Red-tailed Hawk is a regular breeder in Fairmount Park. This bird was photographed at Lemon Hill, Fairmount Park East, in January 2000.

Photo by Steve Kerr

1998 Fairmount Park Breeding Bird Census

ANDREW INGERSOLL

I: Introduction

Fairmount Park has long been a treasured resource for Delaware Valley ornithologists. The largest municipal park system in a North American city, Fairmount Park plays an increasingly important role as a wildlife sanctuary in a regional context due to rapid and unplanned suburban development. The bird life of Fairmount Park is one of its greatest, though least appreciated, attributes. While previous papers in *Cassinia* and other journals have focused on particular segments of the park, no comprehensive census of the breeding birds of Fairmount Park has ever been published. (To the knowledge of the author, no such census has been done.)

During the summer of 1998, under the auspices of a William Penn Trust grant to the Fairmount Park Commission designed to facilitate the restoration of the park's so-called "natural lands" and to foster their appreciation, the Academy of Natural Sciences was contracted to inventory various taxonomic groups, including vegetation, invertebrates, and vertebrates. The breeding-bird census took place in seven segments of the park. Using the compiled baseline data, the scientific team provided recommendations for restoration goals and activities, as well as nominate sites for acquisition and inclusion into the park system. Additional information was also provided to help in the site selection of four new environmental-education centers.

II: Objective

The objective of this paper is to summarize the results of a 1998 breeding-bird census done to assist Fairmount Park in determining past and present natural conditions within the park's designated "natural lands" that make up over 5,400 acres of the park's area. By understanding the diversity and abundance of breeding birds, one can make an informed interpretation about the quality of natural habitats. Consequently, certain birds were singled out as being important indicators of habitat health. The presence of these indicator species can be interpreted to mean habitats either with low levels of disturbance or of high quality. Indicator species are classified as distinct from those species that are common throughout either the park or Philadelphia in general (common "backyard" birds), and closer attention was paid to the location of observed individuals. For the 55 indicator species, observations of all individuals were recorded in the field and later plotted on Fairmount Park base maps before being entered into the data base. (Appendix 1 lists species observed during the census and highlights those that are considered indicator species. All original field notes have been deposited in the Academy's archives.)

Prior to the census, a survey of historical documents was performed. This allowed for a comparison of past and present data on abundances of indicator species that can be used to interpret changes that have occurred over the past century. The compiled historic and census data will provide a benchmark against which to measure any changes brought about as a result of the actions taken under the William Penn restoration project.

III: Methods

The disparate nature of the park segments and the relative isolation of the birds in each segment from those of the other segments required that each of the seven natural areas be approached as a separate ecological unit when sampling the park's bird life. Simply stating that Eastern Phoebes breed in Fairmount Park would not have provided a fine enough level of understanding to allow for effective management of either the bird or its habitat. Thus,

both in the historical survey and in the breeding-bird survey, each of the seven natural areas was treated separately. As a consequence, results reflect with moderate accuracy the diversity and abundance of breeding birds for each segment. The seven natural areas are: Cobbs Creek, Franklin Delano Roosevelt, Fairmount East/West Park, Pennypack, Poquessing, Tacony, and Wissahickon.

What species were included?

Only breeding birds were censused. For this project, the most appropriate group to study was breeding birds because their habitat requirements are narrower and more specific than they are for birds present at other times of the year. Budgetary constraints also prevented further censuses throughout the year. Therefore, the breeding-bird census was chosen as the most useful tool for determining each area's importance to wild birds. For the historical review, records for all species were included because the information could prove useful to future research and did not require significant additional work.

Historical review

The first phase of the project included a thorough literature review to understand general and specific information about the historic (c. 1890–1990) bird populations present within the park. The lack of significant records prior to the formation of the Delaware Valley Ornithological Club (DVOC) in 1890 prohibits accurate interpretations of the abundances and distribution of those birds that were recorded in the park prior to that date. However, inferences may be made based on what is known about the habitats that were present in the park (or lands that became park) or lands adjacent to park boundaries.

Documents reviewed included published records on the birds of the Wissahickon, Pennypack, and Tacony Creek areas, along with field notes taken from *Cassinia* and *The Oölogist*. Single-specimen records from the Academy of Natural Sciences' ornithological specimen collections were also included in the historic overview. In total, 12 published articles that took a comprehensive look at the birds of Philadelphia, or some segment of Fairmount Park, were reviewed. An additional 11 published documents that dealt with single species or a more narrow research focus were also reviewed. Unfortunately, historic information on the bird life of the Cobbs Creek section, Fairmount East/West Park, Poquessing, and Franklin Delano Roosevelt sections are nonexistent.

A spreadsheet (deposited in the Academy archives) was created for each of the three areas for which data was available; this document lists 190 species that either occurred in the park or were believed to occur in a segment of the park at one time over the past 100 years. Voucher records for those species that have been recorded for a particular area are included along with any additional information, including date of observation/collection, collector, locality, breeding status, or other anecdotes.

In addition, the spreadsheets contain a column titled "State Conservation Status," which helps highlight those species of special concern, which are: (1) endangered, (2) threatened, (3) vulnerable, and (4) undetermined. These categories were taken from a comprehensive study published by the Carnegie Museum of Natural History titled "Species of Special Concern in Pennsylvania" (Genoways and Brenner 1985). Another column, "Noted Regional Change," indicates any perceived regional changes in the species' population. This information is taken from Richard Mellon's paper "An Ornithological History of the Delaware Valley Region" (Mellon 1990). Mellon presents a number of different categories for bird-population trends, but we have chosen simply to interpret species as either decreasing (–) or increasing (+) during the past 100 years, regardless of their prior status. This is perhaps the most subjective and difficult aspect of the data sheets because of the lack of long-term, quantitative studies of regional bird populations. But if interpreted with caution, it can also be the most instructive and useful piece of data when trying to understand how the park has changed.

Census methods

To survey the park for the various groups of birds, two trained observers (the author and Keith Russell) with extensive local birding experience visited the natural areas of the park for a total of 28.5 person-days between June 1 and July 3, 1998. Most areas of the park were visited. The typical field day started around 5:15 a.m., at which point a transect through a particular section of the park began. Generally, transects followed foot paths or bike paths, as these allowed most birds within park boundaries to be heard or seen. From the beginning to the end of the transect, all birds observed were recorded in a field notebook. Up to as many as 11 point counts were done during a transect. A point count was simply a tool used to fix data to a very specific locality. This was done by taking careful note of the observer's exact location and then recording all birds heard or seen for up to 20 minutes during the point count. Between point counts, the identification and number of birds were recorded, and any information that might help fix the bird to a locality was also recorded in the field notebook. Notes on habitat were also recorded for point counts and at other localities along the transects because habitat types and habitat quality can greatly affect the kinds and abundance of breeding-bird species observed.

All seven major natural park segments were visited during the peak breeding season for birds in the Philadelphia region. Nearly all portions of each segment were visited and all birds observed were recorded (except for the most common birds) into field books. Observations about habitats, additional wildlife, and other issues pertinent to the overall restoration project were also noted in a daily log.

After finishing field work, which usually lasted five to seven hours, we used Fairmount Park base maps to fix particular individuals of indicator species to the map. This was an important step, and was taken within hours of finishing a particular transect. This allowed for correct locality data to be associated with each individual of the indicator species.

IV: Results

Historical data

Published voucher records or specimens from Philadelphia were found for over 175 species (105 breeding species), most of which were from locations within Fairmount Park. The data overwhelmingly demonstrate that certain areas of Fairmount Park have been extremely important to native breeding birds, including such songbirds as thrushes, vireos, flycatchers, wood-warblers, tanagers, and orioles. Other important groups such as owls, hawks, swallows, ducks, and woodpeckers also have been consistently recorded in the park. In fact, such a suite of birds is remarkable when considering the general isolation of the park segments due to urban and suburban development. While many species have been classified as occurring "abundantly," others have only been recorded as "rare breeders." Many of these have been relatively consistently documented throughout the twentieth century, but a strict comparison of our present records for 80 species with the 105 may not yield an accurate view of a reduction in diversity. In part, this is due to the loss of species that required large tracts of open farmland (such as near Pennypack at the turn of the twentieth century), where species like Upland Sandpiper, Eastern Meadowlark, and Dickcissel were found. Also, the limited time that could be dedicated to each segment very likely left some species unrecorded.

1998 census data

Observations of occurrences of the 55 indicator species totaled 1,149 records (1,430 individuals), while there were well over 1,700 observations for all species. Of the 55 indicator species, there were singular to quadruplicate records for individuals of 17 species. Although populations fluctuate from year to year, this brings to 38 the total number of indicator species that have modest to well-represented populations. Appendix 1 illustrates the diversity of bird life observed in each of the park segments, along with those groups of birds that are

particularly well represented and areas where restoration activities could be focused for the benefit of wild birds. The total number of species present should be discounted to allow for those individuals that may represent species with a low probability of actually breeding in the park (e.g., Chimney Swifts nesting in neighborhood houses, or Black-and-white Warbler probably not nesting in Wissahickon). Appendix 2 gives a more complete inventory of species abundance by park segment.

Parkwide, species that showed especially healthy populations were forest, riverine, and human-modified habitat generalists. Within the first group, the following species (indicator and otherwise) seemed to be well represented, especially in the wooded valleys of the Wissahickon and Pennypack creeks: Eastern Wood-Pewee, Acadian Flycatcher, Great Crested Flycatcher, Carolina Chickadee, Downy Woodpecker, Red-bellied Woodpecker, Hairy Woodpecker, Tufted Titmouse, Blue-gray Gnatcatcher, Veery, Wood Thrush, Yellow-throated Vireo, Red-eyed Vireo, Northern Parula Warbler, and Scarlet Tanager. Riverine species were doing well in those two valleys as well, with Louisiana Waterthrush well represented exclusively in the Wissahickon, and Warbling Vireo well represented at Cobbs Creek, Pennypack, and Fairmount–West Park. Interestingly, Belted Kingfisher (a stream-bank cavity nester) was found in all five river valleys. Rough-winged Swallow was also common anywhere there was appropriate bridge habitat, while Wood Duck was found only on the Wissahickon. As for human-modified habitat generalists, the golf courses at Cobbs Creek, FDR, and Wissahickon, along with some areas of all other parks were providing fairly good habitat for such birds as Eastern Kingbird, Northern Mockingbird, and Chipping Sparrow. A species that was not recorded, but is known to nest in at least Wissahickon Park (and likely other segments), is the Eastern Screech-Owl.

Table 1.

Park unit	Days visited	Species present	Major strength (bird group based on habitat type)	Conservation priority
Cobbs Creek	2	48	Parkland/human-modified	Human traffic
FDR	2	44	Parkland/wetland	Wildland restoration
Fairmount	4	59	Parkland	Fragmentation
Pennypack	4	56	Forest	Deer browse
Poquessing	2	34	Shrub/edge	Land acquisition
Tacony	2	39	Riverine	Exotics control
Wissahickon	7	60	Forest/riverine	Deer browse
TOTALS	23	80	Forest; generalist	Land acquisition; deer browse; fragmentation

Cobbs Creek — Overview of census results
Total acreage: 848
Observed individuals of indicator species: 173
Census dates: June 10 and 24

Cobbs Creek Park, located in Southwest Philadelphia, extends from City Line Avenue in the northwest to Woodland Avenue in the southeast. The park can be divided roughly into lower and upper sections, with a dividing line at 63rd Street. The upper section is characterized by its golf courses and some small woodlots on moderately sloping hills. In addition to Cobbs Creek, two smaller tributaries run through the park: Indian Creek and Indian Run. The lower section is almost exclusively a thin strip of park along the course of the stream. The slopes along the Philadelphia side of the creek are generally steep and wooded with mixed deciduous species, while those on the Delaware County side are more gently sloping in sections. At the lower end of the park, adjacent cemeteries increase the area of open land.

An interesting aspect to the park that contrasts with the valleys like the Wissahickon and Pennypack is the absence of White-tailed Deer (*Odocoileus virginianus*). While many ground-nesters may not be present in Cobbs Creek Park because of the small size of forested tracts, the absence of deer has left a higher-quality forest for the less area-dependent species like Wood Thrush and Red-eyed Vireo (both of which were surprisingly numerous in the small woodlots of the golf course). There were 48 summer residents observed in Cobbs Creek Park, although several are probably not breeders. Much of the park is currently modified for recreational purposes and the abundance of birds like Eastern Kingbird, American Robin, Gray Catbird, and Chipping Sparrow reflects this. The forests that do exist in the upper half are in varying states of condition. Along Indian Creek and Indian Run, there is an abundance of knotweed (*Polygynum* spp.), and Norway maple (*Acer platanoides)* is common along the edges, particularly near Sherwood Avenue. Forest remnants between the golf course, Daggett Street, and the creek are attractive, but the size of the area appears to be limiting bird diversity. On the lower stretches of the park, impact from all-terrain vehicles and other human activities limits the availability of high-quality habitat. The forest in this area is relatively young, with very limited regeneration, and is different in composition than that found in the Wissahickon or the Pennypack.

FDR — Overview of census results
Total acreage: 348
Observed individuals of indicator species: 125
Census dates: June 1 and 9

Located in the heart of South Philadelphia close to the sports complex, I-95, and other transportation corridors, FDR Park is heavily impacted. The park is on level ground, which has proved an irresistible attraction to recreation planners — much of the park is now managed for recreational purposes such as picnicking, baseball, and golf. Several ponds and a tidal stream weave through the central and southern sections, while a loop road with side extensions to parking areas permits vehicular traffic throughout much of the park. The least impacted area, in the southern corner, is characterized by *Phragmites* and a forest of white mulberry (*Morus alba*) and Siberian elm (*Ulmus pumila*). Mowed grass, high amounts of garbage, and high levels of human use all combine to limit the attractiveness of FDR to most species of birds.

In spite of these shortcomings, the total species count for the park was 44, among which were six probable nonbreeders that were found in abundances not encountered elsewhere in Fairmount Park (Herring and Ring-billed gulls, Double-crested Cormorant, Black-crowned Night-Heron, Great Egret, and Great Blue Heron). A number of species were observed only in the unmowed areas of natural vegetation in the southern section, and include Swamp Sparrow, Willow Flycatcher, and Yellow Warbler. While FDR Park may not have the most abundant wildlife among the seven natural areas, it is extremely valuable for the relatively rare species that breed exclusively there (or nearly so). Interestingly, the only sizable Ring-necked Pheasant population within Philadelphia seemed to be surviving by using the unmanaged areas next to the golf course

(both within the park and adjacent to the park to the south of the apartment complex) as cover during the day when the golf course is being used.

While one imagines what bird life would be like had architect Frederick Law Olmsted's original plan for the park (with its more extensive natural areas) been kept in place, the continued existence of so much and so varied a bird life is a testament to the birds' resilience. Their continued presence also indicates that some of the ways the park is currently being managed are beneficial to wild birds. Certainly, FDR Park may hold some wonderful and unique opportunities for natural-lands restoration, in spite of its small area and high recreational use.

Fairmount East/West —
Overview of census results
Total acreage: 2,434
Observed individuals of indicator species: 174
Dates censused: June 13, 15, 16, 19

One of the largest segments of Fairmount Park, Fairmount East/West Park harbors an extensive bird life and, more importantly, has the potential to be an even more significant bird sanctuary if bird-friendly management techniques are adopted. The park spans an area on the east and west slopes of the Schuylkill River between Ridge Avenue on the east and the SEPTA rail corridor on the west.

Surprisingly little was uncovered during a review of documents for historical data on the birds found in East and West Park. Thus, while many area birders are familiar with small areas of the park, no historical documents exist on this area. Additionally, of the people generally consulted for the birds of Philadelphia (e.g., Edward D. Fingerhood), there was apparently no one with long-term experience in the park who could interpret trends or identify particularly rich areas. Certainly, forestation since the 1876 Centennial exhibition has benefited forest song birds.

The combined sections were used by a total of 59 species, some of which were uncommon for the rest of the park system. Nonbreeding species encountered included Double-crested Cormorant, Laughing and Herring gulls, one White-throated Sparrow (June 19, below Belmont Plateau), one Prothonotary Warbler (June 13, below Belmont Plateau), and one Winter Wren (June 15, West River Drive).

East Park

The east section is relatively small, is highly modified for recreational purposes (baseball), contains many of the park's mansions, and is characterized by highly fragmented habitats. Additionally, water-department reservoirs border the park on the east. Bird life along the Schuylkill is almost entirely absent due to the extensive mowed areas and lack of shrub habitat. The one exception is Canada Goose, which is abundant year-round. Habitats found in this section include small woodlands along the ridge, mowed picnic areas, recreation areas, and some edge habitat between all of these areas. The most notable natural area in the segment is an unmanaged field located west of the Amtrak rail corridor. The area probably had not been mowed for at least five years and was in an early stage of succession. Box elder (*Acer negundo*) is common, and *Phragmites* was observed in the wetter areas. Birds found here included Great Horned Owl, House and Carolina wrens, Willow Flycatcher, Common Yellowthroat, Yellow Warbler, and Orchard and Baltimore orioles. Less than two miles from the Philadelphia Museum of Art, this is a remarkably diverse piece of habitat and a good example of what many parklands could revert to if returned to a less-frequent mowing cycle.

West Park

The west section is considerably larger than the east, retains many landscaping characters of the Centennial exhibition, and is highly fragmented. But it also holds the most potential as a wildlife refuge. Although some areas have reverted to forest since the Centennial exhibition, severe fragmentation has resulted in vine- and exotics-dominated woodlands. Deer are apparently absent from the entire segment, and the understory in some sections is rich floristically — although the size of woodlots

probably limits the diversity of forest birds. Landscaped areas predominate, and the proliferation of mowed areas prevents native habitat — whether forest or field — from returning. Consequently, the area is far less valuable to wild birds than it could be, given its tremendous size. One of the most surprising aspects of the census was the abundance of riparian-zone specialists that use the strip of vegetation between the Schuylkill River and the bike path of West River Drive. No other area in the park system harbored such a high density of Warbling Vireo, Orchard Oriole, and Yellow Warbler.

The forest between Belmont Plateau and Sweetbriar Mansion uphill from I-76 is a relatively large section of forest. Some of the species encountered here were Wood Thrush, Blue-gray Gnatcatcher, Red-eyed Vireo, and Scarlet Tanager.

Pennypack — Overview of census results
Total acreage: 1,776
Observed individuals of indicator species: 337
Dates censused: June 2, 3, 4, 18, 1998, and June 7, 1997

Pennypack Park is located in Northeast Philadelphia between Fox Chase and the creek's confluence with the Delaware River in Holmesburg. As this section is most similar in geology and habitat to the Wissahickon, its bird life reflects this. The upper sections of the park are the widest and most forested. However, some of Fairmount Park's only shrublands (along Verree Road) and a small *Andropogon* grassland (just west of the Conrail rail line at Krewstown) were found here.

Overall, the 1998 bird census of Pennypack Park provides clear proof that the park is second only to Wissahickon in its diversity of breeding birds. Many of the same birds are present in both areas, although for various reasons, it appears that the diversity and abundance are higher in the Wissahickon. In spite of being visually appealing, the park's size (especially its narrowness in many sections) appears to limit the abundance of quite a few of the species that were common in the much larger and wider Wissahickon. The 1998 census yielded a total of 56 species.

Most notable among the differences from the Wissahickon is the complete absence of Ovenbirds and fewer Veeries than expected at Pennypack. Differences such as these may be due to extremely heavy deer browse. There is a general lack of understory, lack of ground cover, and a pervasiveness of vines and honeysuckle (*Lonicera* spp.) in certain areas of the Pennypack. Such conditions are not favorable to Ovenbirds (although other factors affect this species), are likely to prevent other ground-nesters from using the Pennypack, and are less favorable to other forest specialists.

During a preliminary visit to the recreation site along the Delaware in June 1997 — prior to a wetlands-restoration project and very soon after the reclamation of land for a new recreation area — a number of interesting species were observed that now apparently are absent. These were Red-tailed Hawk, Ring-necked Pheasant, Yellow Warbler, and Orchard Oriole, in the area now plowed under for wetlands, and Killdeer, Spotted Sandpiper, Bank and Tree swallows, and other species in the new recreational area. While restoration of the wetlands, if done well, may attract now-absent species, in its current condition, the mouth of the Pennypack is less attractive to birds than the shrub/edge habitat that existed prior to the wetlands and recreation projects. Most of the shrubs and trees that had been providing cover in the recreation area have died or have been eliminated. With our knowledge about the historical importance of the wetlands at the mouth of the Pennypack, efforts to improve the area ought to be a priority.

Poquessing — Overview of census results
Total acreage: 289
Observed individuals of indicator species: 46
Dates censused: June 26, 30

Poquessing Park is an ill-defined set of parklands in far northeastern Philadelphia, with the principle segments located along the creek with the county border. The creek is slow moving, and land adjacent to the creek is very gently sloping — setting

it apart from all other river valleys in Fairmount Park. The park certainly "feels" different from anywhere else in the park system. The addition of roosters crowing (from Bucks County) added to the very rural feel in some areas. Habitats include floodplain forest, mixed-deciduous woodlands, and old field/early successional.

The park is in a state of general neglect — apparent immediately because of a complete lack of signage indicating park boundaries. The existing park is very narrow, and recent developments right up against the creek in some areas (both in Philadelphia and Bucks counties) have made the open lands even more narrow. The effects of this narrowness are apparent in the proliferation of multiflora rose *(Rosa multiflora)* throughout the understory and up into the canopy of many trees.

The nonforested areas within the park and adjacent to it are what make the park unique, however. Shrublands and open fields are extremely under-represented in the seven major park segments, and it is here where we find the best examples, even if they are degraded by exotics like multiflora rose. Only 34 species were encountered during the two days visiting the park, although it is believed a number of other common species not recorded could also be found in the park with additional time.

Shrubland species were better represented at Poquessing than at any other segment in the Fairmount Park system. Many of these were found in an area located behind the recently constructed National Archives building and must have been much more abundant prior to the construction of these sites. The remaining patches of adjacent land in the park may be close approximations but are unlikely to represent habitat that will allow for populations to continue many years in the future. Species found here and in other edge habitat included Willow Flycatcher, Brown Thrasher, House Wren, Chestnut-sided Warbler, Common Yellowthroat, Yellow-breasted Chat, Red-winged Blackbird, Eastern Towhee, and Orchard and Baltimore orioles.

Of all segments visited, the Poquessing was the most surprising because of the wealth of opportunities to conserve adjacent lands and to enhance the value of the park for wild bird life. Nothing was known about this park segment by the author or those local bird watchers consulted for advice. The sheer abundance of lands (especially those that are in an early state of succession and are level grades) adjacent to the park that are abandoned or lightly developed creates a perfect opportunity to expand the park in a way that the small, existing core lands can be more easily maintained (i.e., fewer problems from exotics). Furthermore, the opportunities for passive recreation (such as bird-watching, biking, hiking) can be increased (thus creating a constituency for park preservation and management) with significant park expansion and clear signage.

Tacony — Overview of census results
Total acreage: 307
Observed individuals of indicator species: 58
Dates censused: June 22 and 25

Tacony Park is located in Northeast Philadelphia, between the city's boundary with Cheltenham Township and the park's abrupt end at the Juniata Golf Course near Wyoming Avenue. The park is characterized by its extremely narrow aspect and overall lack of healthy habitats. Consisting of lightly forested areas along the slopes leading down to the creek, riparian zones overgrown with Japanese knotweed *(Polygonum cuspidatum)*, and managed parklands for recreation, the available wildlands in even moderately favorable conditions for breeding birds are extremely limited at Tacony. Impacts from motorized ATVs and discarded automobiles are especially severe in the lower reaches of the park, while a lack of deer has allowed for understory to develop in areas not overgrown with knotweed or other exotics. The largest tract of forest is opposite a woodlot owned by the Friends Hospital. There is also an area upslope from this forest of several small, old fields separated by treelines.

Very little was known about the bird life of Tacony Creek Park prior to the 1998 census. Few amateur bird-watchers in the Philadelphia area regularly visited the park, and only one published record, from 1915, covers the valley. The following is a paragraph from *Cassinia* (Morris 1914).

"For well nigh fifty years I have lived on the edge of the valley through which winds the Tacony Creek, a stream flowing into the Delaware in the northern section of the county of Philadelphia. Each year the city creeps closer to us. That red-brick wave has almost reached to the opposite edge of our valley, yet still the quiet stream comes down as of old between its wooded hillsides, its marshy meadows, its over-hanging willows and its alder thickets. For the study of bird-life this valley is almost ideal."

— George Spencer Morris, 1914

So much has changed since the time this passage was written that, without recent benchmarks, there is little against which to measure current conditions. The remnants of a once wild and beautiful river valley, now completely without marshy meadows and nearly devoid of willows and alder, harbors little of the bird life that once flourished there.

The census of the Tacony provides an excellent comparison with the relatively larger Pennypack and Wissahickon creeks. In large part, the narrowness of the park appears to be a clear reason for its impoverished bird life. In fact, only 39 species were recorded for Tacony Creek Park, of which there were only several individuals for many of the 20 significant species recorded there (including Wood Thrush, Carolina Wren, Great Crested Flycatcher, and Red-eyed and Warbling vireos). This wonderfully clear illustration of the direct relationship between an area's size and its diversity of bird life lends strong support to the argument for adjacent lands acquisition in all natural-lands segments.

Wissahickon — Overview of census results
Total acreage: 2,091
Observed individuals of indicator species: 517
Dates censused: June 5, 7, 8, 11, 20, 29; July 1

The crown jewel of Fairmount Park's natural areas, the Wissahickon Valley is located between the city boundary with Whitemarsh Township to the west and the creek's confluence with the Schuylkill at East Falls. The segment is characterized by its large size, extensive forests, steep slopes and rocky outcroppings, and many tributary valleys.

The Wissahickon is currently dominated by mature hardwood forests, with many of its largest stands dominated by the quick-growing tulip poplar *(Liriodendron tulipifera)*. Interspersed are other hardwoods such as maples, oaks *(Quercus* spp.), and hickories *(Carya* spp.), with stands of eastern hemlocks *(Tsuga canadensis)* — many of which are dead or dying — on some of the wetter slopes. This extensive forest provides excellent habitat for many forest birds, but especially for the canopy nesters (such as Scarlet Tanagers) and cavity nesters (such as woodpeckers and chickadees), which rely on mature or aging trees. Unfortunately, the aging tulip-dominated stands do not seem to be the preferred tree type for many species. Indeed, if left to natural forces, tulip stands are intermediate to the local climax oak/hickory forest.

Because deer are so abundant and because they so completely remove understory vegetation (i.e., herbaceous plants, shrubs, tree saplings), the natural forest-maturation process is not taking place in the Wissahickon. In fact, one of the few species that seems to be able to regenerate is tulip poplar. During this census, very few, if any, young saplings of either oaks or hickories were observed. Therefore, while populations of many forest birds appear healthy now, it is only a matter of time before many of the large, mature trees start dying off, and then replacement is uncertain. A process of further fragmentation by forest gaps and almost exclusive regeneration of tulip poplars does not bode well for many forest specialists that need oaks and other types of native trees to survive.

Shrublands and open fields were once prominent components of the Wissahickon's varied habitats. Many of these were contiguous to adjacent farms, which have been developed. The remaining grasslands and shrublands in Andorra, near Manatawna Avenue, and at the Andorra Nature Center have been fragmented by recent subdivisions and are in later stages of succession. These areas were once home to populations of chats, thrashers, Blue-winged Warblers, and other birds now entirely absent.

Especially well-represented bird groups in the Wissahickon are the forest and riverine specialists. Notably lacking or under-represented within the former group were the understory specialists like Kentucky and Worm-eating warblers.

Despite these and other deficiencies, the potential clearly exists to increase the present 60 species of birds and improve conditions for long-term bird population stability. These improvements will not happen, however, if the current causes of disturbance from adjacent land development, fragmentation, the proliferation of exotic invasives, and the loss of nonforest habitat are allowed to continue.

V: Conclusions

After censusing all natural-lands segments for breeding birds in June 1998, it is clear that Fairmount Park is an invaluable sanctuary for many wild species native to the Philadelphia region. In fact, over 70 species are believed to breed in the park or to use it during the breeding season. Despite this encouraging finding, there are clear indications that the number of species currently using the parks is markedly lower than earlier in the twentieth century, and, that the downward trend in diversity will continue unless certain problems are corrected.

Fairmount Park probably harbors a greater diversity of breeding birds than any other urban park in North America. But is this apparent diversity an inherent capacity of the park or can management activities (either deliberate or de facto) increase or decrease the diversity? Clearly, passive management for much of the twentieth century has changed the park's various habitats and thus its birds. Historical records, when cautiously compared with the 1998 census, bear out this truth.

Why a cautious approach?

Trying to determine just what birds lived in the area and how abundant they were is a speculative business. Undoubtedly, human activities of the nineteenth century, and even the eighteenth century, negatively impacted birds native to the areas now considered part of Fairmount Park, and the bird diversity we see today is probably less than that of pre-Columbian times. More difficult still is trying to assess the causes behind this loss of diversity. However, we can, with a good degree of certainty, note that significant clearing of the land for agriculture and fuelwood during the eighteenth and nineteenth centuries probably favored grassland species at the expense of many native forest species. Small urban centers that sprang up during the nineteenth century fragmented the existing landscape, and in all likelihood, the conditions observed by ornithologists at the turn of the twentieth century (when our first reliable published records exist) were drastically different from the conditions that would have been present 100 years earlier. Furthermore, around the turn of the century, filling in of wetlands along the Delaware River and smaller tributaries greatly reduced habitat diversity. Perhaps the changes that took place during the nineteenth century were even more drastic than those that have occurred between today and what existed 100 years ago.

VI. Comparing present with past: General trends, losses, gains to the park's avifauna

Comparing the present findings with historical records can shed some light on the current conditions for wild birds and what kinds of population trends have taken place or are ongoing for the various species. What species are now missing that were once present? What species are now present for which earlier records are scant or nonexistent? Comparisons between historical documents and our current survey illustrate some general trends as well as more specific cases of species recently lost or gained in the park system.

Gains in bird-species diversity

Generally speaking, the maturation of natural lands into deciduous woodlands since the beginning of the twentieth century has improved and increased the amount of habitat for many of the for-

est specialists like vireos, thrushes, some warblers, and woodpeckers. Concomitant with the increase in forestland species has been a loss of grassland and shrubland species such as Ring-necked Pheasant, White-eyed Vireo, Chestnut-sided Warbler, Yellow-breasted Chat, Northern Bobwhite, Brown Thrasher, and Eastern Meadowlark, which were all once fairly common. This pattern is particularly evident in the extensive natural lands of the Wissahickon and Pennypack creeks. Although this process is natural, the inclusion of many exotic species into the native forests, such as Norway maple and Japanese knotweed, may have an impact on the quality of bird breeding habitat. Without reliable measures of abundances of many woodland species earlier in the century, it is difficult to say whether, for example, the Wissahickon holds more suitable habitat now than it did 80 years ago for birds like the Red-eyed Vireo and Wood Thrush. Species that have recently (within the past 30 years) returned to the park after long absences because of recent maturation of these forests include Pileated Woodpecker and Great Horned Owl. Species that have seen their populations increase as the forests have matured include Red-bellied Woodpecker, Carolina Chickadee, Blue-gray Gnatcatcher, and Acadian Flycatcher. Other species may have seen increases, but insufficient data prevent accurate interpretations. Species that prefer riparian (riverine) habitats (White-eyed Vireo, Yellow Warbler, Orchard Oriole) have also increased in the park over the last 30 years because so much of this edge habitat exists.

A species that has only recently become abundant in Philadelphia, in particular along the Schuylkill and in FDR Park, is the Canada Goose. Traditionally, this species was a winter visitor to the area, spending its breeding season in the arctic tundra. For various reasons, populations have established themselves as year-round residents and breeders in the mid-Atlantic region. Essentially, mowed lawns adjacent to open water mimic in some ways their tundra breeding habitat, and as long as such conditions exist, Canada Geese are likely to remain breeders in Fairmount Park.

Losses in bird-species diversity

Many different factors have contributed to, and continue to contribute to, an overall decline in bird species diversity for Fairmount Park. Various examples of species lost are outlined below.

The extinction of the Passenger Pigeon, which was once an abundant deciduous forest-nesting bird in the region, is a well-documented natural-history story. Though the species did not become extinct until 1914, its population had already been significantly reduced in the latter part of the nineteenth century. One interesting Philadelphia record is a report of a flock of 50 birds in Holmesburg in 1878 (McNeil 1941). The Passenger Pigeon was certainly an inhabitant of Fairmount Park, although not necessarily a breeder, but its loss illustrates well how forces beyond the control of the park are often the cause for a particular species' decline.

The loss or severe reduction of such ground-nesters as Worm-eating Warbler (only one individual heard during census) and Hooded Warbler (only one individual observed) illustrates the devastating effects of deer on the understory, which these birds need for nesting. In fact, another ground-nester, the Kentucky Warbler, which was recorded as the most common warbler in the Wissahickon Valley as recently as 1951 (Pettingill 1951), appears to be completely gone from Fairmount Park — not a single individual was recorded during the 1998 census. Local experts with years of birding in the Wissahickon, like Keith Russell and Dr. Robert Ridgely, remember the abundance of these birds prior to the eruption in the deer population in the early 1980s. The Ovenbird, also a ground-nester, has suffered decline as well, but the area of the park that held the largest population of Ovenbirds was one with the most deer-ravaged understory; however, it was one of the most extensive areas of level, not sloped forest in the Wissahickon. Thus, the Ovenbird may not be as dependent on understory as Kentucky Warbler, for example. Although the effect of deer may be most acutely felt by ground- and shrub-nesters now, its effects on canopy-nesters will likely be felt if nothing is done to regenerate the aging canopy forest. However, Wood Thrush and Veery, which don't

need dense understory, appear unaffected by these conditions as they occur in considerable abundance.

For the songbirds and gamebirds that require varying degrees of open fields and edge habitat for breeding, the maturation of fields into forest has been nothing short of devastating. In the Cresheim Valley section of the Wissahickon watershed, for example, as late as 1942, J.C. Tracy noted, "Woodland, meadow and swamp are well defined. … On the hilltops, and occasionally on the valley floor itself are open meadows which afford good localities for field birds" (1942: 35). During the period while Tracy was writing his account, the conditions of the valley were very likely undergoing profound changes as his records of two species typical of open areas, or edge habitat illustrate. Regarding the Ring-necked Pheasant (an introduced European species), he notes, "An early morning walk in May seldom failed to show up fifteen or more cackling males. No young birds were seen, due probably to depredation by dogs and other natural enemies" (1942: 36). For the Yellow-breasted Chat, he noted, "This past summer the chats deserted the valley except as visitors, although they have been found nesting there before" (1942: 39). In both of these cases, the decline and eventual loss of the species as breeding birds may reflect a regional decline but is probably also closely tied to the degradation and decrease of early-successional habitat within Cresheim Valley watershed and the placement of a road through the valley.

Other species that require various stages of open habitat that are noticeably absent or reduced park-wide include the following: Northern Bobwhite; Eastern Bluebird; Brown Thrasher; Chestnut-sided and Blue-winged warblers; Upland Sandpiper, White-eyed Vireo, Indigo Bunting; Field, Savannah, and Grasshopper sparrows; Bobolink; and Eastern Meadowlark. Some of these species would likely return if habitat-management techniques were adopted to promote early-successional habitats.

Another group of birds that seem to have disappeared are raptors, such as Broad-winged and Cooper's hawks, and American Kestrel. The apparent loss of the latter (although one was observed during the census where Route 1 crosses the Schuylkill) is probably due to a loss of open habitat — its preferred foraging grounds. The loss of Broad-wings and reduction or extirpation of Cooper's Hawks may reflect a reduction in the amount of high-quality forest habitat (particularly in the Wissahickon, where most of these birds have been recorded in the past), or may reflect the relatively recent addition of the territorially aggressive Great Horned Owl. Great Horned Owls were observed in East Park and are known to nest regularly in the Pennypack and Wissahickon valleys, although they were not observed there during this census. Broad-winged and Cooper's hawks may also need open fields and meadows in which to forage, and loss of such habitat may have impacted them as well.

The decline and eventual extirpation (local extinction) of American and Least bitterns, King Rail, Common Moorhen, Red-headed Woodpecker, Northern Bobwhite, Ring-necked Pheasant, Vesper and Savannah sparrows, and Bobolink, among others, especially reflect a loss of habitat within Philadelphia. In the case of bitterns and rails, they inhabited the wetlands along the river and at the mouth of the Pennypack in Holmesburg, prior to these areas being filled in. These wetlands were the most significant such habitat in Philadelphia that was a well-documented refuge for marshbirds, and that has been lost. Without creation (or re-creation) of large wetlands (i.e., greater than 10 acres), it is unlikely that these species and other wetland-dependent species will return to Philadelphia.

Status of species of special concern

The degree to which a natural area provides habitat for species that are recognized as threatened or endangered could be used as one measure of an area's usefulness in contributing to conservation. A comprehensive study published by the Carnegie Museum of Natural History, entitled "Species of Special Concern in Pennsylvania" (Genoways and Brenner 1985), classifies species as being (1) endangered, (2) threatened, (3) vulnerable, or (4) undetermined. Fifteen of these species have been recorded as breeders in Fairmount Park or nearby adjacent lands, but none is currently found within

the park. Management for some of these species (e.g., Eastern Bluebirds, Purple Martins, and wetland specialists) would go far to improve the value of Fairmount Park as a refuge for endangered birds.

Current threats

At the turn of the millennium, the diversity and abundance of wild birds breeding in Fairmount Park is under threat from several directions. As these threats are likely to change, subside, or grow more severe, they are here documented for future reference.

Fragmentation

The negative effects of the loss and/or change of habitat, as illustrated above, have been further aggravated by habitat fragmentation and actual loss of parklands and/or adjacent open spaces to development. If one looks at the total species diversity for each park segment, there is a fairly close correlation between a segment's size and the number of species: The larger, more contiguous a park is, the greater its species diversity. Within each segment, only the largest areas of each habitat are able to attract what might be considered healthy populations of the most significant species. This tight connection between a park's size and its bird-species diversity illustrates the importance of acquiring adjacent open lands (and putting a halt to inappropriate development within the natural lands) to prevent further loss of diversity.

Aside from development pressures, a significant cause of fragmentation in some segments of the park is heavy human use. Joggers, horseback-riders, bikers, and especially illegal all-terrain-vehicle users trample plants, compact soil, and generally degrade available habitat.

All of the factors that contribute to fragmentation leave a landscape that is less productive for those species of birds that still use them for breeding. Certainly, much of Fairmount Park may be a population sink for some species, with a higher mortality rate than reproductive rate. A vision of the park as an 8,000-acre ecological trap is a frightening one, but probably an accurate speculation for some of the more area-sensitive species.

Exotic plants and their impacts on native breeding birds

A number of exotic plants are well established in the park, and some of these are clearly reducing the quality and abundance of appropriate habitat for our breeding birds. Chief among the most troublesome exotics in some sections is Norway maple. This tree dominates in only a few sections, but its ability to shade out competitors and understory vegetation and its unattractiveness to nearly all breeding birds has created impoverished stands unnaturally devoid of bird song.

To illustrate this point, areas predominated by Norway maple, such as Andorra in the Wissahickon, were much quieter than one would expect for such a piece of woods were it to have native tree species. Norway maple is generally the only tree that will regenerate in its own stands.

Another exotic that is having a significant effect on birds is Japanese knotweed. Patches of this plant are frequently used by catbirds for cover, and even nesting, but no other species was observed using this plant regularly. Along stream banks, the plant may be directly displacing the Louisiana Waterthrush by growing over its preferred foraging grounds along the rocks and shorelines of swift-flowing streams. In most areas, however, the plant most likely reduces habitat structural diversity to the detriment of shrub-, edge-, and ground-nesters. In the long term, corridors of knotweed may be preventing the regeneration of forest such that even canopy-nesters are impacted. Control of this species would help many bird species.

Multiflora rose is yet another invasive plant that impacts native bird populations. Although it can provide cover and nesting habitat for a variety of species, its ability to create a monoculture is not particularly attractive to birds. Certainly, where it occurs, a mosaic of native shrubs would provide more adequate habitat for birds.

Lastly, two plants that may not be a current prob-

lem because of the paucity of wetland areas but that have disturbed some habitats (and could become a problem at the newly constructed wetlands of the Pennypack), are *Phragmites* and purple loosestrife (*Lythrum salicaria*). Both species are invasive and create large expanses of monoculture. They do not provide particularly good habitat for marsh birds like rails, blackbirds, and Swamp Sparrows. An acutely impacted area is in the southwest corner of FDR Park. No birds were heard or observed in the core of this habitat.

There are many exotic herbaceous plants that carpet sections of the park, such as garlic mustard (*Alliaria officianalis*). There is not sufficient evidence that these species or their invasive habits are detrimental to birds.

Forest gaps and vines

Much attention has been paid to the pervasiveness of vines in some areas of Fairmount Park. Vines such as native grapes (*Vitis* spp.), native and introduced honeysuckles and bittersweets (*Celastrus* spp.), Virginia creeper (*Parthenocissus quinquefolia*), and poison ivy (*Rhus radicans*) are often targeted as problems. In fact, many bird species use the berries of these plants (both native and introduced varieties) as significant food sources, especially during fall migration, when the high sugar content of the berries is used to build up energy reserves. Additionally, some of these vines (like poison ivy) do not choke and kill trees, but instead keep most of their growth along the trunk and thus do not create "undesirable" openings.

The habitat diversity created by vines is a very important, natural component of the forest ecosystem to which birds have adapted (although some vines, especially the exotics like kudzu, have the potential to greatly reduce available forested habitat). Just as a forest completely fragmented by large areas of vine-choked trees is unattractive to forest birds, a forest without gaps is also less attractive. Efforts to afforest all gaps in segments such as the Wissahickon, Pennypack, and West Park should be done with the knowledge that bird diversity will be reduced as a result.

VII: Closing remarks

The 1998 census of Fairmount Park's breeding birds provided an excellent opportunity to expand our knowledge of Philadelphia's breeding birds. Fairmount Park's natural lands are a tremendous local resource that, with proper management techniques, can be even more important to wild birds. If the Fairmount Park Commission were prompted by constituencies such as DVOC members to incorporate bird-friendly management techniques, the park could serve as a model for other urban communities wishing to live near an enriching natural environment.

This census should serve as an excellent benchmark against which to measure the effects of future park activities. It should also serve as a stimulus to encourage DVOC members to consider undertaking follow-up activities such as education programs. Future research activities could include more detailed censuses of particular segments and monitoring programs for the productivity of particular bird groups (e.g., Neotropical migrants) to determine the extent to which the park acts as an ecological trap. Club members should also use the knowledge gained through this census to immediately advocate for improved natural management for neglected Fairmount Park segments and adjacent natural lands, especially at the Poquessing.

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Appendix 1.

List of species observed during 1998 census (late migrants, aberrant individuals, and non-native species not included). Where appropriate, species ID abbreviations after Pyle 1997.

Name	Species ID	Indicator species (Y=Yes)	Status[1]
Double-crested Cormorant *Phalacrocorax auritus*	DCCO		R
Great Blue Heron *Ardea herodias*	GRBH	Y	R
Great Egret *Ardea alba*	GREG	Y	S
Black-crowned Night-Heron *Nycticorax nycticorax*	BCNH	Y	R
Canada Goose *Branta canadensis*	CAGO		R
Wood Duck *Aix sponsa*	WODU	Y	R
Mallard *Anas platyrhynchos*	MALL		R
Osprey *Pandion haliaetus*	OSPR	Y	S
Red-tailed Hawk *Buteo jamaicensis*	RTHA	Y	R
Ring-necked Pheasant *Phasianus colchicus*	RINP	Y	R
American Coot *Fulica americana*	AMCO	Y	?
Killdeer *Charadrius vociferus*	KILL	Y	R
Spotted Sandpiper *Actitis macularia*	SPSA	Y	S
Laughing Gull *Larus atricilla*	LAGU		S
Ring-billed Gull *Larus delawarensis*	RBGU		R
Mourning Dove *Zenaida macroura*	MODO		R
Yellow-billed Cuckoo *Coccyzus americanus*	YBCU	Y	S
Great Horned Owl *Bubo virginianus*	GHOW	Y	R
Chimney Swift *Chaetura pelagica*	CHSW		S
Ruby-throated Hummingbird *Archilochus colubris*	RTHU	Y	S
Belted Kingfisher *Ceryle alcyon*	BEKI	Y	R
Red-bellied Woodpecker *Melanerpes carolinus*	RBWO		R
Downy Woodpecker *Picoides pubescens*	DOWO		R
Hairy Woodpecker *Picoides villosus*	HAWO		R
Northern Flicker *Colaptes auratus*	NOFL		R
Pileated Woodpecker *Dryocopus pileatus*	PIWO	Y	R
Eastern Wood-Pewee *Contopus virens*	EAWP	Y	S
Acadian Flycatcher *Empidonax virescens*	ACFL	Y	S
Willow Flycatcher *Empidonax traillii*	WIFL	Y	S
Eastern Phoebe *Sayornis phoebe*	EAPH	Y	S
Great Crested Flycatcher *Myiarchus crinitus*	GCFL	Y	S
Eastern Kingbird *Tyrannus tyrannus*	EAKI	Y	S
White-eyed Vireo *Vireo griseus*	WEVI	Y	S
Yellow-throated Vireo *Vireo flavifrons*	YTVI	Y	S
Warbling Vireo *Vireo gilvus*	WAVI	Y	S
Red-eyed Vireo *Vireo olivaceus*	REVI	Y	S
Blue Jay *Cyanocitta cristata*	BLJA		R
American Crow *Corvus brachyrhynchos*	AMCR		R
Fish Crow *Corvus ossifragus*	FICR		R
Tree Swallow *Tachycineta bicolor*	TRSW	Y	S
N. Rough-winged Swallow *Stelgidopteryx serripennis*	NRWS	Y	S
Bank Swallow *Riparia riparia*	BANS	Y	S
Barn Swallow *Hirundo rustica*	BARS	Y	S
Carolina Chickadee *Poecile carolinensis*	CACH		R
Tufted Titmouse *Baeolophus bicolor*	TUTI		R
White-breasted Nuthatch *Sitta carolinensis*	WBNU		R

Name	Species ID	Indicator species (Y=Yes)	Status[1]
Carolina Wren *Thryothorus ludovicianus*	CARW	Y	R
House Wren *Troglodytes aedon*	HOWR	Y	S
Blue-gray Gnatcatcher *Polioptila caerulea*	BGGN	Y	S
Veery *Catharus fuscescens*	VEER	Y	S
Wood Thrush *Hylocichla mustelina*	WOTH	Y	S
American Robin *Turdus migratorius*	AMRO		R
Gray Catbird *Dumetella carolinensis*	GRCA		S
Northern Mockingbird *Mimus polyglottus*	NOMO		R
Brown Thrasher *Toxostoma rufum*	BRTH	Y	S
Cedar Waxwing *Bombycilla cedrorum*	CEDW		R
Blue-winged Warbler *Vermivora pinus*	BWWA	Y	S
Northern Parula *Parula americana*	NOPA	Y	S
Yellow Warbler *Dendroica petechia*	YEWA	Y	S
Chestnut-sided Warbler *Dendroica pensylvanica*	CSWA	Y	S
Cerulean Warbler *Dendroica cerulea*	CERW	Y	S
Black-and-white Warbler *Mniotilta varia*	BAWW	Y	S
American Redstart *Setophaga ruticilla*	AMRE	Y	S
Prothonotary Warbler *Protonotaria citrea*	PROW	Y	S
Worm-eating Warbler *Helmitheros vermivorus*	WEWA	Y	S
Ovenbird *Seiurus aurocapillus*	OVEN	Y	S
Louisiana Waterthrush *Seiurus motacilla*	LOWA	Y	S
Common Yellowthroat *Geothlypis trichas*	COYE	Y	S
Hooded Warbler *Wilsonia citrina*	HOWA	Y	S
Yellow-breasted Chat *Icteria virens*	YBCH	Y	S
Scarlet Tanager *Piranga olivacea*	SCTA	Y	S
Eastern Towhee *Pipilo erythrophthalmus*	EATO	Y	R
Chipping Sparrow *Spizella passerina*	CHSP	Y	S
Field Sparrow *Spizella pusilla*	FISP	Y	R
Song Sparrow *Melospiza melodia*	SOSP		R
Swamp Sparrow *Melospiza georgiana*	SWSP	Y	R
Northern Cardinal *Cardinalis cardinalis*	NOCA		R
Rose-breasted Grosbeak *Pheucticus ludovicianus*	RBGR	Y	S
Indigo Bunting *Passerina cyanea*	INBU	Y	S
Red-winged Blackbird *Agelaius phoeniceus*	RWBB	Y	R
Common Grackle *Quiscalus quiscula*	COGR		R
Brown-headed Cowbird *Molothrus ater*	BHCO		R
Orchard Oriole *Icterus spurius*	OROR	Y	S
Baltimore Oriole *Icterus galbula*	BAOR	Y	S
House Finch *Carpodacus mexicanus*	HOFI		R
American Goldfinch *Carduelis tristis*	AMGO		R

[1]R = Resident, S = Summer

Appendix 2.

Individuals of indicator species observed by park segment. For Species ID, see Appendix 1. Locations: A = Cobbs Creek; B = FDR; C = Fairmount; D = Pennypack; E = Poquessing; F = Tacony; G = Wissahickon

Species ID	A	B	C	D	E	F	G	Total
GRBH	1	4	1					6
GREG	1	3	1			1		6
BCNH	1	3	1			1		6
WODU			1				43	44
OSPR	1			1				2
RTHA			1	1			1	3
RINP		9		1				10
AMCO		2						2
KILL		1		1				2
SPSA		7		2				9
YBCU							1	1
GHOW			1					1
RTHU				1			6	7
BEKI	3			1	1	2	2	9
PIWO							1	1
EAWP	12		1	23	1	2	30	69
ACFL	5			15		1	41	62
WIFL		3	1	2	1			7
EAPH	2		1	5		1	10	19
GCFL		1	3	10		2	12	28
EAKI	10	9	9	3		4	1	36
WEVI			1	1			4	6
YTVI				3			1	4
WAVI	22	2	9	10	1	4		48
REVI	15	1	7	33	1	7	56	120
TRSW		5		2				7
BANS				1				1
NRWS	8	10	19	4			16	57
BARS	1	14	9	10		3	11	48
CARW	6	1	6	9	4	3	21	50
HOWR	2	7	10	14	10	3	8	54
BGGN	10		2	31		1	43	87
VEER				8			35	43
WOTH	25		12	41	9	6	59	152

Appendix 2.

Species ID	A	B	C	D	E	F	G	Total
BRTH	1	1			1			3
BWWA							2	2
NOPA				2			3	5
YEWA	5	7	14	23	3		4	56
CSWA					1		1	2
CERW							1	1
BAWW	1						1	2
AMRE	1	1	1	12			8	23
PROW			1					1
WEWA							1	1
OVEN							20	20
LOWA							16	16
COYE	8	5	15	7	5	1	9	50
HOWA				1				1
YBCH					1			1
SCTA			1	7			13	21
EATO	9		5	8	3	2	9	36
CHSP	3						3	6
FISP							3	3
SWSP		1		1				2
RBGR							1	1
INBU		1	2	2			2	7
RWBB	3	22	13	8	1	1		48
ORORO	1	1	13	3	2	1		21
BAOR	19	6	13	32	2	12	18	102