Torrey Botanical Society

The Historical and Extant Vascular Flora of Pelham Bay Park, Bronx County, New York 1947-1998 Author(s): Robert DeCandido and Eric E. Lamont Source: *Journal of the Torrey Botanical Society*, Vol. 131, No. 4 (Oct. - Dec., 2004), pp. 368-386 Published by: Torrey Botanical Society Stable URL: <u>http://www.jstor.org/stable/4126941</u> Accessed: 18/06/2009 03:05

Your use of the JSTOR archive indicates your acceptance of JSTOR's Terms and Conditions of Use, available at http://www.jstor.org/page/info/about/policies/terms.jsp. JSTOR's Terms and Conditions of Use provides, in part, that unless you have obtained prior permission, you may not download an entire issue of a journal or multiple copies of articles, and you may use content in the JSTOR archive only for your personal, non-commercial use.

Please contact the publisher regarding any further use of this work. Publisher contact information may be obtained at http://www.jstor.org/action/showPublisher?publisherCode=tbs.

Each copy of any part of a JSTOR transmission must contain the same copyright notice that appears on the screen or printed page of such transmission.

JSTOR is a not-for-profit organization founded in 1995 to build trusted digital archives for scholarship. We work with the scholarly community to preserve their work and the materials they rely upon, and to build a common research platform that promotes the discovery and use of these resources. For more information about JSTOR, please contact support@jstor.org.



Torrey Botanical Society is collaborating with JSTOR to digitize, preserve and extend access to Journal of the Torrey Botanical Society.

The historical and extant vascular flora of Pelham Bay Park, Bronx County, New York 1947–1998¹

Robert DeCandido^{2,3}

Department of Biology, The City College of the City University of New York, New York, NY 10031

Eric E. Lamont

Honorary Research Associate, Institute of Sytematic Botany, The New York Botanical Garden, Bronx, NY 10458

DECANDIDO, R. (Department of Biology, The City College of the City University of New York, New York, NY 10031) AND E. E. LAMONT (Institute of Sytematic Botany, The New York Botanical Garden, Bronx, NY 10458). The historical and extant vascular flora of Pelham Bay Park, Bronx County, New York 1947-1998. J. Torrey Bot. Society 131: 368-386. 2004.-This vascular flora of Pelham Bay Park, Bronx County, New York is based on collections made by H.E. Ahles in 1946-47 and by the authors from March of 1994 through October of 1998. Altogether, 123 families, 471 genera and 956 species are reported here. Of these 956 species, 583 (61.0%) are native, 321 (33.6%) non-native and 52 (5.4%) either planted or introduced and not spreading to any degree. The largest families were the Asteraceae (120 species) and the Poaceae (106 species), and the largest genera were Carex, Polygonum and Aster. The park's current flora is analyzed by habitat and four plant communities are described and discussed. Most of the extant plant species diversity occurs in two habitats: 255 species were found primarily in the woodland community, and 288 species usually occurred in the grassland/ meadow community. According to current criteria in New York, 27 native species collected in 1994-98 are considered uncommon, rare, threatened or endangered in the state. The most pernicious non-native species that occur in PBPK are: Acer platanoides, Alliaria petiolata, Ampelopsis brevipedunculata, and Rhamnus frangula. The future of the remaining natural areas of Pelham Bay Park will depend upon the degree biologists make people aware of the significant plant species diversity remaining in New York City's second largest park.

Key words: Flora, urban, Pelham Bay Park, New York City, plant communities, H. E. Ahles.

Pelham Bay Park (PBPK), Bronx County, New York is located along the southwestern shore of the Long Island Sound (40° 52' 30" N, 73° 47' 30" W), north of Manhattan and south of New Rochelle, Westchester County. At 1119.4 hectares, it is the second largest park in New York City, and the largest under the jurisdiction of the New York City Department of Parks and Recreation. The park was established in 1884 through the efforts of the New Parks Movement (Schnitz and Loeb 1984). Since the 1930's, numerous development projects have transformed much of the park (see Monachino 1958, Kaltman 1968). Fortunately, there still remain several natural areas representing a diversity of habitats of the region.

PBPK is mostly isolated from the surrounding communities by several large water bodies and roadways, including the Long Island Sound, Hutchinson River, and the New England Thruway (Figure 1). The park is heavily used by the public from June through August, but, except for areas immediately adjacent to the water, the natural areas are not as frequently visited. The only previous extensive plant survey of PBPK was conducted in 1946-47 by Harry E. Ahles. (For a brief biography of H. E. Ahles, see Tippo 1982.) In his two-year field study of PBPK, Ahles collected 1531 specimens, eventually donating these to the New York State Museum, but his research in PBPK has only been analyzed recently (DeCandido 2001). Ahles never published any papers based on collections he made at PBPK, and published only one paper that incorporated specimens from the Bronx (see Ahles 1951).

Landform in PBPK was largely determined by several glacial flows during the Pleistocene Period. Evidence for these glaciers in the park is in the form of roche moutonees, rock erratics, striae and groove markings. The underlying ge-

¹Funding for this research came from the City of New York Department of Parks and Recreation and the Bobolink Foundation.

² This paper is dedicated to the late Jess Hanks of the City College of New York (CUNY), since he encouraged everyone to take an active interest in the local flora. Howard Becker of the Bronx accompanied the senior author on plant collecting forays from 1994– 1998. We thank him for his indefatiguable effort and friendship. We also want to thank Andrew M. Greller, Professor Emeritus of Botany, Queens College (CUNY) for his encouragement and thoughtful suggestions.

³ Present Address: International Bird Research Center, Eilat, Israel; E-mail: rdcny@earthlink.net

Received for publication March 1, 2002, and in revised form February 11, 2004.



FIG. 1. Map of Pelham Bay Park, Bronx County, New York City showing the different habitats of the park.

ology of PBPK is primarily metamorphic in origin and includes felsic gneisses, sillimanite schists and amphibolites, with extensive veins of quartz (Schubert 1968, Leveson and Seyfert 1969). These rocks are classified as part of the Hutchinson River Group that is correlative with the Hartland Formation of western Connecticut and southeastern New York (Merguerian and Sanders 1993).

Pre-historical evidence of Native American

land use exists in the form of recovered Indian artifacts as well as oyster and clam middens, remnants of which can still be found today (Bolton 1922, Kaeser 1970). Recovered Zea mays pollen indicates that Native Americans were utilizing PBPK at least by 1175 A.D., \pm 100 years (Loeb 1998a). From 1888–1934, much of the park remained an open canopy woodland and grassland, since trees were selectively removed by the City of New York Department of Parks

and Recreation from Hunter Island and other areas of PBPK (Loeb 1998b). Other more grandscale projects, such as those undertaken by the WPA in the 1930s, changed water flow patterns through the larger salt marshes and even some of the woodlands of PBPK. From 1934-1948, the New York City Department of Parks under the direction of Robert Moses made significant changes to the park by filling in the original Pelham Bay for use as a parking lot, creating Orchard Beach (Caro 1974). Beginning in 1964, approximately 105 acres in the southern portion of the park were taken over by the Department of Sanitation and converted to a landfill (Kaltman 1968). This site was eventually closed in the 1970s, but not before it had become the highest point in the eastern Bronx (Pons 1987). During the last fifty years, one major roadway (the New England Thruway) has been built through PBPK, while another (the Hutchinson River Parkway) has been expanded. Today, the more serious forms of disturbance continue to be anthropogenic in nature, including intentionally set fires, abandonment of stolen cars, offtrail dirt biking and jet-skiing in the water bodies adjacent to the park. In the late 1990s, it was estimated that 28% of the PBPK was mixed deciduous woods, 24% marine, 7% salt marsh, 6% salt flats, 3% meadows and 2% shrub or scrub land (Wells 1998). The remaining 33% of the park has been classified as developed, including golf courses, parking lots, buildings, a New York City Police Department Pistol Range and the man-made Orchard Beach (Wells 1998).

Since no comprehensive flora of PBPK had ever been published, and no systematic plant collections made in fifty years, the authors initiated the present study. Our objectives were to study the plants that H.E. Ahles collected in 1946-1947 and incorporate them into the present research; collect and identify extant plant species of Pelham Bay Park; determine the relative status of each species collected in 1994-1998 (rare, uncommon, common); and describe several of the more distinctive habitats in the park. By compiling these data, we hope to make it possible for future researchers to assess longterm changes in plant species diversity in PBPK and facilitate comparisons with other parks in the region.

Methods. Pelham Bay Park was sampled a minimum of two times per week, from April through August, and at least once per week in February and March, as well as September and October, from 1994 to 1998 (inclusive) for a total of at least 200 field days over five years by the senior author. The park was walked for about five hours each visit, in such a way that all areas of the park were sampled at least every other week. Voucher specimens of each taxon with collection notes were deposited at the New York State Museum in Albany in 1999. These voucher specimens have since been transferred to the Brooklyn Botanic Garden.

The plant specimens of PBPK that H.E. Ahles collected in 1946-1947, and now held at the New York State Museum at Albany, were examined along with his field notes for those two years (Ahles 1947, 1948). Ahles spent a total of 33 days of the 1946 field season making his collections (from 10 March to 6 October) in PBPK. During 1947, Ahles did not record the specific date a species was collected, so it is not known how many total days he spent in the field that year. If the nomenclature by which a species was known and listed by Ahles in 1946-1947 has been changed, the authors made the appropriate updates to those adopted by Mitchell and Tucker (1997) and Mitchell (2000). In one instance a paper by Lamont (1994) was consulted for information regarding a species collected by Ahles in 1946.

The species checklist of PBPK (Appendix A) presents an inventory of the vascular plants found in PBPK by H. E. Ahles in 1946-47 or for at least one season in the years from 1994-1998 with one exception (see DeCandido 1991). Appendix A includes native species, naturalized alien (non-native) species, species that have escaped from cultivation and have become established in the park, and species planted by the New York City Department of Parks and Recreation. Alien species are those not native to the northeastern United States. These are designated by a leading asterisk (*). All planted or escaped species (those not reproducing to any significant degree) are enclosed by brackets []. Vascular plants are preceded by a plus (+) sign if they were only collected as part of the 1994-98 survey, and not by Ahles in 1946-47. Vascular plants collected only by Ahles in 1946-47, but not collected or observed by the authors in 1994–1998 are listed in Appendix A by a leading minus (-) sign. These species are considered to be extirpated from the park. Vascular plants collected both by Ahles and during 1994–1998 have no special leading designation unless they are not native to the area.

Identification of specimens was made using

	Pteridophytes		Conifers		Dicots		Monocots		Total		Total
	1947	1998	1947	1998	1947	1998	1947	1998	1947	1998	1947+1998
Native Species	15	12	1	2	327	326	139	102	481	442	582
Non-native Species	0	0	2	1	154	240	31	59	187	300	321
Planted Species	0	0	1	7	2	43	0	0	3	50	52
Total Species	15	12	4	10	483	609	170	161	672	792	956
Genera	11	9	2	5	268	345	73	72	354	431	471
Families	7	6	2	5	85	96	14	10	108	117	123

Table 1. Comparison between plant species diversity of Pelham Bay Park found in 1946–1947 by H. E. Ahles and the 1994–1998 flora.

Gleason and Cronquist (1991). Nomenclature followed Mitchell and Tucker (1997) the minor revisions in Mitchell (2000). For the data analysis, subspecies and varieties were treated as full species. Clemants (1990), the New York Flora Association (1990) and Clemants (1999) were the primary references used to verify the historical occurrence(s) of particular species in the Bronx and New York City.

In Appendix A, following the scientific name of all native and non-native species is the current status in PBPK as follows. Rare: if an herbaceous species then it must only have been present at three different sites or fewer, with no more than 25 individuals present at any one site; or, present at one site with no more than 50 total plants. If a tree or shrub, it must only have been present at six or fewer locations, with no site having more than five individuals; or present at one site with no more than 10 individuals found at that location. Uncommon: if an herbaceous species then it must have been present at four to six sites with no more than 50 individuals at any one of those sites; or present at one locality only, with no more than 100 individuals found at that site. If a tree or shrub, the species must have been present at 7 to 10 sites with no stand greater than five individuals; or, present at one site only with 15 or fewer individuals. A species was listed as extirpated if it was found during one or more field seasons, but not seen subsequently, despite several attempts at relocating plants at the site or in other likely areas of PBPK. Species that were abundant or common are not designated with any symbol on this list. Species that are indicated as planted have not been evaluated regarding their status in the park.

Results. Appendix A, the vascular flora of PBPK, lists 123 families, 471 genera and 956 species with the H.E. Ahles flora of 1947–1948 combined with the 1994-1998 flora. Of these, 583 (61.0%) were native, 321 (33.6%) were non-native and 52 (5.4%) were planted and not spreading to any degree (Table 1). One species, Hibiscus laevis, originally collected in 1991 (DeCandido 1991) and since extirpated, was new to New York State (Mitchell and Tucker 1997, Mitchell 2000). In addition, PBPK is one of only two sites in New York State for Lactuca floridana. New records for the park (as compared to the 1946-1947 unpublished list compiled by Ahles) number 284 species. These included 102 native species that Ahles probably overlooked, 135 non-native species, and 47 species that have been planted and are not reproducing in the park. By comparison, 142 native and 25 non-native species were collected by Ahles and not found during the course of this study. Most likely, these 167 species have been extirpated from PBPK in the last 50 years (De-Candido 2004). A comparison of numbers of species from PBPK collected by Ahles (1946-1947) and the current authors during 1994-1998 is presented in Table 1. According to Table 2, collections made in Bronx County since the late

Table 2. Statistical summary of the plant species diversity found in Pelham Bay Park in 1946–1947 and 1994–1998, as well as Bronx County (1850–2000) and New York City (1850–2000).

Locale		Number of Species							
	Families	Native	Non-Native	Planted	Total				
PBPK 1946-1947	108	483 (71.8%)	187 (27.8%)	3 (0.4%)	672				
PBPK 1994-1998	117	442 (55.8%)	300 (37.9%)	50 (6.3%)	792				
Bronx County	146	988 (65.3%)	417 (27.7%)	106 (7.0%)	1511				
New York City	161	1357 (62.3%)	610 (28.0%)	210 (9.6%)	2177				

19th century and kept at the State Museum at Albany (NYFA 1990) show that there have been at least 146 families of plants present in the boro, with 1511 total species. Of this species total, 988 are native (65.3%), 417 non-native (27.7%) and 106 were planted (7.0%). For all of New York City (see DeCandido et al. 2004), 2177 species in 161 families have been found. Of these, 1357 have been native species (62.3%), 610 have been non-native species (28.0%), and 210 species were planted (9.6%).

When the Ahles' flora and the present flora are combined, the families with the greatest species richness at PBPK are the Asteraceae (120 species) and the Poaceae (106 species), and the largest genera are Carex (35 spp.), Aster (18) Polygonum (18) and Panicum (15). The families in the flora (collections from 1994–98) with the greatest species richness are the Asteraceae with 45 genera and 101 species, and the Poaceae, with 48 genera and 88 species. Together, they comprise 21.8% of all genera and 23.9% of all species collected from 1994-98. Other large families are the Fabaceae (21 gen., 35 spp.), Rosaceae (15 gen., 32 spp.), Brassicaceae (18 gen., 29 spp.), Cyperaceae (5 gen., 29 spp.), Liliaceae (18 gen., 23 spp.) and the Caryophyllacaeae (11 gen., 20 spp.). The largest genera are: Carex, Polygonum (each with 16 spp.), Aster (15 spp.), Quercus (10 spp.), Eupatorium, Solidago (each with 8 spp.), and Acer, Panicum (each with 7 spp.). When extant flora was analyzed by habitat, (see Reschke 1990), 30 species were found primarily in the maritime plant community that was periodically inundated with brackish or marine water. By comparison, 255 species occurred mostly in the woodland community including gaps within the forest; 288 species usually occurred in the grassland/meadow community; 139 species occurred in sites that have been disturbed in the recent past, such as roadsides, parking lots and areas adjacent to buildings and other structures. A further 30 species were primarily confined to freshwater riparian areas distributed throughout the park.

During the course of the 1994–1998 survey, 53 of the 326 (16.3 %) native herbaceous species (exclusive of planted species) were judged to be rare at PBPK, while 27 native herbaceous species (8.3%) were considered uncommon. For the woody species, 15 of the 116 native species (12.9%) were classified as rare, while 5 (4.8%) were considered uncommon. In all, of the 742 extant native and non-native species of PBPK, 142 (19.1%) have been judged to be rare or uncommon in the park. Another 21 species (5 native; 16 non-native) became extirpated during five years of field work in PBPK. Overall, 26 native species (5.9% of the native flora) of PBPK collected in 1994–98 are considered endangered, threatened or rare in New York State (Mitchell 2000, Young and Weldy 2003). These include 22 herbaceous and four woody species.

As compared to a recent list of the 26 most serious invasive plants in the state (New York State Ad Hoc Invasive Plant Group 2001), PBPK currently has 17 of the species on the list. At least 16 of these have established themselves widely in natural areas of the park, or have formed monodominant stands in disturbed areas. These are: Acer platanoides, Alliaria petiolata, Ampelopsis brevipedunculata, Berberis thunbergii, Celastrus orbiculata, Centaurea maculosa, Cynanchum louiseae, Elaeagnus umbellata, Lonicera japonica, Lonicera morrowii, Lonicera x bella, Lythrum salicaria, Phragmites australis, Rhamnus cathartica, Rhamnus frangula, Robinia pseudoacacia, and Rosa multiflora. In addition, three other species not on the state list: Populus alba, Viburnum dilatatum and Viburnum sieboldii (for the last of these, see Kunstler 1993), had also established themselves in some of the natural areas of PBPK. These 19 species posed the greatest threat to natural communities in PBPK.

Discussion. The vascular flora of PBPK is composed of 956 species in 471 genera and 123 families. Compared to an unpublished flora of PBPK by H.E. Ahles in 1946-47, there were more total species, genera and families collected in 1994-1998. However, there were fewer native species collected during 1994-1998 than in the Ahles' study (Table 1). In the intervening years, the proportion of native plant species declined from 71.8% in 1946-47 to 55.8% in this study. As the absolute and proportional number of native species declined, the number of non-native species increased from the 187 collected by Ahles, to 300 collected in 1994-98 (Table 1). Overall, according to Table 2, 44.6% of all the native plant species ever collected in Bronx County were collected in 1994-1998 in PBPK. Also, 72.1% of all non-native species ever collected in Bronx County were present in PBPK in 1994-1998. Similarly, almost half (49.1%) of all the non-native species ever collected in New York City were collected in PBPK as part of this study.

The vegetation of Pelham Bay Park from

1994–1998 can be classified into five general plant communities based upon descriptions developed by Reschke (1990): Maritime including intertidal marine, gravelly shores, beach and salt marsh; forest including lowland and upland woods; freshwater riparian areas; meadows/ grasslands; and wasteland/disturbed sites. Each of these habitats (except for wasteland/disturbed) contains more non-native than native species compared with the same habitat in 1946–1947 (DeCandido 2004). Four of these habitats are discussed below. By far, most of the species in this study came from two communities: upland forest and grasslands/meadows.

MARITIME PLANT COMMUNITY. Salt marshes flourish where the Long Island Sound and the Hutchinson River estuary border PBPK. The vegetation of the low salt marsh consists primarily of Spartina alterniflora, while the high marsh is dominated by Spartina patens, Distichlis spicata and Juncus gerardii. In this marine plant community, four herbaceous species that are disappearing from many other salt marshes in southern New York State can be found: Aster subulatus, Aster tenuifolius, Limonium carolinianum and Suaeda linearis. Salt pannes are interspersed throughout the salt marsh. In these poorly drained areas, especially in the high marsh, species such as Salicornia europaea, S. perennis, Pluchea odorata, Spergularia salina, and S. rubra can be found. Although gravelly shores are fairly common at PBPK, there was no extensive beach plant community typical of the nearby north shore of Long Island as described by Lamont and Stalter (1991). Also, no primary dune system exists at PBPK, such as found in parks on the south shore of Long Island that border the Atlantic Ocean at the Fire Island National Seashore (see Stalter et al. 1986).

Moving landward from the high salt marsh, one encountered a transition zone before the upland forest begins. This area is largely dominated by stands of *Tripsacum dactyloides*. Here also can be found *Hibiscus moscheutos*, *Phragmites australis*, *Polygonum ramosissimum* and *Teucrium canadense*. In other places, especially where the terrain is slightly elevated or the bedrock was exposed, a salt shrub and grass community is found. Species of this drier zone include *Baccharis halimifolia*, *Iva frutescens* ssp. *oraria* and *Myrica pensylvanica*. Typical herbaceous species include *Panicum virgatum*, *Euthamia graminifolia*, *Solidago sempervirens* and rarely, *Spartina pectinata*. In more rocky and slightly elevated areas, species that can be found are Amelanchier stolonifera, Aronia x prunifolia, Lechea mucronata, Parthenocissus quinquefolia, Quercus stellata, and Silene caroliniana var. pensylvanica.

WOODLAND PLANT COMMUNITY. The upland forest community occurs on well-drained acidic soils beginning approximately three meters above sea level. The amount of land classified as forest in one section of the park (Hunter Island) has increased by more than 2.5 times from 1888–1984 (Loeb 1998a). The upland woodland community in PBPK most closely resembles an Appalachian oak-hickory forest of the northeastern United States also described from other parks in New York City (Lefkowitz and Greller 1973, Loeb 1986). Most trees in the canopy are between 15 and 25 meters high though certain individuals (such as specimens of Liriodendron tulipifera) are estimated to be up to 45 meters in height. The dominant trees in the two largest patches of mature forest in PBPK (Hunter Island and the Central Woodlands) are Quercus alba, Q. rubra and Q. velutina. Mixed with the oaks but less frequently encountered are Betula lenta, Carya glabra, C. tomentosa and Fraxinus americana. Occasional stems of Castanea dentata still emerge from stumps of dead trees. In the sub-canopy, species such as Cornus florida and Sassafras albidum predominate, while Amelanchier arborea and Hammamelis virginiana occur to a lesser extent. Common low shrubs include Cornus sericea, Gaylussacia baccata, Rubus allegheniensis, Vaccinium pallidum, and Viburnum acerifolium. The ground layer herbaceous flora is diverse and includes such species as Alliaria petiolata, Aster divaricatus, Circaea lutetiana ssp. canadensis, Geranium maculata, Helianthus divaricatus, Maianthemum canadensis, Monotropa uniflora, Pedicularis canadensis, Solidago bicolor, S. caesia and S. canadensis var. scabra.

In richer and moister soils of the forest, species such as *Betula alleghaniensis*, *Carpinus caroliniana* ssp. virginiana, *Cornus alternifolia*, *Liquidamber styraciflua*, *Platanus occidentalis*, *Quercus bicolor*, and *Ostrya virginiana* were collected. Beneath this canopy layer, certain shrub species are more abundant, such as *Corylus americana*, *Ilex verticillata* and *Lindera benzoin*. Herbaceous species include Agrimonia gryposepala, Arisaema triphyllum, Cardamine cocatenata, Impatiens capensis, Osmunda cin-

namomea, Phyrma leptostachya, Piptochaetium avenaceum, and Thalictrum pubescens.

A unique aspect of the upland forest for New York City Parks is that at PBPK this community extends out in hillocks into the salt marsh in some areas. These hillocks can also occasionally be found as lone islands surrounded by the salt marsh. Typical understory species in this habitat include: Andropogon gerardii, Aralia nudicaulis, Aster macrophyllus, Aster paternus, Aureolaria flava, Chimaphila maculata, Gaylussacia baccata, Helianthus divaricatus, Lespedeza hirta, L. virginica, Lysimachia quadrifolia, Pteridium aquilinum var. latiusculum, Smilax glauca, Smilacina racemosa, Sorghastrum nutans and Tripsacum dactyloides.

Many herbaceous species that are rare and uncommon within PBPK are confined to forest edges and isolated small gaps within the forest. In the latter case, the canopy gaps are often produced and maintained because of elevated, rocky areas of the forest floor overlain with thin soils. In addition, gaps are formed at PBPK when freshwater collected to form small pools within the forest, above which few trees have grown. Since these areas have been too difficult to maintain by mowing or artificial plantings, isolated havens exist for several species otherwise rare or uncommon in the park. These taxa include: Agastache nepetoides, Ceanothus americana, Desmodium canadense, Dicentra cucullaria, Diervilla lonicera, Eupatorium sessilifolium, Mimulus alatus, Mitchella repens, Paronychia canadensis, Polypodium virginianum, Pyrola americana and Viola pubescens.

GRASSLAND/MEADOW PLANT COMMUNITY. From 1885-1984, land classified as meadow declined by 85%, from 69.7 hectares to 10.5 hectares (Sisinni and Anderson 1993). Compared to habitat descriptions provided by Ahles (Ahles 1947, 1948), there were many more grasslands, meadows and fields in 1946-47 than in 1994-1998 (DeCandido 2001, DeCandido 2004). In the last fifty years, many open areas have become dominated by shrubs and young trees. The only "natural" meadow (the topsoil was removed for fill in the 1930s) with a high diversity of native herbaceous species in PBPK is composed primarily of Tripsacum dactyloides. Other important species of this meadow are Lythrum salicaria, Pycnanthemum tenuifolium, P. virginianum, Solidago speciosa, Viburnum dentatum var. lucidum and V. dentatum var. venosum. Elsewhere, fields and shrub lands were often dominated by non-native species such as Ampelopsis brevipedunculata, Artemisia vulgaris, Bromus spp., Centaurea spp., Cynanchum louiseae, Linaria vulgaris, Lonicera japonica, Prunus spp., Trifolium pratense, and Vicia spp.

WASTELAND/DISTURBED HABITAT. Plants inhabiting frequently disturbed or artificially maintained areas include species that are often nonnative in origin. Such species occur primarily in and around buildings, parking lots, golf courses, highways, railways and the abandoned landfill. Typical species of these habitats include Hieracium spp., Mazus pumilus, Poa pratensis, Taraxacum officinale, Veronica spp., as well as many of the non-native species that may also invade successional old fields and shrub lands. If these disturbed sites were left alone over time. woodlands with a limited number of plant species could develop. These habitats are then frequently dominated by woody species such as Acer platanoides, Acer pseudoplatanus and Populus alba.

RARE PLANTS AND EXTIRPATED SPECIES. Twenty-seven species found during 1994–98 are considered uncommon, rare, threatened or endangered in New York State (Mitchell 2000, Young and Weldy 2003). Eight of these species were at or near the northern limits of their range at PBPK. These were: *Cyperus echinatus, Diospyros virginiana, Eupatorium hyssopifolium* var. *laciniatum, Eupatorium serotinum, Lactuca floridana, Lechea racemulosa, Ptelea trifoliata* and *Viburnum dentatum* var. *venosum*.

Other New York State listed species were indicative of habitats (e.g., salt marshes) that have a limited distribution in the state, or were found in a habitat that has declined in New York City (grasslands). These were: Asclepias purpurascens, Aster subulatus, Aster tenuifolius, Cenchrus tribuloides, Cuscuta pentagona, Iris prismatia, Juncus brachycarpus, Oenothera laciniata, Oenothera parviflora var. oakesiana, Paspalum setaceum var. muhlenbergii, Suaeda linearis, and Tripsacum dactyloides. Finally there were seven New York State species found in PBPK for which no discernible cause of decline could be determined. These were: Agastache nepetoides, Juglans cinerea, Mimulus alatus, Polygonum hydropiperoides var. opelousanum, Ranunculus hispidus var. nitidus, Silene caroliniana var. pensylvanica and Veronicastrum virginicum.

Appendix A also lists 17 plant species collected by H.E. Ahles in 1946–47 that have special rarity designations in New York State, and have since become extirpated in PBPK. These are: Carex bushii, Carex buxbaumii, Carex polymorpha, Carex seorsa, Crotolaria sagittalis, Cyperus lupulinus, Eleocharis halophila, Juncus scirpoides, Lespedeza violacea, Oxalis violacea, Panicum scabriusculum, Plantago maritima ssp. juncoides, Polygonum erectum, Prunus pumila var. depressa, Salicornia bigelovii, Solidago sempervirens var. mexicana and Spiranthes vernalis. With the exception of P. pumila var. depressa (a small shrub), each of these extirpated plants is an herbaceous species.

There were also two important discoveries of plant species not known from New York State, or believed to have been extirpated in the state. One of these (*Hibiscus laevis*) was first seen in flower in July of 1990 (DeCandido 1991). It was subsequently extirpated due to repeated mowing of the area in the summer of 1992. The second species, *Lactuca floridana*, was found in the same location it was originally discovered in 1954 (see Monachino 1955). This species was previously thought to have been extirpated in New York State.

During the course of this five-year study, a total of 21 plant species became extirpated (5 native; 16 non-native) from PBPK. The five native species were: Aster patens, Desmodium cuspidatum, Hibiscus laevis, Oenothera laciniata and Spiranthes cernua. Each of these five species had been reduced to a small population of less than three individuals when initially discovered. It was difficult to determine whether proximate or long-term factors were the decisive causes of particular native plant species extirpations. Overall, 100 of 442 (22.6%) native species identified in this study were considered rare or uncommon at PBPK (Appendix A). The majority of the native species at greatest risk of extirpation were herbaceous plants. Two factors seemed to be at work in the decline of herbaceous species: successional ecological forces and the loss of open habitat such as meadows/ grasslands to development (DeCandido 2004).

NON-NATIVE SPECIES. Compared to the 1946– 1947 study of the flora of PBPK, there were 135 more non-native species collected in the park in 1994–98. Since the earlier study, significant disturbance events have affected PBPK (see Monachino 1958, Kaltman 1968). These included the placement of a sanitary landfill in the southern region of the park, the expansion of highways in the park and other, small-scale disturbance events such as construction of buildings or even natural area restoration efforts. In the woodlands, the most pernicious of these non-native species are: Acer platanoides, Alliaria petiolata, Celastrus orbiculatus, Lonicera japonica, Lonicera morrowii, and Rhamnus frangula. The most widespread alien species in open habitats are Ampelopsis brevipedunculata, Artemisia vulgaris, Lythrum salicaria, and Populus alba.

The flora of Pelham Bay Park is a rich assemblage of native and non-native species in one of the world's largest cities. Though much of the plant species diversity found by H. E. Ahles in 1946-47 still remains, significant changes have occurred in the last half-century. Establishing a park does not insure the preservation of its native species diversity, and may not even protect its natural areas from development. As we enter a new millennium with open space at a premium in New York City, parks represent low-cost land, where developers and city officials frequently attempt to build recreational facilities, expand highways or place water treatment facilities. At Pelham Bay Park from 1990-2001, there have been proposals for placing an ice-skating rink, bicycle paths, tennis courts, and baseball fields in natural areas. In the 21st century, the future of the natural areas of PBPK depends on those people who believe that biologically significant habitats for plants, wildlife (and humans) must continue to exist in New York City. The degree to which biologists and educators create opportunities for people to appropriately enjoy the remaining natural areas will determine the level of popular support, and in turn, the future of natural areas in PBPK and New York City.

Literature Cited

- AHLES, H. E. 1947. Letter to Dr. H. D. House at the New York State Museum. 19 March 1947. New York State Museum at Albany. Albany, NY.
- AHLES, H. E. 1948. Letter to Dr. H. D. House at the New York State Museum. 18 March 1948. New York State Museum at Albany. Albany, NY.
- AHLES, H. E. 1951. Interesting weeds in New York City. Bull. Torrey Bot. Club 78: 273–274.
- BOLTON, R. P. 1922. Indian paths in the great metropolis. Indian Notes and Monographs Misc. 23. Two Volumes. Museum of the American Indian, New York, NY.
- CARO, R. A. 1974. The Power Broker. Robert Moses and the fall of New York. Alfred A. Knopf, New York, NY.
- CLEMANTS, S. E. 1990. New York metropolitan flora. New York City checklist. The Brooklyn Botanic Garden. Brooklyn, New York, NY. 44 p.
- CLEMANTS, S. E. [ed.]. 1999. Woody plant workbook.

Brooklyn Botanic Garden. Brooklyn, New York, NY. 307 p.

- DECANDIDO, R. 1991. *Hibiscus militaris* L. (Malvaceae) new to New York. Bull. Torrey Bot. Club 118: 329.
- DECANDIDO, R. 2001. Recent changes in plant species diversity in Pelham Bay Park, Bronx County, New York City, 1947–1998. PhD thesis. The City University of New York. New York, NY.
- DECANDIDO, R. 2004. Recent changes in plant species diversity in urban Pelham Bay Park, 1947–1998. Biological Conservation. 120: 129–136.
- DECANDIDO, R., A. A. MUIR, AND M. B. GARGIULLO. 2004. A first approximation of the historical and extant vascular flora of New York City: Implications for native plant species conservation. J. Torrey Bot. Soc. 131: 243–251.
- GLEASON, H. A. AND A. CRONQUIST. 1991. Manual of vascular plants of northeastern United States and adjacent Canada. The New York Botanical Garden, Bronx, New York, NY.
- KAESER, E. J. 1970. The archery range site ossuary, Pelham Bay Park, Bronx, New York. Pennsylvania Archaeologist 40: 9–34.
- KALTMAN, H. 1968. Field Trip Report: July 14. Pelham Bay Park. Bull. Torrey Bot. Club 95: 660.
- KUNTSLER, D. S. 1993. Siebold's viburnum, Viburnum sieboldii Miquel, new non-native species record for New York. Bull. Torrey Bot. Club 120: 188–190.
- LAMONT, E. E. 1994. Rediscovery of *Solidago sempervirens* var. *mexicana* (Asteraceae) in New York, with notes on its taxonomic history. Bull. Torrey Bot. Club 121: 292–294.
- LAMONT, E. E. AND R. STALTER. 1991. The vascular flora of Orient Beach State Park, Long Island, New York. Bull. Torrey Bot. Club 118: 459–468.
- LEFKOWITZ, A. AND A. M. GRELLER. 1973. The distribution of tree species on the uplands of Cunningham Park, Queens County, New York. Bull. Torrey Bot. Club 100: 313–318.
- LEVESON, D. J. AND C. K. SEYFERT. 1969 The role of metasomatism in the formation of layering in amphibolites of Twin Island, Pelham Bay Park, the Bronx, New York. p. 379–399. In L. H. Larsen, M. Prinz, and V. Manson [eds.], Igneous and Metamorphic Geology. Geological Society of America Memoir 115. New York, NY.
- LOEB, R. E. 1986. Plant communities of Inwood Hill Park, New York County, New York. Bull. Torrey Bot. Club 113: 46–52.
- LOEB, R. E. 1998a. Evidence of prehistoric corn (Zea mays) and hickory (Carya spp.) planting in New York City: Vegetation history of Hunter Island, Bronx County, New York. Jour. of the Torrey Bot. Soc. 125: 74–86.
- LOEB, R. E. 1998b. Urban ecosystem management and change during the past millennium: a case study from New York City. Urban Ecosystems 2: 17–26.

- MERGUERIAN, C. AND J. E. SANDERS. 1991. Geology of Manhattan and the Bronx. Notes for field trip 16. New York Academy of Sciences, Publication 3, New York, NY.
- MERGUERIAN, C. AND J. E. SANDERS. 1993. Cameron's line and the Bronx parks. Notes for field trip 26. New York Academy of Sciences, Publication 16, New York, NY.
- MITCHELL, R. S. 2000. Database and revised checklist of New York state plants. Part 1): A Database of New York State Plants. In *Microsoft Access*. 3779 entries. CD-ROM format. New York State Museum. Albany, NY.
- MITCHELL, R. S. AND G. C. TUCKER. 1997. Revised checklist of New York plants. Bull. No. 490, New York State Museum, Albany, NY.
- MONACHINO, J. 1955. Field Trip Report: October 10. Pelham Bay Park, NY. Bull. Torrey Bot. Club 82: 64.
- MONACHINO, J. 1958. Field Trip Report: October 20. Pelham Bay Park, NY. Bull. Torrey Bot. Club 85: 73–74.
- NEW YORK FLORA ASSOCIATION. 1990. Preliminary vouchered atlas of the New York State Flora. New York Flora Association of the New York State Museum Institute. Albany, NY. (Xerographic) 498 p.
- NEW YORK STATE AD HOC INVASIVE PLANT GROUP. 2001. Top twenty list of the most serious invasive plants in New York State. The Nature Conservancy, Troy, NY.
- Pons, L. [ed.]. 1987. Pelham Bay Park: Creating the sanctuaries. City of New York Department of Parks and Recreation, Van Cortlandt and Pelham Bay Park Administrator's Office, Bronx, NY.
- RESCHKE, C. 1990. Ecological communities of New York State. New York Natural Heritage Program, New York State Department of Environmental Conservation, Latham, NY.
- SCHNITZ, A. AND R. E. LOEB. 1984. "More public parks!" The first New York environmental movement. Bronx County Historical Jour. XIX: 51–66.
- SCHUBERT, C. J. 1968. The geology of New York City and environs. The Natural History Press, Garden City, New Jersey.
- SISINNI, S. M. AND M. O. ANDERSON. 1993. Methods and results of natural resource assessments in New York City, New York. Landscape and Urban Planning 25: 95–114.
- STALTER, R., E. E. LAMONT, AND J. NORTHRUP. 1986. Vegetation of Fire Island, New York. Bull. Torrey Bot. Club 113: 298–306.
- TIPPO, O. 1982. Harry E. Ahles, 1924–1981. Bull. Torrey Bot. Club 109: 84–86.
- WELLS, J. V. 1998. Important bird areas in New York State. National Audubon Society, Albany, NY.
- YOUNG, S. M AND T. W. WELDY. 2003. New York rare plant status list. New York Natural Heritage Program. Albany, New York. 82 p.

Appendix A

The following is a checklist of the vascular flora of Pelham Bay Park (PBPK), Bronx County, New York State. Nomenclature follows that of Mitchell and Tucker (1997) with minor revisions by Mitchell (2000). The following symbols have been used throughout the list: an asterisk (*) indicates a species non-native (alien) to northeastern United States. Brackets [] surrounding the scientific name indicate a species planted in the park that is not reproducing to any great degree in any natural area of PBPK. Species preceded by a plus (+) sign were collected only in 1994–1998. Species preceded by a minus (-) sign were collected only by H. E. Ahles in 1946–47. Vascular plants collected in both 1946–47 and 1994–1998 are preceded by no symbol unless the species is non-native (alien).

Immediately following the scientific name, certain plants collected in 1994–98 have been classified as rare or uncommon in Pelham Bay Park (see the Methods section for definitions of these terms). If no mention is made regarding the status of a plant, it should be considered common in the appropriate habitat. Finally, if a species is considered uncommon, rare, threatened or endangered in New York State (NYS), its rarity designation is provided (see Young and Weldy 2003 for exact definitions of these terms for New York State plants).

DIVISION: EQUISETOPHYTA

Family SELAGINACEAE

–Selaginella apoda –Selaginella rupestris

Family **EQUISETACEAE** *Equisetum arvense*

DIVISION POLYPODIOPHYTA

Family **OPHIOGLOSSACEAE**

-Botrychium dissectum

Family OSMUNDACEAE

Osmunda cinnamomea Osmunda claytoniana—Rare in PBPK Osmunda regalis var. spectabilis

Family **DENNSTAEDTIACEAE**

–Dennstaedtia punctiloba Pteridium aquilinum var. latiusculum

Family THELYTPTERIDACEAE

+Phegopteris hexagonoptera Thelypteris noveboracensis Thelypteris palustris var. pubescens

Family **ASPLENIACEAE** +*Asplenium platyneuron*—Rare in PBPK

Family DRYOPTERIDACEAE

+Athyrium filix-femina var. asplenioides –Dryopteris intermedia Onoclea sensibilis –Polystichum acrostichoides

Family **POLYPODIACEAE** +*Polypodium virginianum*—Uncommon in PBPK

DIVISION: PINOPHYTA Family **GINKGOACEAE** [+*Ginkgo biloba*]

Family **TAXACEAE** [+*Taxus cuspidata*]

Family **PINACEAE** [+Picea abies] [+Pinus nigra] [+Pinus resinosa] [Pinus strobus] *Pinus sylvestris

Family **TAXODIACEAE** [+*Taxodium distichum*]

Family CUPRESSACEAE

+Juniperus communis var. depressa—Rare in PBPK [Juniperus virginiana]

DIVISION: MAGNOLIOPHYTA CLASS: MAGNOLIOPSIDA

Family MAGNOLIACEAE

Liriodendron tulipifera

Family LAURACEAE

Lindera benzoin Sassafras albidum

Family SAURURACEAE

Saururus cernuus

Family ARISTOLOCHIACEAE

*+Aristolochia clematitis—Uncommon in PBPK Asarum canadense—Rare in PBPK

Family RANUNCULACEAE

–Actaea pachypoda Anemone quinquefolia Anemone virginiana-Uncommon in PBPK Aquilegia canadensis [*+Aquilegia vulgaris] Caltha palustris Cimicifuga racemosa *+Clematis terniflora +Clematis virginiana Ranunculus arbortivus *Ranunculus acris *Ranunculus bulbosus Ranunculus hispidus var. nitidus-NYS Endangered **S1** Ranunculus recurvatus—Uncommon in PBPK *Ranunculus sceleratus—Uncommon in PBPK -Thalictrum aquilegifolium Thalictrum dioicum +Thalictrum pubescens +Thalictrum revolutum-Rare in PBPK -Thalictrum thalictroides

Family **BERBERIDACEAE**

*Berberis thunbergii Podophyllum peltatum

Family MENISPERMACEAE

Menispermum canadense

Family PAPAVERACEAE

*Chelidonium majus *+Macleaya cordata—Uncommon in PBPK Sanguinaria canadensis—Uncommon in PBPK

Family FUMARIACEAE

Dicentra cucullaria

Family PLATANACEAE

Platanus occidentalis

Family HAMAMELIDACEAE

Hamamelis virginiana Liquidambar styraciflua

Family ULMACEAE

Celtis occidentalis—Uncommon in PBPK Ulmus americana [+Ulmus minor] [+Ulmus pumila] Ulmus rubra [Zelkova serrata]

Family CANNABACEAE

[+Cannabis sativa]—no specimen collected *-Humulus japonicus *-Humulus lupulus

Family MORACEAE

*Broussonetia papyrifera *+Maclura pomifera—Uncommon in PBPK *Morus alba Morus rubra—Rare in PBPK

Family URTICACEAE

Boehmeria cylindrica -Laportea canadensis Pilea pumila *+Urtica dioica

Family JUGLANDACEAE

Carya cordiformis +Carya glabra Carya ovata Carya tomentosa +Juglans cinerea—Rare in PBPK; NYS Uncommon S4 Juglans nigra

Family MYRICACEAE

-Comptonia peregrina Myrica pensylvanica

Family FAGACEAE

Castanea dentata Fagus grandifolia [+Fagus sylvatica] Quercus alba Quercus bicolor—Uncommon in PBPK Quercus coccinea [+Quercus macrocarpa] Quercus montana Quercus palustris [+Quercus robur] Quercus rubra Quercus stellata Quercus velutina

Family BETULACEAE

*Alnus glutinosa +Alnus incana ssp. rugosa—Rare in PBPK Betula alleghaniensis—Rare in PBPK Betula lenta Betula populifolia Carpinus caroliniana ssp. virginiana Corylus americana [+Corylus avellana] Ostrya virginiana—Rare in PBPK

Family PHYTOLACCACEAE

Phytolacca americana

Family NYCTAGINACEAE

*Mirabilis nyctaginea

Family CACTACEAE

+Opuntia humifusa--Rare in PBPK

Family CHENOPODIACEAE

Atriplex patula *+Atriplex prostrata *+Bassia scoparia *Chenopodium album *Chenopodium ambrosioides *+Chenopodium glaucum—Uncommon in PBPK +Chenopodium simplex *+Cycloloma atriplicifolium—Rare in PBPK -Salicornia bigelovii–NYS Threatened S2-S3 Salicornia europaea Salicornia perennis *Salsola kali Suaeda calceoliformis Suaeda linearis—NYS Endangered S1 -Suaeda maritima

Family AMARANTHACEAE

*Amaranthus albus—Uncommon in PBPK *+Amaranthus blitum—Uncommon in PBPK *+Amaranthus cruentus *+Amaranthus hybridus *+Amaranthus retroflexus

Family PORTULACACEAE

Claytonia virginica *Portulaca oleracea

Family **MOLLUGINACEAE** **Mollugo verticillata*

Family CARYOPHYLLACEAE

*+Agrostemma githago—Rare in PBPK *Arenaria serpyllifolia *Cerastium fontanum *Cerastium glomeratum *+Cerastium semidecandrum *Dianthus armeria [+Lychnis coronaria] +Paronychia canadensis-Rare in PBPK *+Sagina japonica *Sagina procumbens *Saponaria officinalis *Scleranthus annuus Silene antirrhina---Uncommon in PBPK Silene caroliniana var. pensylvanica-NYS Vulnerable S3 *Silene latifolia Silene stellata *Silene vulgaris—Rare in PBPK *+Spergularia rubra *+Spergularia salina *Stellaria graminea -Stellaria longifolia *Stellaria media

Family POLYGONACEAE

*+Polygonum arenastrum Polygonum arifolium *Polygonum aviculare *+Polygonum bellardii *Polygonum cespitosum var. longisetum *-Polygonum convolvulus *+Polygonum cuspidatum -Polygonum erectum-NYS: Extirpated *Polygonum hydropiper Polygonum hydropiperoides *Polygonum lapathifolium Polygonum pensylvanicum *+Polygonum persicaria Polygonum punctatum var. confertiflorum-Uncommon in PBPK Polygonum ramosissimum-Rare in PBPK Polygonum sagittatum *Polygonum scandens Polygonum virginianum *Rumex acetosella *Rumex crispus *Rumex obtusifolius *Rumex patienta *Rumex salicifolius var. mexicanus

Family PLUMBAGINACEAE

Limonium carolinianum

Family CLUSIACEAE

-Hypericum boreale Hypericum gentianoides-Rare in PBPK +Hypericum mutilum *Hypericum perforatum Hypericum punctatum

Family TILIACEAE

Tilia americana [+Tilia cordata]

Family MALVACEAE

*Abutilon theophrasti [+Alcea rosea] *Althaea officinalis +Hibiscus laevis—Extirpated in PBPK Hibiscus moscheutos [+Hibiscus syriacus] *+Malva moschata—Extirpated in PBPK *+Malva neglecta

Family CISTACEAE

-Helianthemum canadense +Lechea mucronata—Uncommon in PBPK -Lechea pulchella +Lechea racemulosa—NYS Rare S3

Family VIOLACEAE

-Viola affinis -Viola conspersa -Viola cucullata *Viola odorata -Viola palmata [+Viola pedata] -Viola x porteriana Viola pubescens-Rare in PBPK Viola sororia

Family CUCURBITACEAE

*+Citrullus colocynthis +Echinocystis lobata—Rare in PBPK Sicyos angulatus

Family SALICACEAE

*Populus alba +Populus deltoides Populus grandidentata Populus tremuloides [+Salix alba] [+Salix babylonica] Salix discolor [+Salix fragilis] [+Salix lucida] +Salix nigra—Rare in PBPK +Salix sericea—Rare in PBPK

Family CAPPARIDACEAE

[+Cleome hassleriana]-Extirpated in PBPK

Family BRASSICACEAE

*Alliaria petiolata *-Allysum alyssoides *Arabidopsis thaliana *+Armoracia rusticana—Extirpated in PBPK *Barbarea vulgaris *–Brassica nigra *+Brassica rapa Cakile edentula *Capsella bursa-pastoris Cardamine bulbosa Cardamine concatenata Cardamine diphylla—Rare in PBPK *+Cardamine hirsuta -Cardamine x maxima +Cardamine parviflora var. arenicola Cardamine pensylvanica +Cardamine pratensis-Rare in PBPK *+Cardaria draba *+Diplotaxis muralis *+Diplotaxis tenuifolia *+Draba verna

*-Erysimum repandum *Hesperis matronalis *Lepidium campestre *+Lepidium ruderale Lepidium virginicum *Raphanus raphanistrum *Rorippa nasturtium-aquaticum *Rorippa palustris *Rorippa sylvestris *+Sinapis alba-Extirpated in PBPK *-Sisymbrium altissimum *Sisymbrium officinale *Thlaspi arvense-Rare in PBPK

Family CLETHRACEAE

Clethra alnifolia

Family ERICACEAE

+ Chimaphila maculata Gaylussacia baccata + Kalmia latifolia Lyonia ligustrina—Rare in PBPK Monotropa uniflora + Pyrola americana—Rare in PBPK [+Rhododendron maximum] Rhododendron periclymenoides Rhododendron viscosum—Rare in PBPK Vaccinium corymbosum Vaccinium pallidum

Family EBENACEAE

Diospyros virginiana-Rare in PBPK; NYS Threatened S2

Family **PRIMULACEAE**

*+Anagallis arvensis—Extirpated in PBPK +Lysimachia ciliata *Lysimachia nummularia Lysimachia quadrifolia Lysimachia terrestris Samolus valerandi ssp. parviflorus—Rare in PBPK

Family HYDRANGEACEAE

*+Philadelphus coronarius

Family **GROSSULARIACEAE** **Ribes rubrum*

Family CRASSULACEAE

+Penthorum sedoides—Uncommon in PBPK *Sedum album—Rare in PBPK *Sedum sarmentosum *Sedum telephium

Family SAXIFRAGACEAE

–Chrysosplenium americanum Heuchera americana –Saxifraga virginiensis

Family ROSACEAE

Agrimonia gryposepala +Agrimonia pubescens–Uncommon in PBPK +Amelanchier arborea + Amelanchier canadensis–Rare in PBPK [+Amelanchier laevis] Amelanchier stolonifera Aronia x prunifolia *+ Aruncus dioicus var. acuminatus [Crataegeus monogyna] *Duchesnea indica Fragaria virginiana Geum canadense *Malus pumila *+Potentilla argentea -Potentilla canadensis Potentilla norvegica ssp. monspeliensis *+Potentilla recta Potentilla simplex Prunus americana *Prunus avium +Prunus maritima-Rare in PBPK +Prunus persica -Prunus pumila var. depressa-NYS Endangered S1 Prunus serotina [+Prunus serrulata] [+Pyrus calleryana 'Bradford'] [+Pyrus communis] *Rhodotypos scandens -Rosa carolina *+Rosa multiflora +Rosa palustris *Rosa rugosa Rosa setigera-Uncommon in PBPK Rosa virginiana Rubus allegheniensis Rubus flagellaris *Rubus laciniatus-Rare in PBPK Rubus occidentalis *Rubus phoenicolasius -Rubus setosus +Spiraea alba var. latifolia-Rare in PBPK -Spiraea tomentosa

Family FABACEAE

*Melilotus officinalis

*+Albizia julibrissin-Rare in PBPK *+Amorpha fruticosa-Rare in PBPK Amphicarpea bracteata—Uncommon in PBPK Apios americana Baptisia tinctoria [+Cercis canadensis] Chamaecrista fasciculata *+Coronilla varia -Crotolaria sagittalis-NYS Endangered S1 Desmodium canadense-Rare in PBPK +Desmodium cuspidatum-Extirpated in PBPK -Desmodium humifusum-NYS: Extirpated Desmodium paniculatum *+Genista tinctoria [+Gleditsia triacanthos] [+Gymnocladus dioica] -Lathyrus japonicus var. maritimus [+Lathyrus latifolius] Lespedeza capitata Lespedeza hirta +Lespedeza intermedia-Rare in PBPK +Lespedeza procumbens----Uncommon in PBPK -Lespedeza violacea- NYS Rare S3 Lespedeza virginica *Lotus corniculata *Medicago lupulina *Medicago sativa *Melilotus alba

Phaseolus polystachios-Rare in PBPK *+Puereria lobata *Robinia pseudo-acacia +Strophostyles helvula *Trifolium arvense-Uncommon in PBPK *-Trifolium aureum *+Trifolium campestre *Trifolium hybridum *Trifolium pratense *Trifolium repens *Vicia cracca ssp. tenuifolia *Vicia sativa ssp. nigra *-Vicia tetrasperma *-Vicia villosa *Vicia tetrasperma-Rare in PBPK *+Wisteria sinensis

Family ELAEAGNACEAE

[+Elaeagnus angustifolia]–Extirpated in PBPK *Elaeagnus umbellata

Family LYTHRACEAE

+Lythrum alatum—Rare in PBPK *Lythrum salicaria

Family ONAGRACEAE

Circaea lutetiana ssp. canadensis Epilobium coloratum *Epilobium hirsutum-Rare in PBPK +Ludwigia alternifolia + Ludwigia palustris Oenothera biennis + Oenothera laciniata-Extirpated; NYS Endangered S1 +Oenothera parviflora var. oakesiana-Rare; NYS Threatened S2 Oenothera perennis

Family NYSSACEAE

Nyssa sylvatica

Family CORNACEAE

+Cornus alternifolia—Rare in PBPK Cornus amomum Cornus florida Cornus foemina ssp. racemosa [+Cornus mas] [+Cornus sericea]

Family SANTALACEAE

-Comandra umbellata

Family CELASTRACEAE

*+Celastrus orbiculata Celastrus scandens—Rare in PBPK [+Euonymus alata] [*Euonymus europaeus] [+Euonymus fortunei var. radicans]

Family AQUIFOLIACEAE

[+Ilex opaca] +Ilex verticillata

Family BUXACEAE

[+Buxus sempervirens] *+Pachysandra terminalis

Family EUPHORBIACEAE

-Acalypha gracilens Acalypha virginica var. rhomboidea Chamaesyce maculata +Chamaesyce polygonifolia—Rare in PBPK *Euphorbia cyparissias

Family RHAMNACEAE

Ceanothus americanus—Rare in PBPK *+Rhamnus cathartica *Rhamnus frangula

Family VITACEAE

*+Ampelopsis brevipedunculata Parthenocissus quinquefolia *+Parthenocissus tricuspidata—Rare in PBPK +Vitis aestivalis Vitis labrusca

Family LINACEAE

*+Linum usitatissimum—Extirpated in PBPK -Linum virginianum

Family POLYGALACEAE

–Polygala sanguinea –Polygala verticillata var. ambigua Polygala verticillata var. isocycla

Family SAPINDACEAE

[+Koelreuteria paniculata]

Family HIPPOCASTANACEAE

[+Aesculus flava]—Rare in PBPK [+Aesculus hippocastanum]

Family ACERACEAE

*+Acer campestre *+Acer ginnala *+Acer negundo *Acer platanoides Acer rubrum Acer saccharinum [+Acer saccharum]

Family ANACARDIACEAE

Rhus copallinum Rhus glabra Rhus hirta—Rare in PBPK Toxicodendron radicans –Toxicodendron vernix

Family SIMAROUBACEAE

*+Ailanthus altissima

Family RUTACEAE

Ptelea trifoliata—Rare in PBPK; NYS Endangered S1-S2

Family OXALIDACEAE

Oxalis stricta -Oxalis violacea—NYS Threatened S2-S3

Family GERANIACEAE

*+Erodium cicutarium

Geranium carolinianum—Rare in PBPK Geranium maculatum

Family BALSAMINACEAE

Impatiens capensis

Family ARALIACEAE

Aralia nudicaulis -Aralia racemosa *+Aralia elata *+Hedera helix -Panax trifolius

Family APIACEAE

*+Aegopodium podagraria *+Aethusa cynapium Angelica venenosa—Rare in PBPK Cicuta maculata *+Conium maculatum—Rare in PBPK Cryptotaenia canadensis *Daucus carota Heracleum maximum Osmorhiza longistylis *Pastinaca sativa Sanicula odorata Sanicula marilandica -Zizia aptera -Zizia aurea

Family GENTIANACEAE

-Bartonia virginica

Family APOCYNACEAE

Apocynum androsaemifolium Apocynum cannabinum var. cannabinum *Vinca minor

Family ASCLEPIADACEAE

Asclepias incarnata var. pulchra Asclepias purpurascens—Rare in PBPK; NYS Uncommon S2-S3 Asclepias syriaca Asclepias tuberosa var interior—Rare in PBPK *Cynanchum louiseae

Family SOLANACEAE

+Datura stramonium *Lycium barbarum *+Lycopersicon esculentum -Physalis heterophylla Solanum carolinense *Solanum dulcamara Solanum ptycanthum

Family CONVOLVULACEAE

*Calystegia sepium *Convolvulus arvensis *+Ipomoea nil—Extirpated in PBPK *+Ipomoea purpurea

Family CUSCUTACEAE

-Cuscuta gronovii Cuscuta pentagona—NYS Uncommon S-3

Family **POLEMONIACEAE** **Phlox paniculata*

Family HYDROPHYLLACEAE

Hydrophyllum virginianum

Family BORAGINACEAE

*+Echium vulgare—Extirpated in PBPK [+Mertensia virginica]—Extirpated in PBPK +Myosotis laxa +Myosotis verna—Rare in PBPK *+Pulmonaria saccharata—Rare in PBPK *+Symphytum officinale—Rare in PBPK

Family VERBENACEAE

+ Phryma leptostachya—Rare in PBPK Verbena hastata—Uncommon in PBPK Verbena urticifolia

Family LAMIACEAE

Agastache nepetoides-Rare in PBPK; NYS Threatened S2-S3 Collinsonia canadensis *Glechoma hederacea Hedeoma pulegioides-Rare in PBPK *+Lamium purpureum *Leonurus cardiaca Lycopus americanus Lycopus uniflorus +Lycopus virginicus *–Mentha arvensis -Monarda fistulosa *–Nepeta cataria -Physostegia virginiana *Prunella vulgaris Pycnanthemum tenuifolium Pycnanthemum virginianum Scutellaria lateriflora Teucrium canadense Trichostema dichotomum

Family PLANTAGINACEAE

*Plantago lanceolata *Plantago major -Plantago maritima ssp. juncoides—NYS Threatened S2-S3 Plantago rugelii -Plantago virginica

Family **OLEACEAE**

[+Chionanthus virginicus]–Extirpated in PBPK [+Forsythia viridissima] Fraxinus americana [+Fraxinus nigra] Fraxinus pennsylvanica *Ligustrum vulgare *+Syringa vulgaris

Family SCROPHULARIACEAE

-Agalinis maritima -Agalinis purpurea -Agalinis tenuifolia Aureolaria flava -Aureolaria virginica *+Chaenorrhinum minus—Rare in PBPK Chelone glabra—Uncommon in PBPK Gratiola neglecta Linaria canadensis

Viburnum prunifolium

*Linaria vulgaris -Lindernia dubia *+Mazus pumilus +Mimulus alatus-Uncommon in PBPK; NYS Rare S-3 +Mimulus ringens Pedicularis canadensis *+Penstemon digitalis-Uncommon in PBPK Scrophularia lanceolata +Scrophularia marilandica *Verbascum blatteria *Verbascum thapsus *Veronica arvensis *+Veronica chamaedrys *+Veronica hederifolia *Veronica officinalis Veronica peregrina *+Veronica persica *Veronica serpyllifolia Veronicastrum virginicum-NYS Threatened S-2

Family OROBANCHACEAE

–Epifagus virginiana Orobanche uniflora

Family **BIGNONIACEAE**

*Campsis radicans—Rare in PBPK *+Catalpa speciosa—Rare in PBPK *Paulownia tomentosa

Family CAMPANULACEAE

*+Campanula rapunculoides—Extipated in PBPK Lobelia inflata -Lobelia spicata +Lobelia siphilitica *+Triodanis perfoliata var. biflora—Rare in PBPK Triodanis perfoliata var. perfoliata

Family RUBIACEAE

Cephalanthus occidentalis—Rare in PBPK Galium aparine +Galium circaezans—Uncommon in PBPK *Galium mollugo +Galium palustre—Rare in PBPK -Galium tinctorum +Galium triflorum +Mitchella repens—Rare in PBPK

Family CAPRIFOLIACEAE

+Diervilla lonicera-Rare in PBPK [+Lonicera fragrantissima] *Lonicera japonica *+Lonicera morrowii *+Lonicera x bella Lonicera sempervirens-Rare in PBPK Sambucus canadensis [+Symphoricarpus albus var. laevigatus]—Extirpated in PBPK Triosteum perfoliatum Viburnum acerifolium Viburnum dentatum var. lucidum Viburnum dentatum var. venosum-Uncommon in PBPK; NYS Threatened S2 *Viburnum dilatatum Viburnum lentago *+Viburnum opulus----Uncommon in PBPK

*+Viburnum sieboldii Family ASTERACEAE *Achillea millefolium var. lanulosa Ambrosia artemisiifolia Ambrosia trifida -Anaphalis margaritacea Antennaria plantaginifolia *+Anthemis arvensis-Rare in PBPK +Anthemis cotula *Arctium minus *+Artemisia annua *Artemisia vulgaris Aster cordifolius Aster divaricatus Aster ericoides Aster laevis +Aster lanceolatus var. simplex Aster lateriflorus +Aster lowrieanus Aster macrophyllus Aster novae-angliae Aster patens-Extirpated in PBPK Aster paternus +Aster pilosus +Aster schreberi -Aster puniceus Aster subulatus-Uncommon in PBPK; NYS Threatened S2 Aster tenuifolius—NYS Uncommon S3 Aster umbellatus—Rare in PBPK -Aster undulatus Baccharis halimifolia Bidens bipinnata-Rare in PBPK Bidens frondosa *+Bidens polylepis—Rare in PBPK +Bidens vulgata *+Carduus nutans-Rare in PBPK *+Centaurea jacea *+Centaurea maculosa -Centaurea nigra *Centaurea nigrescens *Cichorium intybus *Cirsium arvense Cirsium discolor *Cirsium horridulum-Uncommon in PBPK *Cirsium vulgare Conyza canadensis *Coreopsis lanceolata—Extirpated in PBPK [+Echinacea purpurea]—Extirpated in PBPK Erechtites hieracifolia Erigeron annuus Erigeron philadelphicus -Erigeron pulchellus +Erigeron strigosus +Eupatorium dubium +Eupatorium fistulosum +Eupatorium hyssopifolium var. laciniatum-Uncommon in PBPK; NYS Threatened S2 -Eupatorium maculatum Eupatorium perfoliatum -Eupatorium pilosum Eupatorium purpureum Eupatorium rugosum +Eupatorium serotinum-NYS Endangered S1 Eupatorium sessilifolium-Rare in PBPK

Euthamia graminifolia +Euthamia tenuifolia *+Gaillardia aristata—Extirpated in PBPK *Galinsoga parviflora *Galinsoga quadriradiata Gnaphalium obtusifolium *+Gnaphalium uliginosum-Rare in PBPK -Helenium flexuosum *+Helianthus annuus-Rare in PBPK Helianthus divaricatus Helianthus giganteus -Helianthus strumosus *Helianthus tuberosus -Heliopsis helianthoides *+Heterotheca subaxillaris-Uncommon in PBPK *Hieracium aurantiacum-Extirpated in PBPK *Hieracium caespitosum *+Hieracium floribundum-Rare in PBPK +Hieracium kalmii *+Hieracium piloselloides -Hieracium scabrum Hieracium venosum *Hypochaeris radicata Iva frutescens ssp. oraria –Krigia biflora Krigia virginica Lactuca biennis Lactuca canadensis +Lactuca floridana-Rare in PBPK; NYS Endangered **S**1 *Lactuca serriola *+Lapsana communis-Uncommon in PBPK *Leucanthemum vulgare *Matricaria discoidea Mikania scandens Pluchea odorata var. succulenta Prenanthes trifoliolata—Uncommon in PBPK *Rudbeckia hirta var. pulcherrima -Rudbeckia lacinata *+Senecio vulgaris Solidago bicolor Solidago caesia Solidago canadensis var. scabra Solidago juncea -Solidago nemoralis Solidago odora Solidago rugosa -Solidago sempervirens var. mexicana-NYS Endangered S1 +Solidago sempervirens var. sempervirens Solidago speciosa -Solidago ulmifolia *-Sonchus arvensis *Sonchus oleraceus [+Tagetes patula] *Tanacetum vulgare *Taraxacum officinale *Tragopogon pratensis *Tussilago farfara Vernonia noveboracensis Xanthium strumarium var. canadense

CLASS: LILIOPSIDA

Family ALISMATACEAE

Alisma subcordatum Sagittaria latifolia—Rare in PBPK

Family **ARACEAE** Acorus americanus—Rare in PBPK Arisaema triphyllum Symplocarpus foetidus

Family **LEMNACEAE**

Lemna minor

Family COMMELINACEAE

*Commelina communis var. ludens *+Tradescantia virginiana—Rare in PBPK

Family JUNCACEAE

Juncus acuminatus -Juncus articulatus +Juncus brachycarpus -Juncus bufonius -Juncus dudleyi Juncus effusus var. pylaei Juncus gerardii -Juncus scirpoides—NYS Endangered S1 Juncus tenuis Luzula campestris var. multiflora

Family CYPERACEAE

Bulbostylis capillaris -Carex alata -Carex amphibola var. turgida Carex annectens -Carex aquatilis -Carex bebbii Carex blanda -Carex bushii- NYS Uncommon S3 -Carex buxbaumii- NYS Threatened S2 Carex cephalophora -Carex conoidea Carex crinita -Carex digitalis Carex festucacea -Carex granularis -Carex gynandra -Carex hirtifolia +Carex intumescens +Carex laxiflora Carex lurida -Carex normalis -Carex pallescens Carex pellita Carex pensylvanica -Carex polymorpha- NYS: Extirpated -Carex projecta -Carex rosea -Carex scoparia -Carex seorsa- NYS Threatened S3 Carex squarrosa Carex stipata Carex stricta Carex swanii Carex tribuloides -Carex trisperma Carex vulpinoidea +Cyperus diandrus Cyperus echinatus-Rare in PBPK; NYS Endangered **S1** *+Cyperus esculentus var. macrostachyus

-Cyperus lupulinus ssp. lupulinus—NYS Threatened S2 Cyperus lupulinus ssp. macilentus Cyperus strigosus -Eleocharis elliptica var. elliptica Eleocharis elliptica var. pseudoptera -Eleocharis halophila - NYS Threatened S2 Eleocharis obtusa -Fimbristylis autumnalis Scirpus atrovirens Scirpus cyperinus +Scirpus pendulus Scirpus pungens Scirpus robustus

Family POACEAE

*Agrostis gigantea Agrostis hyemalis +Agrostis perennans *+Aira caryophyllea *+Aira praecox *+Alopecurus pratensis Andropogon gerardii Andropogon virginicus Anthoxanthum nitens *Anthoxanthum odoratum Aristida dichotoma-Rare in PBPK +Aristida longespica *Aristida oligantha *Arrhenatherum elatius *+Avena fatua ssp. sativa *Bromus commutatus *+Bromus hordeaceus *Bromus inermis *+Bromus sterilis *Bromus tectorum Calamagrostis canadensis -Calamagrostis cinnoides +Cenchrus tribuloides-Rare in PBPK; NYS Threatened S2 Cinna arundinacea -Cinna latifolia *Dactylis glomerata +Danthonia compressa +Danthonia spicata +Deschampsia flexuosa *Digitaria ischaemum *Digitaria sanguinalis Distichlis spicata *Echinochloa crusgalli +Echinochloa muricata var. microstachya -Echinochloa muricata var. muricata *Eleusine indica -Elymus canadensis -Elymus villosus var. arkansanus Elymus virginicus *+Elytrigia repens -Eragrostis capillaris *Eragrostis cilianensis *+Eragrostis minor Eragrostis pectinacea Eragrostis spectabilis *Festuca rubra *-Festuca trachyphylla Glyceria striata *Holcus lanatus *+Hordeum jubatum

*+Hordeum murinum ssp. leporinum *+Hordeum pusillum Leersia oryzoides Leersia virginica *Lolium perenne var. aristatum *Lolium perenne var. perenne *Lolium pratense -Muhlenbergia mexicana Muhlenbergia schreberi -Panicum acuminatum -Panicum boscii Panicum capillare Panicum clandestinum Panicum dichotomiflorum Panicum dichotomum -Panicum latifolium -Panicum oligisanthes var. scribnerianum Panicum rigidulum var. pubescens -Panicum sabulorum var. thinum -Panicum scabriusculum-NYS Endangered S1 Panicum sphaerocarpon -Panicum verrucosum Panicum virgatum var. spissum -Panicum virgatum var. virgatum Paspalum setaceum var. muhlenbergii Paspalum setaceum var. setaceum-NYS Threatened **S**2 +Phalaris arundinacea----*Phleum pratense Phragmites australis Piptochaetium avenaceum-Rare in PBPK *Poa annua *+Poa bulbosa *Poa compressa *+Poa nemoralis *Poa pratensis *Poa trivialis *+Puccinellia distans Schizachyrium scoparium ssp. scoparium *+Secale cereale *+Setaria faberi *-Setaria italica +Setaria parviflora-Rare in PBPK *Setaria pumila *Setaria viridis Sorghastrum nutans +Spartina alterniflora Spartina cynosuroides- Rare in PBPK Spartina patens Spartina pectinata—Rare in PBPK Sporobolus asper—Rare in PBPK Tridens flavus Tripsacum dactyloides-NYS Threatened S2 *Triticum aestivum-Rare in PBPK -Vulpia octoflora *+Vulpia myuros [+Zea mays]

Family SPARGANIACEAE

-Sparganium americanum Sparganium eurycarpum-Rare in PBPK

Family TYPHACEAE

Typha angustifolia Typha latifolia

Family LILIACEAE

Allium canadense *-Allium schoenoprasum *Allium vineale *Asparagus officinalis *+Convallaria majalis *+Chionodoxa luciliae Erythronium americanum *+Galanthus nivalis *Hemerocallis fulva *Hosta ventricosa *+Hyascinthoides nonscripta Hypoxis hirsuta Lilium canadense—Rare in PBPK Lilium superbum-Rare in PBPK Maianthemum canadense Maianthemum racemosum -Medeola virginiana *Muscari botryoides *+Narcissus pseudo-narcissus *+Ornithogalum umbellatum Polygonatum biflorum Polygonatum commutatum-Uncommon in PBPK *+Scilla siberica [+Trillium grandiflorum]—Extirpated in PBPK [+Trillium cernuum] Uvularia perfoliata-Rare in PBPK Uvularia sessilifolia Veratrum viride

Family IRIDACEAE

*+Crocus sp. Iris prismatica—Uncommon in PBPK; NYS Threatened S2 *+Iris pseudacorus Iris versicolor—Uncommon in PBPK Sisyrinchium angustifolium -Sisyrinchium atlanticum +Sisyrinchium montanum

Family AGAVACEAE

*+Yucca filamentosa

Family SMILACACEAE

Smilax glauca Smilax herbacea Smilax rotundifolia

Family **DIOSCOREACEAE**

Dioscorea villosa-Rare in PBPK

Family ORCHIDACEAE

*+Epipactis helleborine -Plantanthera lacera Spiranthes cernua—No specimen collected; Extirpated in PBPK -Spiranthes vernalis - NYS Endangered S1