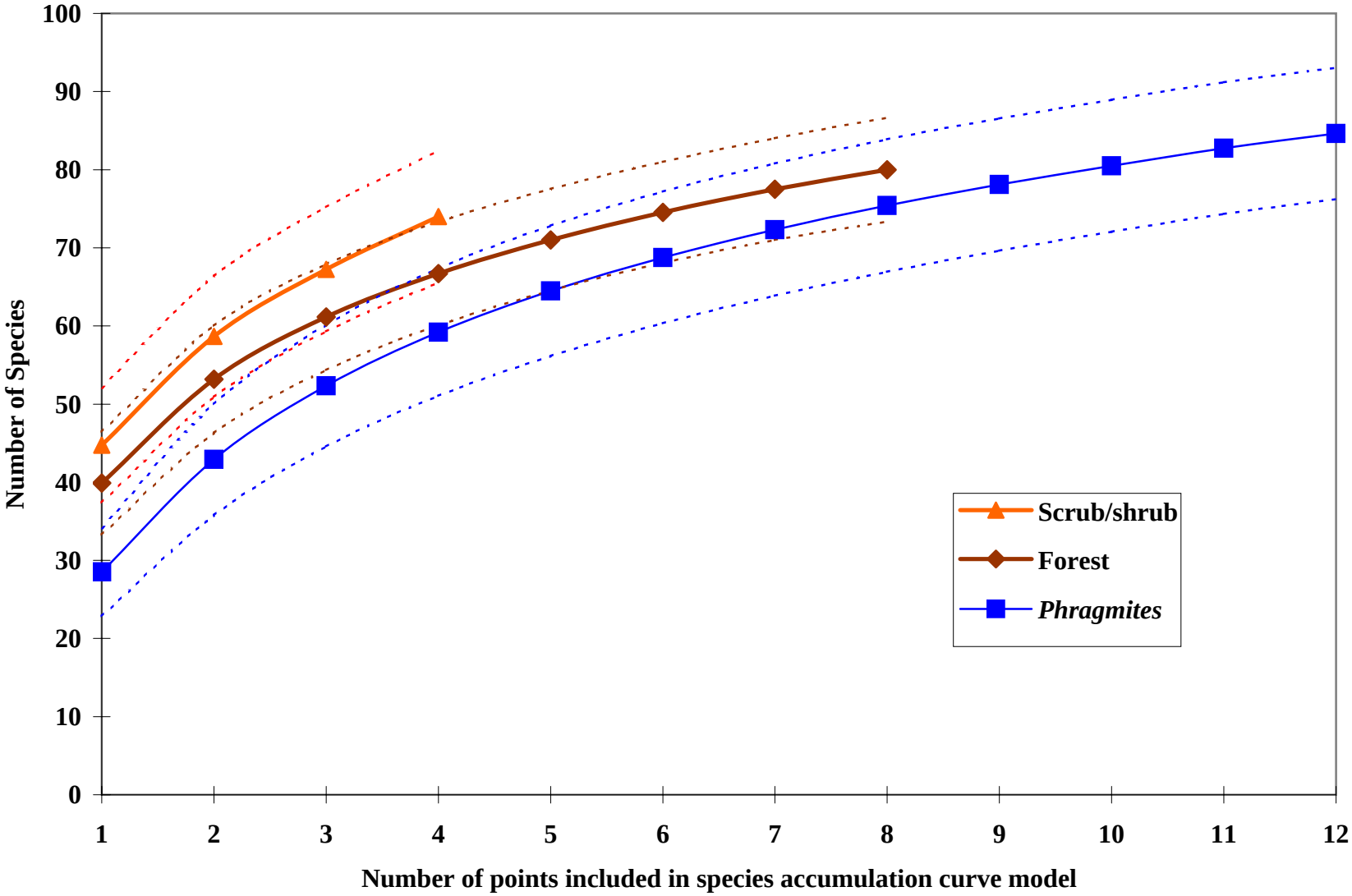


Figure 12.
Species Accumulation Curves for wetland points, with 95%confidence intervals

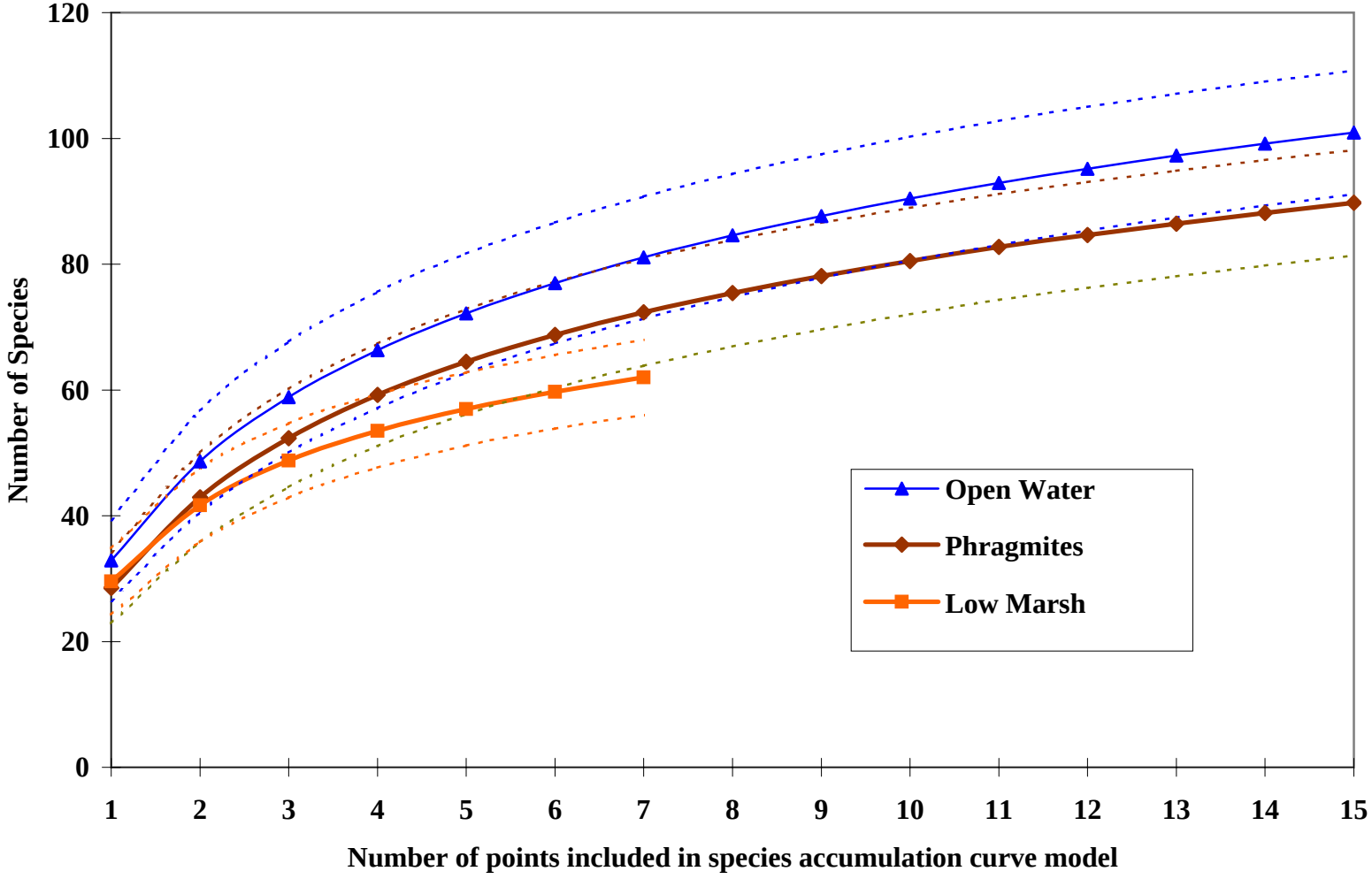
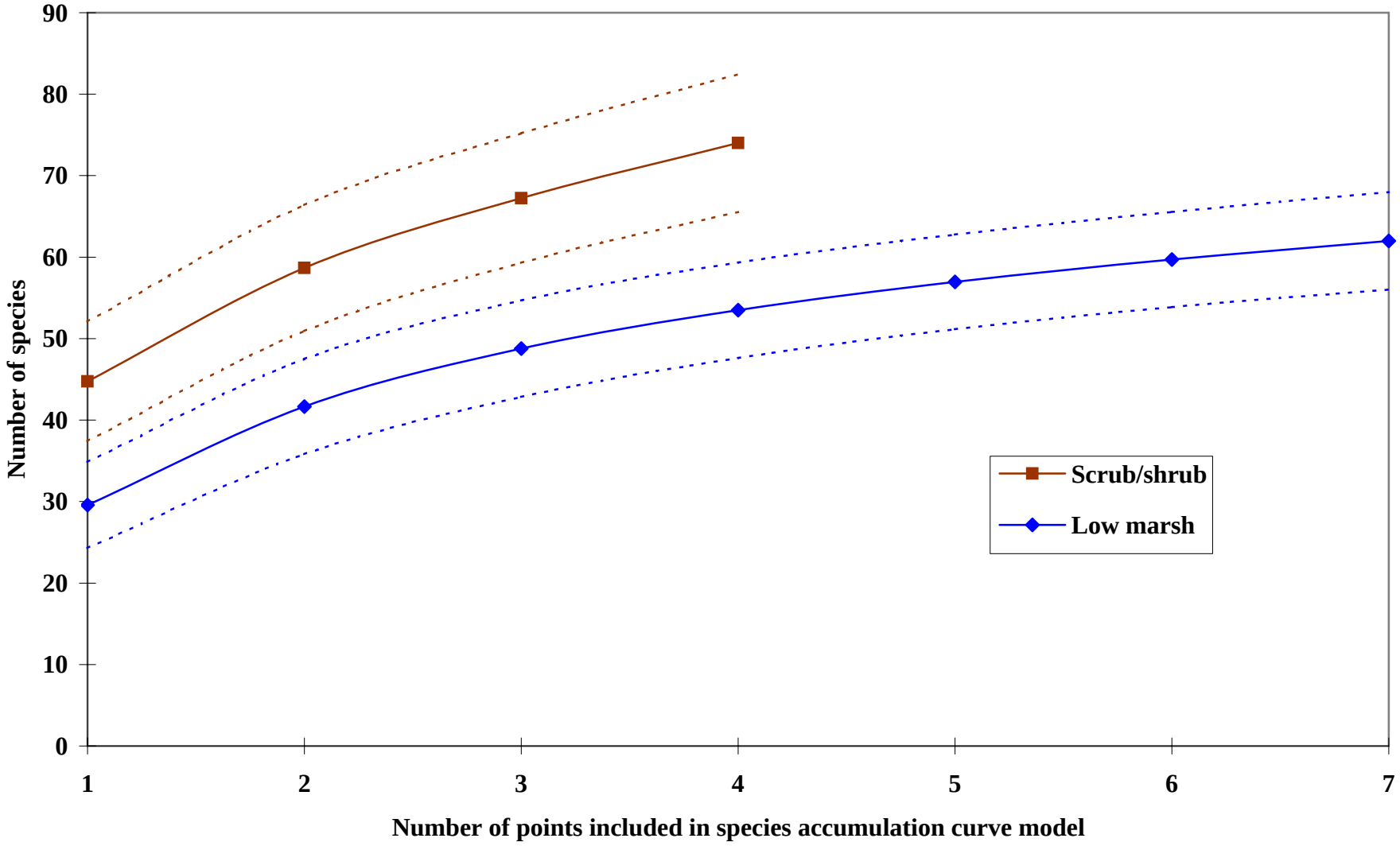


Figure 13.
Species Accumulation Curves: Scrub/Shrub vs. Low Marsh



Appendix 1. List of points visited, their coordinates, and access methods

Name	GPS Name	Point Number	Longitude	Latitude	Access Method	Winter Access
1A Landfill	1ALF01	1	-74.11096	40.75145	Car/Foot	Yes
1A Landfill	1ALF02	2	-74.10777	40.75074	Car/Foot	Yes
1D Landfill	1DLF01	1	-74.12689	40.74703	Car/Foot	Yes
1D Landfill	1DLF02	2	-74.12443	40.74858	Car/Foot	Yes
Bellemeade Mitigation	BEMI1A	1	-74.09028	40.78505	Kayak	No
Bellemeade Mitigation	BEMI2A	2	-74.08841	40.78666	Kayak	No
Eastern Brackish Marsh	EABM01	1	-74.03754	40.79824	Kayak	No
Eastern Brackish Marsh	EABM02	2	-74.03347	40.79840	Kayak	No
Eastern Brackish Marsh	EABM03	3	-74.03431	40.80233	Kayak	No
Eastern Brackish Marsh	EABM04	4	-74.03637	40.79577	Kayak	No
Empire Tract	EMP02A	1	-74.05766	40.82098	On Foot	Yes
Empire Tract	EMP03A	2	-74.05163	40.82803	On Foot	Yes
Empire Tract	EMP09A	4	-74.05586	40.81993	On Foot	Yes
Empire Tract	EMP11A	5	-74.04004	40.82365	On Foot	Yes
Empire Tract	EMP14A	6	-74.04641	40.82685	On Foot	Yes
Empire Tract	EMP15A	7	-74.03906	40.82113	On Foot	Yes
Empire Tract 2	EMP201	1	-74.05873	40.81082	On Foot	Yes
Empire Tract 2	EMP202	2	-74.05661	40.80782	On Foot	Yes
Empire Tract	EMPM06	3	-74.03967	40.82820	On Foot	Yes
Empire Tract	EMPM18	8	-74.03765	40.82593	On Foot	Yes
Harrier Marsh	HARR01	1	-74.12044	40.78566	On Foot	Yes
Harrier Marsh	HARR02	2	-74.11804	40.78800	On Foot	Yes
Harrier Marsh	HARR3A	3	-74.11785	40.78354	On Foot	Yes
Kearny Freshwater Marsh	KFWM01	1	-74.12490	40.76338	Kayak	No
Kearny Freshwater Marsh	KFWM03	2	-74.12258	40.75872	Kayak	No
Kearny Freshwater Marsh	KFWM04	3	-74.12842	40.76370	Kayak	No
Kearny Freshwater Marsh	KFWM07	5	-74.12623	40.75957	Kayak	No
Kearny Freshwater Marsh	KFWM1W	7	-74.12420	40.76400	On Foot	Winter On
Kearny Freshwater Marsh	KFWM4W	8	-74.12802	40.76458	On Foot	Winter On
Kearny Freshwater Marsh	KFWM6A	4	-74.12129	40.76124	Kayak	No
Kearny Freshwater Marsh	KFWM6W	9	-74.12008	40.76333	On Foot	Winter On
Kearny Freshwater Marsh	KFWM7W	10	-74.13017	40.75757	On Foot	Winter On
Kearny Freshwater Marsh	KFWM8A	6	-74.13244	40.76127	Kayak	No

Appendix 1. Continued

Name	GPS Name	Point Number	Longitude	Latitude	Access Method	Winter Access
Kingsland Landfill	KILF01	1	-74.11016	40.79392	Car/Foot	Yes
Kingsland Landfill	KILF02	2	-74.10703	40.79189	Car/Foot	Yes
Kingsland Landfill	KILF04	3	-74.11215	40.79204	Car/Foot	Yes
Kingsland Landfill	KILF05	4	-74.10526	40.78911	Car/Foot	Yes
Kingsland Landfill	KILF6A	5	-74.10622	40.78723	Car/Foot	Yes
Kingsland Walkway	KIWA01	1	-74.11217	40.78843	On Foot	Yes
Kingsland Walkway	KIWA02	2	-74.10993	40.78447	On Foot	Yes
Kingsland Walkway	KIWA03	3	-74.11021	40.77915	On Foot	Yes
Kingsland Impoundments	KLIM2A	1	-74.10144	40.78158	On Foot	Yes
Kingsland Impoundments	KLIM3A	2	-74.10287	40.78540	On Foot	Yes
Kingsland Impoundments	KLIM4A	3	-74.09688	40.78314	On Foot	Yes
Kearny Marsh 1	KYM1_04	4	-74.10344	40.75888	On Foot	Yes
Kearny Marsh 1	KYM1_1A	1	-74.09776	40.75594	On Foot	Yes
Kearny Marsh 1	KYM1_2A	2	-74.10453	40.75594	On Foot	Yes
Kearny Marsh 1	KYM1_3A	3	-74.09662	40.75717	On Foot	Yes
Kearny Marsh 2	KYM2_02	2	-74.10161	40.75497	On Foot	Yes
Kearny Marsh 2	KYM2_1A	1	-74.09927	40.75522	On Foot	Yes
Kearny Marsh 2	KYM2_3A	3	-74.09867	40.75352	On Foot	Yes
Laurel Hill Upland	LHUP04	2	-74.08857	40.75931	On Foot	Yes
Laurel Hill Upland	LHUP05	3	-74.08578	40.76248	On Foot	Yes
Laurel Hill Upland	LHUP3A	1	-74.08525	40.76525	On Foot	Yes
Losen Slote Creek Park	LSCP01	1	-74.03999	40.83665	On Foot	Yes
Losen Slote Creek Park	LSCP02	2	-74.03887	40.83885	On Foot	Yes
Lyndhurst Riverside	LYRI1A	1	-74.08589	40.78567	By Kayak	No
Lyndhurst Riverside	LYRI2A	2	-74.09175	40.78417	By Kayak	No
Lyndhurst Riverside	LYRI3A	3	-74.08821	40.78374	By Kayak	No
Mill Creek Marsh	MCMA02	2	-74.04107	40.79892	Kayak	No
Mill Creek Marsh	MCMA04	4	-74.04545	40.79853	Kayak	No
Mill Creek Marsh	MCMA05	5	-74.04772	40.79385	On Foot	Yes
Mill Creek Marsh	MCMA1A	1	-74.04597	40.79649	On Foot	Yes
Mill Creek Marsh	MCMA3A	3	-74.05105	40.79589	Car/Foot	Yes
Merhof Pond	MEPO02	2	-74.03404	40.83663	Car/Foot	Yes
Merhof Pond	MEPO1A	1	-74.04086	40.83238	Car/Foot	Yes

Appendix 1. Continued

Name	GPS Name	Point Number	Longitude	Latitude	Access Method	Winter Access
Oritani Marsh	ORMA02	1	-74.08462	40.79495	On Foot	Yes
Oritani Marsh	ORMA03	2	-74.07755	40.80064	On Foot	Yes
Oritani Marsh	ORMA09	4	-74.08943	40.80802	RiverKeep	No
Oritani Marsh	ORMA10	5	-74.08585	40.80652	RiverKeep	No
Oritani Marsh	ORMA4A	3	-74.08061	40.79816	On Foot	Yes
Riverbend Marsh	RBMA02	2	-74.09236	40.75352	Kayak	No
Riverbend Marsh	RBMA04	3	-74.09206	40.75073	Kayak	No
Riverbend Marsh	RBMA1A	1	-74.08861	40.75143	Kayak	No
Resources Metromedia Marsh	REM04A	2	-74.04102	40.81257	Car	Yes
Resources Metromedia Marsh	REM05A	3	-74.03429	40.81477	Kayak	No
Resources Metromedia Marsh	REM07A	5	-74.04600	40.81624	Car	Yes
Resources Metromedia Marsh	REMM03	1	-74.04705	40.81276	Kayak	No
Resources Metromedia Marsh	REMM06	4	-74.03727	40.81424	Kayak	No
Resources Metromedia Marsh	REMM08	6	-74.03734	40.81858	On Foot	Yes
Resources Metromedia Marsh	REMM09	7	-74.04394	40.81136	Kayak	No
Resources Metromedia Marsh	REMM11	8	-74.04094	40.81690	Kayak	No
Resources Metromedia Marsh 2	REM201	1	-74.05351	40.81191	On Foot	Yes
Resources Metromedia Marsh 2	REM202	2	-74.05189	40.80925	On Foot	Yes
Hackensack River	RIVR01	1	-74.03031	40.84481	Riverkeep	No
Hackensack River	RIVR03	2	-74.02861	40.83519	Riverkeep	No
Hackensack River	RIVR06	3	-74.03488	40.82170	Riverkeep	No
Hackensack River	RIVR07	4	-74.02976	40.81877	Riverkeep	No
Hackensack River	RIVR09	5	-74.03320	40.80962	Riverkeep	No
Hackensack River	RIVR16	6	-74.07181	40.79826	Riverkeep	No
Hackensack River	RIVR18	7	-74.08081	40.79271	Riverkeep	No
Hackensack River	RIVR19	8	-74.08011	40.78779	Riverkeep	No
Hackensack River	RIVR21	9	-74.08692	40.78033	Riverkeep	No
Hackensack River	RIVR23	10	-74.08756	40.77217	Riverkeep	No
Hackensack River	RIVR24	11	-74.08920	40.76738	Riverkeep	No
Hackensack River	RIVR32	12	-74.07657	40.74319	Riverkeep	No
Sawmill WMA 1	SAW1_03A	1	-74.09798	40.76709	Riverkeep	No
Sawmill WMA 1	SAW1_06A	2	-74.10318	40.76052	On Foot	Yes
Sawmill WMA 1	SAW1_07A	3	-74.09996	40.77340	Riverkeep	No

Appendix 1. Continued

Name	GPS Name	Point Number	Longitude	Latitude	Access Method	Winter Access
Sawmill WMA 1	SAW1_09	4	-74.09814	40.77017	Riverkeep	No
Sawmill WMA 1	SAW1_10	5	-74.09696	40.75966	On Foot	Yes
Sawmill WMA 1	SAW1_12	6	-74.09279	40.77768	Riverkeep	No
Sawmill WMA 1	SAW1_13A	7	-74.09402	40.76984	Riverkeep	No
Sawmill WMA 1	SAW1_14A	8	-74.10800	40.76135	On Foot	Yes
Sawmill WMA 2	SAW21A	1	-74.11651	40.76368	Car/Foot	Yes
Sawmill WMA 2	SAW23A	2	-74.11152	40.77462	Car/Foot	Yes
Sawmill WMA 2	SAW24A	3	-74.11470	40.76775	Car/Foot	Yes
Schmidt's Woods	SCHM01	1	-74.05070	40.79978	On Foot	Yes
Secaucus High School Marsh	SEHS01	1	-74.04830	40.80447	On Foot	Yes
Secaucus High School Marsh	SEHS02	2	-74.04488	40.80455	On Foot	Tes
Sawmill Landfill	SMLF02	1	-74.12004	40.76982	Car/Foot	Yes
Sawmill Landfill	SMLF08	4	-74.12004	40.78036	Car/Foot	Yes
Sawmill Landfill	SMLF11	6	-74.11414	40.77630	Car/foot	Yes
Sawmill Landfill	SMLF4A	2	-74.11762	40.77989	Car/Foot	Yes
Sawmill Landfill	SMLF6A	3	-74.12075	40.77704	Car/Foot	Yes
Sawmill Landfill	SMLF9A	5	-74.11862	40.76438	Car/Foot	Yes
Teterboro Woods East	TWEA02	2	-74.05363	40.84785	On Foot	Yes
Teterboro Woods East	TWEA1A	1	-74.05375	40.84560	On Foot	Yes
Teterboro Woods East	TWEA4A	3	-74.05321	40.85032	On Foot	Yes
Teterboro Woods West	TWWE4A	1	-74.07552	40.84577	On Foot	Yes
Teterboro Woods West	TWWE6A	2	-74.07048	40.84240	On Foot	Yes
Western Brackish Marsh	WEBM01	1	-74.03652	40.80403	Kayak	No
Western Brackish Marsh	WEBM02	2	-74.04163	40.80297	Kayak	No
Western Brackish Marsh	WEBM03	3	-74.03975	40.80594	Kayak	No

Appendix 2

Survey point locations for the Kingsland Landfill (KILF), Kingsland Marsh (KIWA, KLIM), Harrier Meadow (HARR), 1E Landfill (SMLF), Sawmill WMA (SAW), Bellemeade Mitigation (BEMI), Lyndhurst Riverside (LYRI), and Hackensack River (RIVR) sites

Appendix 3

Survey point locations for the Kearny Freshwater Marsh (KFWM), Kearny Brackish Marsh (KYM), 1A Landfill (1ALF), ID Landfill (1DLF), Sawmill WMA (SAW), Riverbend Marsh (RBM), Laurel Hill Upland (LHUP), and Hackensack River (RIVR) sites

Appendix 4
Survey point locations for Losen Slote Creek Park (LSCP), Merhoff Pond (MEPO), and Hackensack River (RIVR) sites

Appendix 5
Survey point locations for Oritani Marsh (ORMA) and Hackensack River (RIVR) sites

Appendix 6

Survey point locations for the Western Brackish Marsh (WEBM), Eastern Brackish Marsh (EABM), Mill Creek Marsh (MCMA), Schmidt's Woods (SCHM), and Secaucus High School (SEHS) sites

Appendix 7
Survey point locations for Teterboro Woods West (TWWE) and Teterboro Woods East (TWEA) sites

Appendix 8
Survey point locations for the Empire Tract (EMP), Resources Metromedia Marsh (REM), and Hackensack River (RIVR) sites

Appendix 9. Corrected seasonal occurrence species list for the Meadowlands District from results of point count bird surveys conducted in the Meadowlands District between August 30, 2004 and September 1, 2005. Table is arranged by species in alphabetical order. Species not previously on the exisitng species list but recorded during survey are shown in bold. Species whose nesting status was previously not acknowledged on the checklist but should be considered probable breeders are shown in italics.

Species	Winter	Spring	Summer	Fall	Breeding
American Bittern				U	
American Coot	U	U		C	
American Crow	C	C	U	C	U
American Goldfinch	C	C	C	C	C
American Kestrel		U	U	U	
American Pipit		U			
American Redstart		U			
American Robin	R	C	C	C	C
American Wigeon	U	U			
American Woodcock	U	U			
Bald Eagle	U			U	
Baltimore Oriole		C	C	U	U
Bank Swallow		U		U	
Barn Swallow		C	C	C	C
Belted Kingfisher			U	C	
Black and White Warbler		U	U	U	
Black Duck	C	C	U	C	R
Black Skimmer			C		
Black-bellied Plover				U	
Black-billed Cuckoo			U	U	
Black-capped Chickadee	C	C	U	C	U
Black-crowned Night-Heron	U	C	C	C	U
Black-necked Stilt				R	
Black-throated Blue Warbler		U			
Black-throated Green Warbler		U			
Blue Grosbeak			U		U
Blue Jay	C	C	C	C	C
Blue-gray Gnatcatcher		U	U		
Blue-headed Vireo		U			
Blue-winged Teal		U		U	
Bobolink		U	U	U	
Brant		U		U	
Brewster's Warbler		R			
Broad-winged Hawk				U	
Brown Thrasher		U	U		U
Brown-headed Cowbird		C	U	C	U
Bufflehead	C	U		C	
Canada Goose	C	C	C	C	C
Canada Warbler			U	U	
Canvasback	C			U	

Appendix 9. Continued

Species	Winter	Spring	Summer	Fall	Breeding
Carolina Wren	U	C	C	C	C
Caspian Tern			U	U	
Cedar Waxwing		U	U	U	U
Chestnut-sided Warbler			U	U	
Chimney Swift		C	U	C	U
Clapper Rail		U	U	U	U
Cliff Swallow		R			
Common Goldeneye	U			U	
Common Grackle	U	C	C	C	C
Common Loon		U		U	
Common Merganser	U	C		C	
Common Moorhen		C	C	U	C
Common Raven		R		R	
Common Yellowthroat		C	C	C	C
Cooper's Hawk	U			U	
Dark-eyed Junco	C			C	
Double-crested Cormorant	U	C	C	C	
Downy Woodpecker	C	C	C	C	C
Dunlin	U	U		U	
Eastern Kingbird		U	C	U	U
Eastern Phoebe			U	U	U
Eastern Towhee		U	U	U	U
Eastern Wood Pewee		R	R	R	R
Eurasian Wigeon	R				
European Starling	C	C	C	C	C
Field Sparrow		U		U	
Fish Crow		U	U	U	U
Forster's Tern		U	C		
Fox Sparrow	U			U	
Gadwall	C	C	C	C	C
Golden-crowned Kinglet		R		U	
Grasshopper Sparrow				U	
Gray Catbird		C	C	C	C
Great Black-backed Gull	C	C	C	C	
Great Blue Heron	C	C	C	C	
Great Cormorant	U	U			
Great Crested Flycatcher		U			
Great Egret		C	C	C	
Greater Yellowlegs	R	C	C	C	
Green Heron		U	U	U	U
Green-winged Teal	C	C		C	
Hairy Woodpecker	U	U	U	U	U
Hermit Thrush				U	
Herring Gull	C	C	C	C	
Hooded Merganser	U	C		C	
House Finch	C	C	C	C	C
House Sparrow	C	C	C	C	C

Appendix 9. Continued

Species	Winter	Spring	Summer	Fall	Breeding
House Wren		U	U		U
Indigo Bunting		C	C	U	C
Killdeer	U	C	C	C	C
Laughing Gull			C	C	
Least Bittern		U	U	U	U
Least Flycatcher		U			
Least Sandpiper		C	C	U	
Least Tern		U	U		
Lesser Black-backed Gull	R				
Lesser Scaup				U	
Lesser Yellowlegs		C	C	C	
Lincoln's Sparrow				U	
Louisiana Waterthrush		U	U		
Magnolia Warbler		U			
Mallard	C	C	C	C	C
Mallard x Black Duck Hybrid	R	R		R	
Marsh Wren		C	C	C	C
Merlin	R	R	R		
Mourning Dove	C	C	C	C	C
Mute Swan	U	C	C	C	U
Nashville Warbler				U	
Northern Cardinal	C	C	C	C	C
Northern Flicker	U	C	C	C	C
Northern Goshawk				R	
Northern Harrier	C	C	R	C	R
Northern Mockingbird	C	C	C	C	C
Northern Parula		U			
Northern Pintail	U	U		C	
Northern Rough-winged Swallow		U	U	U	U
Northern Shoveler	U	U		C	
Northern Waterthrush			U		
Orchard Oriole		U	U		U
Osprey		C	U	C	
Ovenbird		U		U	
Palm Warbler		C		C	
Pectoral Sandpiper			U	U	
Peregrine Falcon	R	R	R	R	
Pied Billed Grebe		U		U	R
Pine Siskin				R	
Prairie Warbler				U	
Red-bellied Woodpecker	C	C	C	C	C
Red-breasted Merganser	U	U		U	
Red-eyed Vireo		U			
Red-tailed Hawk	C	U	U	C	U
Red-winged Blackbird	R	C	C	C	C
Ring-billed Gull	C	C	C	C	
Ring-necked Duck	U	U		U	
Ring-necked Pheasant	C	C	C	C	C

Appendix 9. Continued

Species	Winter	Spring	Summer	Fall	Breeding
Rock Pigeon	C	C	C	C	C
Rough-legged Hawk	U				
Ruby-crowned Kinglet	R	C		C	
Ruby-throated Hummingbird				U	
Ruddy Duck				C	R
Saltmarsh Sharp-tailed Sparrow			U	U	U
Savannah Sparrow	U	C		C	
Semipalmated Plover		U	C	U	
Semipalmated Sandpiper		C	C	U	
Sharp-shinned Hawk	U			U	
Sharp-tailed Sparrow		U			
Short-billed Dowitcher		C	C	C	
Snow Bunting				U	
Snow Goose				U	
Snowy Egret		C	C	C	
Solitary Sandpiper				U	
Song Sparrow	C	C	C	C	C
Spotted Sandpiper		C	C	C	C
Swamp Sparrow	U	C	C	C	C
Tree Sparrow	C			C	
Tree Swallow		C	C	C	C
Tri-colored Heron			U		
Tufted Titmouse	C	C	C	C	C
Turkey Vulture	U	U		U	
Virginia Rail		U	U		U
Warbling Vireo		C	C		C
White-breasted Nuthatch	U	U	U	U	U
White-crowned Sparrow				U	
White-rumped Sandpiper			U		
White-throated Sparrow	C	C		C	
Willow Flycatcher		C	C	U	C
Wilson's Phalarope			R		
Wilson's Snipe		U		U	
Winter Wren	U			U	
Wood Duck	U	C	C	C	U
Wood Thrush		U			
Yellow Warbler		C	C	U	C
Yellow-bellied Sapsucker				U	
Yellow-crowned Night-Heron		U	U		U
Yellow-rumped Warbler	U	C		C	

Appendix 10. List of total numbers of sightings of each species at each Meadowlands site during surveys conducted from August 30, 2004 to September 5, 2006.

1A Landfill

Species	# recorded	Species	# recorded
American Crow	2	Great Egret	8
American Goldfinch	9	Herring Gull	48
American Kestrel	3	Hooded Merganser	12
American Robin	159	Indigo Bunting	16
Bald Eagle	1	Killdeer	9
Baltimore Oriole	1	Least Tern	1
Bank Swallow	1	Mallard	28
Barn Swallow	22	Mourning Dove	19
Belted Kingfisher	2	Northern Flicker	6
Black Skimmer	2	Northern Harrier	1
Bobolink	1	Northern Mockingbird	9
Brown-headed Cowbird	4	Northern Rough-winged Swallow	4
Canada Goose	58	Orchard Oriole	1
Cedar Waxwing	5	Palm Warbler	1
Chimney Swift	9	Pied-billed Grebe	1
Common Grackle	11	Red-tailed Hawk	9
Common Merganser	35	Red-winged Blackbird	245
Common Yellowthroat	11	Ring-billed Gull	31
Dark-eyed Junco	9	Ring-necked Duck	4
Double-crested Cormorant	52	Ring-necked Pheasant	9
Downy Woodpecker	10	Rock Pigeon	3
Eastern Kingbird	2	Ruby-crowned Kinglet	2
Eastern Meadowlark	1	Savannah Sparrow	15
Eastern Phoebe	1	Song Sparrow	71
European Starling	60	Swamp Sparrow	2
Forster's Tern	2	Tree Sparrow	5
Fox Sparrow	1	Tree Swallow	27
Gadwall	15	Turkey Vulture	1
Grasshopper Sparrow	1	Warbling Vireo	1
Gray Catbird	1	White-throated Sparrow	4
Great Black-backed Gull	11	Yellow Warbler	4
Great Blue Heron	2	Yellow-rumped Warbler	16
TOTAL	**1117**		

1D Landfill

Species	# recorded	Species	# recorded
American Crow	1	House Wren	2
American Goldfinch	18	Indigo Bunting	20
American Robin	202	Killdeer	1
Bald Eagle	1	Mallard	10
Baltimore Oriole	2	Mourning Dove	19
Barn Swallow	16	Northern Cardinal	1
Black and White Warbler	1	Northern Flicker	10
Black-capped Chickadee	5	Northern Mockingbird	1
Blue Jay	10	Northern Rough-winged Swallow	4
Brewster's Warbler	1	Orchard Oriole	3
Brown-headed Cowbird	9	Ovenbird	1
Canada Goose	5	Palm Warbler	4
Carolina Wren	3	Red-tailed Hawk	13
Cedar Waxwing	62	Red-winged Blackbird	79
Chimney Swift	3	Ring-billed Gull	11
Common Grackle	17	Ring-necked Pheasant	6
Common Yellowthroat	12	Rock Pigeon	25
Dark-eyed Junco	28	Ruby-crowned Kinglet	2
Downy Woodpecker	10	Savannah Sparrow	5
Eastern Kingbird	1	Sharp-shinned Hawk	1
Eastern Phoebe	1	Song Sparrow	43
European Starling	173	Swamp Sparrow	8
Field Sparrow	4	Tree Sparrow	35
Fox Sparrow	1	Tree Swallow	7
Golden-crowned Kinglet	3	White-throated Sparrow	6
Gray Catbird	8	Willow Flycatcher	1
Great Black-backed Gull	10	Winter Wren	1
Herring Gull	22	Yellow Warbler	16
House Finch	1	Yellow-rumped Warbler	4
TOTAL	**969**		

Appendix 10. Continued

Bellemeade Mitigation	
Species	**# recorded**
American Goldfinch	3
American Robin	3
Baltimore Oriole	1
Barn Swallow	22
Black Duck	3
Black-crowned Night-Heron	3
Blue Jay	1
Cedar Waxwing	20
Common Grackle	1
Common Yellowthroat	1
Double-crested Cormorant	140
European Starling	3
Great Black-backed Gull	4
Great Egret	3
Greater Yellowlegs	2
Green-winged Teal	73
Herring Gull	10
Laughing Gull	4
Least Sandpiper	1
Mallard	28
Marsh Wren	61
Mourning Dove	5
Northern Flicker	8
Northern Harrier	3
Peeps	4
Red-tailed Hawk	2
Red-winged Blackbird	282
Ring-billed Gull	2
Rock Pigeon	24
Sharp-shinned Hawk	1
Snowy Egret	2
Solitary Sandpiper	1
Song Sparrow	9
Swamp Sparrow	31
Tree Sparrow	1
Tree Swallow	1
Willow Flycatcher	4
Yellow Warbler	2
Yellow-rumped Warbler	19
Grand Total	**788**

Eastern Brackish Marsh			
Species	**# recorded**	**Species**	**# recorded**
American Crow	1	Mallard	326
American Goldfinch	6	Marsh Wren	5
American Robin	37	Mourning Dove	43
Barn Swallow	105	Northern Cardinal	10
Belted Kingfisher	2	Northern Flicker	3
Black Duck	7	Northern Harrier	2
Black Skimmer	3	Northern Mockingbird	6
Black-billed Cuckoo	1	Northern Rough-winged Swallow	3
Black-capped Chickadee	7	Northern Shoveler	24
Black-crowned Night-Heron	1	Northern Waterthrush	1
Blue Jay	1	Osprey	1
Blue-winged Teal	10	Palm Warbler	1
Bufflehead	2	Peeps	561
Canada Goose	128	Peregrine Falcon	1
Cedar Waxwing	22	Red-tailed Hawk	8
Chimney Swift	3	Red-winged Blackbird	54
Common Grackle	6	Ring-billed Gull	479
Common Yellowthroat	1	Ring-necked Pheasant	4
Double-crested Cormorant	13	Rock Pigeon	2
Downy Woodpecker	7	Ruby-crowned Kinglet	1
Eastern Kingbird	13	Ruby-throated Hummingbird	1
Eastern Phoebe	2	Ruddy Duck	26
European Starling	125	Semipalmated Plover	32
Forster's Tern	7	Semipalmated Sandpiper	299
Gadwall	67	Short-billed Dowitcher	1
Gray Catbird	21	Snowy Egret	27
Great Black-backed Gull	15	Song Sparrow	62
Great Blue Heron	2	Spotted Sandpiper	3
Great Egret	2	Swamp Sparrow	5
Greater Yellowlegs	9	Tree Swallow	44
Green-winged Teal	2029	Turkey Vulture	1
Herring Gull	44	White-throated Sparrow	1
House Finch	1	Willow Flycatcher	5
House Sparrow	16	Yellow Warbler	28
Killdeer	9	Yellow-crowned Night-Heron	1
Laughing Gull	2	Yellow-rumped Warbler	18
Least Sandpiper	384		
Lesser Yellowlegs	2		
Grand Total	**5,202**		

Appendix 10. Continued

Empire Tract			
Species	**# recorded**	**Species**	**# recorded**
American Crow	11	House Finch	8
American Goldfinch	49	House Sparrow	2
American Kestrel	2	House Wren	2
American Robin	115	Indigo Bunting	10
American Woodcock	2	Killdeer	8
Baltimore Oriole	1	Laughing Gull	1
Barn Swallow	137	Least Sandpiper	2
Belted Kingfisher	2	Lesser Yellowlegs	1
Black Duck	17	Louisiana Waterthrush	1
Black Skimmer	1	Mallard	196
Black-billed Cuckoo	1	Marsh Wren	16
Blackbird Sp.	15	Mourning Dove	197
Black-capped Chickadee	47	Northern Cardinal	54
Blue Jay	23	Northern Flicker	24
Bobolink	45	Northern Harrier	20
Brown-headed Cowbird	12	Northern Mockingbird	26
Canada Goose	467	Palm Warbler	5
Carolina Wren	4	Peeps	7
Cedar Waxwing	17	Peregrine Falcon	1
Chimney Swift	5	Red-tailed Hawk	47
Common Grackle	137	Red-winged Blackbird	1071
Common Merganser	13	Ring-billed Gull	53
Common Yellowthroat	170	Ring-necked Pheasant	37
Cooper's Hawk	2	Rock Pigeon	40
Dark-eyed Junco	4	Ruby-crowned Kinglet	7
Double-crested Cormorant	136	Ruby-throated Hummingbird	1
Downy Woodpecker	37	Ruddy Duck	3
Eastern Kingbird	12	Savannah Sparrow	29
Eastern Phoebe	4	Sharp-shinned Hawk	1
European Starling	223	Song Sparrow	188
Field Sparrow	2	Spotted Sandpiper	1
Fox Sparrow	1	Swamp Sparrow	216
Gadwall	9	Tree Sparrow	81
Golden-crowned Kinglet	1	Tree Swallow	12
Gray Catbird	58	Turkey Vulture	1
Great Black-backed Gull	8	Warbling Vireo	7
Great Blue Heron	6	White-throated Sparrow	28
Great Egret	6	Willow Flycatcher	28
Green Heron	4	Winter Wren	1
Green-winged Teal	58	Wood Duck	2
Hermit Thrush	1	Yellow Warbler	15
Herring Gull	64	Yellow-bellied Sapsucker	1
Hooded Merganser	15	Yellow-rumped Warbler	10
Grand Total	**4,405**		

Hackensack River			
Species	**# recorded**	**Species**	**# recorded**
American Bittern	1	Green-winged Teal	151
American Crow	8	Herring Gull	362
American Goldfinch	1	House Finch	15
American Kestrel	3	House Sparrow	29
American Robin	34	Indigo Bunting	1
Bald Eagle	1	Killdeer	25
Baltimore Oriole	2	Laughing Gull	158
Barn Swallow	164	Least Sandpiper	76
Belted Kingfisher	10	Least Tern	8
Black Duck	4	Lesser Yellowlegs	41
Black Skimmer	10	Mallard	721
Black-capped Chickadee	3	Marsh Wren	89
Black-crowned Night-Heron	17	Mourning Dove	33
Black-necked Stilt	1	Northern Cardinal	2
Blue Jay	3	Northern Flicker	9
Boat-tailed Grackle	1	Northern Harrier	4
Bonaparte's Gull	2	Northern Mockingbird	12
Brown-headed Cowbird	49	Northern Rough-winged Swallow	3
Canada Goose	401	Osprey	6
Caspian Tern	1	Peeps	443
Cedar Waxwing	2	Peregrine Falcon	4
Chimney Swift	5	Red-tailed Hawk	13
Clapper Rail	3	Red-winged Blackbird	317
Common Grackle	11	Ring-billed Gull	1657
Common Loon	1	Ring-necked Pheasant	1
Common Moorhen	1	Rock Pigeon	204
Common Tern	1	Ruddy Duck	45
Common Yellowthroat	14	Saltmarsh Sharp-tailed Sparrow	1
Double-crested Cormorant	727	Semipalmated Sandpiper	25
Downy Woodpecker	2	Sharp-shinned Hawk	1
Dunlin	2	Snowy Egret	166
Eastern Kingbird	1	Song Sparrow	39
Eastern Phoebe	1	Spotted Sandpiper	9
Eastern Wood Pewee	1	Swamp Sparrow	10
European Starling	499	Tree Swallow	28
Fish Crow	1	Tufted Titmouse	1
Forster's Tern	93	Turkey Vulture	1
Gadwall	19	Willow Flycatcher	4
Gray Catbird	5	Yellow Warbler	13
Great Black-backed Gull	176	Yellow-crowned Night-Heron	3
Great Blue Heron	18	Yellowlegs Sp.	49
Great Egret	91	Yellow-rumped Warbler	10
Greater Yellowlegs	131		
Grand Total	**7,310**		

Appendix 10. Continued

Harrier Marsh			
Species	**# recorded**	**Species**	**# recorded**
American Crow	180	Lesser Yellowlegs	154
American Goldfinch	7	Mallard	291
American Robin	8	Marsh Wren	11
Barn Swallow	49	Merlin	1
Belted Kingfisher	4	Mourning Dove	67
Black Duck	31	Mute Swan	55
Black Skimmer	4	Northern Flicker	4
Black-bellied Plover	2	Northern Harrier	12
Black-capped Chickadee	3	Northern Mockingbird	28
Black-crowned Night-Heron	15	Northern Pintail	2
Blue Jay	8	Northern Shoveler	41
Blue-winged Teal	3	Osprey	3
Bobolink	85	Palm Warbler	4
Brown-headed Cowbird	9	Pectoral Sandpiper	2
Canada Goose	1264	Peeps	1160
Carolina Wren	1	Peregrine Falcon	2
Caspian Tern	4	Pied-billed Grebe	2
Cedar Waxwing	4	Prairie Warbler	1
Common Grackle	28	Red-bellied Woodpecker	1
Common Merganser	134	Red-tailed Hawk	13
Common Yellowthroat	5	Red-winged Blackbird	194
Cooper's Hawk	2	Ring-billed Gull	186
Double-crested Cormorant	12	Ring-necked Pheasant	12
Dunlin	1	Rock Pigeon	32
Eastern Kingbird	1	Ruddy Duck	4
European Starling	157	Savannah Sparrow	10
Fish Crow	4	Semipalmated Plover	16
Forster's Tern	1	Semipalmated Sandpiper	835
Gadwall	149	Short-billed Dowitcher	1
Golden-crowned Kinglet	3	Snow Goose	1
Great Black-backed Gull	155	Snowy Egret	124
Great Blue Heron	19	Song Sparrow	61
Great Egret	66	Spotted Sandpiper	18
Greater Yellowlegs	203	Swamp Sparrow	2
Green Heron	1	Tree Sparrow	1
Green-winged Teal	183	Tree Swallow	31
Herring Gull	551	Turkey Vulture	1
Hooded Merganser	19	Willow Flycatcher	13
Killdeer	144	Wilson's Phalarope	1
Laughing Gull	183	Wilson's Snipe	8
Least Sandpiper	181	Wood Duck	1
Least Tern	2	Yellow Warbler	5
Lesser Black-backed Gull	1	Yellow-rumped Warbler	14
Grand Total	**7,311**		

Kearny Freshwater Marsh			
Species	**# recorded**	**Species**	**# recorded**
American Bittern	1	Least Tern	8
American Coot	19	Lesser Yellowlegs	6
American Crow	36	Mallard	270
American Kestrel	2	Marsh Wren	82
American Robin	21	Mourning Dove	67
American Wigeon	2	Mute Swan	36
Bank Swallow	36	Northern Cardinal	1
Barn Swallow	155	Northern Flicker	4
Belted Kingfisher	1	Northern Harrier	14
Black Duck	10	Northern Mockingbird	4
Black-capped Chickadee	2	Northern Rough-winged Swallow	8
Black-crowned Night-Heron	8	Northern Shoveler	25
Black-throated Green Warbler	1	Osprey	6
Bobolink	3	Palm Warbler	7
Bufflehead	51	Pectoral Sandpiper	10
Canada Goose	706	Peeps	2
Caspian Tern	1	Pied Billed Grebe	1
Chimney Swift	21	Pied-billed Grebe	2
Cliff Swallow	6	Red-tailed Hawk	14
Common Grackle	69	Red-winged Blackbird	448
Common Merganser	67	Ring-billed Gull	390
Common Moorhen	17	Ring-necked Duck	18
Common Yellowthroat	8	Rock Pigeon	12
Double-crested Cormorant	193	Ruddy Duck	17
Downy Woodpecker	1	Savannah Sparrow	2
Dunlin	1	Semipalmated Plover	6
European Starling	131	Semipalmated Sandpiper	12
Forster's Tern	6	Sharp-shinned Hawk	2
Gadwall	38	Snowy Egret	1
Great Black-backed Gull	105	Song Sparrow	112
Great Blue Heron	43	Spotted Sandpiper	9
Great Cormorant	3	Swamp Sparrow	82
Great Egret	79	Tree Sparrow	3
Greater Yellowlegs	2	Tree Swallow	123
Green Heron	1	Turkey Vulture	2
Green-winged Teal	171	Virginia Rail	4
Herring Gull	845	White-throated Sparrow	3
Hooded Merganser	5	Willow Flycatcher	2
House Wren	1	Wilson's Snipe	7
Killdeer	24	Wood Duck	33
Laughing Gull	9	Yellow Warbler	3
Least Bittern	6	Yellow-rumped Warbler	19
Least Sandpiper	89		
Grand Total	**4,873**		

Appendix 10. Continued

Kearny Marsh

Species	# recorded	Species	# recorded
American Coot	17	Least Sandpiper	30
American Crow	2	Least Tern	12
American Goldfinch	1	Lesser Yellowlegs	1
American Robin	3	Mallard	1203
American Wigeon	19	Mallard X Black Duck Hybrid	1
Barn Swallow	74	Marsh Wren	6
Belted Kingfisher	3	Mourning Dove	3
Black Duck	54	Mute Swan	712
Black Skimmer	17	Northern Harrier	2
Black-crowned Night-Heron	56	Northern Mockingbird	9
Brant	1	Northern Pintail	56
Bufflehead	92	Northern Rough-winged Swallow	3
Canada Goose	577	Northern Shoveler	17
Caspian Tern	2	Osprey	6
Common Grackle	31	Palm Warbler	2
Common Merganser	296	Pectoral Sandpiper	1
Common Moorhen	8	Peregrine Falcon	5
Common Yellowthroat	2	Pied Billed Grebe	2
Dark-eyed Junco	3	Red-breasted Merganser	43
Double-crested Cormorant	1080	Red-tailed Hawk	7
Eurasian Wigeon	2	Red-winged Blackbird	214
European Starling	103	Ring-billed Gull	298
Forster's Tern	50	Rock Pigeon	6
Gadwall	721	Ruby-crowned Kinglet	2
Golden-crowned Kinglet	1	Ruddy Duck	454
Great Black-backed Gull	52	Savannah Sparrow	3
Great Blue Heron	18	Semipalmated Sandpiper	1
Great Egret	351	Snowy Egret	221
Greater Yellowlegs	8	Song Sparrow	38
Green-winged Teal	18	Spotted Sandpiper	20
Herring Gull	186	Swamp Sparrow	8
Hooded Merganser	55	Tree Swallow	46
Horned Lark	14	Yellow Warbler	2
Killdeer	103	Zero Birds	0
Laughing Gull	33	Yellow-rumped Warbler	19
Grand Total	**7,506**		

Kingsland Impound

Species	# recorded	Species	# recorded
American Crow	71	Lesser Scaup	3
American Robin	16	Lesser Yellowlegs	99
Bank Swallow	6	Mallard	1015
Barn Swallow	186	Marsh Wren	3
Belted Kingfisher	16	Mourning Dove	16
Black Duck	115	Mute Swan	28
Black Skimmer	4	Northern Cardinal	7
Black-capped Chickadee	10	Northern Flicker	1
Black-crowned Night-Heron	18	Northern Harrier	4
Bufflehead	40	Northern Mockingbird	21
Canada Goose	76	Northern Pintail	28
Canvasback	552	Northern Shoveler	2
Carolina Wren	1	Orchard Oriole	2
Cliff Swallow	1	Osprey	3
Common Grackle	27	Peeps	206
Common Merganser	84	Pied Billed Grebe	1
Common Yellowthroat	2	Pied-billed Grebe	1
Double-crested Cormorant	13	Red-tailed Hawk	7
Downy Woodpecker	4	Red-winged Blackbird	203
Dunlin	2	Ring-billed Gull	80
Eastern Kingbird	1	Ring-necked Duck	4
European Starling	170	Rock Pigeon	27
Forster's Tern	22	Ruby-crowned Kinglet	5
Fox Sparrow	1	Ruddy Duck	617
Gadwall	74	Savannah Sparrow	1
Golden-crowned Kinglet	2	Semipalmated Sandpiper	173
Gray Catbird	5	Short-billed Dowitcher	5
Great Black-backed Gull	20	Snow Bunting	16
Great Blue Heron	5	Snowy Egret	38
Great Egret	74	Song Sparrow	61
Greater Yellowlegs	151	Spotted Sandpiper	1
Green Heron	1	Swamp Sparrow	1
Green-winged Teal	38	Tree Sparrow	5
Herring Gull	38	Tree Swallow	247
Hooded Merganser	12	Tri-colored Heron	1
House Finch	31	White-throated Sparrow	10
House Sparrow	22	Wilson's Snipe	1
Indigo Bunting	1	Wood Duck	1
Killdeer	6	Yellow Warbler	5
Laughing Gull	3	Yellowlegs Sp.	10
Least Sandpiper	12	Yellow-rumped Warbler	5
Grand Total	**4,897**		

Appendix 10. Continued

Kingsland Landfill

Species	# recorded	Species	# recorded
American Crow	266	House Finch	17
American Goldfinch	106	House Sparrow	1
American Kestrel	5	House Wren	3
American Pipit	3	Indigo Bunting	46
American Robin	323	Killdeer	42
Baltimore Oriole	2	Mallard	20
Barn Swallow	72	Merlin	1
Black Duck	1	Mourning Dove	186
Black-capped Chickadee	6	Northern Cardinal	9
Blue Jay	1	Northern Flicker	4
Bobolink	239	Northern Harrier	6
Brown Thrasher	1	Northern Mockingbird	10
Brown-headed Cowbird	95	Northern Rough-winged Swallow	6
Canada Goose	148	Notdone	0
Carolina Wren	3	Orchard Oriole	3
Cedar Waxwing	6	Palm Warbler	6
Chimney Swift	6	Peregrine Falcon	6
Chipping Sparrow	1	Red-tailed Hawk	19
Common Grackle	217	Red-winged Blackbird	1240
Common Merganser	6	Ring-billed Gull	20
Common Yellowthroat	47	Ring-necked Pheasant	30
Dark-eyed Junco	5	Rock Pigeon	26
Double-crested Cormorant	5	Ruby-crowned Kinglet	1
Downy Woodpecker	13	Savannah Sparrow	30
Eastern Kingbird	2	Sharp-shinned Hawk	3
Eastern Phoebe	2	Song Sparrow	155
European Starling	359	Spotted Sandpiper	2
Field Sparrow	2	Swamp Sparrow	4
Fish Crow	1	Tree Sparrow	7
Fox Sparrow	11	Tree Swallow	21
Gadwall	1	Warbling Vireo	12
Golden-crowned Kinglet	3	White-crowned Sparrow	2
Gray Catbird	20	White-throated Sparrow	52
Great Black-backed Gull	43	Willow Flycatcher	13
Green Heron	1	Yellow Warbler	25
Herring Gull	188	Yellow-rumped Warbler	19
Horned Lark	46		
Grand Total	**4,303**		

Kingsland Walkway

Species	# recorded	Species	# recorded
American Crow	176	Mallard X Black Duck Hybrid	1
American Robin	3	Marsh Wren	6
Barn Swallow	4	Mute Swan	113
Belted Kingfisher	1	Northern Cardinal	7
Black Duck	599	Northern Flicker	1
Black Skimmer	1	Northern Harrier	2
Black-crowned Night-Heron	14	Northern Mockingbird	5
Blue Jay	1	Northern Pintail	284
Brant	55	Northern Rough-winged Swallow	2
Bufflehead	70	Northern Shoveler	100
Canada Goose	86	Osprey	7
Canvasback	77	Peeps	125
Caspian Tern	4	Peregrine Falcon	2
Common Goldeneye	1	Red-breasted Merganser	15
Common Grackle	7	Red-tailed Hawk	5
Common Merganser	115	Red-winged Blackbird	35
Common Yellowthroat	2	Ring-billed Gull	601
Double-crested Cormorant	233	Ring-necked Duck	1
European Starling	12	Rock Pigeon	88
Forster's Tern	12	Ruddy Duck	60
Gadwall	409	Semipalmated Plover	8
Glaucous Gull	1	Semipalmated Sandpiper	10522
Great Black-backed Gull	192	Sharp-shinned Hawk	1
Great Blue Heron	14	Short-billed Dowitcher	1
Great Egret	198	Snow Bunting	20
Greater Yellowlegs	181	Snowy Egret	60
Green-winged Teal	998	Song Sparrow	57
Herring Gull	697	Spotted Sandpiper	11
Hooded Merganser	7	Swamp Sparrow	1
House Finch	3	Tree Sparrow	7
Killdeer	11	Tree Swallow	55
Laughing Gull	516	White-rumped Sandpiper	1
Least Sandpiper	1645	Willow Flycatcher	2
Lesser Yellowlegs	70	Yellow Warbler	3
Mallard	1762	Yellow-crowned Night-Heron	1
Grand Total	**20,387**		

Appendix 10. Continued

Laurel Hill Upland

Species	# recorded	Species	# recorded
American Crow	3	Great Egret	1
American Goldfinch	14	Herring Gull	21
American Kestrel	4	House Finch	6
American Robin	169	House Wren	8
American Woodcock	1	Indigo Bunting	6
Bald Eagle	1	Killdeer	19
Baltimore Oriole	7	Least Flycatcher	1
Barn Swallow	22	Louisiana Waterthrush	1
Belted Kingfisher	1	Magnolia Warbler	1
Black-capped Chickadee	25	Mallard	4
Black-crowned Night-Heron	2	Mourning Dove	72
Blue Jay	8	Northern Cardinal	16
Broad-winged Hawk	1	Northern Flicker	27
Brown Creeper	1	Northern Harrier	4
Brown Thrasher	3	Northern Mockingbird	53
Brown-headed Cowbird	29	Osprey	1
Canada Goose	25	Palm Warbler	5
Carolina Wren	7	Red-bellied Woodpecker	1
Cedar Waxwing	51	Red-tailed Hawk	12
Chimney Swift	9	Red-winged Blackbird	170
Chipping Sparrow	1	Ring-billed Gull	16
Common Grackle	185	Ring-necked Pheasant	14
Common Raven	23	Rock Pigeon	1
Common Yellowthroat	9	Ruby-crowned Kinglet	3
Dark-eyed Junco	23	Song Sparrow	47
Double-crested Cormorant	67	Swamp Sparrow	12
Downy Woodpecker	15	Tree Sparrow	45
Eastern Kingbird	2	Tree Swallow	7
Eastern Phoebe	3	Tufted Titmouse	2
Eastern Towhee	1	Warbling Vireo	9
Eastern Wood Pewee	1	White-breasted Nuthatch	2
European Starling	255	White-throated Sparrow	40
Fish Crow	2	Willow Flycatcher	16
Golden-crowned Kinglet	5	Wilson's Snipe	1
Gray Catbird	52	Yellow Warbler	16
Great Black-backed Gull	12	Yellow-bellied Sapsucker	1
Great Blue Heron	2	Yellow-rumped Warbler	10
Grand Total	**1,712**		

Losen Slote Forest

Species	# recorded	Species	# recorded
American Crow	7	House Wren	2
American Goldfinch	39	Magnolia Warbler	2
American Robin	62	Mourning Dove	6
Baltimore Oriole	3	Nashville Warbler	2
Black and White Warbler	7	Northern Cardinal	23
Black-capped Chickadee	58	Northern Flicker	29
Black-throated Blue Warbler	3	Northern Parula	2
Black-throated Green Warbler	4	Ovenbird	4
Blue Jay	65	Palm Warbler	1
Blue-winged Warbler	1	Red-bellied Woodpecker	25
Brown-headed Cowbird	5	Red-eyed Vireo	3
Canada Goose	1	Red-tailed Hawk	4
Canada Warbler	3	Red-winged Blackbird	15
Carolina Wren	13	Ring-billed Gull	5
Cedar Waxwing	6	Ring-necked Pheasant	5
Chestnut-sided Warbler	4	Rock Pigeon	40
Common Grackle	20	Ruby-crowned Kinglet	4
Common Yellowthroat	7	Sharp-shinned Hawk	3
Dark-eyed Junco	20	Song Sparrow	2
Downy Woodpecker	33	Swamp Sparrow	3
Eastern Phoebe	1	Tree Sparrow	2
Eastern Towhee	2	Tufted Titmouse	9
Eastern Wood Pewee	14	White-breasted Nuthatch	6
European Starling	2	White-throated Sparrow	13
Field Sparrow	1	Willow Flycatcher	3
Golden-crowned Kinglet	3	Winter Wren	1
Gray Catbird	22	Wood Thrush	1
Great Crested Flycatcher	1	Yellow Warbler	2
Hermit Thrush	3	Yellow-rumped Warbler	8
House Finch	1		
Grand Total	**636**		

Appendix 10. Continued

Lyndhurst Riverside

Species	# recorded	Species	# recorded
American Crow	1	Lesser Yellowlegs	4
American Goldfinch	3	Mallard	27
American Robin	12	Marsh Wren	57
Bald Eagle	1	Merlin	1
Bank Swallow	1	Mourning Dove	5
Barn Swallow	22	Northern Cardinal	1
Black-crowned Night-Heron	2	Northern Flicker	7
Blue Jay	4	Northern Harrier	4
Canada Goose	14	Osprey	1
Chimney Swift	1	Peeps	1
Clapper Rail	2	Red-tailed Hawk	2
Common Grackle	1	Red-winged Blackbird	199
Common Loon	1	Ring-billed Gull	16
Common Moorhen	1	Rock Pigeon	126
Common Yellowthroat	3	Ruby-crowned Kinglet	1
Double-crested Cormorant	63	Sharp-shinned Hawk	1
European Starling	5	Snowy Egret	11
Gadwall	2	Song Sparrow	1
Great Black-backed Gull	1	Spotted Sandpiper	1
Great Egret	4	Swamp Sparrow	45
Green Heron	1	Yellow Warbler	1
Green-winged Teal	3	Yellow-crowned Night-Heron	4
Herring Gull	12	Yellow-rumped Warbler	22
Grand Total	**698**		

Mehrhof Pond

Species	# recorded	Species	# recorded
American Coot	1	Killdeer	7
American Goldfinch	13	Least Sandpiper	2
American Robin	69	Lesser Scaup	345
Bald Eagle	1	Lesser Yellowlegs	25
Baltimore Oriole	4	Mallard	696
Barn Swallow	24	Mourning Dove	20
Belted Kingfisher	6	Northern Cardinal	12
Black Duck	6	Northern Flicker	5
Blackbird Sp.	30	Northern Harrier	2
Black-capped Chickadee	3	Northern Mockingbird	3
Blue Jay	29	Northern Rough-winged Swallow	4
Bobolink	2	Northern Shoveler	869
Brown-headed Cowbird	5	Palm Warbler	2
Bufflehead	5	Peeps	47
Canada Goose	1,700	Pied Billed Grebe	3
Carolina Wren	3	Purple Martin	1
Cedar Waxwing	48	Red-eyed Vireo	1
Chimney Swift	9	Red-tailed Hawk	7
Common Grackle	7	Red-winged Blackbird	229
Common Merganser	231	Ring-billed Gull	813
Common Yellowthroat	17	Ring-necked Duck	51
Double-crested Cormorant	32	Ring-necked Pheasant	8
Downy Woodpecker	7	Rock Pigeon	3
Eastern Kingbird	6	Ruddy Duck	18,609
European Starling	302	Savannah Sparrow	2
Fish Crow	2	Semipalmated Sandpiper	4
Fox Sparrow	3	Song Sparrow	34
Gadwall	82	Spotted Sandpiper	8
Gray Catbird	19	Swamp Sparrow	5
Great Black-backed Gull	66	Tree Swallow	23
Great Blue Heron	19	Warbling Vireo	6
Great Egret	12	White-crowned Sparrow	1
Greater Yellowlegs	29	White-throated Sparrow	8
Green Heron	4	Willow Flycatcher	12
Green-winged Teal	695	Wilson's Snipe	1
Herring Gull	24	Wood Duck	6
Hooded Merganser	91	Yellow Warbler	10
House Sparrow	6	Yellow-rumped Warbler	12
Grand Total	**25,508**		

Appendix 10. Continued

Mill Creek Marsh

Species	# recorded	Species	# recorded
American Goldfinch	22	Mallard X Black Duck Hybric	2
American Robin	41	Marsh Wren	12
Baltimore Oriole	1	Mourning Dove	132
Bank Swallow	2	Nashville Warbler	1
Barn Swallow	67	Northern Cardinal	20
Belted Kingfisher	4	Northern Flicker	3
Black Duck	32	Northern Harrier	8
Black Skimmer	4	Northern Mockingbird	20
Black-capped Chickadee	11	Northern Parula	1
Black-crowned Night-Heron	13	Northern Pintail	4
Blue Jay	4	Northern Shoveler	118
Blue-winged Teal	13	Northern Waterthrush	1
Brown-headed Cowbird	3	Orange-crowned Warbler	1
Canada Goose	434	Orchard Oriole	2
Canada Warbler	1	Palm Warbler	3
Cedar Waxwing	9	Peeps	88
Chimney Swift	2	Peregrine Falcon	3
Common Grackle	60	Pied Billed Grebe	1
Common Merganser	37	Prairie Warbler	1
Common Yellowthroat	2	Red-tailed Hawk	6
Cooper's Hawk	1	Red-winged Blackbird	283
Dark-eyed Junco	15	Ring-billed Gull	1368
Double-crested Cormorant	26	Ring-necked Pheasant	1
Downy Woodpecker	1	Rock Pigeon	12
European Starling	700	Ruby-crowned Kinglet	6
Fish Crow	2	Ruby-throated Hummingbird	1
Forster's Tern	6	Ruddy Duck	1
Gadwall	130	Semipalmated Plover	4
Golden-crowned Kinglet	2	Semipalmated Sandpiper	4970
Gray Catbird	12	Sharp-shinned Hawk	1
Great Black-backed Gull	33	Short-billed Dowitcher	5
Great Blue Heron	10	Snowy Egret	116
Great Egret	55	Song Sparrow	187
Greater Yellowlegs	179	Spotted Sandpiper	15
Green Heron	1	Swamp Sparrow	4
Green-winged Teal	1884	Tree Sparrow	3
Herring Gull	73	Tree Swallow	99
Hooded Merganser	25	Warbling Vireo	1
House Finch	5	White-rumped Sandpiper	1
House Sparrow	4	White-throated Sparrow	3
Hudsonian Godwit	1	Willow Flycatcher	7
Indigo Bunting	1	Wilson's Snipe	1
Killdeer	14	Wood Duck	1
Least Sandpiper	214	Yellow Warbler	22
Lesser Yellowlegs	12	Yellow-crowned Night-Heron	1
Mallard	1823	Yellow-rumped Warbler	16
Grand Total	**13,547**		

Oritani Marsh

Species	# recorded	Species	# recorded
American Crow	12	Indigo Bunting	1
American Goldfinch	8	Killdeer	1
American Robin	51	Laughing Gull	8
Baltimore Oriole	3	Lesser Yellowlegs	7
Barn Swallow	66	Mallard	58
Belted Kingfisher	1	Marsh Wren	26
Black Duck	10	Mourning Dove	17
Black Skimmer	4	Northern Cardinal	4
Black-capped Chickadee	8	Northern Flicker	4
Black-crowned Night-Heron	16	Northern Harrier	11
Bobolink	9	Northern Mockingbird	2
Brown Thrasher	1	Osprey	2
Brown-headed Cowbird	1	Palm Warbler	1
Canada Goose	36	Peeps	17
Cedar Waxwing	6	Peregrine Falcon	3
Clapper Rail	1	Red-tailed Hawk	35
Common Grackle	6	Red-winged Blackbird	772
Common Merganser	12	Ring-billed Gull	95
Common Yellowthroat	43	Rock Pigeon	98
Cooper's Hawk	2	Rough-legged Hawk	4
Double-crested Cormorant	91	Ruddy Duck	4
Downy Woodpecker	5	Savannah Sparrow	12
Eastern Kingbird	2	Sharp-tailed Sparrow	1
Eastern Phoebe	2	Snowy Egret	11
European Starling	115	Song Sparrow	54
Gadwall	8	Spotted Sandpiper	6
Gray Catbird	16	Swamp Sparrow	88
Great Black-backed Gull	27	Tree Sparrow	6
Great Blue Heron	7	Tree Swallow	80
Great Egret	15	Turkey Vulture	4
Greater Yellowlegs	27	White-crowned Sparrow	1
Green-winged Teal	94	White-throated Sparrow	3
Hermit Thrush	1	Willow Flycatcher	14
Herring Gull	117	Yellow Warbler	8
Hooded Merganser	15	Yellow-rumped Warbler	8
Grand Total	**2,304**		

Appendix 10. Continued

Resources Metro Marsh

Species	# recorded	Species	# recorded
American Crow	13	Killdeer	41
American Goldfinch	31	Least Sandpiper	82
American Kestrel	1	Lesser Yellowlegs	2
American Pipit	2	Mallard	541
American Robin	36	Marsh Wren	263
Bald Eagle	1	Merlin	1
Bank Swallow	3	Mourning Dove	96
Barn Swallow	202	Northern Cardinal	5
Belted Kingfisher	2	Northern Flicker	10
Black Duck	49	Northern Goshawk	1
Black Skimmer	4	Northern Harrier	30
Black-capped Chickadee	6	Northern Mockingbird	28
Black-crowned Night-Heron	2	Osprey	8
Blue Jay	3	Palm Warbler	19
Bobolink	25	Peeps	71
Brown-headed Cowbird	8	Peregrine Falcon	9
Canada Goose	404	Red-tailed Hawk	53
Carolina Wren	7	Red-winged Blackbird	772
Cedar Waxwing	15	Ring-billed Gull	74
Chimney Swift	12	Ring-necked Pheasant	11
Clapper Rail	4	Rock Pigeon	92
Common Grackle	7	Rough-legged Hawk	4
Common Merganser	2	Ruby-crowned Kinglet	1
Common Moorhen	11	Ruby-throated Hummingbird	3
Common Yellowthroat	62	Saltmarsh Sharp-tailed Sparrow	1
Cooper's Hawk	1	Savannah Sparrow	21
Double-crested Cormorant	38	Semipalmated Plover	5
Downy Woodpecker	3	Semipalmated Sandpiper	2
Eastern Kingbird	19	Sharp-shinned Hawk	1
European Starling	711	Snow Goose	1
Field Sparrow	2	Snowy Egret	33
Fish Crow	3	Song Sparrow	147
Forster's Tern	14	Spotted Sandpiper	6
Gadwall	30	Swamp Sparrow	114
Golden-crowned Kinglet	2	Tree Sparrow	8
Gray Catbird	16	Tree Swallow	44
Great Black-backed Gull	13	Turkey Vulture	3
Great Blue Heron	16	Warbling Vireo	5
Great Cormorant	1	White-crowned Sparrow	2
Great Egret	13	White-throated Sparrow	10
Greater Yellowlegs	18	Willow Flycatcher	11
Green-winged Teal	1286	Wood Duck	1
Herring Gull	46	Yellow Warbler	21
House Wren	1	Yellowlegs Sp.	3
Indigo Bunting	1	Yellow-rumped Warbler	25
Grand Total	**5,827**		

Riverbend Marsh

Species	# recorded	Species	# recorded
American Bittern	1	Least Bittern	1
American Goldfinch	3	Lesser Yellowlegs	2
American Kestrel	2	Mallard	29
American Robin	12	Marsh Wren	101
Barn Swallow	69	Merlin	1
Black Duck	3	Mourning Dove	3
Black Skimmer	1	Northern Flicker	1
Black-capped Chickadee	3	Northern Harrier	1
Boat-tailed Grackle	1	Northern Mockingbird	3
Bobolink	4	Palm Warbler	4
Canada Goose	40	Peeps	22
Clapper Rail	12	Peregrine Falcon	2
Common Grackle	13	Red-tailed Hawk	1
Common Yellowthroat	5	Red-winged Blackbird	194
Cooper's Hawk	1	Ring-billed Gull	8
Double-crested Cormorant	8	Ring-necked Pheasant	1
European Starling	173	Rock Pigeon	50
Forster's Tern	1	Saltmarsh Sharp-tailed Sparrow	8
Gadwall	11	Savannah Sparrow	6
Great Black-backed Gull	7	Sharp-shinned Hawk	1
Great Blue Heron	4	Song Sparrow	7
Great Egret	6	Swamp Sparrow	14
Green Heron	2	Tree Swallow	4
Green-winged Teal	2	Virginia Rail	1
Herring Gull	33	Warbling Vireo	1
House Finch	1	Willow Flycatcher	1
Killdeer	6	Yellow-rumped Warbler	22
Laughing Gull	39		
Grand Total	**952**		

Appendix 10. Continued

Sawmill Landfill 1 E

Species	# recorded	Species	# recorded
American Crow	362	Laughing Gull	56
American Goldfinch	66	Least Sandpiper	72
American Kestrel	2	Least Tern	1
American Pipit	3	Lesser Yellowlegs	29
American Robin	119	Lincoln's Sparrow	2
Bank Swallow	1	Mallard	301
Barn Swallow	81	Merlin	1
Black Duck	16	Mourning Dove	74
Black Skimmer	1	Northern Cardinal	1
Black-billed Cuckoo	1	Northern Flicker	7
Black-crowned Night-Heron	5	Northern Harrier	22
Blue Grosbeak	4	Northern Mockingbird	4
Blue Jay	57	Northern Rough-winged Swallow	7
Blue-winged Teal	1	Northern Shoveler	3
Bobolink	36	Orchard Oriole	7
Brown-headed Cowbird	45	Palm Warbler	6
Canada Goose	294	Pectoral Sandpiper	2
Cedar Waxwing	13	Peeps	3
Chimney Swift	55	Red-tailed Hawk	55
Common Grackle	136	Red-winged Blackbird	793
Common Merganser	1	Ring-billed Gull	220
Common Yellowthroat	64	Ring-necked Pheasant	63
Cooper's Hawk	3	Rock Pigeon	47
Dark-eyed Junco	4	Ruby-crowned Kinglet	1
Double-crested Cormorant	3	Savannah Sparrow	103
Downy Woodpecker	2	Semipalmated Sandpiper	55
Eastern Kingbird	1	Sharp-shinned Hawk	4
European Starling	1251	Snow Bunting	37
Field Sparrow	2	Snowy Egret	19
Gadwall	162	Song Sparrow	274
Golden-crowned Kinglet	1	Spotted Sandpiper	27
Gray Catbird	9	Swamp Sparrow	21
Great Black-backed Gull	218	Tree Sparrow	15
Great Blue Heron	1	Tree Swallow	29
Great Egret	16	Warbling Vireo	1
Greater Yellowlegs	35	White-crowned Sparrow	8
Green-winged Teal	89	White-throated Sparrow	39
Hermit Thrush	1	Willow Flycatcher	17
Herring Gull	1863	Wilson's Phalarope	1
Horned Lark	26	Wilson's Snipe	5
House Sparrow	2	Yellow Warbler	10
Indigo Bunting	16	Yellow-rumped Warbler	8
Killdeer	166		
Grand Total	**7,684**		

Sawmill WMA

Species	# recorded	Species	# recorded
American Coot	1	Killdeer	18
American Crow	39	Laughing Gull	667
American Goldfinch	16	Least Bittern	2
American Robin	37	Least Sandpiper	532
American Wigeon	5	Lesser Yellowlegs	92
Bald Eagle	3	Mallard	976
Barn Swallow	137	Mallard X Black Duck Hybrid	1
Belted Kingfisher	4	Marsh Wren	157
Black Duck	631	Mourning Dove	4
Black Skimmer	27	Mute Swan	78
Black-bellied Plover	2	Northern Flicker	1
Black-capped Chickadee	2	Northern Harrier	8
Black-crowned Night-Heron	27	Northern Mockingbird	3
Blue-winged Teal	7	Northern Pintail	427
Boat-tailed Grackle	1	Osprey	22
Bobolink	6	Palm Warbler	2
Brant	7	Peeps	2389
Brown-headed Cowbird	26	Peregrine Falcon	2
Bufflehead	102	Pied-billed Grebe	1
Canada Goose	857	Red-breasted Merganser	16
Canvasback	263	Red-shouldered Hawk	1
Caspian Tern	1	Red-tailed Hawk	21
Cedar Waxwing	7	Red-winged Blackbird	428
Chimney Swift	10	Ring-billed Gull	2133
Clapper Rail	8	Rock Pigeon	67
Common Grackle	83	Ruby-throated Hummingbird	1
Common Merganser	69	Ruddy Duck	6
Common Moorhen	11	Savannah Sparrow	2
Common Yellowthroat	6	Seaside Sparrow	1
Double-crested Cormorant	1095	Semipalmated Plover	48
Dunlin	14	Semipalmated Sandpiper	2547
Eastern Kingbird	1	Short-eared Owl	1
European Starling	217	Snowy Egret	212
Forster's Tern	57	Song Sparrow	64
Gadwall	499	Spotted Sandpiper	18
Gray Catbird	2	Swamp Sparrow	10
Great Black-backed Gull	219	Tree Sparrow	21
Great Blue Heron	37	Tree Swallow	22
Great Cormorant	21	Turkey Vulture	1
Great Egret	160	Virginia Rail	1
Greater Yellowlegs	193	White-throated Sparrow	8
Green-winged Teal	1529	Yellow-crowned Night-Heron	2
Herring Gull	1437	Yellowlegs Sp.	37
Hooded Merganser	4	Yellow-rumped Warbler	8
House Finch	19		
Grand Total	**18,957**		

Appendix 10. Continued

Schmidt's Woods

Species	# recorded	Species	# recorded
American Crow	1	Great-crested Flycatcher	1
American Goldfinch	16	Hairy Woodpecker	1
American Redstart	1	Hermit Thrush	2
American Robin	38	House Finch	3
Baltimore Oriole	1	Northern Cardinal	9
Black and White Warbler	2	Northern Flicker	15
Black-capped Chickadee	25	Ovenbird	1
Black-throated Blue Warbler	1	Palm Warbler	1
Blue Jay	24	Pine Siskin	7
Brown-headed Cowbird	2	Red-bellied Woodpecker	14
Carolina Wren	10	Red-eyed Vireo	2
Common Grackle	41	Red-tailed Hawk	3
Dark-eyed Junco	20	Red-winged Blackbird	32
Downy Woodpecker	20	Ruby-crowned Kinglet	2
Eastern Wood Pewee	2	Song Sparrow	1
European Starling	37	Tufted Titmouse	29
Fish Crow	6	White-breasted Nuthatch	13
Fox Sparrow	3	White-throated Sparrow	82
Golden-crowned Kinglet	1	Wood Thrush	1
Gray Catbird	2	Yellow-crowned Night-Heron	1
Grand Total	**473**		

Secaucus H.S. Marsh

Species	# recorded	Species	# recorded
American Robin	10	Mourning Dove	5
Barn Swallow	14	Northern Cardinal	1
Black-capped Chickadee	1	Northern Flicker	1
Canada Goose	28	Northern Mockingbird	3
Common Grackle	14	Palm Warbler	1
Common Merganser	1	Peeps	65
Double-crested Cormorant	1	Red-tailed Hawk	3
Downy Woodpecker	2	Red-winged Blackbird	143
European Starling	104	Ring-billed Gull	31
Fish Crow	2	Short-billed Dowitcher	2
Gadwall	3	Snowy Egret	36
Great Black-backed Gull	8	Solitary Sandpiper	1
Great Egret	2	Song Sparrow	5
Greater Yellowlegs	3	Spotted Sandpiper	3
Herring Gull	11	Swamp Sparrow	1
Killdeer	19	Tree Sparrow	2
Least Sandpiper	2	Tree Swallow	1
Lesser Yellowlegs	5	Willow Flycatcher	1
Mallard	16	Wilson's Snipe	1
Marsh Wren	3		
Grand Total	**555**		

Appendix 10. Continued

Teterboro Woods

Species	# recorded	Species	# recorded
American Crow	7	Hermit Thrush	4
American Goldfinch	45	Herring Gull	6
American Kestrel	1	House Finch	1
American Redstart	1	House Sparrow	1
American Robin	236	House Wren	1
American Woodcock	1	Mallard	3
Baltimore Oriole	24	Mourning Dove	51
Barn Swallow	8	Northern Cardinal	52
Black and White Warbler	9	Northern Flicker	33
Black-capped Chickadee	45	Northern Mockingbird	7
Black-throated Green Warbler	2	Northern Parula	2
Blue Jay	200	Ovenbird	6
Blue-gray Gnatcatcher	2	Palm Warbler	3
Blue-headed Vireo	2	Red-bellied Woodpecker	34
Brown Thrasher	7	Red-breasted Nuthatch	1
Brown-headed Cowbird	10	Red-eyed Vireo	2
Canada Goose	40	Red-tailed Hawk	14
Carolina Wren	47	Red-winged Blackbird	140
Cedar Waxwing	18	Ring-billed Gull	35
Chimney Swift	4	Rock Pigeon	17
Common Grackle	114	Ruby-crowned Kinglet	5
Common Yellowthroat	21	Ruby-throated Hummingbird	4
Cooper's Hawk	2	Rusty Blackbird	31
Dark-eyed Junco	20	Scarlet Tanager	2
Downy Woodpecker	71	Sharp-shinned Hawk	8
Eastern Kingbird	7	Song Sparrow	51
Eastern Phoebe	7	Swamp Sparrow	4
Eastern Towhee	27	Tufted Titmouse	47
Eastern Wood Pewee	2	Turkey Vulture	1
European Starling	51	Warbling Vireo	9
Field Sparrow	2	White-breasted Nuthatch	13
Fox Sparrow	4	White-throated Sparrow	92
Golden-crowned Kinglet	7	Willow Flycatcher	7
Gray Catbird	92	Winter Wren	1
Great Blue Heron	1	Wood Thrush	6
Great-crested Flycatcher	2	Yellow Warbler	12
Hairy Woodpecker	12	Yellow-rumped Warbler	8
Grand Total	**1,865**		

Western Brackish Marsh

Species	# recorded	Species	# recorded
American Crow	2	Marsh Wren	45
American Goldfinch	1	Mourning Dove	21
American Robin	17	Northern Cardinal	11
Bald Eagle	1	Northern Flicker	4
Barn Swallow	69	Northern Harrier	1
Belted Kingfisher	3	Northern Mockingbird	4
Black Skimmer	3	Northern Rough-winged Swallow	1
Black-capped Chickadee	4	Northern Waterthrush	1
Black-crowned Night-Heron	10	Osprey	2
Blue Jay	4	Palm Warbler	5
Brown-headed Cowbird	125	Peeps	26
Canada Goose	71	Peregrine Falcon	1
Chimney Swift	1	Red-tailed Hawk	7
Common Grackle	6	Red-winged Blackbird	153
Common Yellowthroat	8	Ring-billed Gull	82
Cooper's Hawk	3	Rock Pigeon	2
Double-crested Cormorant	32	Ruby-crowned Kinglet	3
Downy Woodpecker	1	Ruddy Duck	1
European Starling	198	Savannah Sparrow	3
Fish Crow	1	Semipalmated Plover	2
Forster's Tern	7	Semipalmated Sandpiper	396
Gadwall	24	Sharp-shinned Hawk	1
Golden-crowned Kinglet	3	Snowy Egret	48
Gray Catbird	19	Solitary Sandpiper	1
Great Black-backed Gull	7	Song Sparrow	45
Great Blue Heron	13	Swamp Sparrow	6
Great Egret	22	Tree Sparrow	3
Greater Yellowlegs	14	Tree Swallow	43
Green-winged Teal	408	Warbling Vireo	1
Herring Gull	32	White-throated Sparrow	4
Killdeer	13	Willow Flycatcher	13
Laughing Gull	4	Wilson's Snipe	1
Least Sandpiper	33	Yellow Warbler	20
Lesser Yellowlegs	6	Yellow-rumped Warbler	19
Mallard	135		
Grand Total	**2,276**		

Appendix 11. Total number of sightings of each species recorded in the Meadowlands District between September 6, 2005 and September 5, 2006 by survey period. Table is arranged by species in alphabetical order.

	Survey starting Year 1 (2004-2005)																		
Species	**30-Aug**	**15-Sep**	**29-Sep**	**18-Oct**	**1-Nov**	**17-Nov**	**6-Dec**	**29-Dec**	**22-Jan**	**9-Feb**	**14-Mar**	**30-Mar**	**18-Apr**	**4-May**	**19-May**	**13-Jun**	**7-Jul**	**1-Aug**	**15-Aug**
American Bittern																			2
American Coot	2	1		2	7	1	1					2							
American Crow	3		1	41	180	126	92	125	70	43	10	14	7	1		3			
American Goldfinch	20	7	33	32	34	21	18	15	4	9	6	10	10	14	4	9	10	14	18
American Kestrel	2	2	3	1		1							1						
American Kestrel (M)																			
American Pipit												1							
American Redstart														1					
American Robin	25	34	53	57	124	56	5	1	3	1	5	95	71	41	39	52	41	55	76
American Wigeon										1	10								
American Woodcock															1				
Bald Eagle	1																		
Bald Eagle (Ad)				1		2	1	1	1	1									
Bald Eagle (Imm.)																			
Baltimore Oriole														4	4	7	2	6	7
Bank Swallow														24					
Barn Swallow	20		1									1	57	178	87	131	135	156	70
Belted Kingfisher	2	2	5	6	6	2	1											2	
Black and White Warbler			1										2	2					2
Black Duck	3	7	7	111	90	132	93	154	34	97	77	38	11	10	2		2	3	3
Black Skimmer																21	14		
Black-bellied Plover					2														
Black-billed Cuckoo	1																		1
Blackbird Sp.								45											
Black-capped Chickadee			7	13	19	19	3	6	12	8	10	8	2	4	1	1	1		
Black-crowned Night-Heron	11	3	1			1						11	19	4	9	14	11	7	9
Black-necked Stilt				1															
Black-throated Blue Warbler														1					
Black-throated Green Warbler														1					
Blue Grosbeak																1			1
Blue Jay	3	57	29	1		1		2	2	1	1	2	8	36	2	3	7	3	5
Blue-gray Gnatcatcher														1				1	
Blue-headed Vireo													2						
Blue-winged Teal	1											4							
Blue-winged Warbler																			
Boat-tailed Grackle																			
Bobolink	322	63	3											3	1		1	2	23
Bonaparte's Gull																			
Brant				7											55				
Brewster's Warbler														1					

Appendix 11. Total number of sightings of each species recorded in the Meadowlands District between September 6, 2005 and September 5, 2006 by survey period. Table is arranged by species in alphabetical order.

	Survey starting																		
	Year 1 (2004-2005)																		
Species	**30-Aug**	**15-Sep**	**29-Sep**	**18-Oct**	**1-Nov**	**17-Nov**	**6-Dec**	**29-Dec**	**22-Jan**	**9-Feb**	**14-Mar**	**30-Mar**	**18-Apr**	**4-May**	**19-May**	**13-Jun**	**7-Jul**	**1-Aug**	**15-Aug**
Broad-winged Hawk		1																	
Brown Creeper																			
Brown Thrasher															1		1		1
Brown-headed Cowbird	1		68		139							44	18	8	3	8			
Bufflehead					15	31	25	4	18	9	7	21							
Canada Goose	126	77	277	209	224	259	398	275	283	109	82	116	240	166	344	171	146	95	160
Canada Warbler			1																3
Canvasback									93	37	6								
Carolina Wren	1	1	1	3	2	2	3	1	3	1	1	8	4	3	1	3	3	4	6
Caspian Tern	3		5																1
Cedar Waxwing	33	82		4	3											13	4	6	10
Chestnut-sided Warbler			1																1
Chimney Swift	9		5											21	8	10	3	10	14
Chipping Sparrow																			
Clapper Rail			1											3	1	3	2		
Cliff Swallow														6					
Common Goldeneye						1													
Common Grackle				1	106	1			1		145	29	64	27	37	24	11	11	1
Common Loon	1											1							
Common Merganser						55	134	122	39	134	94	20							
Common Moorhen												1	2	5	4	3	5	1	2
Common Raven					1								2						
Common Tern																			
Common Yellowthroat	15	9	9										3	44	51	37	51	16	12
Cooper's Hawk	1		3		1		1	1											
Dark-eyed Junco			1	8	31	21	2	1			1								
Double-crested Cormorant	127	232	1189	397	192	122	89	17	2	6	26	30	69	28	36	34	27	59	221
Downy Woodpecker	3	3	11	6	1	5	5	5	7	9	9	10	8	2	2	4	10	6	6
Dunlin				18										1					
Eastern Kingbird	1													1	5	1	4	5	28
Eastern Meadowlark																			
Eastern Phoebe		2	1	7							1	3					1		1
Eastern Towhee			1										1	2	1	2	1		
Eastern Wood Pewee	2													1	1	1	1	1	2
Eurasian Wigeon										1	1								
European Starling	373	456	311	450	98	181	380	155	39	17	9	37	58	51	46	79	108	401	387
Field Sparrow			5	1	1							1							
Fish Crow	2					1					2	1	2	3		1			
Forster's Tern													4	5		1	8	48	3
Fox Sparrow					2	2	1	1	1	1	1								
Gadwall	13	11	47	98	170	49	98	9	45	62	82	28	48	47	30	49	62	21	55
Glaucous Gull																			
Golden-crowned Kinglet				8								1							

Appendix 11. Total number of sightings of each species recorded in the Meadowlands District between September 6, 2005 and September 5, 2006 by survey period. Table is arranged by species in alphabetical order.

	Survey starting																		
	Year 1 (2004-2005)																		
Species	**30-Aug**	**15-Sep**	**29-Sep**	**18-Oct**	**1-Nov**	**17-Nov**	**6-Dec**	**29-Dec**	**22-Jan**	**9-Feb**	**14-Mar**	**30-Mar**	**18-Apr**	**4-May**	**19-May**	**13-Jun**	**7-Jul**	**1-Aug**	**15-Aug**
Grasshopper Sparrow				1															
Gray Catbird	22	17	16	4										13	26	29	17	23	22
Great Black-backed Gull	68	33	41	37	54	101	53	74	97	70	32	45	19	23	13	14	14	28	27
Great Blue Heron	15	7	14	13	13	10	9	5	1	1		3	2		6		9	10	10
Great Cormorant							1	1	3	10		2							
Great Crested Flycatcher																1			
Great Egret	82	48	87	75	18	10						13	11	20	24	32	27	50	58
Great-crested Flycatcher																			
Greater Yellowlegs	30	126	103	105	48	2	1	1				8	25	196	8		18	12	22
Green Heron	1	1	1											1		1			1
Green-winged Teal	68	320	608	890	1010	1991	465	24	10	14	289	119	156	16				7	24
Hairy Woodpecker				1		1	1	1		1									
Hermit Thrush				3	2														
Herring Gull	95	158	455	77	327	298	486	290	572	429	239	64	61	73	29	47	64	41	90
Hooded Merganser					15	20	27	23	3	30	31	2	1						
Horned Lark																			
House Finch	2					15	4	28	1	1	1				5	2		1	13
House Sparrow			1		2	7	2					2	3	4	5	3	4	2	4
House Wren															1	3	1	2	1
Hudsonian Godwit																			
Indigo Bunting	1	4	1												10	19	13	7	
Killdeer	6	30	3	7	12		1				11	23	19	12	21	21	23	46	21
Laughing Gull	165	241	144	388	85												4	29	139
Least Bittern																		1	1
Least Flycatcher														1					
Least Sandpiper	62	20	25										21	1118	648	2	113	11	11
Least Tern														2	1	1	2		
Lesser Black-backed Gull										1									
Lesser Scaup					3	16	16												
Lesser Yellowlegs	25	59	17	3								5	21	188	1	1	29	28	21
Lincoln's Sparrow					1														
Louisiana Waterthrush												1						1	
Magnolia Warbler															1				
Mallard	333	265	209	288	326	290	248	263	19	183	155	176	222	188	375	571	547	394	261
Mallard x Black Duck Hybrid					1			1		1		1							
Mallard X Black Hybrid																			
Marsh Wren	19	10	4	1	1	1	1						6	42	86	100	94	51	22
Merlin		1	1		1			1					1						
Mourning Dove	49	51	36	38	31	21	37	10	1	13	13	9	14	8	20	25	49	53	50
Mute Swan	57	41	35	32	12	31	19	1	9	18	12	10	15	6	28	10	34	31	28
Nashville Warbler			2																
Northern Cardinal	3			7	4	7	5	3	6	4	14	14	17	9	7	8	4	4	6
Northern Flicker	5	9	7	5	1	2	1				1	15	10	4	5	6	10	15	8

Appendix 11. Total number of sightings of each species recorded in the Meadowlands District between September 6, 2005 and September 5, 2006 by survey period. Table is arranged by species in alphabetical order.

	Survey starting																		
	Year 1 (2004-2005)																		
Species	**30-Aug**	**15-Sep**	**29-Sep**	**18-Oct**	**1-Nov**	**17-Nov**	**6-Dec**	**29-Dec**	**22-Jan**	**9-Feb**	**14-Mar**	**30-Mar**	**18-Apr**	**4-May**	**19-May**	**13-Jun**	**7-Jul**	**1-Aug**	**15-Aug**
Northern Goshawk		1																	
Northern Harrier	1	8	5	6	6	10	8	6	10	3	2	8	5	5	2	1		1	
Northern Harrier (F)																			
Northern Harrier (Juv)																			2
Northern Harrier (M & F)																			
Northern Harrier (M)																			
Northern Mockingbird	11	8	3	4	5	5	3	4	1		3	6	4	8	5	7	11	7	14
Northern Parula														1					
Northern Pintail			1	60	32	60	55	60	4	13	45								
Northern Rough-winged Swallow												1	1	7	3	5	2	4	
Northern Shoveler		17	9	40	69	92	161	43		59	42	22	8	1					
Northern Waterthrush																		1	
Orange-crowned Warbler																			
Orchard Oriole														1	1	5	1		
Osprey	15	10	4										1		1	5	1	3	4
Ovenbird														3					1
Palm Warbler		6	11	2								4	2						
Pectoral Sandpiper	2			6														1	
Peeps	15	200												226	132		903	368	111
Peregrine Falcon			2	3	1	1		1		1					1	1			1
Peregrine Falcon (Juv)							1												
Pied Billed Grebe	2		2			2						2							
Pied-billed Grebe																			
Pine Siskin							7												
Prairie Warbler	1				1														
Purple Martin																			
Red-bellied Woodpecker			1	1	2		2	1	2	3	1	2	3	2	1	1	3	3	
Red-breasted Merganser					4	25			7	15	6		1						
Red-breasted Nuthatch																			
Red-eyed Vireo														3	1				
Red-shouldered Hawk																			
Red-tailed Hawk	1	3	1	15	20	34	26	29	29	22	22	10	8		3	3	3	1	1
Red-winged Blackbird	66	77	262	663	469	106	138	18	154	87	124	224	289	251	268	298	278	173	140
Ring-billed Gull	143	85	457	578	445	655	315	297	183	271	342	228	191	174	42	18	42	197	100
Ring-necked Duck						1	1	5			48	5							
Ring-necked Pheasant		2	8	4	2	2	1	2	4	2	5	12	20	8	8	12	4	5	4
Rock Pigeon	67	75	152	7	20	39	2	37	7	9	6	78	11	23	6	10	37	78	48
Rough-legged Hawk									8										
Ruby-crowned Kinglet				6		1	1					4	2						
Ruby-throated Hummingbird	3	1																	1
Ruddy Duck	5	1	40	363	799	2035	2281	207		376	1278	532	206	1	4	8	3	9	
Rusty Blackbird																			
Saltmarsh Sharp-tailed Sparrow																1		1	

Appendix 11. Total number of sightings of each species recorded in the Meadowlands District between September 6, 2005 and September 5, 2006 by survey period. Table is arranged by species in alphabetical order.

	Survey starting																		
	Year 1 (2004-2005)																		
Species	**30-Aug**	**15-Sep**	**29-Sep**	**18-Oct**	**1-Nov**	**17-Nov**	**6-Dec**	**29-Dec**	**22-Jan**	**9-Feb**	**14-Mar**	**30-Mar**	**18-Apr**	**4-May**	**19-May**	**13-Jun**	**7-Jul**	**1-Aug**	**15-Aug**
Savannah Sparrow		36	70	28	20	11	5	16	3	4		4	5	6					
Scarlet Tanager																			
Seaside Sparrow																			
Semipalmated Plover	2	3												4	8		6	12	26
Semipalmated Sandpiper	387	115	4											19	99		503	11579	189
Sharp-shinned Hawk		4	2	4	2		1												
Sharp-tailed Sparrow				1															
Short-billed Dowitcher	2	2													3				
Short-eared Owl																			
Snow Bunting					7	30													
Snow Goose						1													
Snowy Egret	60	73	76	20	1							1	11	8	13	57	44	67	124
Solitary Sandpiper		1																	
Song Sparrow	17	23	70	85	42	38	20	29	30	22	29	58	68	51	64	71	86	48	9
Spotted Sandpiper			1										4	9	21	14	18	4	2
Swamp Sparrow		13	27	47	8	22	13	4	3		3	4	41	39	36	31	26	25	4
Tree Sparrow					7	17	20	9	14	7	3								
Tree Swallow			11									80	89	116	69	61	20	1	
Tri-colored Heron		1																	
Tufted Titmouse		1	5	3		1		1	5	2	3	1	3	1	2	2	4	3	1
Turkey Vulture					1	2							2						
Virginia Rail													1	1	1				
Warbling Vireo														6	9	5	3	1	1
White-breasted Nuthatch		2	2	2	2	3	3	2			1								
White-crowned Sparrow			2	5	2														
White-rumped Sandpiper	1																	1	
White-throated Sparrow		1	11	42	18	10	16	10	3	10	8	4	14						
Willow Flycatcher														8	40	16	11	3	
Wilson's Phalarope																			1
Wilson's Snipe		1	3									1	4						
Winter Wren				1			1												
Wood Duck			6	1								2			7	1		5	1
Wood Thrush														1	1				
Yellow Warbler	2	2											6	37	36	27	7	8	1
Yellow-bellied Sapsucker			2																
Yellow-crowned Night-Heron													1				1	1	
Yellowlegs sp.			10										20	12			3		25
Yellow-rumped Warbler			65	58	2	1							16	5					
Grand Total	**3,038**	**3,263**	**5,216**	**5,513**	**5,402**	**7,119**	**5,808**	**2,447**	**1,846**	**2,229**	**3,355**	**2,342**	**2,374**	**3,711**	**2,983**	**2,242**	**3,768**	**14,390**	**2,782**

Appendix 11. Total number of individuals of each species recorded in the Meadowlands District between September 6, 2005 and September 5, 2006 by survey period. Table is arranged by species in alphabetical order.

	Survey starting																		
	Year 2 (2005-2006)																		
Species	**6-Sept**	**21-Sept**	**11-Oct**	**3-Nov**	**17-Nov**	**5-Dec**	**22-Dec**	**12-Jan**	**1-Feb**	**19-Feb**	**13-Mar**	**30-Mar**	**14-Apr**	**1-May**	**22-May**	**13-Jun**	**5-Jul**	**24-Jul**	**13-Aug**
American Bittern		1																	
American Coot			1	10	4		1	1			5								
American Crow			1	63	76	118	108	62	27	22	2		1	1			4		
American Goldfinch	10	2	4	13	12	7	5	4	15	3	3	14	14	24	2	10	13	17	17
American Kestrel	1	1	3				1	1	1			1	1	1			1		1
American Kestrel (M)		1	1																
American Pipit				7															
American Redstart		1																	
American Robin	213	44	108	71	14	14	22	1	3	36	60	86	53	33	36	43	52	41	69
American Wigeon									2	1	8	3	1						
American Woodcock			1							1	1								
Bald Eagle		1	1																
Bald Eagle (Ad)																			
Bald Eagle (Imm.)			1																
Baltimore Oriole														7	4	5	1		5
Bank Swallow														24					2
Barn Swallow	92											2	25	138	101	148	142	105	198
Belted Kingfisher	1	4	6	7	1		3	3	1	2			1				1		6
Black and White Warbler		1											1	7					3
Black Duck	13	5	41	16	57	76	95	101	76	75	98	30	7	6		5	5	6	
Black Skimmer															4	20	24	3	
Black-bellied Plover														2					
Black-billed Cuckoo	1																		
Blackbird Sp.																			
Black-capped Chickadee		5	24	19	6	11	12	23	17	18	8	4	4		3	1	1	1	3
Black-crowned Night-Heron	1	3		2			6						4	9	21	22	18	11	12
Black-necked Stilt																			
Black-throated Blue Warbler														3					
Black-throated Green Warbler			2											4					
Blue Grosbeak															1		1		
Blue Jay	12	19	33	16	11	23	12	15	18	17	17	24	31	10	2	4	6	7	6
Blue-gray Gnatcatcher																			
Blue-headed Vireo																			
Blue-winged Teal	13	1												5		1			9
Blue-winged Warbler																			1
Boat-tailed Grackle														2	1				
Bobolink	4	3																	30
Bonaparte's Gull			2																
Brant																1			
Brewster's Warbler																			

Appendix 11. Total number of individuals of each species recorded in the Meadowlands District between September 6, 2005 and September 5, 2006 by survey period. Table is arranged by species in alphabetical order.

	Survey starting																		
	Year 2 (2005-2006)																		
Species	**6-Sept**	**21-Sept**	**11-Oct**	**3-Nov**	**17-Nov**	**5-Dec**	**22-Dec**	**12-Jan**	**1-Feb**	**19-Feb**	**13-Mar**	**30-Mar**	**14-Apr**	**1-May**	**22-May**	**13-Jun**	**5-Jul**	**24-Jul**	**13-Aug**
Broad-winged Hawk																			
Brown Creeper		1																	
Brown Thrasher	1												2	1	2	2	1		
Brown-headed Cowbird	15	8	25	18	1						4	24	15	22	5	7	4		
Bufflehead				45	18	12	35	24	27	44	19	8							
Canada Goose	240	58	34	675	175	230	225	239	398	160	111	103	152	138	299	310	284	111	150
Canada Warbler																			
Canvasback						2	35	298	325	85	11								
Carolina Wren	2		2	2				3	5	2	4	2	4	3	3		4	6	6
Caspian Tern		1															1	1	1
Cedar Waxwing	5		7	13	75										17	18	9	11	1
Chestnut-sided Warbler		1																	1
Chimney Swift	3	43	11											1	1	7	1	5	3
Chipping Sparrow		1	1																
Clapper Rail	2	1	1	1									3	2	3	3	1	1	2
Cliff Swallow															1				
Common Goldeneye																			
Common Grackle	1	23	27	373	4			1	1	15	97	39	64	44	40	45	15	5	3
Common Loon																			
Common Merganser				4	4	9	52	119	153	47	88	24	2	2				1	
Common Moorhen	2										1		5	7	4	1	3	2	1
Common Raven						2				2	1	1	3	6	3	2			
Common Tern																			1
Common Yellowthroat	28	11			1					1			2	58	46	42	55	23	8
Cooper's Hawk			5	3		1											1		
Dark-eyed Junco			18	25	2	23			5	5	8								
Double-crested Cormorant	253	112	106	107	24	4	13	14	1	3	3	23	81	34	30	53	41	52	176
Downy Woodpecker	8	9	7	9	6	3	13	9	9	5	4	9	7	3	6	4	9	4	8
Dunlin														1					
Eastern Kingbird														3	3	3	2	7	8
Eastern Meadowlark											1								
Eastern Phoebe		2	3								1	1			1				
Eastern Towhee		3	4	1	1	1		1		1	1	2	2	1	1	2	1		
Eastern Wood Pewee														1	1	3	2	1	3
Eurasian Wigeon																			
European Starling	188	240	339	106	198	22	11	56	17	35	68	38	47	37	80	106	324	291	247
Field Sparrow			3	1							1			1		1			
Fish Crow									2		2	3	1	1			2	1	
Forster's Tern													12	19	6		6	115	51
Fox Sparrow				4	3	5	1	1	1		1								
Gadwall	18	6	66	64	102	60	36	47	114	72	169	108	114	121	61	76	70	64	61
Glaucous Gull						1													
Golden-crowned Kinglet		4	9	2	4	2		3			1	3							

Appendix 11. Total number of individuals of each species recorded in the Meadowlands District between September 6, 2005 and September 5, 2006 by survey period. Table is arranged by species in alphabetical order.

	Survey starting																		
	Year 2 (2005-2006)																		
Species	**6-Sept**	**21-Sept**	**11-Oct**	**3-Nov**	**17-Nov**	**5-Dec**	**22-Dec**	**12-Jan**	**1-Feb**	**19-Feb**	**13-Mar**	**30-Mar**	**14-Apr**	**1-May**	**22-May**	**13-Jun**	**5-Jul**	**24-Jul**	**13-Aug**
Grasshopper Sparrow																			
Gray Catbird	18	17	7										1	17	26	26	30	22	26
Great Black-backed Gull	36	22	28	16	59	70	62	29	50	22	14	14	23	13	18	21	14	17	28
Great Blue Heron	17	21	1	5	6	2	2		3		1	2	2	7	5	4	10	9	12
Great Cormorant							2	1	2		2	1							
Great Crested Flycatcher																			
Great Egret	167	64	31	2	2			1				5	15	19	26	34	84	109	65
Great-crested Flycatcher														1	1	1			
Greater Yellowlegs	29	82	37	2							3	18	102	158	3	2	3	8	33
Green Heron	2	1													1	1		4	1
Green-winged Teal	493	775	270	423	93	4	117	101	229	63	342	207	387	4	1	1		5	152
Hairy Woodpecker		1	1	2			1		1				1	1					
Hermit Thrush			6	1															
Herring Gull	130	110	108	193	266	356	440	132	299	162	130	72	45	77	44	53	58	37	101
Hooded Merganser				21	26	4	13	9	6	11	16		2						
Horned Lark							4		40	8	34								
House Finch	1	11	2	6	3			2			3		1			3	1	5	1
House Sparrow			12				2	6			1		3	5	5	3	4	2	1
House Wren	2													2	1		4	2	1
Hudsonian Godwit			1																
Indigo Bunting		1												1	10	13	9	19	11
Killdeer	63	26	13	5		5				2	29	34	22	22	27	43	43	56	40
Laughing Gull	112	161	40	9													7	14	82
Least Bittern															1	2	3		1
Least Flycatcher																			
Least Sandpiper	6	10											16	728	2	3	186	304	71
Least Tern														4	2	2	8	10	
Lesser Black-backed Gull																			
Lesser Scaup				10	28			45	122		95	12	1						
Lesser Yellowlegs	24	12												55				35	34
Lincoln's Sparrow		1																	
Louisiana Waterthrush																			
Magnolia Warbler		1												1					
Mallard	379	340	219	131	130	50	173	174	233	79	156	203	257	247	241	563	451	771	364
Mallard x Black Duck Hybrid																			
Mallard X Black Hybrid				1															
Marsh Wren	25	6	4	2	3				1				15	76	89	106	96	52	30
Merlin				1															
Mourning Dove	93	69	106	34	19	9	41	14	5	6	11	8	5	13	17	18	50	48	67
Mute Swan	55	12	28	17	7	7	2	13	13	31	28	24	11	36	37	73	86	47	66
Nashville Warbler																			1
Northern Cardinal	4	1	1	5	2	1	7	5	2	3	13	15	14	13	10	8	10	6	4
Northern Flicker	15	8	25	1	1	3				3		16	7	3	8	3	7	6	9

Appendix 11. Total number of individuals of each species recorded in the Meadowlands District between September 6, 2005 and September 5, 2006 by survey period. Table is arranged by species in alphabetical order.

	Survey starting																		
	Year 2 (2005-2006)																		
Species	**6-Sept**	**21-Sept**	**11-Oct**	**3-Nov**	**17-Nov**	**5-Dec**	**22-Dec**	**12-Jan**	**1-Feb**	**19-Feb**	**13-Mar**	**30-Mar**	**14-Apr**	**1-May**	**22-May**	**13-Jun**	**5-Jul**	**24-Jul**	**13-Aug**
Northern Goshawk																			
Northern Harrier		3	4	5	6	5	2	1	1	4	1	2	3	1		1		1	3
Northern Harrier (F)		1		1		1	1	1			2		2						
Northern Harrier (Juv)		1	4	1			5	1	1										
Northern Harrier (M & F)												2							
Northern Harrier (M)							1						1		2				
Northern Mockingbird	9	4	10	8	2	4	4	5	6	1	10	7	7	4	11	11	19	9	21
Northern Parula													1	3					
Northern Pintail		1	8	33	116	145	12	29	12	63	48	2	2						
Northern Rough-winged Swallow													8	4	3	1	2	4	
Northern Shoveler		2	51	75	69		30	66	54	95	81	99	14						
Northern Waterthrush	1																		1
Orange-crowned Warbler		1																	
Orchard Oriole														3	2	3			2
Osprey	3	3									1	1	1	1	2	2	2	1	6
Ovenbird	1													6	1				
Palm Warbler	11	9	29	5								4							
Pectoral Sandpiper	4	2																	
Peeps														268			1193	1705	116
Peregrine Falcon	6	4	7		1	2			2	1		1						1	2
Peregrine Falcon (Juv)																			
Pied Billed Grebe																			
Pied-billed Grebe			1	2								2					1	1	
Pine Siskin																			
Prairie Warbler																			
Purple Martin												1							
Red-bellied Woodpecker	1	1	2	1	2	5	5	4	3	3	5	3	3	3	2	1		1	2
Red-breasted Merganser						3		7	2	1	3								
Red-breasted Nuthatch	1																		
Red-eyed Vireo		2												1	1				
Red-shouldered Hawk				1															
Red-tailed Hawk	2	2	7	12	12	18	27	15	11	14	13	7		1	1	2	1	1	3
Red-winged Blackbird	93	154	587	897	261	53	16	19	36	269	152	235	287	277	296	287	225	281	186
Ring-billed Gull	206	479	161	484	566	256	148	116	204	342	39	39	219	119	35	55	113	102	104
Ring-necked Duck										3	3	12							
Ring-necked Pheasant	1	3	3	4	1	2		2	2	5	6	16	20	16	9	5			2
Rock Pigeon	89	17	3	2	2		2	8	17	3	6	14	9	15	3	8	80	10	26
Rough-legged Hawk																			
Ruby-crowned Kinglet			20	9		1							2						
Ruby-throated Hummingbird	3																		3
Ruddy Duck			47	2898	2554	11	2	828	1837		1770	1193	436	96	13	9	4	1	
Rusty Blackbird							15				16								
Saltmarsh Sharp-tailed Sparrow															1	4	1	1	1

Appendix 11. Total number of individuals of each species recorded in the Meadowlands District between September 6, 2005 and September 5, 2006 by survey period. Table is arranged by species in alphabetical order.

	Survey starting																		
	Year 2 (2005-2006)																		
Species	**6-Sept**	**21-Sept**	**11-Oct**	**3-Nov**	**17-Nov**	**5-Dec**	**22-Dec**	**12-Jan**	**1-Feb**	**19-Feb**	**13-Mar**	**30-Mar**	**14-Apr**	**1-May**	**22-May**	**13-Jun**	**5-Jul**	**24-Jul**	**13-Aug**
Savannah Sparrow	1	5	6	1	2			1				1	14	5					
Scarlet Tanager														2					
Seaside Sparrow													1						
Semipalmated Plover	11													19	12			2	16
Semipalmated Sandpiper	26	1												3	65		661	5144	1046
Sharp-shinned Hawk			5	6	1			1	1	1		1							
Sharp-tailed Sparrow																			
Short-billed Dowitcher														1			2		5
Short-eared Owl			1																
Snow Bunting				16			20												
Snow Goose														1					
Snowy Egret	156	67	6									5	6	13	26	28	52	109	101
Solitary Sandpiper																	1		1
Song Sparrow	16	26	101	44	37	32	21	26	24	19	70	67	68	71	75	75	73	73	37
Spotted Sandpiper	1	3											1	10	19	19	12	14	6
Swamp Sparrow	1	12	27	33	9	10	11	10	4	5	2	9	53	45	30	35	31	18	6
Tree Sparrow					17	34	32	31	29	28	1	1							
Tree Swallow		50	1								14	39	97	83	66	126	36	4	31
Tri-colored Heron																			
Tufted Titmouse			5	6	1	4	6	4	6	4	2	9	1	2					
Turkey Vulture			2	1		2					1	3							2
Virginia Rail												1	1						1
Warbling Vireo	1												2	4	9	5	4	1	2
White-breasted Nuthatch	1	1	3	2		2	2	1	2	1	1			1					
White-crowned Sparrow			2	3															
White-rumped Sandpiper																			
White-throated Sparrow		6	66	19	25	34	26	22	2	13	13	14	8	11					
Willow Flycatcher														5	43	23	12	11	2
Wilson's Phalarope	1																		
Wilson's Snipe											6	9	2						
Winter Wren			2																
Wood Duck	1	2													10	2	1	6	
Wood Thrush														2	3				1
Yellow Warbler	1	1											4	33	35	27	7	6	3
Yellow-bellied Sapsucker																			
Yellow-crowned Night-Heron		1											1	1	1		2	3	1
Yellowlegs sp.			3											2					
Yellow-rumped Warbler		11	121	21	1								7	9					
Grand Total	**3,446**	**3,243**	**3,132**	**7,154**	**5,129**	**1,761**	**1,940**	**2,756**	**4,480**	**1,917**	**3,942**	**2,982**	**2,870**	**3,426**	**2,139**	**2,657**	**4,804**	**9,990**	**4,033**

Appendix 12. Number of points surveyed per cycle

Cycle	Dates	# Points surveyed
1	8/30/2004-9/14/2004	106
2	9/15/2004-9/29/2004	92
3	9/29/2004-10/13/2004	111
3.1	**	14
4	10/18/2004-10/28/2004	112
5	11/1/2004-11/16/2004	113
6	11/17/2004-12/3/2004	113
7	12/6/2004-12/28/2004	76
8	12/29/2004-1/19/2005	69
9	1/22/2005-2/8/2005	69
10	2/9/2005-3/2/2005	69
11	3/14/2005-3/29/2005	69
12	3/30/2005-4/14/2005	88
13	4/18/2005-5/3/2005	112
14	5/4/2005-5/19/2005	112
15	5/19/2005-6/10/2005	113
16	6/13/2005-7/5/2005	112
17	7/7/2005-7/29/2005	112
18	8/1/2005-8/12/2005	112
19	8/15/2005-9/1/2005	112
20	9/6/2005-9/20/2005	112
21	9/21/2005-10/10/2005	112
22	10/11/200511/1/2005	114
23	11/3/2005-11/16/2005	106
24	11/17/2005-12/2/2005	82
25	12/5/2005-12/21/2005	75
26	12/22/2005-1/9/2006	75
27	1/12/2006-1/30/2006	75
28	2/1/2006-2/16/2006	75
29	2/19/2006-3/9/2006	75
30	3/13/2006-3/29/2006	75
31	3/30/2006-4/14/2006	75
32	4/14/2006-5/1/2006	118
33	5/1/2006-5/22/2006	118
34	5/22/2006-6/13/2006	118
35	6/13/2006-7/3/2006	118
36	7/5/2006-7/24/2006	118
37	7/24/2006-8/10/2006	117
38	8/13/2006-9/5/2006	118

** this cycle included points that were not surveyed during cycle 2 and were surveyed twice during cycle 3, and it was not included in the seasonal analysis

Appendix 13. Distribution of different habitat types in Meadowlands District within the 100m circle around each point surveyed between August 30, 2004 and September 5, 2006. Table is arranged by survey point in alphabetical order.

Site	Point	Habitat (based on NJ lu/lc definition)	# of hectares	Percentage
1A Landfill	1ALF01	ALTERED LANDS	3.14	100.00
1A Landfill	1ALF02	ALTERED LANDS	3.02	96.18
1A Landfill	1ALF02	DISTURBED WETLANDS (MODIFIED)	0.12	3.82
1D Landfill	1DLF01	ALTERED LANDS	2.79	88.85
1D Landfill	1DLF01	PHRAGMITES DOMINATE URBAN AREA	0.35	11.15
1D Landfill	1DLF02	ALTERED LANDS	2.83	90.13
1D Landfill	1DLF02	PHRAGMITES DOMINATE URBAN AREA	0.31	9.87
Bellemeade Mitigation	BEMI1A	HERBACEOUS WETLANDS	0.43	13.82
Bellemeade Mitigation	BEMI1A	PHRAGMITES DOMINATE INTERIOR WETLANDS	1.36	43.35
Bellemeade Mitigation	BEMI1A	SALINE MARSH (LOW MARSH)	1.34	42.80
Bellemeade Mitigation	BEMI2A	HERBACEOUS WETLANDS	0.83	26.32
Bellemeade Mitigation	BEMI2A	PHRAGMITES DOMINATE INTERIOR WETLANDS	0.49	15.53
Bellemeade Mitigation	BEMI2A	SALINE MARSH (LOW MARSH)	1.27	40.54
Bellemeade Mitigation	BEMI2A	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	0.55	17.57
Eastern Brackish Marsh	EABM01	OTHER URBAN OR BUILT-UP LAND	0.01	0.44
Eastern Brackish Marsh	EABM01	PHRAGMITES DOMINATE COASTAL WETLANDS	0.05	1.71
Eastern Brackish Marsh	EABM01	SALINE MARSH (HIGH MARSH)	0.50	16.03
Eastern Brackish Marsh	EABM01	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	2.57	81.79
Eastern Brackish Marsh	EABM02	COMMERCIAL/SERVICES	0.49	15.46
Eastern Brackish Marsh	EABM02	INDUSTRIAL	0.57	18.03
Eastern Brackish Marsh	EABM02	STORMWATER BASIN	0.07	2.31
Eastern Brackish Marsh	EABM02	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	2.02	64.18
Eastern Brackish Marsh	EABM03	DECIDUOUS BRUSH/SHRUBLAND	0.06	1.98
Eastern Brackish Marsh	EABM03	MAJOR ROADWAY	0.45	14.20
Eastern Brackish Marsh	EABM03	OTHER URBAN OR BUILT-UP LAND	0.78	24.73
Eastern Brackish Marsh	EABM03	PHRAGMITES DOMINATE COASTAL WETLANDS	0.02	0.60
Eastern Brackish Marsh	EABM03	SALINE MARSH (HIGH MARSH)	0.38	12.01
Eastern Brackish Marsh	EABM03	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	1.46	46.45
Eastern Brackish Marsh	EABM04	PHRAGMITES DOMINATE COASTAL WETLANDS	0.24	7.69
Eastern Brackish Marsh	EABM04	SALINE MARSH (HIGH MARSH)	0.16	5.03
Eastern Brackish Marsh	EABM04	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	2.74	87.25
Empire Tract	EMP02A	DISTURBED WETLANDS (MODIFIED)	1.32	42.00
Empire Tract	EMP02A	PHRAGMITES DOMINATE COASTAL WETLANDS	1.82	57.96
Empire Tract	EMP03A	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	0.27	8.61
Empire Tract	EMP03A	DECIDUOUS WOODED WETLANDS	0.00	0.02
Empire Tract	EMP03A	HERBACEOUS WETLANDS	0.09	2.92
Empire Tract	EMP03A	INDUSTRIAL	0.61	19.31
Empire Tract	EMP03A	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	0.04	1.28
Empire Tract	EMP03A	OTHER URBAN OR BUILT-UP LAND	0.84	26.75
Empire Tract	EMP03A	PHRAGMITES DOMINATE COASTAL WETLANDS	0.04	1.19
Empire Tract	EMP03A	SALINE MARSH (HIGH MARSH)	1.24	39.42
Empire Tract	EMP03A	TRANSPORTATION/COMMUNICATION/UTILITIES	0.01	0.48
Empire Tract	EMP09A	DISTURBED WETLANDS (MODIFIED)	0.63	19.99
Empire Tract	EMP09A	PHRAGMITES DOMINATE COASTAL WETLANDS	2.46	78.47
Empire Tract	EMP09A	SALINE MARSH (HIGH MARSH)	0.05	1.50
Empire Tract	EMP11A	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	0.34	10.80
Empire Tract	EMP11A	PHRAGMITES DOMINATE COASTAL WETLANDS	1.86	59.23
Empire Tract	EMP11A	SALINE MARSH (HIGH MARSH)	0.94	29.94
Empire Tract	EMP14A	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	0.47	14.96
Empire Tract	EMP14A	INDUSTRIAL	0.82	26.13
Empire Tract	EMP14A	OTHER URBAN OR BUILT-UP LAND	0.98	31.32
Empire Tract	EMP14A	PHRAGMITES DOMINATE COASTAL WETLANDS	0.87	27.57
Empire Tract	EMP15A	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	0.31	9.90
Empire Tract	EMP15A	OTHER URBAN OR BUILT-UP LAND	0.27	8.50
Empire Tract	EMP15A	PHRAGMITES DOMINATE COASTAL WETLANDS	2.35	74.75
Empire Tract	EMP15A	STREAMS AND CANALS	0.21	6.82
Empire Tract 2	EMP201	MAJOR ROADWAY	0.31	9.75
Empire Tract 2	EMP201	OTHER URBAN OR BUILT-UP LAND	0.20	6.36
Empire Tract 2	EMP201	PHRAGMITES DOMINATE COASTAL WETLANDS	2.35	74.76
Empire Tract 2	EMP201	UPLAND RIGHTS-OF-WAY DEVELOPED	0.29	9.10
Empire Tract 2	EMP202	DECIDUOUS BRUSH/SHRUBLAND	0.00	0.05
Empire Tract 2	EMP202	PHRAGMITES DOMINATE COASTAL WETLANDS	0.70	22.22
Empire Tract 2	EMP202	RECREATIONAL LAND	0.43	13.78
Empire Tract 2	EMP202	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	0.95	30.22
Empire Tract 2	EMP202	TRANSITIONAL AREAS	1.06	33.70
Empire Tract	EMPM06	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	0.34	10.81
Empire Tract	EMPM06	PHRAGMITES DOMINATE COASTAL WETLANDS	1.97	62.63
Empire Tract	EMPM06	PHRAGMITES DOMINATE OLD FIELD	0.31	9.86
Empire Tract	EMPM06	SALINE MARSH (LOW MARSH)	0.28	9.02
Empire Tract	EMPM06	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	0.24	7.65
Empire Tract	EMPM18	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	0.36	11.37
Empire Tract	EMPM18	PHRAGMITES DOMINATE COASTAL WETLANDS	2.07	65.97
Empire Tract	EMPM18	SALINE MARSH (LOW MARSH)	0.07	2.28
Empire Tract	EMPM18	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	0.64	20.34
Harrier Marsh	HARR01	ARTIFICIAL LAKES	0.78	24.86
Harrier Marsh	HARR01	DECIDUOUS BRUSH/SHRUBLAND	0.00	0.02

Harrier Marsh	HARR01	HERBACEOUS WETLANDS	0.49	15.63
Harrier Marsh	HARR01	OTHER URBAN OR BUILT-UP LAND	0.66	21.13
Harrier Marsh	HARR01	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	1.20	38.33
Harrier Marsh	HARR02	ARTIFICIAL LAKES	1.07	34.20
Harrier Marsh	HARR02	DECIDUOUS SCRUB/SHRUB WETLANDS	0.08	2.50
Harrier Marsh	HARR02	HERBACEOUS WETLANDS	1.99	63.27
Harrier Marsh	HARR3A	ARTIFICIAL LAKES	0.95	30.29
Harrier Marsh	HARR3A	HERBACEOUS WETLANDS	0.75	23.97
Harrier Marsh	HARR3A	OTHER URBAN OR BUILT-UP LAND	0.32	10.16
Harrier Marsh	HARR3A	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	1.12	35.55
Kearny Freshwater Marsh	KFWM01	ARTIFICIAL LAKES	2.92	92.96
Kearny Freshwater Marsh	KFWM01	INDUSTRIAL	0.04	1.36
Kearny Freshwater Marsh	KFWM01	TRANSPORTATION/COMMUNICATION/UTILITIES	0.18	5.64
Kearny Freshwater Marsh	KFWM03	ARTIFICIAL LAKES	2.42	77.07
Kearny Freshwater Marsh	KFWM03	DECIDUOUS SCRUB/SHRUB WETLANDS	0.08	2.55
Kearny Freshwater Marsh	KFWM03	PHRAGMITES DOMINATE INTERIOR WETLANDS	0.63	20.06
Kearny Freshwater Marsh	KFWM04	ARTIFICIAL LAKES	2.93	93.35
Kearny Freshwater Marsh	KFWM04	PHRAGMITES DOMINATE INTERIOR WETLANDS	0.21	6.62
Kearny Freshwater Marsh	KFWM07	ARTIFICIAL LAKES	2.86	91.08
Kearny Freshwater Marsh	KFWM07	PHRAGMITES DOMINATE INTERIOR WETLANDS	0.28	8.92
Kearny Freshwater Marsh	KFWM1W	ARTIFICIAL LAKES	1.45	46.32
Kearny Freshwater Marsh	KFWM1W	INDUSTRIAL	1.33	42.30
Kearny Freshwater Marsh	KFWM1W	PHRAGMITES DOMINATE INTERIOR WETLANDS	0.03	0.81
Kearny Freshwater Marsh	KFWM1W	TRANSPORTATION/COMMUNICATION/UTILITIES	0.33	10.54
Kearny Freshwater Marsh	KFWM4W	ARTIFICIAL LAKES	1.50	47.84
Kearny Freshwater Marsh	KFWM4W	DECIDUOUS BRUSH/SHRUBLAND	0.87	27.56
Kearny Freshwater Marsh	KFWM4W	PHRAGMITES DOMINATE INTERIOR WETLANDS	0.10	3.11
Kearny Freshwater Marsh	KFWM4W	TRANSITIONAL AREAS	0.31	10.00
Kearny Freshwater Marsh	KFWM4W	TRANSPORTATION/COMMUNICATION/UTILITIES	0.36	11.47
Kearny Freshwater Marsh	KFWM6A	ARTIFICIAL LAKES	1.32	42.04
Kearny Freshwater Marsh	KFWM6A	DECIDUOUS SCRUB/SHRUB WETLANDS	0.14	4.46
Kearny Freshwater Marsh	KFWM6A	HERBACEOUS WETLANDS	0.52	16.56
Kearny Freshwater Marsh	KFWM6A	PHRAGMITES DOMINATE INTERIOR WETLANDS	1.17	37.26
Kearny Freshwater Marsh	KFWM6W	DECIDUOUS SCRUB/SHRUB WETLANDS	0.31	9.86
Kearny Freshwater Marsh	KFWM6W	INDUSTRIAL	0.61	19.52
Kearny Freshwater Marsh	KFWM6W	OTHER URBAN OR BUILT-UP LAND	0.06	1.82
Kearny Freshwater Marsh	KFWM6W	PHRAGMITES DOMINATE INTERIOR WETLANDS	1.41	44.87
Kearny Freshwater Marsh	KFWM6W	STREAMS AND CANALS	0.11	3.39
Kearny Freshwater Marsh	KFWM6W	TRANSPORTATION/COMMUNICATION/UTILITIES	0.64	20.50
Kearny Freshwater Marsh	KFWM7W	ARTIFICIAL LAKES	1.52	48.41
Kearny Freshwater Marsh	KFWM7W	DECIDUOUS BRUSH/SHRUBLAND	0.00	0.00
Kearny Freshwater Marsh	KFWM7W	OLD FIELD (< 25% BRUSH COVERED)	0.16	5.10
Kearny Freshwater Marsh	KFWM7W	PHRAGMITES DOMINATE INTERIOR WETLANDS	0.02	0.64
Kearny Freshwater Marsh	KFWM7W	PHRAGMITES DOMINATE OLD FIELD	1.43	45.54
Kearny Freshwater Marsh	KFWM8A	ARTIFICIAL LAKES	3.09	98.41
Kearny Freshwater Marsh	KFWM8A	PHRAGMITES DOMINATE INTERIOR WETLANDS	0.05	1.59
Kingsland Landfill	KILF01	ALTERED LANDS	1.43	45.64
Kingsland Landfill	KILF01	DECIDUOUS BRUSH/SHRUBLAND	1.71	54.33
Kingsland Landfill	KILF02	ALTERED LANDS	0.91	28.84
Kingsland Landfill	KILF02	DECIDUOUS BRUSH/SHRUBLAND	2.23	71.13
Kingsland Landfill	KILF04	ALTERED LANDS	3.14	99.97
Kingsland Landfill	KILF05	ALTERED LANDS	2.90	92.36
Kingsland Landfill	KILF05	DECIDUOUS BRUSH/SHRUBLAND	0.24	7.61
Kingsland Landfill	KILF6A	ALTERED LANDS	3.14	99.97
Kingsland Walkway	KIWA01	OTHER URBAN OR BUILT-UP LAND	0.20	6.39
Kingsland Walkway	KIWA01	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	2.91	92.80
Kingsland Walkway	KIWA01	UPLAND RIGHTS-OF-WAY UNDEVELOPED	0.02	0.77
Kingsland Walkway	KIWA02	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	3.14	99.97
Kingsland Walkway	KIWA03	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	3.14	99.97
Kingsland Impound	KLIM2A	ARTIFICIAL LAKES	1.66	52.80
Kingsland Impound	KLIM2A	PHRAGMITES DOMINATE INTERIOR WETLANDS	0.17	5.54
Kingsland Impound	KLIM2A	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	1.31	41.62
Kingsland Impound	KLIM3A	ARTIFICIAL LAKES	1.90	60.66
Kingsland Impound	KLIM3A	PHRAGMITES DOMINATE INTERIOR WETLANDS	0.15	4.76
Kingsland Impound	KLIM3A	PHRAGMITES DOMINATE OLD FIELD	0.07	2.16
Kingsland Impound	KLIM3A	RECREATIONAL LAND	1.02	32.39
Kingsland Impound	KLIM4A	ARTIFICIAL LAKES	0.48	15.34
Kingsland Impound	KLIM4A	HERBACEOUS WETLANDS	0.00	0.01
Kingsland Impound	KLIM4A	OLD FIELD (< 25% BRUSH COVERED)	0.00	0.04
Kingsland Impound	KLIM4A	OTHER URBAN OR BUILT-UP LAND	0.47	14.85
Kingsland Impound	KLIM4A	PHRAGMITES DOMINATE INTERIOR WETLANDS	1.59	50.72
Kingsland Impound	KLIM4A	STREAMS AND CANALS	0.12	3.84
Kingsland Impound	KLIM4A	TRANSPORTATION/COMMUNICATION/UTILITIES	0.15	4.66
Kingsland Impound	KLIM4A	UPLAND RIGHTS-OF-WAY UNDEVELOPED	0.33	10.51
Kearny Marsh 1	KYM1_04	ARTIFICIAL LAKES	3.03	96.51
Kearny Marsh 1	KYM1_04	OLD FIELD (< 25% BRUSH COVERED)	0.01	0.42
Kearny Marsh 1	KYM1_04	TRANSPORTATION/COMMUNICATION/UTILITIES	0.10	3.04
Kearny Marsh 1	KYM1_1A	ARTIFICIAL LAKES	3.14	99.97
Kearny Marsh 1	KYM1_2A	ARTIFICIAL LAKES	1.96	62.30
Kearny Marsh 1	KYM1_2A	DECIDUOUS BRUSH/SHRUBLAND	0.21	6.71
Kearny Marsh 1	KYM1_2A	HERBACEOUS WETLANDS	0.07	2.22
Kearny Marsh 1	KYM1_2A	MAJOR ROADWAY	0.61	19.52
Kearny Marsh 1	KYM1_2A	PHRAGMITES DOMINATE INTERIOR WETLANDS	0.29	9.21

Kearny Marsh 1	KYM1_3A	ARTIFICIAL LAKES	2.11	67.16
Kearny Marsh 1	KYM1_3A	BRIDGE OVER WATER	0.09	2.91
Kearny Marsh 1	KYM1_3A	MAJOR ROADWAY	0.54	17.06
Kearny Marsh 1	KYM1_3A	OLD FIELD (< 25% BRUSH COVERED)	0.17	5.49
Kearny Marsh 1	KYM1_3A	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	0.23	7.34
Kearny Marsh 2	KYM2_02	ARTIFICIAL LAKES	3.14	99.97
Kearny Marsh 2	KYM2_1A	ARTIFICIAL LAKES	2.96	94.29
Kearny Marsh 2	KYM2_1A	OLD FIELD (< 25% BRUSH COVERED)	0.18	5.68
Kearny Marsh 2	KYM2_3A	ARTIFICIAL LAKES	1.82	57.90
Kearny Marsh 2	KYM2_3A	HERBACEOUS WETLANDS	0.16	4.99
Kearny Marsh 2	KYM2_3A	OLD FIELD (< 25% BRUSH COVERED)	0.08	2.41
Kearny Marsh 2	KYM2_3A	OTHER URBAN OR BUILT-UP LAND	1.09	34.66
Laurel Hill Upland	LHUP04	DECIDUOUS BRUSH/SHRUBLAND	0.17	5.52
Laurel Hill Upland	LHUP04	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	0.77	24.43
Laurel Hill Upland	LHUP04	OTHER URBAN OR BUILT-UP LAND	1.21	38.67
Laurel Hill Upland	LHUP04	RECREATIONAL LAND	0.98	31.34
Laurel Hill Upland	LHUP05	DECIDUOUS BRUSH/SHRUBLAND	3.08	97.96
Laurel Hill Upland	LHUP05	RECREATIONAL LAND	0.06	2.01
Laurel Hill Upland	LHUP3A	DECIDUOUS BRUSH/SHRUBLAND	3.03	96.57
Laurel Hill Upland	LHUP3A	OLD FIELD (< 25% BRUSH COVERED)	0.10	3.14
Laurel Hill Upland	LHUP3A	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	0.01	0.26
Losen Slote Forest	LSCP01	DECIDUOUS FOREST (>50% CROWN CLOSURE)	0.53	16.77
Losen Slote Forest	LSCP01	DECIDUOUS SCRUB/SHRUB WETLANDS	0.00	0.01
Losen Slote Forest	LSCP01	DECIDUOUS WOODED WETLANDS	1.97	62.82
Losen Slote Forest	LSCP01	HERBACEOUS WETLANDS	0.56	17.90
Losen Slote Forest	LSCP01	RESIDENTIAL, SINGLE UNIT, MEDIUM DENSITY	0.04	1.37
Losen Slote Forest	LSCP01	TRANSPORTATION/COMMUNICATION/UTILITIES	0.03	1.09
Losen Slote Forest	LSCP02	DECIDUOUS FOREST (>50% CROWN CLOSURE)	0.68	21.68
Losen Slote Forest	LSCP02	DECIDUOUS WOODED WETLANDS	2.45	77.91
Losen Slote Forest	LSCP02	RESIDENTIAL, SINGLE UNIT, MEDIUM DENSITY	0.01	0.37
Lyndhurst Riverside	LYRI1A	PHRAGMITES DOMINATE INTERIOR WETLANDS	1.77	56.48
Lyndhurst Riverside	LYRI1A	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	1.37	43.48
Lyndhurst Riverside	LYRI2A	OLD FIELD (< 25% BRUSH COVERED)	0.07	2.22
Lyndhurst Riverside	LYRI2A	PHRAGMITES DOMINATE INTERIOR WETLANDS	2.76	87.97
Lyndhurst Riverside	LYRI2A	SALINE MARSH (LOW MARSH)	0.31	9.78
Lyndhurst Riverside	LYRI3A	PHRAGMITES DOMINATE INTERIOR WETLANDS	2.06	65.54
Lyndhurst Riverside	LYRI3A	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	1.08	34.43
Mill Creek Marsh	MCMA02	SALINE MARSH (HIGH MARSH)	0.52	16.56
Mill Creek Marsh	MCMA02	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	2.62	83.41
Mill Creek Marsh	MCMA04	PHRAGMITES DOMINATE COASTAL WETLANDS	0.35	11.24
Mill Creek Marsh	MCMA04	SALINE MARSH (HIGH MARSH)	0.74	23.50
Mill Creek Marsh	MCMA04	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	2.05	65.22
Mill Creek Marsh	MCMA05	DECIDUOUS BRUSH/SHRUBLAND	0.28	9.02
Mill Creek Marsh	MCMA05	OTHER URBAN OR BUILT-UP LAND	0.26	8.35
Mill Creek Marsh	MCMA05	SALINE MARSH (HIGH MARSH)	0.18	5.83
Mill Creek Marsh	MCMA05	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	2.41	76.78
Mill Creek Marsh	MCMA1A	SALINE MARSH (HIGH MARSH)	0.53	16.73
Mill Creek Marsh	MCMA1A	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	2.61	83.24
Mill Creek Marsh	MCMA3A	COMMERCIAL/SERVICES	0.06	1.93
Mill Creek Marsh	MCMA3A	RESIDENTIAL, HIGH DENSITY OR MULTIPLE DWELLING	1.12	35.63
Mill Creek Marsh	MCMA3A	SALINE MARSH (HIGH MARSH)	0.35	11.29
Mill Creek Marsh	MCMA3A	SALINE MARSH (LOW MARSH)	0.18	5.60
Mill Creek Marsh	MCMA3A	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	1.43	45.56
Mehrhof Pond	MEPO02	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	0.38	11.97
Mehrhof Pond	MEPO02	NATURAL LAKES	1.96	62.45
Mehrhof Pond	MEPO02	OTHER URBAN OR BUILT-UP LAND	0.30	9.63
Mehrhof Pond	MEPO02	TRANSPORTATION/COMMUNICATION/UTILITIES	0.50	15.92
Mehrhof Pond	MEPO1A	DECIDUOUS SCRUB/SHRUB WETLANDS	0.07	2.15
Mehrhof Pond	MEPO1A	HERBACEOUS WETLANDS	1.25	39.86
Mehrhof Pond	MEPO1A	INDUSTRIAL	0.39	12.47
Mehrhof Pond	MEPO1A	OTHER URBAN OR BUILT-UP LAND	1.00	31.85
Mehrhof Pond	MEPO1A	SALINE MARSH (HIGH MARSH)	0.05	1.70
Mehrhof Pond	MEPO1A	STREAMS AND CANALS	0.37	11.93
Oritani Marsh	ORMA02	DECIDUOUS BRUSH/SHRUBLAND	0.08	2.63
Oritani Marsh	ORMA02	PHRAGMITES DOMINATE COASTAL WETLANDS	2.47	78.82
Oritani Marsh	ORMA02	STREAMS AND CANALS	0.01	0.36
Oritani Marsh	ORMA02	TRANSPORTATION/COMMUNICATION/UTILITIES	0.38	12.13
Oritani Marsh	ORMA02	UPLAND RIGHTS-OF-WAY UNDEVELOPED	0.19	6.03
Oritani Marsh	ORMA03	OTHER URBAN OR BUILT-UP LAND	0.00	0.00
Oritani Marsh	ORMA03	PHRAGMITES DOMINATE COASTAL WETLANDS	1.68	53.45
Oritani Marsh	ORMA03	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	1.32	42.14
Oritani Marsh	ORMA03	UPLAND RIGHTS-OF-WAY UNDEVELOPED	0.14	4.37
Oritani Marsh	ORMA09	PHRAGMITES DOMINATE COASTAL WETLANDS	2.12	67.63
Oritani Marsh	ORMA09	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	1.02	32.34
Oritani Marsh	ORMA10	PHRAGMITES DOMINATE COASTAL WETLANDS	1.22	38.99
Oritani Marsh	ORMA10	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	1.41	44.79
Oritani Marsh	ORMA4A	PHRAGMITES DOMINATE COASTAL WETLANDS	2.80	89.32
Oritani Marsh	ORMA4A	UPLAND RIGHTS-OF-WAY UNDEVELOPED	0.33	10.65
Riverbend Marsh	RBMA02	OTHER URBAN OR BUILT-UP LAND	0.13	4.26
Riverbend Marsh	RBMA02	PHRAGMITES DOMINATE COASTAL WETLANDS	2.89	91.90
Riverbend Marsh	RBMA02	TRANSPORTATION/COMMUNICATION/UTILITIES	0.12	3.81
Riverbend Marsh	RBMA04	PHRAGMITES DOMINATE COASTAL WETLANDS	1.81	57.72
Riverbend Marsh	RBMA04	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	1.33	42.25

Riverbend Marsh	RBMA1A	PHRAGMITES DOMINATE COASTAL WETLANDS	2.03	64.71
Riverbend Marsh	RBMA1A	PHRAGMITES DOMINATE OLD FIELD	0.55	17.62
Riverbend Marsh	RBMA1A	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	0.55	17.64
Resources Metro Marsh	REM04A	SALINE MARSH (LOW MARSH)	2.25	71.50
Resources Metro Marsh	REM04A	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	0.89	28.47
Resources Metro Marsh	REM05A	PHRAGMITES DOMINATE COASTAL WETLANDS	0.96	30.46
Resources Metro Marsh	REM05A	SALINE MARSH (LOW MARSH)	1.62	51.71
Resources Metro Marsh	REM05A	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	0.56	17.83
Resources Metro Marsh	REM07A	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	0.34	10.75
Resources Metro Marsh	REM07A	MAJOR ROADWAY	0.50	15.89
Resources Metro Marsh	REM07A	PHRAGMITES DOMINATE COASTAL WETLANDS	0.58	18.51
Resources Metro Marsh	REM07A	SALINE MARSH (LOW MARSH)	0.85	26.92
Resources Metro Marsh	REM07A	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	0.63	19.97
Resources Metro Marsh	REM07A	UPLAND RIGHTS-OF-WAY DEVELOPED	0.25	7.90
Resources Metro Marsh 2	REM201	PHRAGMITES DOMINATE COASTAL WETLANDS	3.14	99.97
Resources Metro Marsh 2	REM202	OLD FIELD (< 25% BRUSH COVERED)	0.27	8.46
Resources Metro Marsh 2	REM202	PHRAGMITES DOMINATE COASTAL WETLANDS	1.81	57.73
Resources Metro Marsh 2	REM202	SALINE MARSH (LOW MARSH)	0.29	9.31
Resources Metro Marsh 2	REM202	STREAMS AND CANALS	0.21	6.63
Resources Metro Marsh 2	REM202	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	0.56	17.84
Resources Metro Marsh	REMM03	OLD FIELD (< 25% BRUSH COVERED)	0.86	27.36
Resources Metro Marsh	REMM03	PHRAGMITES DOMINATE COASTAL WETLANDS	0.13	4.19
Resources Metro Marsh	REMM03	SALINE MARSH (LOW MARSH)	0.80	25.58
Resources Metro Marsh	REMM03	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	1.13	36.05
Resources Metro Marsh	REMM03	TRANSPORTATION/COMMUNICATION/UTILITIES	0.21	6.78
Resources Metro Marsh	REMM06	SALINE MARSH (LOW MARSH)	2.25	71.74
Resources Metro Marsh	REMM06	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	0.89	28.23
Resources Metro Marsh	REMM08	ALTERED LANDS	0.06	1.84
Resources Metro Marsh	REMM08	DISTURBED WETLANDS (MODIFIED)	1.24	39.56
Resources Metro Marsh	REMM08	PHRAGMITES DOMINATE COASTAL WETLANDS	0.47	15.11
Resources Metro Marsh	REMM08	SALINE MARSH (HIGH MARSH)	0.38	12.04
Resources Metro Marsh	REMM08	SALINE MARSH (LOW MARSH)	0.45	14.33
Resources Metro Marsh	REMM08	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	0.18	5.57
Resources Metro Marsh	REMM08	UPLAND RIGHTS-OF-WAY DEVELOPED	0.37	11.68
Resources Metro Marsh	REMM09	DISTURBED WETLANDS (MODIFIED)	0.31	9.92
Resources Metro Marsh	REMM09	SALINE MARSH (LOW MARSH)	2.44	77.67
Resources Metro Marsh	REMM09	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	0.39	12.38
Resources Metro Marsh	REMM11	DISTURBED WETLANDS (MODIFIED)	0.35	11.10
Resources Metro Marsh	REMM11	SALINE MARSH (HIGH MARSH)	0.34	10.84
Resources Metro Marsh	REMM11	SALINE MARSH (LOW MARSH)	1.99	63.42
Resources Metro Marsh	REMM11	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	0.46	14.54
Resources Metro Marsh	REMM11	UPLAND RIGHTS-OF-WAY DEVELOPED	0.00	0.07
Hackensack River	RIVR01	INDUSTRIAL	0.29	9.34
Hackensack River	RIVR01	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	2.85	90.63
Hackensack River	RIVR03	PHRAGMITES DOMINATE COASTAL WETLANDS	0.81	25.66
Hackensack River	RIVR03	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	2.33	74.31
Hackensack River	RIVR06	BRIDGE OVER WATER	0.12	3.74
Hackensack River	RIVR06	MAJOR ROADWAY	0.26	8.24
Hackensack River	RIVR06	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	0.03	0.87
Hackensack River	RIVR06	OLD FIELD (< 25% BRUSH COVERED)	0.13	4.23
Hackensack River	RIVR06	PHRAGMITES DOMINATE COASTAL WETLANDS	0.09	2.98
Hackensack River	RIVR06	SALINE MARSH (LOW MARSH)	0.03	0.93
Hackensack River	RIVR06	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	0.09	2.98
Hackensack River	RIVR07	OTHER URBAN OR BUILT-UP LAND	0.03	0.91
Hackensack River	RIVR07	PHRAGMITES DOMINATE COASTAL WETLANDS	0.71	22.48
Hackensack River	RIVR07	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	2.40	76.57
Hackensack River	RIVR09	PHRAGMITES DOMINATE COASTAL WETLANDS	0.79	25.08
Hackensack River	RIVR09	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	2.35	74.89
Hackensack River	RIVR16	PHRAGMITES DOMINATE COASTAL WETLANDS	0.84	26.69
Hackensack River	RIVR16	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	2.30	73.28
Hackensack River	RIVR18	PHRAGMITES DOMINATE COASTAL WETLANDS	0.55	17.52
Hackensack River	RIVR18	SALINE MARSH (LOW MARSH)	0.10	3.25
Hackensack River	RIVR18	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	2.49	79.20
Hackensack River	RIVR19	RESIDENTIAL, HIGH DENSITY OR MULTIPLE DWELLING	0.47	14.96
Hackensack River	RIVR19	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	2.67	85.01
Hackensack River	RIVR21	PHRAGMITES DOMINATE COASTAL WETLANDS	0.61	19.40
Hackensack River	RIVR21	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	2.53	80.56
Hackensack River	RIVR23	DECIDUOUS BRUSH/SHRUBLAND	0.29	9.09
Hackensack River	RIVR23	INDUSTRIAL	0.13	4.09
Hackensack River	RIVR23	PHRAGMITES DOMINATE COASTAL WETLANDS	0.12	3.70
Hackensack River	RIVR23	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	2.61	83.09
Hackensack River	RIVR24	PHRAGMITES DOMINATE COASTAL WETLANDS	0.18	5.75
Hackensack River	RIVR24	SALINE MARSH (LOW MARSH)	0.09	2.72
Hackensack River	RIVR24	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	2.87	91.50
Hackensack River	RIVR32	BRIDGE OVER WATER	0.24	7.65
Hackensack River	RIVR32	DECIDUOUS BRUSH/SHRUBLAND	0.07	2.35
Hackensack River	RIVR32	INDUSTRIAL	0.13	4.27
Hackensack River	RIVR32	OTHER URBAN OR BUILT-UP LAND	0.01	0.40
Hackensack River	RIVR32	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	2.62	83.52
Hackensack River	RIVR32	TRANSPORTATION/COMMUNICATION/UTILITIES	0.06	1.79
Sawmill WMA 1	SAW1_03A	SALINE MARSH (LOW MARSH)	1.05	33.49
Sawmill WMA 1	SAW1_03A	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	2.09	66.48
Sawmill WMA 1	SAW1_06A	ARTIFICIAL LAKES	0.79	25.21

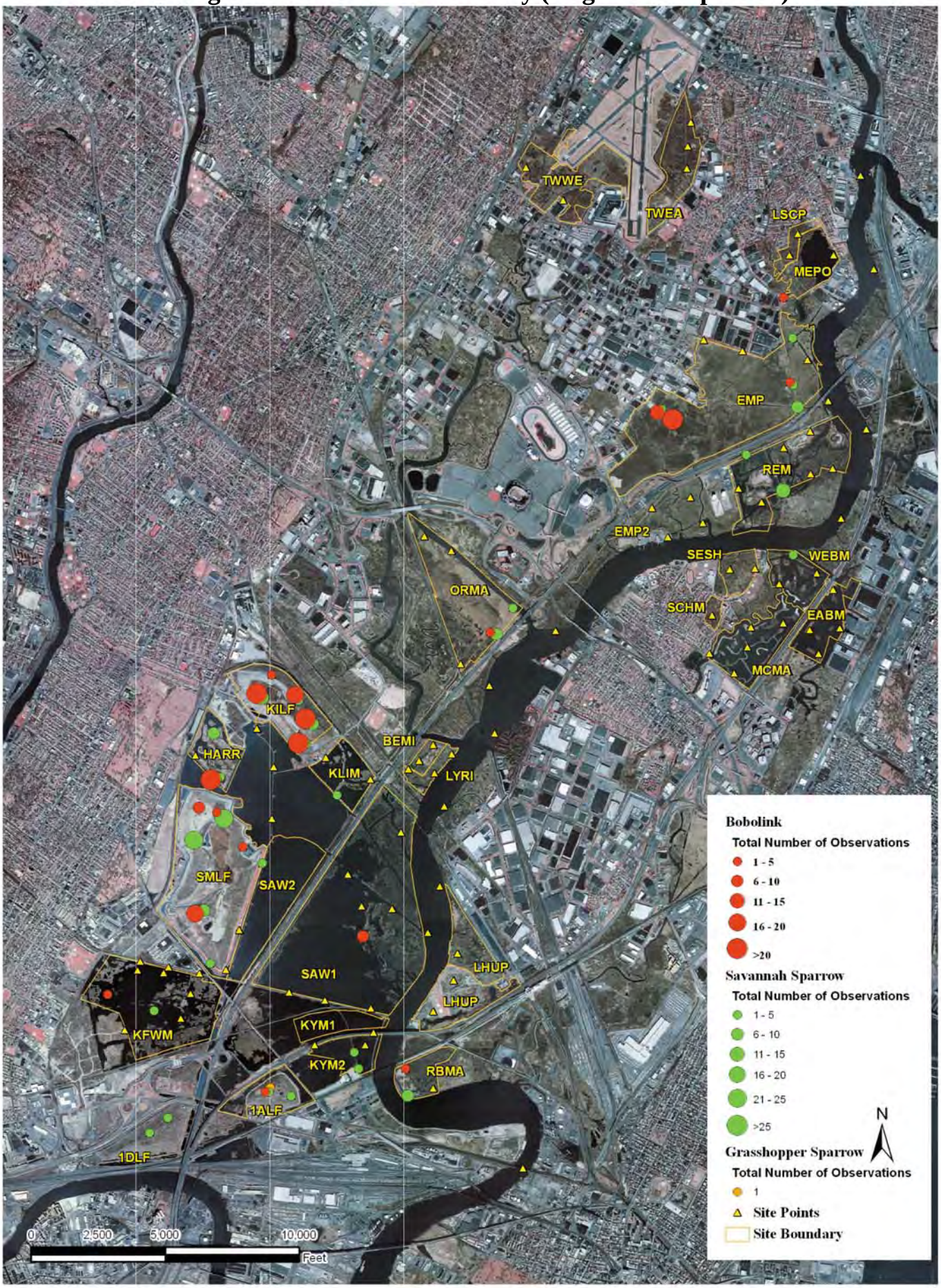
Sawmill WMA 1	SAW1_06A	OLD FIELD (< 25% BRUSH COVERED)	0.03	1.10
Sawmill WMA 1	SAW1_06A	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	1.55	49.39
Sawmill WMA 1	SAW1_06A	TRANSPORTATION/COMMUNICATION/UTILITIES	0.76	24.27
Sawmill WMA 1	SAW1_07A	SALINE MARSH (LOW MARSH)	0.21	6.54
Sawmill WMA 1	SAW1_07A	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	2.93	93.42
Sawmill WMA 1	SAW1_09	SALINE MARSH (LOW MARSH)	0.44	14.04
Sawmill WMA 1	SAW1_09	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	2.70	85.93
Sawmill WMA 1	SAW1_10	ARTIFICIAL LAKES	0.62	19.89
Sawmill WMA 1	SAW1_10	DECIDUOUS BRUSH/SHRUBLAND	0.20	6.47
Sawmill WMA 1	SAW1_10	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	1.97	62.79
Sawmill WMA 1	SAW1_10	TRANSPORTATION/COMMUNICATION/UTILITIES	0.34	10.82
Sawmill WMA 1	SAW1_12	PHRAGMITES DOMINATE COASTAL WETLANDS	1.60	50.92
Sawmill WMA 1	SAW1_12	SALINE MARSH (LOW MARSH)	0.80	25.37
Sawmill WMA 1	SAW1_12	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	0.74	23.68
Sawmill WMA 1	SAW1_13A	SALINE MARSH (LOW MARSH)	2.30	73.32
Sawmill WMA 1	SAW1_13A	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	0.84	26.65
Sawmill WMA 1	SAW1_14A	ARTIFICIAL LAKES	1.06	33.60
Sawmill WMA 1	SAW1_14A	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	1.57	50.12
Sawmill WMA 1	SAW1_14A	TRANSPORTATION/COMMUNICATION/UTILITIES	0.51	16.24
Sawmill WMA 2	SAW21A	ALTERED LANDS	1.74	55.43
Sawmill WMA 2	SAW21A	STREAMS AND CANALS	0.81	25.87
Sawmill WMA 2	SAW21A	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	0.48	15.23
Sawmill WMA 2	SAW21A	TRANSPORTATION/COMMUNICATION/UTILITIES	0.11	3.44
Sawmill WMA 2	SAW23A	ALTERED LANDS	1.76	55.90
Sawmill WMA 2	SAW23A	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	1.38	44.06
Sawmill WMA 2	SAW24A	ALTERED LANDS	1.87	59.69
Sawmill WMA 2	SAW24A	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	1.26	40.28
Schmidt's Woods	SCHM01	DECIDUOUS FOREST (>50% CROWN CLOSURE)	2.04	64.92
Schmidt's Woods	SCHM01	DECIDUOUS WOODED WETLANDS	0.84	26.84
Schmidt's Woods	SCHM01	RECREATIONAL LAND	0.07	2.15
Schmidt's Woods	SCHM01	RESIDENTIAL, HIGH DENSITY OR MULTIPLE DWELLING	0.19	6.06
Secaucus H.S. Marsh	SEHS01	PHRAGMITES DOMINATE COASTAL WETLANDS	3.12	99.51
Secaucus H.S. Marsh	SEHS01	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	0.01	0.46
Secaucus H.S. Marsh	SEHS02	DECIDUOUS BRUSH/SHRUBLAND	0.21	6.59
Secaucus H.S. Marsh	SEHS02	INDUSTRIAL	0.11	3.35
Secaucus H.S. Marsh	SEHS02	OLD FIELD (< 25% BRUSH COVERED)	0.36	11.35
Secaucus H.S. Marsh	SEHS02	OTHER URBAN OR BUILT-UP LAND	0.00	0.02
Secaucus H.S. Marsh	SEHS02	PHRAGMITES DOMINATE COASTAL WETLANDS	1.68	53.60
Secaucus H.S. Marsh	SEHS02	RECREATIONAL LAND	0.54	17.27
Secaucus H.S. Marsh	SEHS02	TRANSITIONAL AREAS	0.24	7.80
Sawmill Landfill 1E	SMFL08	ALTERED LANDS	3.14	99.97
Sawmill Landfill 1E	SMLF02	ALTERED LANDS	2.67	85.06
Sawmill Landfill 1E	SMLF02	ARTIFICIAL LAKES	0.47	14.90
Sawmill Landfill 1E	SMLF11	ALTERED LANDS	3.14	99.97
Sawmill Landfill 1E	SMLF4A	ALTERED LANDS	3.14	99.97
Sawmill Landfill 1E	SMLF6A	ALTERED LANDS	3.14	99.97
Sawmill Landfill 1E	SMLF9A	ALTERED LANDS	2.36	75.26
Sawmill Landfill 1E	SMLF9A	STREAMS AND CANALS	0.66	21.08
Sawmill Landfill 1E	SMLF9A	TRANSPORTATION/COMMUNICATION/UTILITIES	0.11	3.62
Teterboro Woods East	TWEA02	DECIDUOUS WOODED WETLANDS	2.77	88.24
Teterboro Woods East	TWEA02	TRANSPORTATION/COMMUNICATION/UTILITIES	0.37	11.73
Teterboro Woods East	TWEA1A	DECIDUOUS BRUSH/SHRUBLAND	0.13	4.00
Teterboro Woods East	TWEA1A	DECIDUOUS WOODED WETLANDS	2.52	80.29
Teterboro Woods East	TWEA1A	HERBACEOUS WETLANDS	0.48	15.41
Teterboro Woods East	TWEA1A	OTHER URBAN OR BUILT-UP LAND	0.01	0.27
Teterboro Woods East	TWEA4A	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	0.66	20.93
Teterboro Woods East	TWEA4A	DECIDUOUS SCRUB/SHRUB WETLANDS	0.61	19.49
Teterboro Woods West	TWEA4A	DECIDUOUS WOODED WETLANDS	4.11	130.99
Teterboro Woods West	TWEA4A	INDUSTRIAL	0.01	0.32
Teterboro Woods West	TWEA4A	RESIDENTIAL, SINGLE UNIT, MEDIUM DENSITY	0.89	28.20
Teterboro Woods West	TWWE6A	AIRPORT FACILITIES	1.05	33.32
Teterboro Woods West	TWWE6A	DECIDUOUS FOREST (>50% CROWN CLOSURE)	0.39	12.28
Teterboro Woods West	TWWE6A	DECIDUOUS WOODED WETLANDS	0.97	30.94
Teterboro Woods West	TWWE6A	PHRAGMITES DOMINATE INTERIOR WETLANDS	0.40	12.75
Teterboro Woods West	TWWE6A	TRANSITIONAL AREAS	0.34	10.68
Western Brackish Marsh	WEBM01	SALINE MARSH (HIGH MARSH)	0.32	10.33
Western Brackish Marsh	WEBM01	SALINE MARSH (LOW MARSH)	0.15	4.91
Western Brackish Marsh	WEBM01	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	2.66	84.73
Western Brackish Marsh	WEBM02	PHRAGMITES DOMINATE COASTAL WETLANDS	0.59	18.80
Western Brackish Marsh	WEBM02	SALINE MARSH (HIGH MARSH)	0.48	15.27
Western Brackish Marsh	WEBM02	SALINE MARSH (LOW MARSH)	0.25	7.83
Western Brackish Marsh	WEBM02	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	1.82	58.07
Western Brackish Marsh	WEBM03	PHRAGMITES DOMINATE COASTAL WETLANDS	0.01	0.28
Western Brackish Marsh	WEBM03	SALINE MARSH (HIGH MARSH)	0.10	3.20
Western Brackish Marsh	WEBM03	SALINE MARSH (LOW MARSH)	0.36	11.53
Western Brackish Marsh	WEBM03	TIDAL RIVERS, INLAND BAYS, AND OTHER TIDAL WATERS	2.67	84.96

Appendix 14. Candidate models in program DISTANCE to describe breeding density of Meadowlands birds counted between August 30, 2004 and September 5, 2006. Delta AIC values reflect the difference in score between the models, and the best fitting model is in bold.

	Red-winged Blackbird		**Marsh Wren**		**Song Sparrow**		**American Robin**		**Common Yellowthroat**		**Yellow Warbler**	
Model ID	**# parameters**	**D AIC$_c$**	**# parameters**	**D AIC$_c$**	**# parameters**	**D AIC$_c$**	**# parameters**	**D AIC$_c$**	**# parameters**	**D AIC$_c$**	**# parameters**	**D AIC$_c$**
Hazard rate simple polynomial	4	**0.00**	2	1.51	6	**0.00**	2	9.01	2	3.58	2	**0.00**
Hazard-rate cosine	4	1.71	3	1.35	4	0.29	4	**0.00**	3	**0.00**	2	**0.00**
Half normal hermite polynomial	1	172.95	1	25.38	1	27.33	1	24.60	1	6.98	1	0.78
Half normal cosine	2	33.38	2	5.30	2	4.30	2	4.56	2	4.28	1	0.78
Uniform simple polynomial	2	529.03	3	14.54	2	245.99	3	82.04	2	33.87	3	2.57
Uniform cosine	5	7.92	4	**0.00**	5	6.92	5	5.17	2	3.59	1	1.07
Best model fit + year	2	173.00	3	22.06	3	41.98	3	22.06		NA		NA
Best model fit + habitat	8	165.94	10	35.69	5	44.61	10	35.69		NA		NA
Best model fit + behavior	4	124.99	5	36.40	8	51.11	5	25.79		NA		NA
Best model fit + year, habitat, behavior	12	122.771	14	43.44	12	57.85	14	43.44		NA		NA

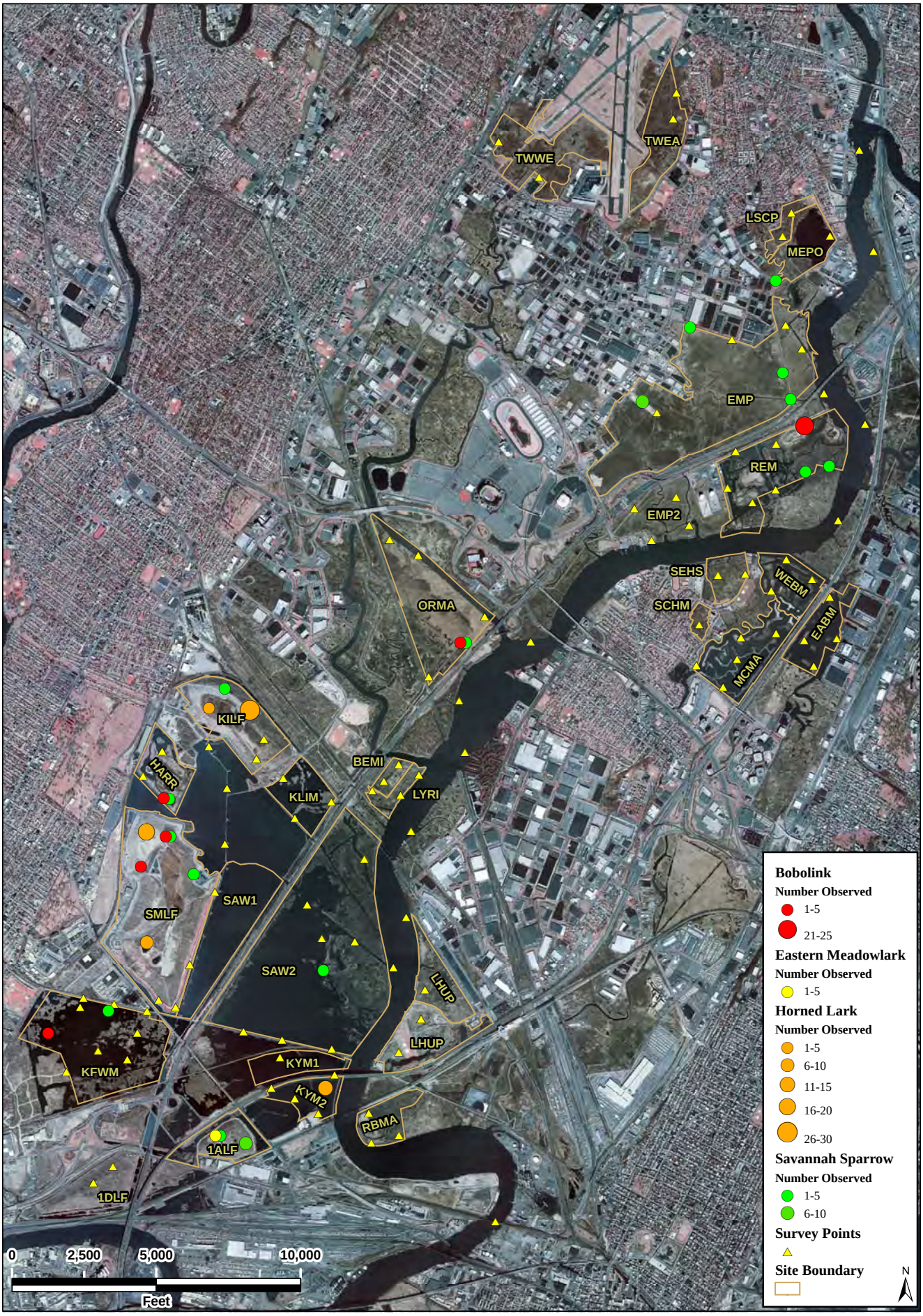
Appendix 15
Yearly Comparison of Bobolink and Savannah Sparrow Observations by Survey Point

Appendix 16
Grassland Species Observations at Survey Locations in the Meadowlands District During the First Year of the Survey (Aug 2004 - Sept 2005).

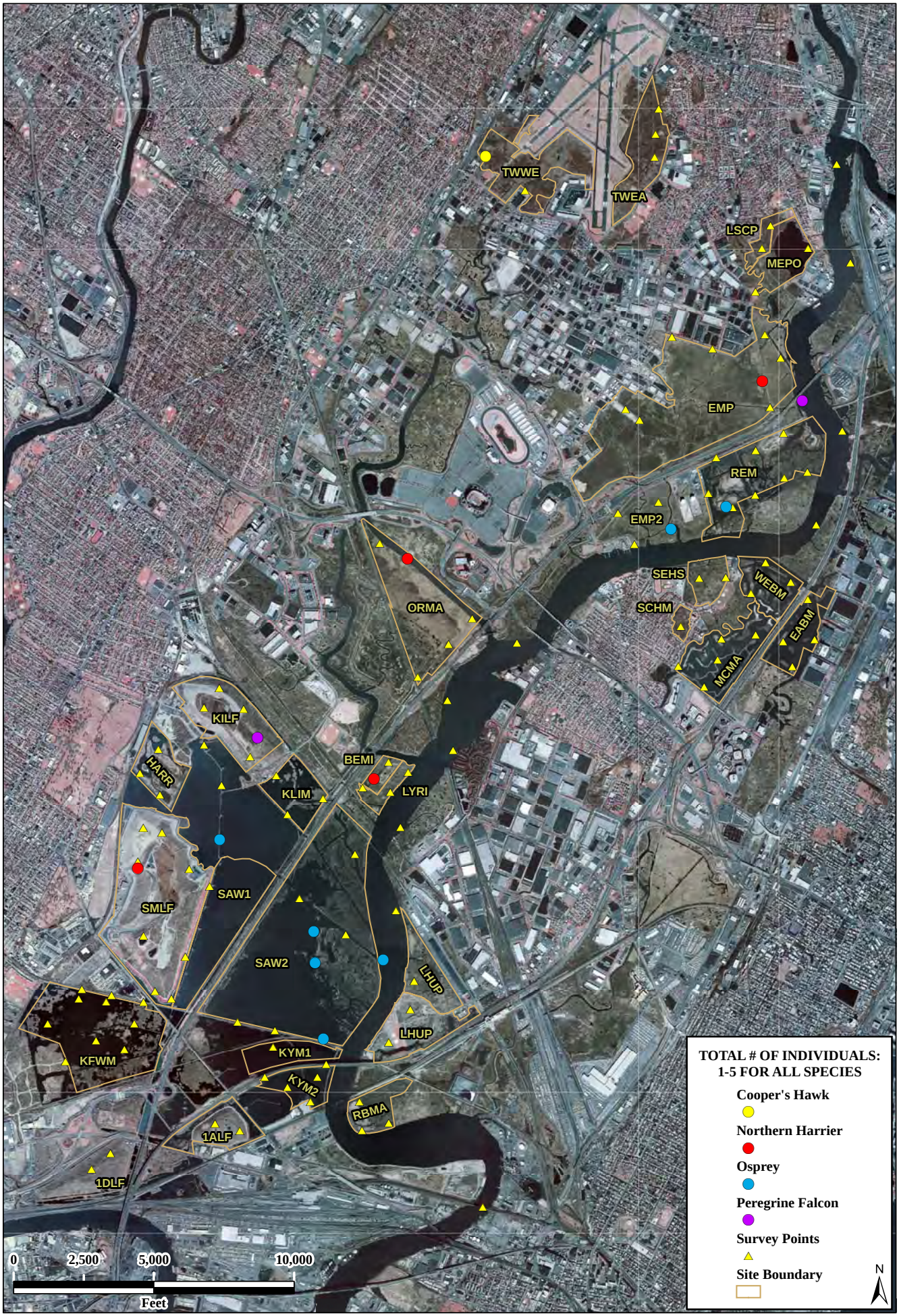


Appendix 17

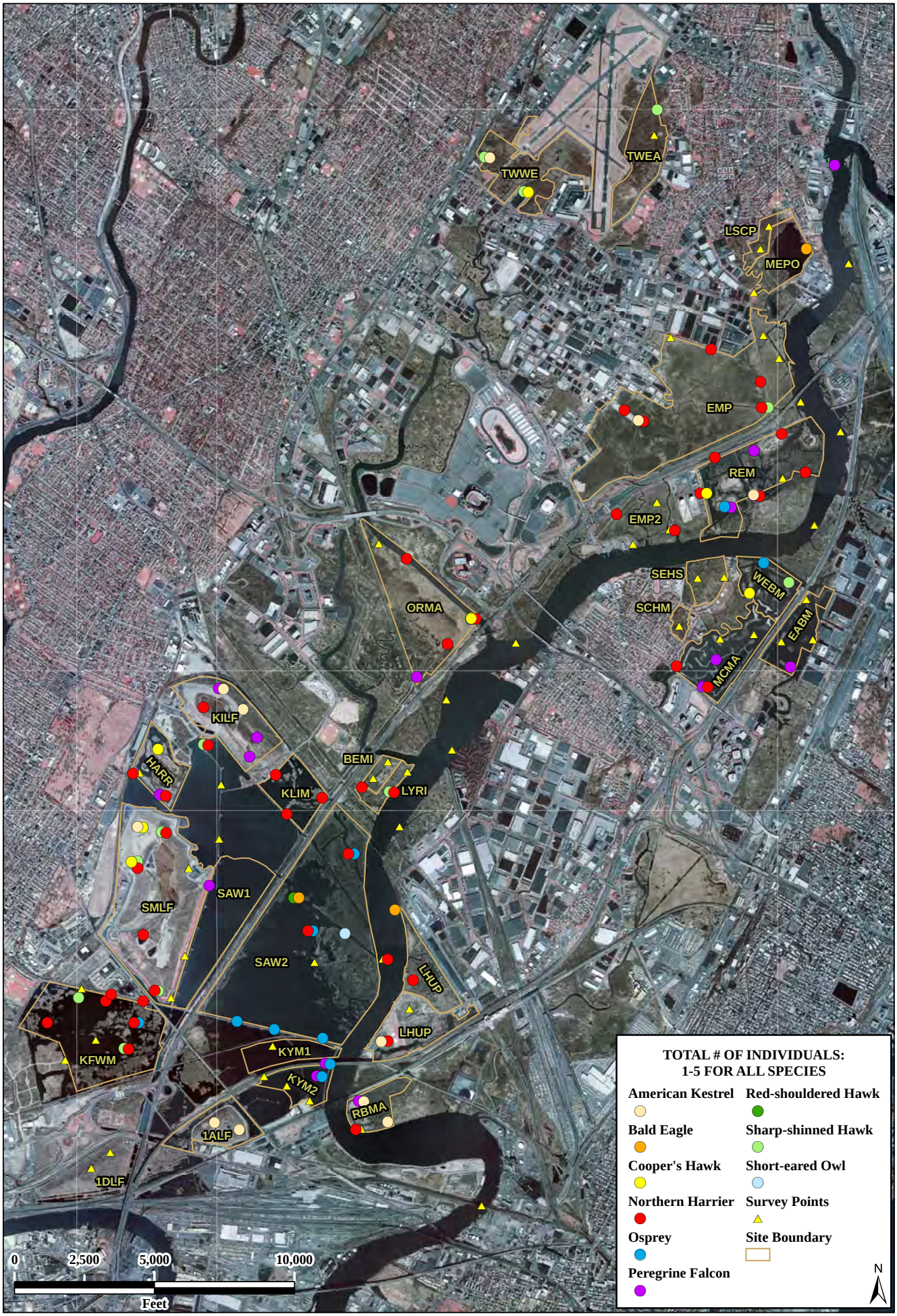
Grassland Species Observations at Survey Locations in the Meadowlands District During the Second Year of the Survey (Sept 2005 - Sept 2006). Grassland Species Were Only Recorded During the Non-Breeding Season.



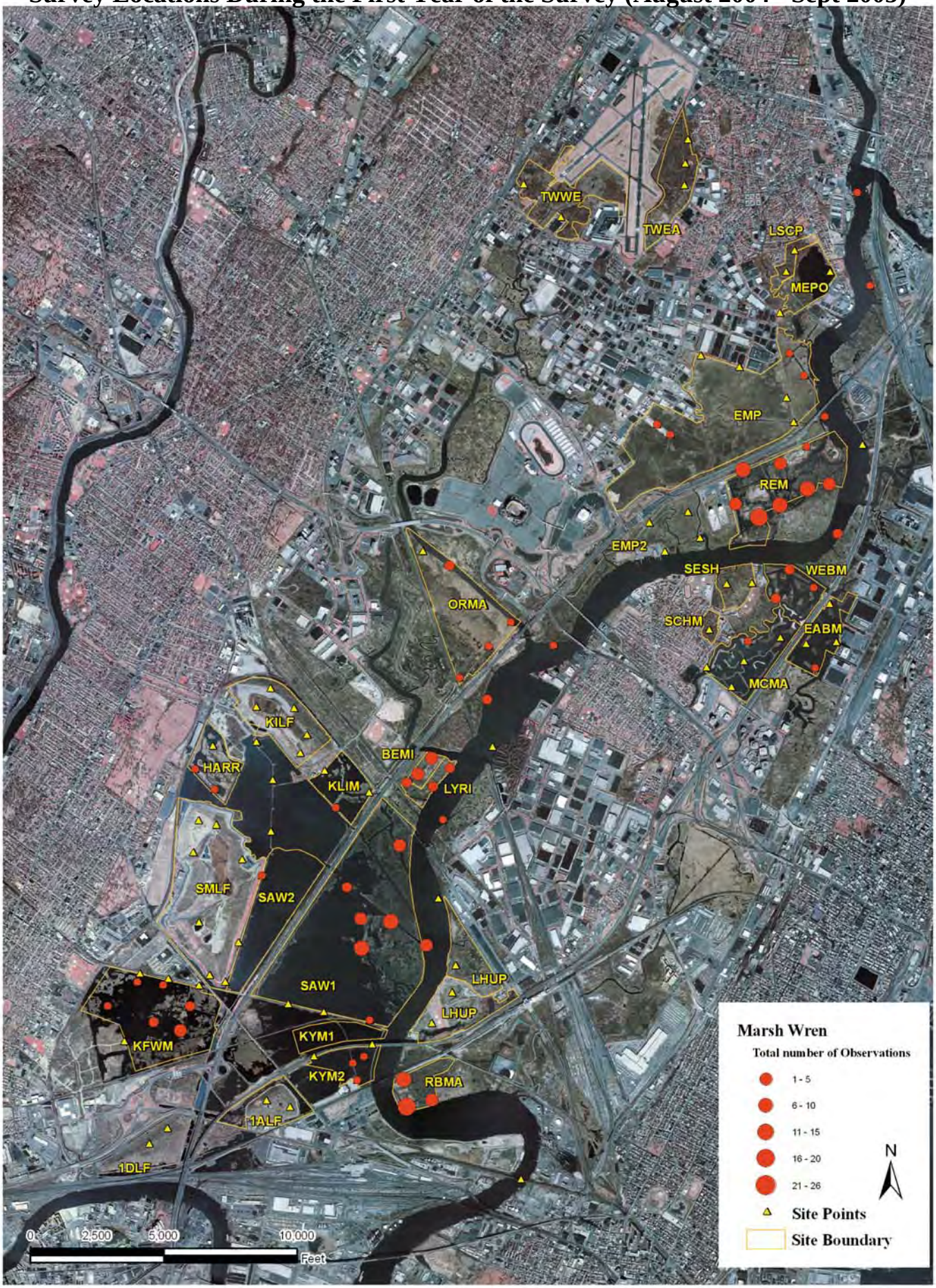
Appendix 18
Locations of Raptor Species Observations During the Breeding Season



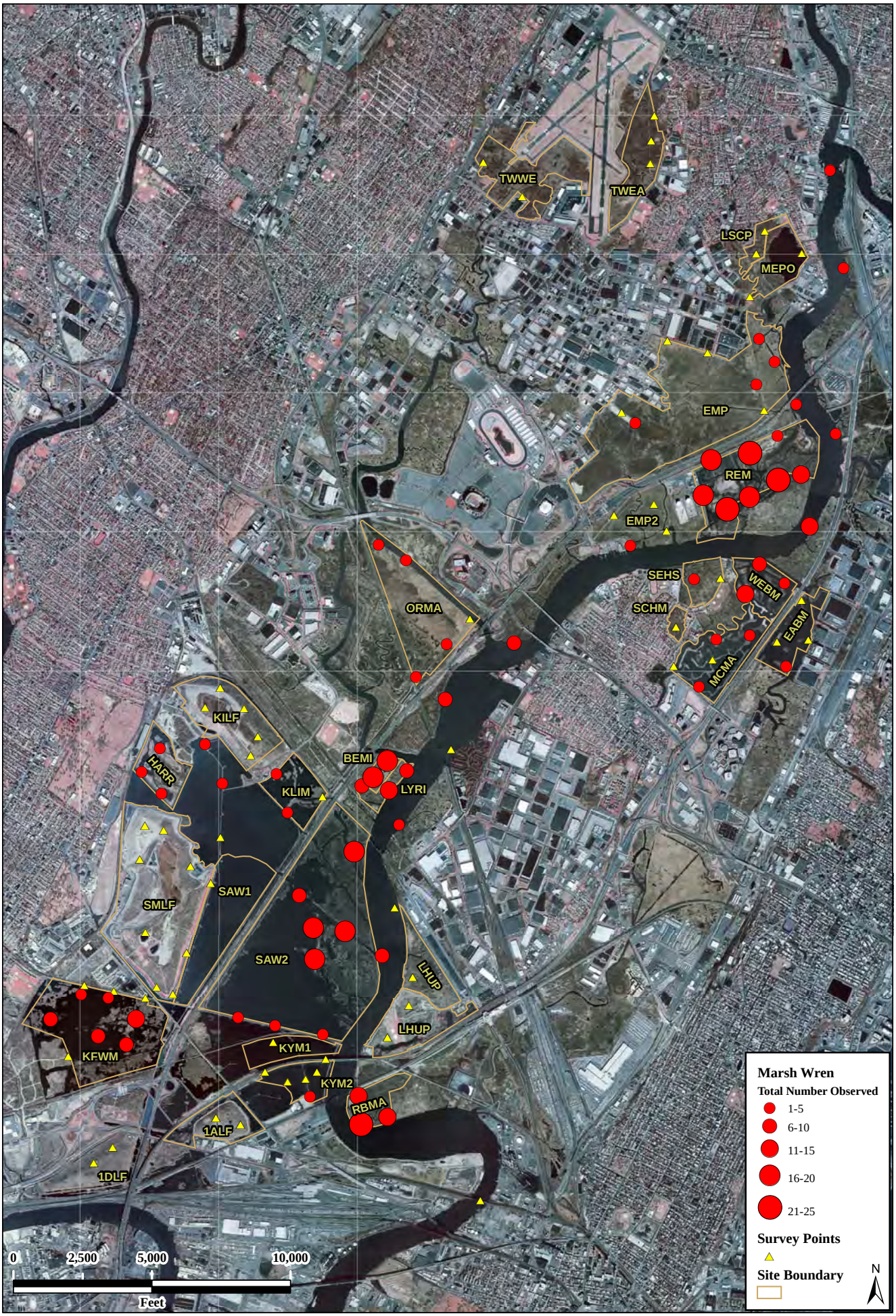
Appendix 19
Locations of Raptor Species Observations During the Non-Breeding Season



Appendix 20
Total Number of Marsh Wrens Observered at Meadlowlands District Survey Locations During the First Year of the Survey (August 2004 - Sept 2005)



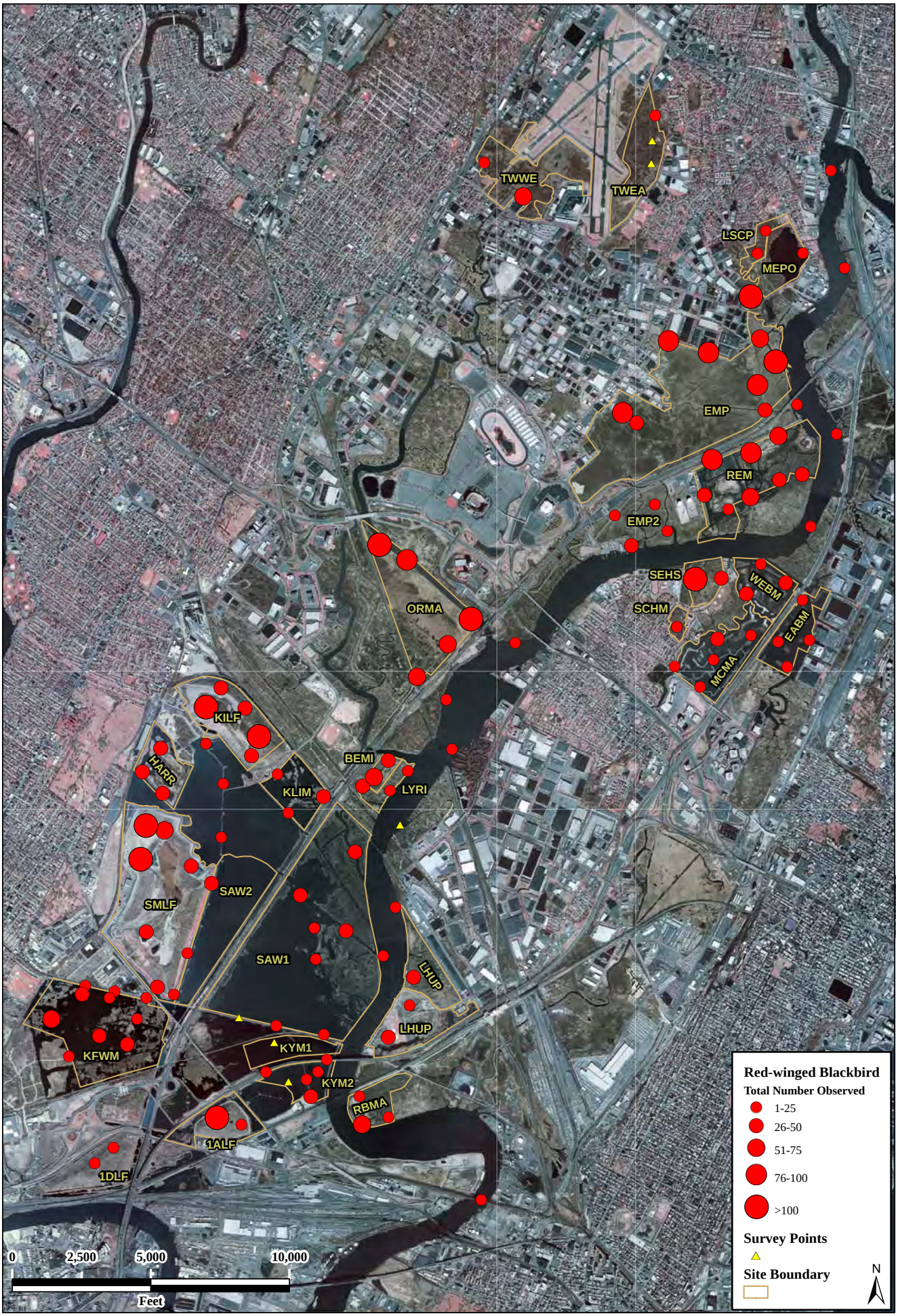
Appendix 21
Total Number of Marsh Wrens Observered at Meadlowlands District Survey Locations During the Second Year of the Survey (Sept 2005 - Sept 2006)



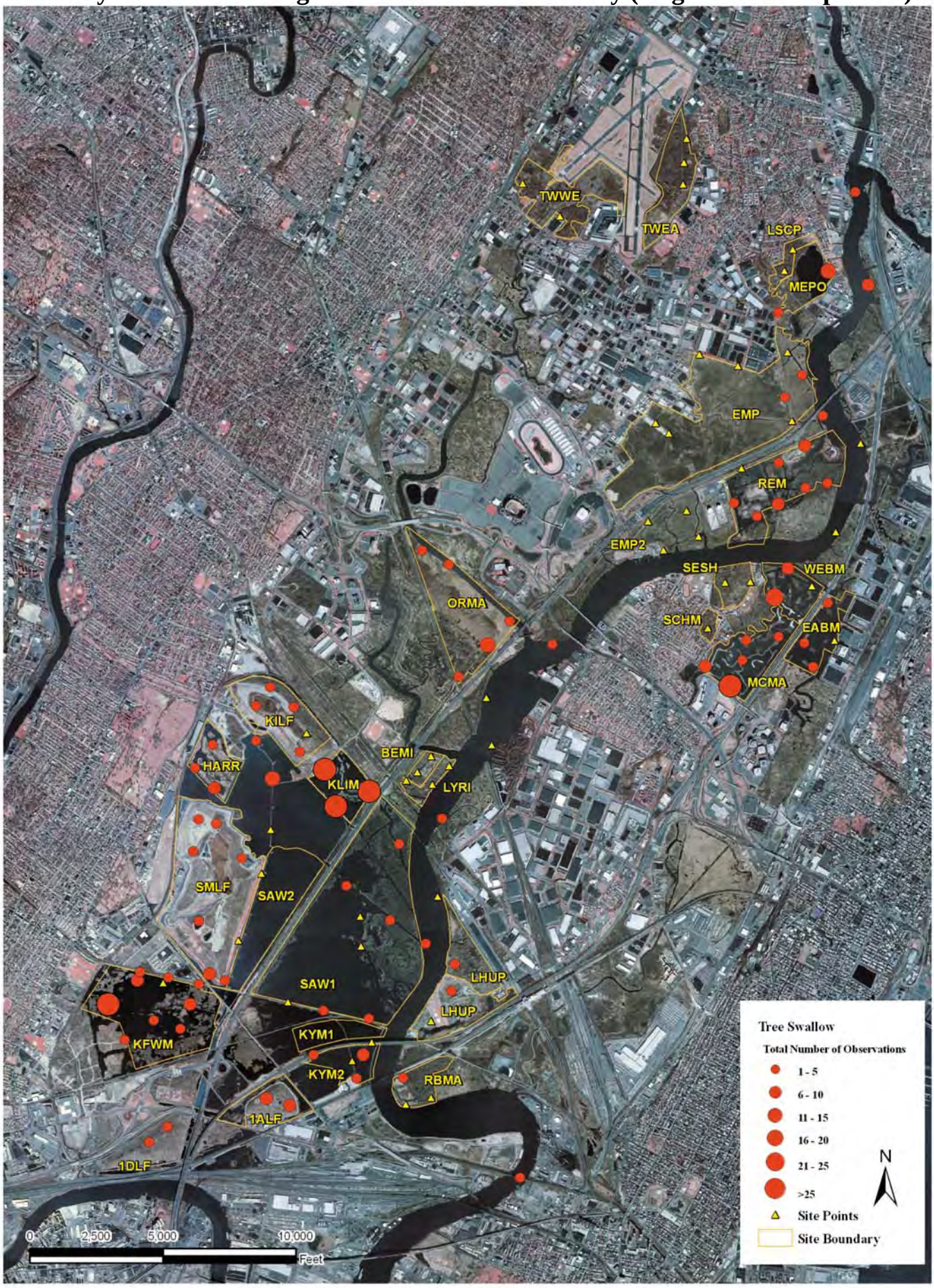
Appendix 22
Total Number of Red-winged Blackbirds Observed at Meadlowlands District Survey Locations During the First Year of the Survey (Aug 2004 - Sept 2005)

Appendix 23

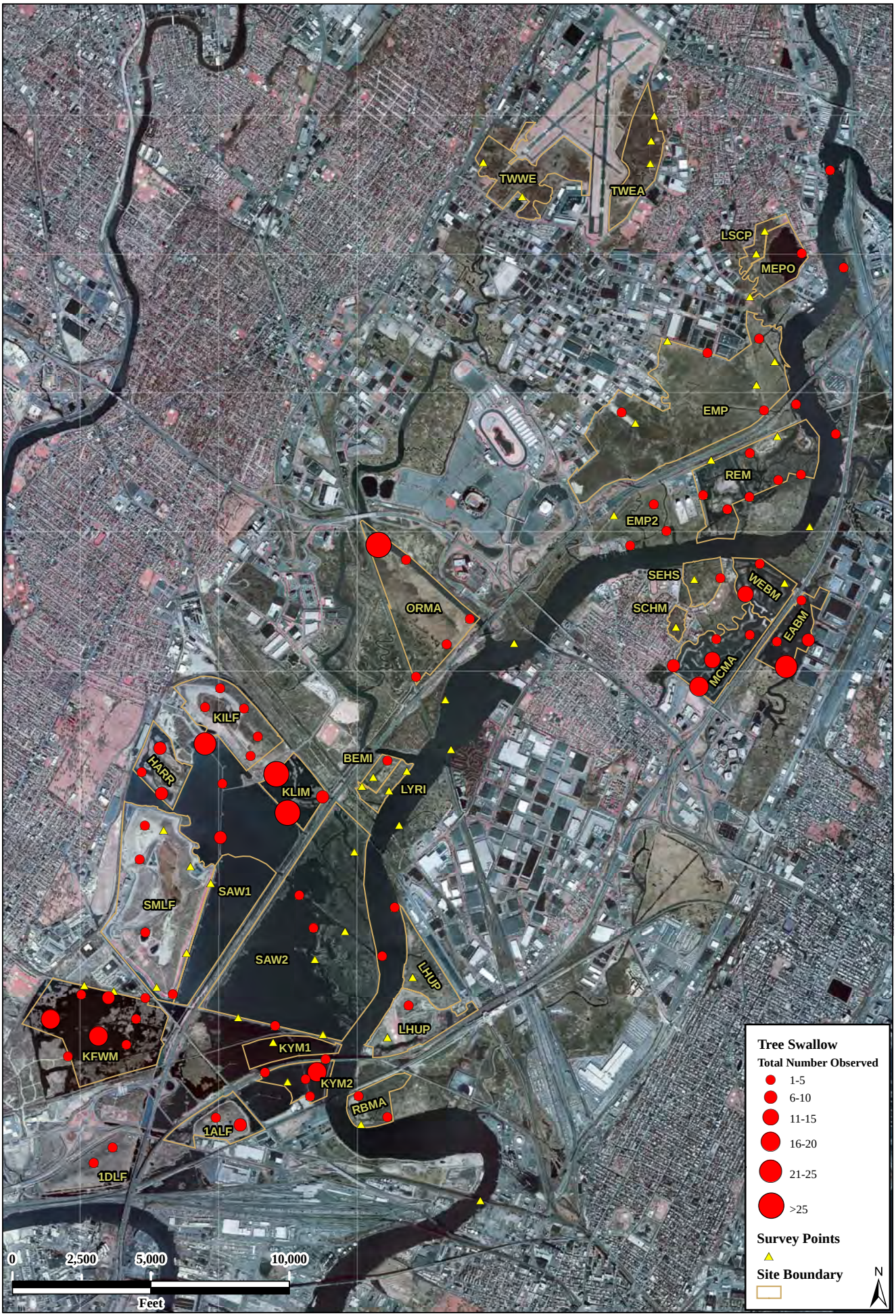
Total Number of Red-winged Blackbirds Observed at Meadlowlands District Survey Locations During the Second Year of the Survey (Sept 2005 - Sept 2006)



Appendix 24
Total Number of Tree Swallows Observered at Meadlowlands District Survey Locations During the First Year of the Survey (August 2004 - Sept 2005)



Appendix 25
Total Number of Tree Swallows Observered at Meadlowlands District Survey Locations During the Second Year of the Survey (Sept 2005 - Sept 2006)



Appendix 26: Harrier Meadow: comparison with Seigel et al. 2005 study

We undertook a brief comparison of our Harrier Meadow Marsh data to those of Seigel et al. (2005). The purpose of that study was to compare abundance and diversity of pre-restoration (1997) and post-restoration (2001, 2002 and 2003) avian communities. A direct statistical comparison of our data with the Seigel et al. (2005) study is not possible because that earlier survey had not used a point count methodology like ours. However, since Harrier Meadow Marsh is small site, and since the two studies covered a similar total acreage (9.45 hectares in the core area of our survey and 9.8 hectares in Seigel et al. 2005)), we are able to provide some more descriptive comparisons, using information on species richness and avian abundance by guild.

We recorded a total of 71 species in the first and 70 species in the second year of our survey, a greater than 20% increase from the Seigel et al. (2005) study that reported 43 species pre-restoration and 57 species post-restoration. Cumulatively, we recorded a total of 86 species for the duration of the survey, a 50% increase over the Seigel et al. (2005) post-restoration number of species. However, the Seigel at al. (2005) study recorded birds only during the spring, summer and early fall, while our study was year-round. If we compare the species richness only for the period surveyed in the earlier study, the numbers are very similar to the post-restoration numbers, 60 and 61 in the first and second year of our survey respectively.

Overall bird abundance was 205 and 178 total number of birds counted per survey in each year of our study respectively, a lower number than Siegel et al.'s (2005) post-restoration reported bird abundance (453.8) but much higher than their pre-restoration reported abundance (33). The overall abundance measured in our study does not change substantially if we only include the spring, summer, and fall surveys, at 235 for the first year and 182 for the second year. Siegel at al. (2005) reported that abundance of flocking species, such as *Calidris* sandpipers and Green-winged Teal (*Anas crecca*), declined during their study from 2001 to 2003. The lower overall abundance that we report in our study may be the result of further declines in numbers of these species.

Finally, Seigel et al. (2005) compared the average abundance per survey of foraging guilds before and after restoration. Prior to restoration, the dominant foraging guild was generalists while after restoration, mudflat foragers were most abundant followed by open-water foragers and generalists. In the early post-restoration years more than twice as many individuals of mudflat species as open water species were reported (see Figure 26A below, from Seigel et a. 2005). In our study, the relative density by guild (Figures 26B below) tended to include as high a percentage of open water species as mudflat species. Furthermore, we recorded a higher abundance of 'generalists' that the Seigel et al. study (2005), up to almost 35% of total site usage during the first year of our study. These differences were more pronounced when using data from year-round counts.

This comparison points to the importance of looking at winter utilization of habitats in trying to determine the importance of a site, not only use during the breeding and migratory season. We see an increase in total species richness as well as changes in the relative density of different foraging guilds when our winter survey data are included in the analysis and when comparing with the previous study at Harrier Marsh.

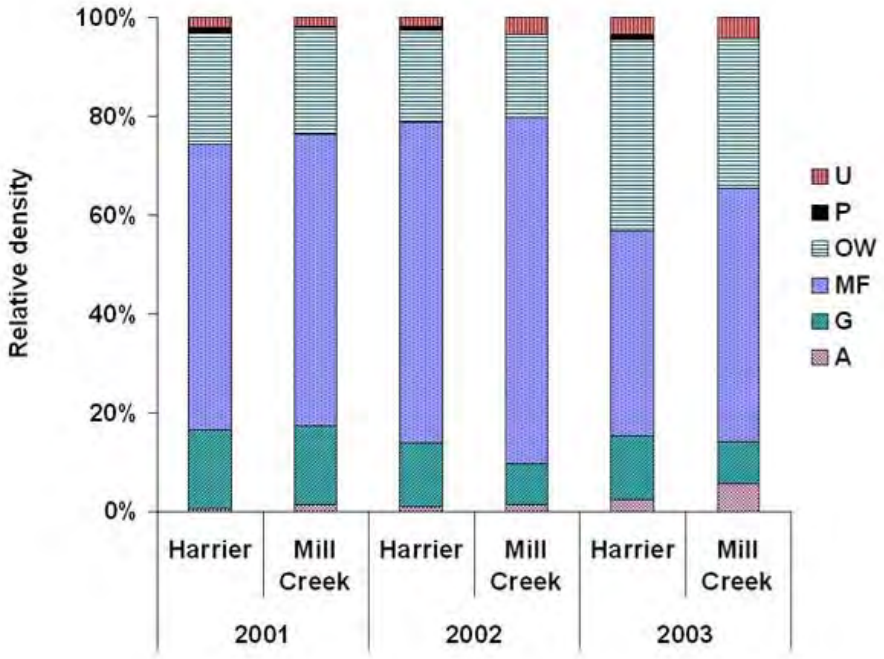


Figure 26A. Relative density of six foraging guilds at Harrier Meadow and Mill Creek after restoration, from Seigel at al. (2005)

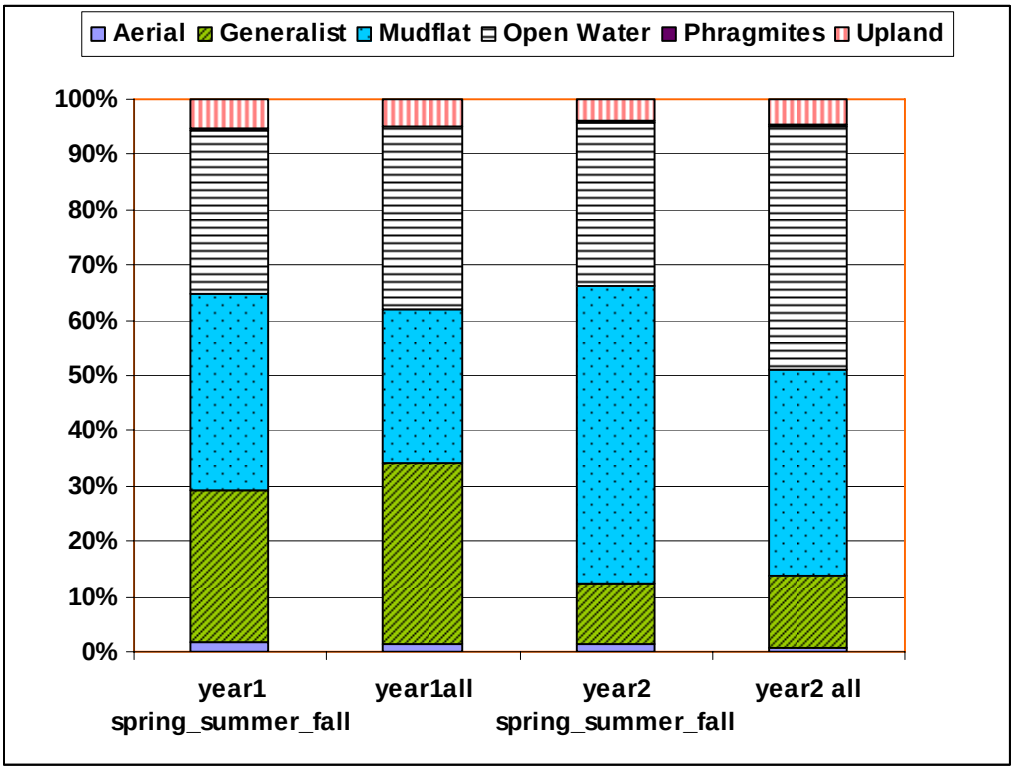


Figure 26B. Relative density of six foraging guilds at Harrier Meadow based on the results of surveys conducted between August 30, 2004 and September 1, 2005 (year1) and September 6, 2005 and September 5, 2006 (year2). Density is shown for the surveys conducted during the same season as the Seigel et al. (2005) survey (spring_summer_fall), and for the entire year round survey (all).