Bronx River Forest and Floodplain Restoration - Bond Act Project

Year 2 Monitoring Report

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1. INTRODUCTION AND OBJECTIVES

The monitoring described in this report is aimed at evaluating the success of the native plantings and invasive species control measures, and their consequent impact on the vegetation community, breeding birds, and channel configuration and stability. The project background and objectives were described in detail in the first year project monitoring report. Project goals were to:

- Re-establish more diverse, native species-dominated riparian and river bank vegetation that could improve habitat and provide soil stability
- Reconnect the channel to the floodplain where possible by reclaiming filled lands and creating over-flow opportunities
- Convert a playing field in the floodplain to a floodplain forest
- Enhance in-stream habitat
- Provide more opportunities for access, passive recreation, and education along the river.

2. ACTIONS IN YEAR TWO

In the spring and summer of 2006, our main actions at the Bond Act site were invasive plant control, monitoring, and educational and recreational tours. The landscaping sub-contractor crews visited the project area to pull vines and cut Japanese knotweed 3 to 4 times over the growing season in areas we identified as problematic. The NRG foresters controlled invasive exotic plants in adjacent areas using chemical pesticides, treating 2 to 12 acres of floodplain forest, riparian area, and adjacent upland each month. In addition, in these adjacent areas, foresters planted over 5,400 one quart sized trees and shrubs.

There were both formal and informal monitoring and educational tours. NRG conducts scheduled monitoring of birds and vegetation and periodically surveys conditions to assess the need for invasive plant control or bank repair. The Bronx River Alliance conducts water quality monitoring as well. Many school groups use the area, and the Bronx River Alliance, Sustainable South Bronx, Green Apple Corps, and NRG use the area for environmental training. The Bronx River Alliance clears debris jams in the river just enough to allow canoe passage for their canoeing programs.

3. MONITORING

3.1. Vegetation

Vegetation monitoring was conducted to evaluate the success of the plantings (percent survival) and impact of the plantings on plant species diversity, cover, and invasive plant dominance in the forest floodplain.

Planting Success
Due to the large numbers of plants installed, a complete post-project count was not conducted. Instead, installed and dead plants were counted in a sub-set of all the planting areas, and visual assessments were made of plant loss.

Cover and Species Richness
Eleven plots were established in 2002 (see Figure 1), each measured 3m x 3m: one reference wetland planting area plot (number 14); two control plots (numbers 19 and 20); two reference plots (numbers 24 and 30); and six floodplain plots established in 2006 (number 40-43, 50, 51). The location of all plots was marked with wooden or rebar stakes, drawn on a map and GPSed.

During sampling, temporary stakes were used to mark all corners of the 3m x 3m plots and a meter tape was strung around the plot. A 1m x 1m plot for herbaceous layer sampling was temporarily demarcated in the NE corner of the 3m x 3m plot. Relative percent cover was estimated at three distinct levels: herbaceous, shrub, and tree canopy. Percent cover at each level was visually estimated for each species found in the plot. At each level all species present as well as dominant species were noted.

Vegetation Communities
An inventory of the vegetation community was conducted in 2005 using entitation, a process of identifying and describing ecologically distinct plant communities, or entities. Entitation results in a map and database that can be used to identify where certain species are dominant or present, and to help prioritize areas that may be threatened, should be protected, or should be restored. This mapping can serve as a baseline for assessing change. The methods used will be available shortly for download from the City of New York Department of Parks and Recreation's Natural Resources Group website. This inventory is to be repeated every 5 to 10 years.

3.2. Breeding birds
To assess changes occurring to the breeding bird population over the course of the Bronx Forest restoration, a breeding bird census was conducted, using spot-mapping techniques based on those employed by the Cornell Laboratory of Ornithology and the National Audubon Society (Robbins, 1970) (see Figure 2).

In 2003, before the beginning of the restoration project, we conducted seven site visits between May 14 and July 16. Our breeding bird survey was abbreviated in 20005 due to ongoing construction of boardwalks on the site. In 2006 we conducted eight site visits between May 3 and July 11. Each visit began within half an hour of sunrise, when bird vocalization peaks (Ralph et al. 1993) and lasted 1.5 to 3 hours.

To ensure birds were detectable, we did not conduct visits during moderate to severe precipitation or winds. During each visit, as we walked the census route, we recorded birds seen or heard on a survey map of the site. Species was indicated using the four letter USGS Bird Banding Codes. We also recorded breeding-related behaviors using symbols established by the British Trust for Ornithology (Bibby et al. 1992). We used these behavior registrations to delineate territories and to classify the breeding status of these territories as outlined below. We always walked the same census route, although we varied starting points to avoid surveying the same areas at the same time each morning. We did not actively search for nests during census visits.

We used the territory classification system formulated by the Natural Resources Group Salt Marsh Restoration (Brown & Alderson, 2001), which fuses the National Audubon Society system (Robbins, 1970) with the system developed by the New York Federation of Bird Clubs for the NYS Breeding Bird Atlas. Any "mapped territory" as defined by the Audubon Society constitutes a "Confirmed Breeding" status under the Breeding Bird Atlas system.
We classified each territory as a "Confirmed", "Probable", or "Possible" breeding territory according to the following guidelines.

CONFIRMED: To classify a territory as confirmed, we made at least one of the following observations for the species in question:

- Singing bird within the territory area on at least three consecutive site visits (criterion for a "mapped territory" according to Robbins, 1970)
- Active nest
- Bird carrying fecal sac
- Bird carrying food
- Unfledged or recently fledged young
- Distraction display or injury-feigning

PROBABLE: To classify a territory as probable, we made at least one of the following observations for the species in question:

- Singing bird within the territory on more than one site visit
- Pair in suitable breeding habitat
- Chasing of conspecifics, agitated behavior or anxiety calls
- Bird carrying nesting material or excavation of a nesting hole
- Courtship and display

POSSIBLE: To classify a territory as possible, we made the following observation for the species in question:

- Singing bird within suitable habitat on at least one site visit

For the purposes of data analysis, we divided the study site into five sections. See Figure 2 for the delineation of these five sections. The thin strip of forest between the Bronx River and the Bronx River Parkway was divided into Parkway 1 on the North and Parkway 2 to the South. The other three sections are the swamp forest (Swamp), the strip of mature forest with skunk cabbage, mayapple, and trout lily in the herbaceous layer that lies between the Bronx River and the ball fields (Skunk), and the island. In 2006 we added a sixth section, the Cricket Pitch, an abandoned playing field that NRG replanted with wetland vegetation. For each section, we tallied the number of species holding possible, probable, and confirmed breeding territories. In addition, for the site as a whole, we calculated the percentage of breeding territories that were held by Red-winged blackbird, Gray catbird, Yellow warbler, and Song sparrow, four of the most common breeding species at disturbed wetland sites. For this calculation, we included only territories and species that qualified as probable or confirmed for breeding. We also calculated breeding species diversity using the Shannon-Weiner index (H'), for all probable and confirmed breeding territories. We calculated H' for the restoration area and upland areas individually and also for the study site as a whole.

3.3 Channel morphology

Although historically the Bronx River had a meandering channel, it has largely been straightened, confined, and anchored in place by bridges, highways, railroads, and rock revetment. Channel morphology monitoring allows us to determine if significant bank erosion,

bank deposition, pool deepening, or pool in-filling is occurring. Because there is no evidence of active channel migration or erosion, only channel cross-sections at outer bends or locations of active sediment deposition or erosion are surveyed more frequently than every 2 to 10 years.

In the spring of 2006, one year after project completion, six permanent cross-sections were established in the Bronx Forest at locations where pre-project cross-sections had been surveyed. This entailed pulling a measuring tape across the river perpendicular to the channel and installing a piece of rebar at the left end (facing downstream) at the 0 end of the tape, and another piece of rebar at the other end of the tape (from about 90 to 150 ft away, depending on the width of the floodplain at that point). The elevation across the tape was then surveyed at 2 to 4 foot intervals. With the installation of permanent cross-sections, we will be able to accurately re-survey in consequent years to assess the degree of change in channel geometry, whether from erosion or sediment. The pre-project surveys (which were used to develop a hydraulic model [HECRAS] for the design phase) were not permanently marked in the field, so approximate locations were used and the pre-and post-project cross-sections were qualitatively compared to assess whether significant differences in channel geometry could be detected.
In 2007, only visual estimates were made of erosion and channel stability at the permanent cross-section sites. Cross-sections will be re-surveyed in 2008 (Figure 3).

In-stream habitat
The decades of straightening and channel clearing, together with flashy high urban storm flows and high sediment deposition, have led to a relatively homogenous channel bed with little in-stream cover and few high flow refugia for aquatic organisms in the Bronx Forest. Five parameters were considered that impact habitat and could be affected by local in-stream structures and improved management. These include:

- *Large woody debris (LWD)* - provides stream structure by creating pools, providing refuge and cover for fish and providing quality macroinvertebrate colonization habitat.
- *Instream Cover* - provides important resting, rearing and hiding habitat for aquatic fauna. The abundance and diversity of cover is important in determining the diversity and abundance of fish and macroinvertebrates that the system is capable of supporting. Furthermore, abundance and diversity in cover types increases how robust the river is, especially in terms of disturbance tolerance.
- *Pools* - provide resting places and cover for fish species. Pool substrate and size are evaluated to determine the diversity of pool types, which impacts the diversity of aquatic organisms supported within present channel pools.
- *Bank Condition* - bank angle, height and vegetation serve as predictors of erosion potential. Bank vegetation provides macroinvertebrate habitat and fish cover.
- *Riparian Zone/Canopy* - provide shade and canopy cover to the stream helping to keep water temperatures low, filter out contaminants and serve as a source of LWD recruitment.

These habitat characteristics were surveyed within the project area using a modified visual assessment adapted from the level II Habitat Assessment in EPA's *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish* (Barbour et al. 1999). A final habitat survey will be conducted in the last year of monitoring.

All reaches were evaluated via stream walks, canoe trips in July and August 2005, and via visual assessment by planting area in April and May 2006. LWD was counted and the residual pool depth (or net pool depth, independent of current water depth at the time of measurement) was

determined by measuring the maximum pool depth and the minimum channel depth downstream of the pool. In 2005, transects were surveyed to better quantify stream and riparian conditions. Transects were spaced so that they would be representative of sampled reaches (Meador et al. 1993) and were measured for substrate, aquatic cover, bank condition and riparian canopy cover measurements. All ocular estimations were periodically calibrated with a survey tape. All transect data were collected in the cross channel corridor that extends 5m upstream and downstream of the transect. Representative transect data were then weighted according to the length of similar stream subreaches to determine overall average habitat cover with stream areas. In 2006, aquatic cover, bank condition, and riparian cover estimates were made visually in planting areas. In 2007, only visual estimates were made of habitat quality, including LWD and pool frequency and cover.

4 MONITORING RESULTS

4.1. *Vegetation*

Planting success:

Based on our qualitative, visual observations in the Bond Act project area, overall the plantings were very successful. Although the monitoring results given below provide a more precise picture of the impact of the plantings at specific sites, on the whole we did not observe many areas where we believe plant success was less than 85%. The exceptions were where there was a lot of vandalism, on the left bank just upstream of the Burke Ave Bridge, and the bioengineering materials. The performance of the brush fascines installed at the toe of the bank was very poor (>75% did not sprout or thrive). However, the brush mattress, on the right bank of the island did very well where Japanese knotweed was managed.

Percent cover was entered into a spreadsheet and used to estimate the percentage of the plot covered by each plant species present. Also calculated for each species were the average percent cover (if present), number of plants present, and relative frequency. Calculations per plot included total percent cover of all plants, percent cover of classes of plants (woody, graminoid, shrub), species richness, the average and standard deviation for each. See Appendix Table 2 for the vegetation data sheet.

Three new species were found in 2006, bringing the total number of species to 151 (see Appendix Table 1 for site flora). These additional species were members of plant families already represented in the 2005 monitoring plots keeping the number of plant families at 52. Of the species found there were 15 graminoids, 66 forbs, three herbaceous vines, 26 shrubs, 37 trees, and four woody vines. The family with the most representatives was Asteraceae (Aster family) with 19 species. The next most prominent families were Poaceae (Grass family) with 13 and Rosaceae (Rose family) with 11 species (see Appendix Table 1).

Of all the plants encountered, 38% (57 species) were exotic, 11% (17 species) were invasive, 15% (23 species) were considered native and uncommon in New York City, 1% (1 species – river birch, *Betula nigra*) was rare in New York State, and 22% (32 species) were planted (see Appendix Table 1). There were 21 (14%) New York City plant species of special interest last year.

Two plots, 20 and 51, were not relocated. Because the most recent set of data from these two plots is missing, it isn't possible to compare all data from the two years post-restoration. This report discusses data for 2006 with comparisons to 2005 only for plots where data is available in all years.

Total percent cover for the 9 plots relocated in 2006 ranged from 75.0-165.2, with an average of 147.5%. Percent cover was not correlated to species richness. The number of species in a plot varied from 4-16, with an average of 7.8.

Plots 14 and 40 had the highest percentage of woody cover, with 140% (see Appendix Table 1). Average woody cover was 101.2%, with the lowest cover at 22.5% in the cricket pitch. Plot 40 also had the highest number of woody species (5) compared to the overall average (3). The woody species with the highest percent cover was American beech *(Fagus grandifolia)* with 100% cover in each of the two plots where it was recorded. The most frequently recorded woody species was silver maple *(Acer saccharinum)*, found in 5 of 9 plots, but the average percent cover was only 9.5% in those plots.

Plot 40 had the highest percent cover of forbs, with 105% for 9 species. In 2006 as in 2005, the plot with the least amount of forb cover was plot 14, with 0% cover for the two species present. The number of forb species present ranged from 1 to 9 and the average number of forbs was 3.8 (see Table 1, Appendix). In 2005, the herb with the highest percent cover was the exotic invasive common mugwort *(Artemisia vulgaris)*, with average cover of 17.9% in the seven plots where it was recorded. In 2006, mugwort was found in 3 plots with 37.5% cover. The two species with the highest percent cover were the native jewelweed *(Impatiens capensis)* with 27.5% and the exotic lady's tearthumb *(Polygonum persicaria)* with 20.8% average cover for two and three plots respectively.

Graminoid percent cover had a wide range, from 0-82.5%, with an average cover of 10.9%. In 2005 plot 50 in the former cricket pitch had the highest percent cover with large concentrations of native species such as Virginia wild rye, rice cut-grass and fall panic grass. In 2006, plot 50 still had the highest percent cover, but the Virginia wild rye was the only graminoid remaining. Plot 43 also had 82.5% cover of the Virginia wild rye and no other grass. The number of graminoid species ranged from 0-2.

Herbaceous cover ranged from 0-105, with an average of 33.5%. The graminoid with the most percent cover was the installed native Virginia wild rye *(Elymus virginicus)*, with an average cover of 82.5% for the two plots where it was recorded. The Virginia wild rye was also the most frequently found grass.

Only two vine species were recorded, the herbaceous field bindweed *(Convolvulus arvensis)* and the woody Virginia creeper *(Parthenocissus quinquifolia)*. The field bindweed volunteer was only found in one plot and the planted Virginia creeper was recorded in two plots. All three occurrences were 5% cover.

Japanese knotweed *(Polygonum cuspidatum)* was found in 6 of 9 plots. In two of these plots its percent cover was less than 1, and so was noted as "present" with zero percent cover. Where present, average cover was 5%. Thus this invasive was not an important presence in any of the plots (see Table 1, Appendix), although there are large concentrations of Japanese knotweed in other sections of the Bronx River Forest.

4.2. Breeding birds

In 2003 we found 27 possible, probable, or confirmed breeding avian species in the Bronx Park study area. Of these, we confirmed the breeding of twelve species according to New York Federation of Bird Clubs protocols. See Appendix Table 4 for a list of all possible, probable, and confirmed breeding species with the numbers of territories each species held in the subsections of the site as well as the site as a whole in 2003. We found 20 species in the swamp forest, 19 in the skunk cabbage area, 16 in Parkway 1, 10 on the island, and 6 in Parkway 2.

In 2003 the skunk cabbage area had 13 probable or confirmed breeding species, whereas the Swamp had only seven. In addition, two species (American robin and Gray Catbird) dominated the number of probable and confirmed territories in the Swamp. No other species held more than 2 territories. Skunk was also dominated by these two species, but two other species (Northern oriole and Red-winged blackbird) also held more than two territories. The island, despite having only 10 species reported, had an H' only slightly lower than that of Skunk. No one species was dominant in terms of total number of territories. The island is also the probable site of nesting by the pair of Wood ducks. Parkway 2 had a substantial number of species (16), but, as in the Swamp, was heavily dominated by the American robin and Gray catbird. Parkway 1 had the fewest species and territories (4). This is not surprising, given that it is area of the site with the thinnest border of trees.

Overall, 27% of all territories were held by the American Robin and 23% by the Gray catbird in 2003. 39.4% of all probable and confirmed territories were held by species typical of disturbed wetlands. The 2003 H's (Shannon-Weiner indices-using only probable and confirmed territories) for the entire site, and each subdivision, are: Entire census area, 2.27; Swamp, 1.31; Parkway2, 1.67; Parkway1, 1.04; Skunk, 2.25; and Island, 2.11.

In 2005, despite the small number of visits, we found 23 possible, probable, or confirmed breeding avian species. Of these, we confirmed the breeding of 9 species according to New York Federation of Bird Clubs protocols. See Appendix Table 5 for a list of all possible, probable, and confirmed breeding species with the numbers of territories each species held in the subsections of the site as well as the site as a whole in 2005. We found 12 species in the swamp forest, 17 in the skunk cabbage area, 8 in Parkway 1, 9 on the island, and 11 in Parkway 2.

In 2005 the skunk cabbage area had 10 probable or confirmed breeding species and the Swamp had 9. In addition, two species (American robin and Gray Catbird) dominated the number of probable and confirmed territories in the Swamp. No other species held more than 2 territories. Skunk was also dominated by these two species, but Warbling vireos held 3 territories. The island had 7 species with probable or confirmed territories, dominated by the American robin and Red-winged blackbird. The two Parkway sites each had 6 species. Parkway 1was dominated by American robin and Gray catbird, and Parkway 2 by American robin and Red-winged blackbird.

Overall, 35% of all probable and confirmed territories were held by the American Robin and 16% by the Gray catbird in 2005. The percentage of probable and confirmed territories held by the species typical of disturbed wetlands was 29.4%.

For 2005, the H's (Shannon-Weiner indeces) for all probable and confirmed territories in each subdivision of the site are: Swamp, 1.8; Parkway2, 1.64; Parkway1, 1.59; Skunk, 2.04; and Island, 1.81. The H' for the entire census area was 2.

Although we sighted wood ducks on two occasions in 2005 (two males on June 9 and a single female on July 6), we did not confirm breeding in our three visits. The continued presence of this species at the Bronx Forest despite extensive excavation and ongoing construction is encouraging. This species has been seen in previous years on the island, and we believe they may breed there. Hopefully, the wood duck nest box that has been placed on the island will increase the chances of successful breeding by this species.

Several species less common in New York City were found in 2005. One male each of Acadian flycatcher, Cerulean warbler, Chestnut-seded warbler, and Northern parula were heard singing in the skunk cabbage area on June 20, but most likely did not remain to breed. The Red-eyed vireo, heard singing on one occasion in the Skunk area, is a rare nester in New York City. We found probable nesting of Warbling vireo, and uncommon nester in New York City, in the Swamp, skunk cabbage area, and Island. The Red-bellied woodpecker, another uncommon nester in the City, was confirmed in Skunk and probable across the river in Parkway 2.

We found 34 possible, probable, or confirmed breeding avian species in the Bronx Park study area during the 2006 breeding season. Of these, we confirmed the breeding of 13 species according to New York Federation of Bird Clubs protocols and one additional species through three observations of a singing male in the same location. Table 4 shows the observations used to confirm breeding for each species for which we observed behaviors more indicative than territorial singing. See Table 6 for a list of all possible, probable, and confirmed breeding species with the numbers of territories each species held in the subsections of the site as well as the site as a whole. We found 26 species in the swamp forest, 22 in the skunk cabbage area, 17 in Parkway 1, 16 in Parkway 2, 19 on the island, and 8 in the cricket pitch. The swamp forest had the greatest number of species with probable or confirmed breeding (17). The cricket pitch had the least, at five. Parkway 1, Parkway 2, and Skunk had 14 probable or confirmed breeders, and the island had 15.

The H's (Shannon-Weiner indices) for all probable and confirmed territories each subdivision of the site are: Swamp, 2.41; Parkway2, 2.4; Parkway1, 2.57; Skunk, 2.41; Island, 2.42; and Cricket, 1.30. The H' for the entire census area was 2.69.

The percentage of probable and confirmed territories held by the five species typical of disturbed wetlands in 2006 was 34% overall.

The three species with the greatest number of probable and confirmed territories in 2006 were the American robin, red-winged blackbird, and warbling vireo. They held, respectively, 14%, 15%, and 14% of all probable and confirmed territories. The top three breeders in Swamp and Skunk were warbling vireo, American robin, and red-winged blackbird. Red-winged blackbird was the most abundant breeder on the Island, with warbling vireo second, and song sparrow and red-winged blackbird tied for third. No species clearly dominated Parkway 1 in 2006. Red-winged blackbird and song sparrow each held four territories, American robin and warbling vireo each held three, and gray catbird and northern oriole each held two. American robins held eight territories in Parkway 2, house sparrow held five, and mallard held four. The cricket pitch had few territories and low diversity. Five of nine probable or confirmed territories were occupied by red-winged blackbirds.

Several species less common in New York City were found during this survey. Eastern wood peewee, Canada warbler, and Cape May warbler were heard singing in the swamp and skunk cabbage areas between May 10th and the 31st, but most likely did not remain to breed. One ovenbird sang on the slope of Parkway 2 on May 10th, but was not heard thereafter. The white-eyed vireo, heard singing on one occasion in the Skunk area, is an uncommon nester in New York City. The Red-bellied woodpecker, another uncommon nester in the City, was confirmed on the Island and Parkway 1, and probable in Parkway 2.

4.3. Channel morphology and in-stream habitat

At the permanent cross-section locations surveyed, there appeared to be no erosion in the straight reaches, no significant erosion at the bends, continued deposition on the inside bend (primarily downstream of cross section A), and some deposition on the tops of the banks and floodplain at cross sections C, D and F. A significant amount of deposition was observed on the floodplain after the April 16, 2007 storm. North of Kazimiroff Blvd, sediment deposition on the floodplain was up to 4-6 inches on the bank in some areas (approximately 10% of the total bank area) in 2005. After the April 16, 2007 storm, our rapid measurement of depths of the new sediment deposition between Kazimiroff Bridge and the Burke Ave Bridge suggested that there was an average of 3" of sediment deposited over at least 10% of the floodplain. This was probably an underestimate and did not include the island, or the in-channel depositional bars. Our highly conservative estimate is that about 200 cubic yards of sediment were deposited on a section of floodplain of approximately 7 acres.

Bank erosion is significant at two sites in the project area, but is not captured by the permanent cross-sections. The first site is approximately 50 ft downstream of the upstream tip of the island, along the left bank of the western channel. About 50 feet of coir log was placed at the toe of this bank in 2005, but it was dislodged and the bank eroded approximately 2 to 3 feet. The coir log had been installed along the bank at an approximately 4 foot deep pool, into a dense loamy clay material, where it was not easy to secure. There was also a root wad directly upstream, which helped to maintain the pool, and a log upstream on the opposite bank which helped deflect flow in that direction. This eroding bank area is at a bit of an outer bank, where the western channel is tending to meander.

The second section of bank erosion is found upstream of the Burke Ave Bridge on the right bank. As this approximately 100 foot section of bank is along the inside of the bend, it is not a site where erosion is expected. However, as at the site downstream, the coir logs installed here were not very secure, as they were placed along a steep bank where a backwater and bend pool occupied the entire channel. We observed the undermining and erosion of these coir logs as well as sediment deposition on top of them. The hardening of the opposite (left) bank to save the pin oaks and trail on that side of the river may have also contributed to scour potential on the right bank.

In 2007, we did not observe any pools being filled in that existed prior to or were constructed by the project. We did observe some cabled large woody debris (LWD) in downstream reaches of the river (at 182nd St downstream of the dam, for example), so there may have been some LWD loss either from the forest or upstream reaches.

Visual estimates of in-stream habitat and riparian vegetation conditions in 2007 were not significantly different than estimates in 2006. In multiple bank planting areas, such as the

southeastern and western banks of the Island, and Areas 9, 6, and 14, the failure of the dogwood and willow fascines has resulted in less woody vegetation along the toe of the bank than intended.

5. DISCUSSION

5.1 Vegetation

The high growth and survival rates of the container plants was a result of good planting material, appropriate handling and irrigation by the contractor, suitable soil and placement, and adequate invasive species control during the first two growing seasons. The brush fascines may have preformed so poorly as a result of a combination of the large amount of sediment deposited on them (up to 6 inches at some sites) and competition from herbs and grasses that colonized the depositional material on top of the dogwood and willow fascines.

The cricket pitch area had the least woody cover, as this area was formerly a playing field with trees only around the perimeter. The shrubs and trees present were all newly planted in 2006. Over time, we expect the planted shrubs and trees to mature and provide more shade. Although the vegetation monitoring plots did not contain purple loosestrife, this exotic herb began to colonize the cricket pitch in 2006 and was cut by NRG foresters once during the growing season.

The family with the greatest number of new species was the Grass family, with seven new species. Some of these were planted, such as Virginia wild rye *(Elymus virginicus)* and rice cut-grass *(Leersia oryzoides).* Both of these species are native wetland grasses, installed with the hope that they maintain permanent residency. The exotic annual rye *(Secale cereale)* was also brought in with the purpose of acting as a temporary erosion control. Over time this plant will be shaded out by perennials. Volunteer species included crabgrass *(Digitaria sanguinalis),* barnyard grass *(Echinochloa crus-galli),* goose grass *(Eleusine indica),* all of which are exotic. One native volunteer was fall panic grass *(Panicum dichotomiflorum).* The exotic grasses are common in open, disturbed sites, while the panic grass is native and found in disturbed, open wet areas.

Although Japanese knotweed was not a dominant species in any of the plots, it was prominent in various other areas throughout the project site, particularly on the west bank downstream of the Burke Ave Bridge and on the island. Similarly, the exotic vine Japanese hops (*Humulus japonicus*) was abundant in various locations throughout the study area on the river banks though not in the plots.

5.2. Birds

The species richness at the Bronx Park study site in 2006 (34) compares favorably with what was found in 2005 (23 species) and 2003 (27 species) at Bronx Park. Riverdale had 27 species in 2002, 24 in 2004, 38 in 2005, and 36 in 2006. The overall H' for Bronx Park in 2006 (2.69) was somewhat higher than that found at the same site in 2005 (2.14), and 2003 (2.27), was equal to the H' from Riverdale in 2002 and 2004(2.69), and only slightly lower than Riverdale's H' of 2.73 in 2005. The diversity index for Riverdale for 2006 (2.87) was quite a big larger than that at the Bronx River. Perhaps this was due to the longer elapsed time since the disturbance of restoration excavation. The difference could also be due to the greater habitat diversity at Riverdale. Riverdale contains a stream/stormwater channel, a small pond, a moist to wet

floodplain, and a larger acreage of uplands than the Bronx Park study area. In addition, the proximity of Riverdale to the Hudson River may have attracted additional species.

As in 2003 and 2005, the least disturbed areas of the Bronx Park study site, the skunk cabbage area and the swamp, had the highest species richness in 2006. However, H' values, which had been highest in these two sections in prior years, were nearly equal in all sections in 2006 (except for the cricket pitch). The island again had intermediate species richness, and the two Parkway sites, areas contiguous with the Bronx River and/or Mosholu Parkways, were the least diverse. It is heartening to see an increase in species richness and H' in all sections of the restoration area, and to see that the highest quality sections, Skunk and Swamp, have benefited the most. The cricket pitch was a seasonally flooded recreational lawn until 2004, when wetland shrubs, saplings, grasses, and forbs were planted. We expect the diversity of this area to increase, both in terms of species richness and H', and the percent of species typical of disturbed wetlands to decrease, as the trees and shrubs mature.

Species typical of disturbed wetlands comprised 35% percent of territories in 2006, as opposed to 39 percent in 2003 and 29% in 2005. Because the survey in 2005 was abbreviated, we may not have detected all the song sparrows, common yellowthroats, and yellow warbler, species which nest on the ground or in low, dense shrubs. The comparison between 2003 and 2006 is more valid, and it shows a slight decrease in the percent of disturbance-associated species. This result occurred despite a large increase in the number of song sparrows, addition of common yellowthroat to the list of breeders, and enlargement of the survey area to include the cricket pitch, in which 6 of 9 territories were held by species typical of disturbed wetlands. We attribute the decrease primarily to the drop in numbers of breeding gray catbirds.

In 2003 the American robin and gray catbird held the greatest number of territories in the Bronx Park BBS, making up 27% and 23% of all probable and confirmed territories. The northern oriole and red-winged blackbird tied for third place, with 9 territories (9%) each. The percent of territories held by the American robin increased in 2005 (35%), but decreased greatly in 2006 (14%), primarily due to an increase in the total number of territories of all species recorded in 2006 (from 85 to 205) while the number of robin territories remained static. The number and percent of gray catbirds decreased each year, from 23 territories (23%) in 2003 to 14 (16.5%) in 2005, to 12 (6%) in 2006. This change was primarily due to large decreases in the number of catbird territories recorded in Swamp and Skunk. The number of red-winged blackbirds increased between 2005 and 2006, from 9 (10.6%) to 29 (15%), due to increases in Swamp, Skunk, and the Island. Northern oriole territories, which had decreased slightly from 2003 to 2005, rebounded in 2006. The species with the greatest increase in territories from 2003 to 2006 was the warbling vireo. In 2003 this species held only 3 (3%) of the probable and confirmed territories, and in 2005 only 5 (6%). In 2006 warbling vireos held 28 territories, 14% of all probable and confirmed territories, making it the third most common breeder. This increase was seen in all sections, but most notably in Swamp and Skunk; two probable and confirmed warbling vireos were recorded in these two sections in 2003, four in 2005, and 19 in 2006.

The reduction in Gray catbird territories may be a result of the removal of Japanese knotweed, a species providing the dense cover preferred by the Gray catbird for nesting. The steepest decrease occurred immediately after the knotweed was removed, but the decrease continued from 2005 to 2006.

The observed increase in red-winged blackbirds and song sparrows may be due to the replacement of Japanese knotweed with a dense seeding of tall grasses among the newly planted

shrubs and saplings. Japanese knotweed creates a deeply-shaded, enclosed, microhabitat, which may be unsuitable for species usually associated with fields and grassy wetlands. This preference is also seen in the early colonization of the cricket pitch by red-winged blackbirds and one pair of song sparrows.

An interesting finding was the explosion in numbers of warbling vireos breeding at this site. This species is considered an uncommon nester in New York City (NYC Audubon, 2007). Breeding pairs of the warbling vireo decreased in the New York region from 1900 to 1964, and Bull (1964) called it a local and uncommon breeder. The US Fish and Wildlife Service, however, lists the warbling vireo as a species showing a statistically significant increase in the northeastern United States. At Riverdale the number of probable and confirmed territories remained nearly constant from 2005 (7) to 2006 (6). It is possible that the restoration at Bronx Park benefited the warbling vireo, whereas that at Riverdale did not. The breeding bird diversity in the restored wetlands at Riverdale declined in 2006, suggesting that any benefit from the wetland restoration may be waning.

2006 was the first year we confirmed breeding of wood ducks. We sighted a female with eight small young on July 11th. Earlier in the season we had seen many seemingly full grown wood ducks in the flooded swamp forest. We believe these may have been the grown offspring of an early breeding. Wood ducks are known to have bred twice in 2006 in Van Cortlandt Park in the Bronx. The wood duck is considered an uncommon nester by New York City Audubon.

The results of the Bronx Forest breeding bird survey suggest improvement in the habitat for nesting bird diversity and productivity after restoration. Ongoing treatment of the re-sprouting Japanese knotweed will be needed to maintain this diversity. However, treatment should be done outside the core breeding season for songbirds. In 2006 a yellow warbler nest was abandoned when grasses and other vegetation was weed-wacked near the nest. The critical period for songbird nesting runs from early May to mid-July. If essential, treatment of knotweed should be done with hand tools and care to avoid nest sites.

5.3. Channel morphology and in-stream habitat

The intent of this project was to try to re-establish large woody plants on the banks of the river that might, over the long term of 30 to 50 years provide the canopy cover, overhanging rooted banks, and source material for large woody debris that will help create a more hydraulically complex channel with more diverse habitat. In the short term, boulder vanes were installed to provide more immediate hydraulic complexity and cover. Most of the boulder structures have functioned well to deflect flow, provide cover and stabilize banks but whether they have had a significant impact on aquatic habitat is not possible to say. It is likely that their impacts are dwarfed by the impact of a flashy hydrologic regime with such a high sediment load.

The many large floods since this project was completed underscore the impact of upstream sediment load on the channel morphology and riparian habitat in the Bronx Forest Floodplain. In many locations where banks were cleared and grubbed to remove Japanese knotweed and rhizomes to a depth of 4-6 inches, sediment deposition has rebuilt the bank to its pre-project height. Where berms or levees were graded down to the elevation of the adjacent flooplain and trail, they have not, in general, built up to their pre-project heights. However, sediment will continue to deposit in these area, presumably at higher rate than would have been found at times prior to the development of the watershed, and sedimentation on trails and underneath the boardwalk will have to be addressed. The management option we intend to take for now is to

schedule one to two days per year to remove debris and sediment under the boardwalk by hand with crews from NRG and, ideally, partners such as the Bronx River Alliance. Deposition of sediment on the banks will pose continued challenges for invasive plant removal, since Japanese hopes and other invasive plants thrive in the newly deposited sediment and can smoother woody vegetation on the banks.

The banks in the Bronx Forest are relatively stable except at two sites where there is active erosion. At the site upstream of the Burke Ave Bridge erosion is a result of new deposition and remobilization of sediment. At the site on the island bank scour is occurring naturally with channel migration at the outside of a slight bend and flow deflection from LWD on the right bank. Though all bank erosion in the Bronx River is exacerbated by the disturbed hydrologic regime, it is not progressing at an alarming rate. We intend to plant additional woody species on the banks at these sites and focus on managing invasive species there so that the woody vegetation will survive. We will also visually assess these sites to determine whether more active intervention, such as installing a structure to deflect flow, is necessary.

6 Partners and Volunteers

Monitoring was conducted primarily by members of the NRG. The Bronx River Alliance, Green Apple Corps and Sustainable South Bronx were active partners in removing debris and managing invasive species.

7 Works Cited

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8 Appendices

8.1 Figures

8.2 Tables

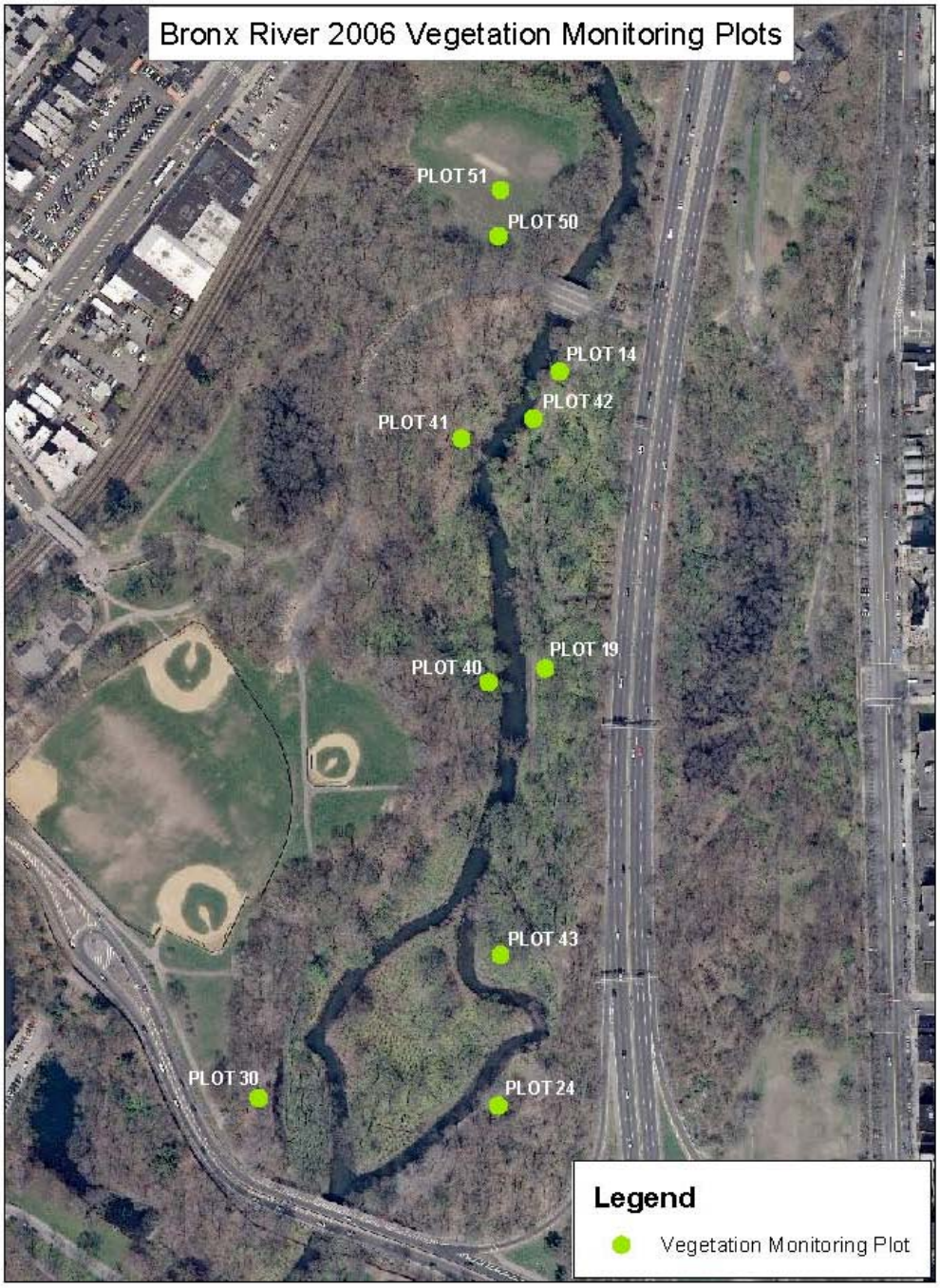

Figure 1: Vegetation Monitoring Plots

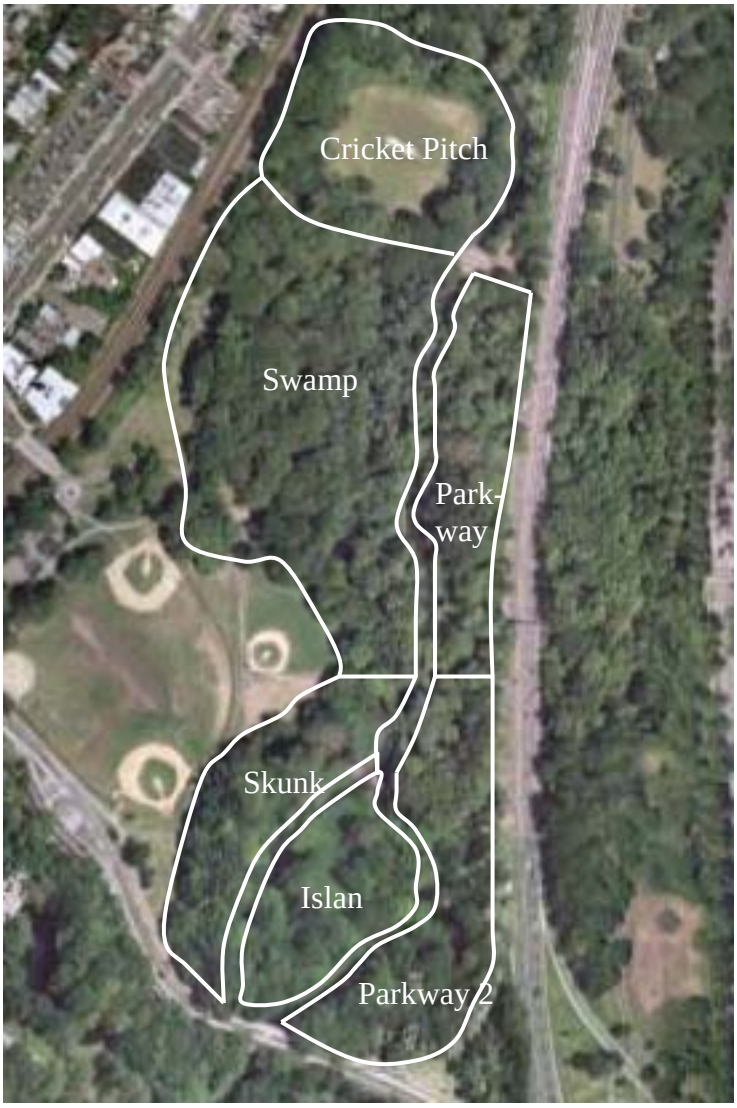

Figure 2: Area surveyed in the Bronx Forest Breeding Bird Survey, Bronx, NY, from 2003 to 2006. Summary statistics were calculated separately for each section delineated in white, and for the area as a whole.

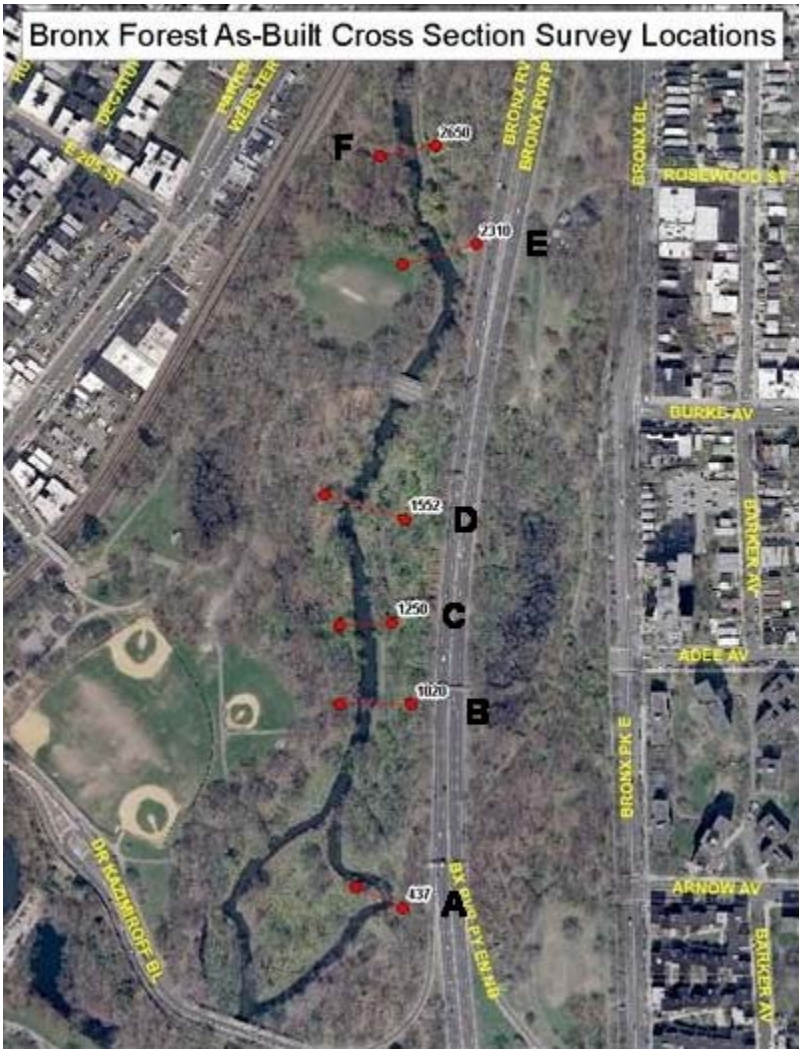

Figure 3: Channel cross-section locations

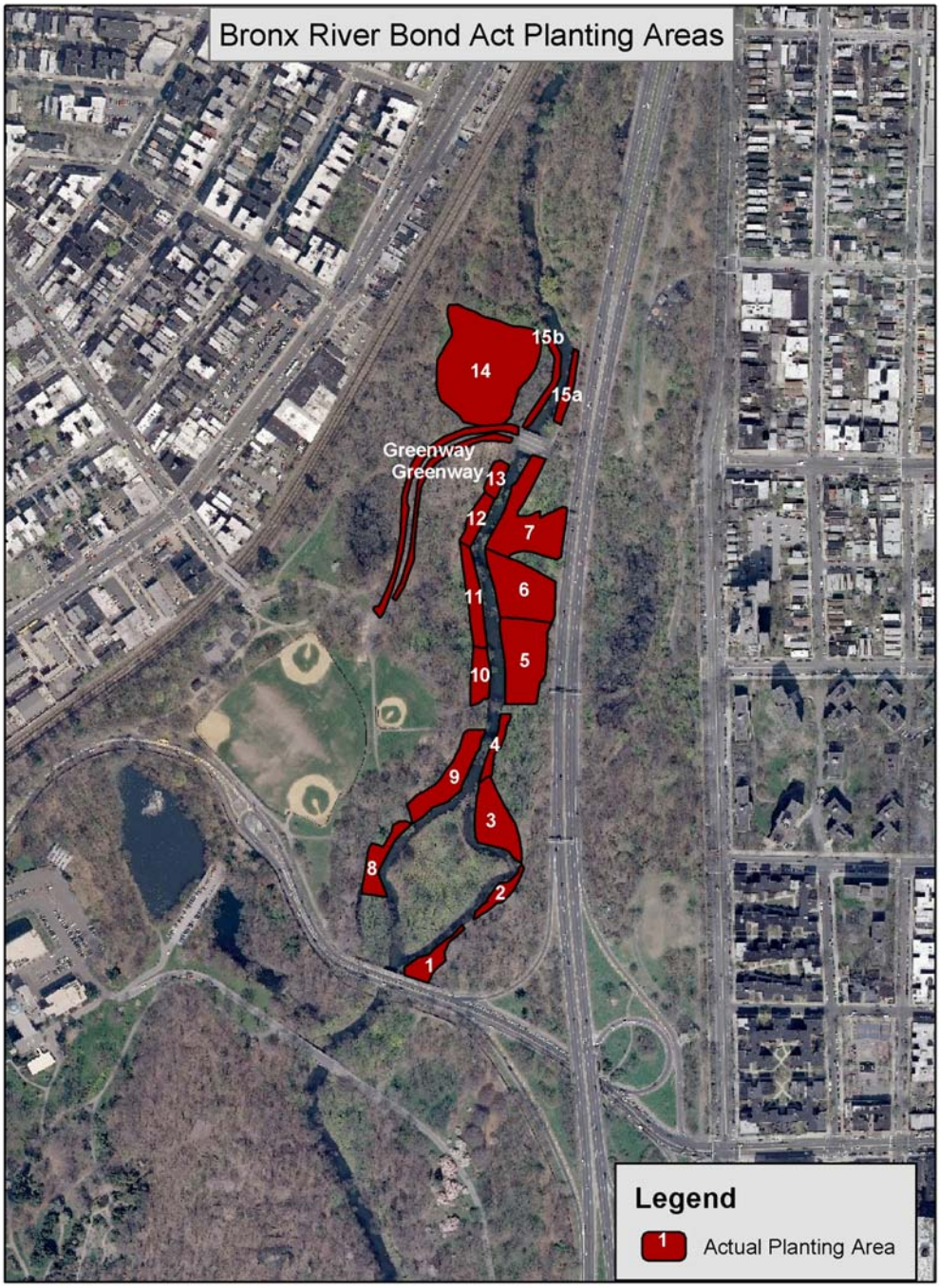

Figure 4: Planting areas

Table 1. Plant species from the Bronx River Park vegetation monitoring plots 2006.

SPECIES	CODE	COMMON	FAMILY	HABIT	EXOTIC	INVSIVE	RARE NYC	STATE T/E	INSTALLED
Acalypha rhomboidea	ACRH	Three-seeded mercury	Euphorbiaceae	forb	N	N	N	N	N
Acer negundo	ACNE	box elder	Aceraceae	tree	N	N	N	N	Y
Acer rubrum	ACRU	red maple	Aceraceae	tree	N	N	N	N	Y
Acer saccharinum	ACSA	Silver maple	Aceraceae	tree	N	N	N	N	Y
Acer sp.	ACsp	maple sp.	Aceraceae	tree	?	?	N	N	N
Aegopodium podaracia	AEPO	Goutweed	Apiaceae	forb	Y	Y	N	N	N
Ailanthus altissima	AIAL	tree-of-heaven	Simaroubaceae	tree	Y	Y	N	N	N
Agrostis sp.	AGsp	Bentgrass species	Poaceae	graminoid	?	?	?	N	N
Allaria petiolata	ALPE	Garlic mustard	Brassicaceae	forb	Y	Y	N	N	N
Alnus incana	ALIN	Speckled alder	Betulaceae	shrub	N	N	N	N	Y
Ambrosia artimisifolia	AMAR	Ragweed	Asteraceae	forb	N	N	N	N	N
Amaranthus blitum	AMBL	Amaranth	Amaranthaceae	forb	Y	N	N	N	N
Ampelopsis brevipedunculata	AMBR	Porcelainberry	Vitaceae	woody vine	Y	Y	N	N	N
Aronia arbutifolia	ARAR	red chokeberry	Rosaceae	shrub	N	N	N	N	Y
Aronia melanocarpa	ARME	black chokeberry	Rosaceae	shrub	N	N	N	N	Y
Artemisia annua	ARAN	Annual ragweed	Asteraceae	forb	Y	N	N	N	N
Artemisia vulgaris	ARVU	Mugwort	Asteraceae	forb	Y	Y	N	N	N
Aster cordifolius	ASCO2	heart-leaved aster	Asteraceae	forb	N	N	N	N	?
Aster divaricatus	ASDI	white-wood aster	Asteraceae	forb	N	N	N	N	?
Aster lanceolata	ASLA	Lined aster	Asteraceae	forb	N	N	N	N	N
Aster novae-angliae	ASNO	New England aster	Asteraceae	forb	N	N	Y	N	Y
Betula lenta	BELE	black birch	Betulaceae	tree	N	N	N	N	N
Betula nigra	BENI	river birch	Betulaceae	tree	N	N	Y	Y	Y
Bidens frondosa	BIFR	Beggar tick	Asteraceae	forb	N	N	N	N	N
Boehmeria cylindrica	BOCY	False nettle	Urticaceae	forb	N	N	N	N	N
Calystegia sepium	CASE	Hedge-bindweed	Convolvulaceae	herbaceous vine	N	N	N	N	N
Carya cordifolius	CACO	Bitternut	Juglandaceae	tree	N	N	N	N	N
Celastrus orbiculatus	CEOR	oriental bittersweet	Celastraceae	woody vine	Y	Y	N	N	N
Chenopodium album	CHAL	Pigweed/lamb's quarters	Chenopodiacea e	forb	Y	N	N	N	N
Chenopodium ambrosioides	CHAM	Mexican tea	Chenopodiacea e	forb	Y	N	N	N	N
Cichorium intybus	CHIN	Chicory	Asteraceae	forb	Y	N	N	N	N
Cinna arundinacea	CIAR3	Common woodreed	Poaceae	graminoid	N	N	Y	N	Y
Clethra alnifolia	CLAL	sweet pepperbush	Clethraceae	shrub	N	N	N	N	Y
Commelina communis	COCO	Asiatic dayflower	Commelinacea	forb	Y	N	N	N	N

			e						
Convolvulus arvensis	COAR	Field bindweed	Convolvulaceae	herbaceous vine	N	N	N	N	N
Conyza canadensis	COCA2	Horseweed	Asteraceae	forb	N	N	N	N	N
Cornus sp. (stakes)	COsp	Dogwood	Cornaceae	shrub	N	N	N	N	Y
Cornus amomum	COAM	Silky dogwood	Cornaceae	shrub	N	N	N	N	N
Cornus sericea	COSE	red-osier dogwood	Cornaceae	shrub	N	N	X	N	Y
Cyperus microiria	CYMI		Cyperaceae	graminoid	Y	N	N	N	N
Desmodium sp.	DEsp	Tick trefoil sp.	Fabaceae	forb	N	N	N	N	N
Digitaria sanguinalis	DISA	Crabgrass	Poaceae	graminoid	Y	N	N	N	N
Echinochloa crusgalli	ECCR	Barnyard grass	Poaceae	graminoid	Y	N	N	N	N
Eleusine indica	ELIN	Goose grass	Poaceae	graminoid	Y	N	N	N	N
Elymus virginicus	ELVI	Virginia wild rye	Poaceae	graminoid	N	N	Y	N	N
Epifagus virginiana	EPVI	Beechdrops	Orobanchaceae	forb	N	N	Y	N	N
Erigeron annuus	ERAN	Daisy fleabane	Asteraceae	forb	N	N	N	N	N
Eupatorium maculatum	EUMA	Spotted joe-pye weed	Asteraceae	forb	N	N	N	N	Y
Eupatorium rugosum	EURU	White snakeroot	Asteraceae	forb	N	N	N	N	N
Fagus grandifolia	FAGR	American beech	Fagaceae	tree	N	N	N	N	N
Fraxinus americana	FRAM	white ash	Oleaceae	tree	N	N	N	N	?
Fraxinus pennsylvanica	FRPE	green ash	Oleaceae	tree	N	N	N	N	Y
Galinsoga quadriradiata	GAQU	galinsoga/quickweed	Asteraceae	forb	Y	N	N	N	N
Geum canadense	GECA	White avens	Rosaceae	forb	N	N	N	N	N
Grass sp.	GRASSLsp	Lawn grass spp.	Poaceae	graminoid	Y	N	N	N	N
Glechoma hederacea	GLHE	gill-over-the-ground	Lamiaceae	forb	Y	N	N	N	N
Gleditsia triacanthos	GLTR	Honey locust	Fabaceae	tree	Y	N	N	N	N
Hamamelis virginiana	HAVI	Witch hazel	Hamamelidaceae	shrub	N	N	N	N	N
Humulus japonicus	HUJA	Japanese hops	Cannabaceae	herbaceous vine	Y	N	N	N	N
Ilex verticillata	ILVE	Winterberry	Aquifoliaceae	shrub	N	N	Y	N	Y
Impatiens capensis	IMCA	Jewelweed	Balsaminaceae	forb	N	N	N	N	N
Juglans sp.	JUsp	Butternut	Juglandaceae	tree	N	N	Y	N	N
Juncus tenuis	JUTE	path rush	Juncaceae	graminoid	N	N	N	N	N
Lactuca sp.	LAsp	lettuce sp.	Asteraceae	forb	?	N	?	?	N
Laportea canadensis	LACA	Wood nettle	Urticaceae	forb	N	N	Y	N	N
Leersia oryzoides	LEOR	Rice cut-grass	Poaceae	graminoid	N	N	Y	N	Y
Liquidambar styraciflua	LIST	Sweet gum	Hamamelidaceae	tree	N	N	N	N	Y
Liriodendron tulipifera	LITU	Tulip poplar	Magnoliaceae	tree	N	N	N	N	Y
Lonicera maackii	LOMA	amur honeysuckle	Caprifoliaceae	shrub	Y	Y	N	N	N
Ludwigia palustris	LUPA	Marsh purslane	Onagraceae	forb	N	N	N	N	N

Lythrum salicaria	LYSA	purple loosestrife	Lythraceae	forb	Y	Y	N	N	N
Maianthemum canadense	MACA	canada mayflower	Liliaceae	forb	N	N	N	N	N
Melilotus alba	MEAL	sweet white clover	Fabaceae	forb	Y	N	N	N	N
	MINTsp	mint sp	Lamiaceae	forb	?	?	?	?	N
Morus alba	MOAL	White mulberry	Moraceae	tree	Y	Y	N	N	N
Ostrya virginiana	OSVI	American hophornbeam	Betulaceae	tree	N	N	Y	N	N
Oxalis stricta	OXST	Common wood sorrel	Oxalidaceae	forb	N	N	Y	N	N
Panicum species	PAsp	panic grass species	Poaceae	graminoid	?	?	?	?	N
Panicum dichotomiflorum	PADI	fall panic grass	Poaceae	graminoid	N	N	N	N	N
Parthenocissus quinquifolia	PAQU	Virginia creeper	Vitaceae	woody vine	N	N	N	N	N
Penthorum sedoides	PESE	Ditch stonecrop	Saxifragaceae	forb	N	N	Y	N	N
Phellodendron amurense	PHAM	Amur corktree	Rutaceae	tree	Y	Y	N	N	N
Phytolacca americana	PHAM2	pokeweed	Phytolaccaceae	forb	N	N	N	N	N
Pilea pumila	PIPU	clearweed	Urticaceae	forb	N	N	N	N	N
Plantago lanceolata	PLLA	English plantain	Plantaginaceae	forb	Y	N	N	N	N
Plantago major	PLMA	Common plantain	Plantaginaceae	forb	Y	N	N	N	N
Platanus x hybrida	PLxHY	London planetree	Platanaceae	tree	Y	N	N	N	N
Platanus occidentalis	PLOC	American sycamore	Platanaceae	tree	N	N	Y	N	Y
Poa sp.	POsp	Kentucky bluegrass	Poaceae	graminoid	Y	?	N	N	N
Polygonatum pubescens	POPU2	hairy solomon's seal	Liliaceae	forb	N	N	N	N	?
Polygonum sp.	POsp	Polygonum sp	Polygonaceae	forb	?	?	?	N	N
Polygonum aviculare	POAV	Prostrate knotweed	Polygonaceae	forb	Y	N	N	N	N
Polygonum cespitosum	POCE	Smartweed	Polygonaceae	forb	Y	N	N	N	N
Polygonum cuspidatum	POCU	Japanese knotweed	Polygonaceae	forb	Y	Y	N	N	N
Polygonum hydropiper	POHY	Water pepper	Polygonaceae	forb	Y	N	N	N	N
Polygonum lapathifolium	POLA	nodding smartweed	Polygonaceae	forb	Y	N	N	N	N
Polygonum persicaria	POPE2	Lady's thumb	Polygonaceae	forb	Y	N	N	N	N
Polygonum punctatum	POPU	dotted smartweed	Polygonaceae	forb	N	N	Y	N	N
Polygonum virginianum	POVI	Virginia jumpseed	Polygonaceae	forb	N	N	N	N	N
Populus alba	POAL	White poplar	Salicaceae	tree	Y	Y	N	N	N
Populus deltoides	PODE	Eastern cottonwood	Salicaceae	tree	N	N	N	N	N?
Populus tremuloides	POTR	Quaking aspen	Salicaceae	tree	N	N	Y	N	N
Prunus sp.	PRsp	cherry sp	Rosaceae	tree	?	N	?	N	N
Prunus serotina	PRSE	Black cherry	Rosaceae	tree	N	N	N	N	Y
Pyrus sp.	PYsp	Crabapple sp.	Rosaceae	tree	Y	N	N	N	N
Pyrus baccata	PYBA	siberian crab-apple	Rosaceae	tree	Y	N	N	N	N
Quercus coccinea	QUCO	Scarlet oak	Fagaceae	tree	N	N	N	N	
Quercus palustris	QUPA	pin oak	Fagaceae	tree	N	N	N	N	N
Quercus rubra	QURU	red oak	Fagaceae	tree	N	N	N	N	Y

Quercus sp.	QUsp	oak sp.	Fagaceae	tree	N	N	?	?	?
Rhamnus cathartica	RHCA	Common buckthorn	Rhamnaceae	tree	Y	Y	N	N	N
Rhus aromatica	RHAR	Fragrant sumac	Anacardiaceae	shrub	N	N	Y	N	Y
Rhus glabra	RHGL	Smooth sumac	Anacardiaceae	shrub	N	N	N	N	?
Robinia pseudoacacia	ROPS	Black locust	Fabaceae	tree	Y	Y	N	N	N
Rorippa sylvestris	ROSY	Creeping yellow-cress	Brassicaceae	forb	Y	N	N	N	N
Rosa sp.	ROsp	Rose sp	Rosaceae	shrub	?	?	?	N	?
Rosa multiflora	ROMU	Multiflora rose	Rosaceae	shrub	Y	Y	N	N	N
Rosa virginiana	ROVI	Virginia rose	Rosaceae	shrub	N	N	N	N	?
Rumex obtusifolius	RUOB	bitter dock	Polygonaceae	forb	Y	N	N	N	N
Salix sp. (stake)	SAsp	willow sp.	Salicaceae	shrub	?	N	N	N	Y
Salix alba x fragilis	SAALXFR		Salicaceae	tree	Y	Y	N	N	N
Salix discolor	SADI	Pussy willow	Salicaceae	shrub	N	N	N	N	Y
Salix exigua	SAEX	Sandbar willow	Salicaceae	shrub	N	N	N	N	Y
Salix nigra	SANI	Black willow	Salicaceae	tree	N	N	N	N	Y
Salix sericea	SASE	silky willow	Salicaceae	shrub	N	N	Y	N	Y
Sambucus canadensis	SACA	elderberry	Caprifoliaceae	shrub	N	N	N	N	Y
Secale cereale	SECE	annual rye	Poaceae	graminoid	Y	N	N	N	Y
Setaria sp.	SEsp	Foxtail grass	Poaceae	graminoid	Y	N	N	N	N
Solanum dulcamara	SODU	bittersweet nightshade	Solanaceae	forb	Y	Y	N	N	N
Solanum nigrum	SONI	black nightshade	Solanaceae	forb	Y	N	N	N	N
Solidago caesia	SOCA2	Blue-stemmed goldenrod	Asteraceae	forb	N	N	Y	N	?
Solidago juncea	SOJU	Early goldenrod	Asteraceae	forb	N	N	N	N	N
Sonchus oleraceus	SOOL	smooth sow thistle	Asteraceae	forb	Y	N	N	N	N
Spirea tomentosa	SPTO	Steeplebush	Rosaceae	shrub	N	N	Y	N	Y
Stellaria media	STME	common chickweed	Caryophyllaceae	forb	Y	N	N	N	N
Taraxacum officinale	TAOF	dandelion	Asteraceae	forb	Y	N	N	N	N
Tilia americana	TIAM	basswood	Tiliaceae	tree	N	N	Y	N	N
Toxicodendron radicans	TORA	poison ivy	Anacardiaceae	woody vine	N	N	N	N	N
Trifolium pratense	TRPR	red clover	Fabaceae	forb	Y	N	N	N	N
Trifolium repens	TRRE	White clover	Fabaceae	forb	Y	N	N	N	N
Trifolium sp.	TRsp	clover sp.	Fabaceae	forb	Y	N	N	N	N
Ulmus americanus	ULAM	American elm	Ulmaceae	tree	N	N	N	N	Y
Urtica dioica var. dioica	URDI	Stinging nettle	Urticaceae	forb	Y	N	N	N	N
Urtica procera	URPR	tall nettle	Urticaceae	forb	N	N	Y	N	N
Verbena urticifolia	VEUR	White vervain	Verbenaceae	forb	N	N	Y	N	N
Viburnum sp.	VIsp	Viburnum sp.	Caprifoliaceae	shrub	?	?	?	N	?
Viburnum acerifolium	VIAC	Maple-leaved viburnum	Caprifoliaceae	shrub	N	N	N	N	N

Viburnum dentatum	VIDE	southern arrowwood	Caprifoliaceae	shrub	N	N	N	N	Y
Viburnum opulus var. opulus	VIOP	European cranberry bush	Caprifoliaceae	shrub	Y	N	N	N	N
Viburnum plicatum	VIPL	Doublefile viburnum	Caprifoliaceae	shrub	Y	N	N	N	Y
Viola sororia	VISO	common blue violet	Violaceae	forb	N	N	N	N	N
			52 Families	15 graminoids	57	17	23	1	33
				66 forbs	38%	11%	15%	1%	22%
				3 herbaceous vines					
				26 shrubs					
				37 trees					
				4 woody vine					

Table 2. Vegetation datasheet

Date **Transect** _____ **Observers**: counting _____ recording _____

Weather _____

			all measurements in cm				
	% cover	dominant spp. & stratum	rhizomes	# stems/1m²	# flowers/1m²	plant height/sp.	basal area/sp.
PLOT A						#1 #2 #3 #4 #5 #6	#1 #2 #3 #4 #5 #6
	% cover	dominant spp. & stratum	rhizomes	# stems/1m²	# flowers/1m²	plant height/sp.	basal area/sp.

PLOT B						#1 #2 #3 #4 #5 #6	#1 #2 #3 #4 #5 #6
	% cover	dominant spp. & stratum	rhizomes	# stems/1m²	# flowers/1m²	plant height/sp.	basal area/sp.
PLOT C						#1 #2 #3 #4 #5 #6	#1 #2 #3 #4 #5 #6
	(>1% cover)	(p=planted, v=volunteer)				(1 from ea corner, 2 from center)	

OBSERVATIONS: (signs of disease, predation, vandalism, drought, etc. - PLEASE NOTE PLOT & PLANT!)

PHOTOS: (1 at each transect endpoint (2 per transect), one at each plot and one elevated site - **NOTE** location and direction of view)

Table 3. Latest phase of reproduction confirmed for avian species during 2006 spot-mapping census of a section of Bronx Park in the Bronx, NY.

SPECIES	REPRODUCTIVE PHASE CONFIRMED	OBSERVATION
American goldfinch	Courtship / Pair bond established	Pair
American robin	Young fledged	Fledgling
Blue jay	Young fledged	Fledgling
Canada goose	Young fledged	Adult with young
Common grackle	Young fledged	Fledgling
Gray catbird	Young fledged	Adult feeding fledgling
House sparrow	Young fledged	Fledgling
Mallard	Territory / Pair bond established	Pair; male chasing conspecific
Mourning dove	Young fledged	Fledgling
Northern cardinal	Courtship / Pair bond established	Pair
Northern flicker	Young fledged	Adult with fledglings
Northern mockingbird	Young fledged	Fledgling
Northern oriole	Young fledged	Adult with fledgling
Red bellied woodpecker	Young fledged	Fledgling
Red-winged blackbird	Young fledged	Adult feeding fledgling
Song sparrow	Young fledged	Adult feeding fledgling
Tufted titmouse	Courtship / Pair bond established	Pair; alarm calls
Warbling vireo	Young fledged	Adult feeding fledgling
White-breasted nuthatch	Young hatched	Adult carrying food
Wood duck	Young fledged	Adult with young
Yellow warbler	Active nest	Female on nest with male nearby

Table 3. Latest phase of reproduction confirmed for avian species during 2006 spot-mapping census of a section of Bronx Park in the Bronx, NY. All species for which we made observation(s) more strongly confirming breeding than territorial singing are included. The table shows the reproductive phase attained by each species as well as the observation used to confirm that phase.

Table 4. Number of territories by species from the Bronx Forest Breeding Bird Survey, 2003.

SPECIES	**Swamp**			**Parkway 2**			**Parkway1**			**Island**			**Skunk**			**Entire Census Area**			
Status	Ps	**Pr**	**Cf**	**Ps**	**Pr**	**Cf**	**Ps**	**Pr**	**Cf**	**Ps**	**Pr**	**Cf**	**Ps**	**Pr**	**Cf**	**Ps**	**Pr**	**Cf**	**All**
American Robin	0	4	6	1	3	3	0	0	0	2	0	2	2	2	7	5	9	18	32
Blue Jay	1	0	0	2	0	0	0	0	0	0	0	0	1	0	1	4	0	1	5
Blackburnian warbler	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1
Black and white warbler	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1
Brown headed cowbird	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Canada goose	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Carolina Wren	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0	2
Chestnut-sided Warbler	0	1	0	3	0	0	0	0	0	0	0	0	1	0	0	4	1	0	5
Common Yellowthroat	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	2	1	0	3
European Starling	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Gray Catbird	2	7	3	0	2	2	0	1	1	0	1	0	0	5	1	2	16	7	25
House Sparrow	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	2
Mallard	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1
Mourning Dove	0	0	0	1	0	0	0	0	0	0	1	0	0	0	1	1	1	1	3
Northern Cardinal	3	0	0	0	1	0	0	0	0	0	1	1	0	2	0	3	4	1	8
Northern Flicker	1	0	0	2	0	0	0	0	0	0	1	1	2	2	0	5	3	1	9
Northern Oriole	1	0	2	1	0	0	1	0	0	2	0	0	3	3	4	8	3	6	17
Northern parula	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	3	0	0	3
Prairie warbler	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	3	0	0	3
Red-bellied Woodpecker	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	1	2	3
Red-winged Blackbird	1	0	0	2	1	1	0	0	0	4	0	3	2	2	2	9	3	6	18
Scarlet tanager	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Song Sparrow	1	0	0	1	0	0	1	0	0	0	1	0	3	0	0	6	1	0	7
Tufted titmouse	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	2
Warbling Vireo	0	0	1	0	0	0	1	1	0	0	0	0	1	1	0	2	2	1	5
Wood duck	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1
Yellow Warbler	0	0	1	0	1	0	0	0	0	2	0	1	3	1	1	5	2	3	10
Totals																71	51	48	170

Table 4. Avian species breeding at Bronx Park, Bronx in 2003. Territories were classified as confirmed (CF), probable (PR), or possible (PS) according to the following criteria: an observation of an active nest, a bird carrying food or a fecal sac, or unfledged or recently fledged young, or three observations of a singing bird on separate study visits during the species' breeding season confirmed a territory; an observation of a bird carrying nesting material, of a male-female pair, of an aggressive encounter between conspecifics, or two observations of a singing bird on separate study visits during the species' breeding season qualified a territory as a probable breeding territory; finally, an observation of a singing bird during the species' breeding season classified a territory as a possible breeding territory. The far right column shows total numbers of breeding territories (confirmed, probable, and possible) for each species. Birds are listed in the taxonomic order established by the American Ornithologist's Union (AOU). New York City Parks & Recreation / Natural Resources Group.

Table 5. Number of territories by species from the Bronx Forest Breeding Bird Survey, 2005.

SPECIES	**Swamp**			**Parkway2**			**Parkway1**			**Island**			**Skunk**			**Entire Census Area**			
Status	Ps	**Pr**	**Cf**	**Ps**	**Pr**	**Cf**	**Ps**	**Pr**	**Cf**	**Ps**	**Pr**	**Cf**	**Ps**	**Pr**	**Cf**	**Ps**	**Pr**	**Cf**	**All**
Acadian Flycatcher	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1
American Robin	1	5	6	0	2	2	0	2	2	0	1	3	0	3	4	1	13	17	31
Black-crowned Night Heron	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1
Blue Jay	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown headed cowbird	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Cedar Waxwing	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	3
Cerulean Warbler	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1
Chestnut-sided Warbler	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Common Grackle	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	1	2	3
Downy Woodpecker	0	0	1	0	0	0	2	0	0	0	0	0	0	0	2	2	0	3	5
European Starling	0	0	1	0	0	0	2	0	0	0	0	0	0	0	2	2	0	3	5
Gray Catbird	2	4	0	0	1	1	2	3	0	1	1	0	1	2	2	6	11	3	20
House Sparrow	1	0	0	3	0	0	0	1	0	0	0	0	0	0	0	4	1	0	5
Mallard	0	1	1	0	0	0	0	0	0	0	2	0	0	0	0	0	3	1	4
Northern Flicker	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	2	0	2
Northern Oriole	1	0	1	1	1	1	1	0	1	2	0	0	1	0	1	6	1	4	11
Northern parula	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1
Red-bellied Woodpecker	1	0	0	1	1	0	0	0	0	0	0	0	0	0	1	2	1	1	4
Red-eyed Vireo	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1
Red-winged Blackbird	0	2	1	1	1	0	3	0	1	2	1	2	1	1	0	7	5	4	16
Song Sparrow	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	2	0	0	2
Warbling Vireo	4	1	0	1	0	0	0	0	0	1	1	0	3	3	0	9	5	0	14
Yellow Warbler	3	0	0	2	0	0	0	0	0	0	2	0	1	0	0	6	2	0	8
Totals	14	15	11	11	7	4	10	6	5	7	9	5	13	10	13	55	47	38	140

Table 5. Avian species breeding at Bronx Park, Bronx in 2005. Territories were classified as confirmed (CF), probable (PR), or possible (PS) according to the following criteria: an observation of an active nest, a bird carrying food or a fecal sac, or unfledged or recently fledged young, or three observations of a singing bird on separate study visits during the species' breeding season confirmed a territory; an observation of a bird carrying nesting material, of a male-female pair, of an aggressive encounter between conspecifics, or two observations of a singing bird on separate study visits during the species' breeding season qualified a territory as a probable breeding territory; finally, an observation of a singing bird during the species' breeding season classified a territory as a possible breeding territory. The far right column shows total numbers of breeding territories (confirmed, probable, and possible) for each species. Birds are listed in the taxonomic order established by the American Ornithologist's Union (AOU). New York City Parks & Recreation / Natural Resources Group.

Table 6. All avian species breeding at Bronx Park, Bronx in 2006

	Swamp			**Parkway2**			**Parkway1**			**Island**			**Skunk**			**Cricket**			**Entire**			
Bronx Park 2005	**Ps**	**Pr**	**Cf**	**Ps**	**Pr**	**Cf**	**Ps**	**Pr**	**Cf**	**Ps**	**Pr**	**Cf**	**Ps**	**Pr**	**Cf**	**Ps**	**Pr**	**Cf**	**Ps**	**Pr**	**Cf**	**All**
American goldfinch	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	1	0	2	2	0	4
American robin	0	1	8	0	2	6	1	0	3	2	0	3	0	2	4	2	0	1	5	5	25	35
Black-capped chickadee	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Blue jay	0	1	0	2	0	1	1	0	0	0	0	0	1	0	0	1	0	0	5	1	1	7
Canada goose	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	1	2	3
Canada warbler	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	2
Cape May warbler	4	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	5	0	0	5
Cedar Waxwing	1	1	0	0	1	0	1	1	0	1	0	0	1	0	0	0	0	0	4	3	0	7
Common grackle	0	2	4	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	2	8	10
Common yellowthroat	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0	4	0	0	4
Downy woodpecker	1	0	0	0	0	0	0	1	0	0	1	0	1	0	0	1	0	0	3	2	0	5
Eastern wood peewee	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	3
European starling	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	1	0	2
Gray catbird	1	0	4	0	1	2	2	2	0	1	1	0	0	1	1	0	0	0	4	5	7	16
House sparrow	0	0	3	0	3	0	1	0	0	0	1	0	1	0	1	0	0	0	2	4	4	10
Mallard	0	0	0	0	4	0	0	1	0	0	2	0	0	0	0	0	0	0	0	7	0	7
Mourning dove	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	2	2
Northern dardinal	1	1	0	1	0	0	1	1	0	0	1	0	0	2	0	0	0	0	3	5	0	8
Northern flicker	0	1	0	0	0	0	0	0	2	1	0	0	0	2	0	0	0	0	1	3	2	6
Northern mockingbird	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Northern oriole	2	2	3	0	1	2	2	1	1	0	1	0	1	1	3	1	0	1	6	6	10	22
Northern parula	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2
Ovenbird	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Red-bellied woodpecker	2	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	2	1	2	5
Red-winged blackbird	1	5	2	2	2	1	1	1	3	0	2	7	0	3	3	0	3	2	4	16	18	38

Song sparrow	3	1	0	2	2	1	1	3	1	2	1	2	0	1	1	0	0	1	8	8	6	22
Tufted titmouse	3	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	5	1	0	6
Warbling vireo	2	4	8	2	0	2	3	2	1	1	0	4	1	1	6	2	0	0	11	7	21	39
White-breasted nuthatch	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1
White-eyed vireo	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	1
Willow flycatcher	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Wood duck	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	2
Yellow-rumped warbler	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Yellow warbler	2	2	2	1	1	0	1	1	1	0	0	2	2	2	0	1	0	0	7	6	5	18
Totals	31	24	35	11	19	16	17	16	13	10	11	23	14	16	23	9	4	5	92	90	115	297

Table 6. Avian species breeding at Bronx Park, Bronx in 2006. Territories were classified as confirmed (CF), probable (PR), or possible (PS) according to the following criteria: an observation of an active nest, a bird carrying food or a fecal sac, or unfledged or recently fledged young, or three observations of a singing bird on separate study visits during the species' breeding season confirmed a territory; an observation of a bird carrying nesting material, of a male-female pair, of an aggressive encounter between conspecifics, or two observations of a singing bird on separate study visits during the species' breeding season qualified a territory as a probable breeding territory; finally, an observation of a singing bird during the species' breeding season classified a territory as a possible breeding territory. The far right column shows total numbers of breeding territories (confirmed, probable, and possible) for each species. Birds are listed in the taxonomic order established by the American Ornithologist's Union (AOU).