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History of the Eastern Screech-Owl (*Megascops asio*) in New York City, 1867–2005

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Abstract

This paper provides a historical review of the occurrence, distribution, and changes in abundance of the eastern screech-owl (*Megascops asio*) in New York City, New York. I also discuss the results of the eastern screech-owl restoration efforts in 1998 and 2001–02 in Central Park, Manhattan. From the late 19th century through the mid-20th century, this owl species was a common permanent member of the avifauna throughout New York City. By the 1960s, information about eastern screech-owls was much less common in New York City bird reports, suggesting the species had declined in the area. In 2005, this owl was believed to be breeding in three of five boroughs of the city but was common only on Staten Island. In order to reestablish the eastern screech-owl in Central Park, a total of 38 first-year owls were released: six in 1998 and 32 in 2001–02. Released owls nested and fledged young in March 2002 and March 2005—the first confirmed nesting of this species in Central Park since 1949. By August 2005, it was estimated that 18.4% (7 of 38) of the released owls were still alive, but the probability of their long-term survival in Central Park is uncertain.

Some potential problems with successful restoration of eastern screech-owls in Central Park include competitors for tree cavities such as eastern gray squirrels (*Sciurus carolinensis*) and predators such as raccoons (*Procyon lotor*). Recommendations are made to facilitate future releases of this species in New York City.

Keywords : Eastern screech-owl; *Megascops asio*; New York City, Central Park; restoration; urban

Introduction

The eastern screech-owl (*Megascops asio*; Figure 1) is the most common owl in eastern North America, often nesting in tree cavities and nest boxes in close proximity to people (Gehlbach, 1995). In New York City, this small owl was formerly quite common, found nesting in all five boroughs in the first half of the 20th century. However, between 2001 and 2005 the species was documented to nest annually in only one of the city's five boroughs (Staten Island), and to probably nest annually in two others (northern Manhattan and parts of the Bronx). In order to reestablish a population in a former breeding area, the New York City Department of Parks and Recreation

Figure 1. Eastern screech-owl, red-morph. Photo courtesy of the Raptor Trust, New Jersey.



released rehabilitated eastern screech-owls into Central Park, in Manhattan, in 1998 and 2001–02. This paper summarizes what is known of the eastern screech-owl in New York City since the latter half of the 19th century and traces the preliminary results of the Central Park restoration effort.

Methodology

A. Historical Distribution and Abundance in New York City

Information regarding the occurrence, number, and natural history of eastern screech-owls in New York City was gathered from 19th- and 20th-century notes and articles in journals and books; reports to New York City organizations; and recent e-mail communications with knowledgeable local bird-watchers. Data about eastern screech-owls are provided for each of the city's five boroughs. To obtain additional information about the relative abundance of eastern screech-owls in each borough in the past, Christmas Bird Count (CBC) data were compiled from 1900 through 1999. In addition, to determine the relative historical proportion of red-versus gray-morph eastern screech-owls in New York City, I examined the collection of bird specimens held at the American Museum of Natural History (AMNH).

B. Restoration Into Central Park, New York City

The project to restore the eastern screech-owl to Central Park was conceived of and designed by me in 1997. A total of 38 eastern screech-owls were released in Central Park over the course of four years (1998: $n = 6$; 2001: $n = 18$; 2002: $n = 14$). All the owls were obtained from raptor rehabilitators and were ca. one year old when released. In August 1998, six eastern screech-owls obtained from the Raptor

Trust in New Jersey were released. The sex of the birds was unknown at the time. An additional 18 owls were released in September through October 2001, 2 in March 2002, and 12 in August 2002. These came from raptor rehabilitators in central Michigan (5), upstate New York near Rochester (23), and Long Island, New York (4). Of these, 13 were males, 18 were females, and the sex of 1 individual could not be determined. The five owls obtained from central Michigan were color-marked on their faces. Thirty of 32 of the 2001–02 group were fitted with a radio transmitter on the day of release. We used a “hard” release method: Owls were brought to the park late in the day of release, banded, and set free at dusk. Once set free, no food was provided to the owls at feeding stations.

Central Park (40°47' N, 73° 58' W), the habitat into which the owls were released, is a 344-hectare (860-acre) public space in the center of Manhattan. There are two primary woodlands in the park: a 15-hectare (38-acre) parcel called “the Ramble” in the center of the park, and a 36-hectare (90-acre) tract in the north end referred to as “the North Woods” (Fowle & Kerlinger, 2001). These two woodlands are composed of deciduous tree species including native black cherry (*Prunus serotina*), hackberry (*Celtis occidentalis*), and red oak (*Quercus rubra*), as well as nonnative black locust (*Robinia pseudoacacia*) and Norway maple (*Acer platanoides*). Both woodlands are heavily transected by pedestrian paths. The ground layer has been greatly affected by different types of disturbance, with the result that nonnative herbaceous species dominate large areas of the forest floor (Loeb, 1993). In order to increase the number of roosting/nesting cavities, 15 cedar-wood owl boxes were placed in these woodlands in June 1998.

The author did not carry out a small-mammal survey or any other type of prey-base analysis as part of this restoration project. It was inferred that the prey base in Central Park was sufficient because each winter from 1990 to 1998, up to five long-eared owls (*Asio otus*), as well as saw-whet owls (*Aegolius acadicus*) and occasionally other owl species, were present concurrently in the park. Each of these raptor species preys upon the same small mammals that eastern screech-owls prey upon. Eastern screech-owls also capture a variety of other prey, including small birds such as the house sparrow (*Passer domesticus*; Nichols, 1953) and invertebrates (Sutton, 1929), and these are common in Central Park for most of the year.

In order to determine prey items consumed by eastern screech-owls in Central Park, I collected owl pellets whenever possible from October 2001 through October 2002. A total of 51 pellets were collected and analyzed in 2001–02. Thirty-nine pellets were recovered in the Ramble and environs, and 12 were collected from the North Woods. Twenty-nine pellets collected from August through late October 2002 came from the same pair of red-morph owls that roosted near the Ramble. The 12 pellets collected from the North Woods area came from one gray-morph individual.

To determine how many individuals should be released in Central Park in the restoration project, I researched published home-range sizes in suburban areas where moderate to high levels of food were also available to eastern screech-owls (see Smith & Gilbert, 1984; Gelhbach, 1994). Owl home ranges varied from between 11 to 131 hectares in a suburban Connecticut study (Smith & Gilbert 1984), so I estimated that Central Park could support up to five pairs of breeding eastern screech-owls. Also, research from

other studies has shown that normal mortality of approximately 60% to 75% could be expected for eastern screech-owls = 1 year old (VanCamp & Henny, 1975). It seemed reasonable to release six owls in 1998 as a test to determine if rehabilitated owls could survive in an urban habitat. In 2001–02, it was believed a greater number (up to 25) of eastern screech-owls should be released simultaneously each year in order to establish breeding pairs as quickly as possible in Central Park.

After the releases, information about the location, behavior, and territories of the Central Park eastern screech-owls came from the author's field notes made during diurnal searches on foot, as well as through playback of the territorial ("whinny") call at night. These data records were made throughout the year from 12 August 1998 through 1 March 2003, and again from January 2004 through August 2005. Also, some information came from Fordham University researchers who monitored (via radiotelemetry) several owls from mid September 2001 to December 2002.

Results

A. Historical Distribution/Abundance in New York City 1867–2005

In the mid- to late 19th century, the eastern screech-owl was known to breed in two boroughs of New York City: the Bronx and Manhattan. Eugene P. Bicknell (see Griscom, 1926) considered this species to be a common permanent resident in the Riverdale area of the Bronx at that time. In Manhattan, as part of a report to the Board of Commissioners of Central Park (Anonymous, 1869), the eastern screech-owl was described as "permanent resident; abundant; build their nest[s] in the crevices of the rocks in the Ramble." However, almost 20 years later, Woodruff

and Paine (1886) listed the owl as “resident; not common” in Central Park. In Brooklyn, Wyman (1883) does not record the presence of this species in Prospect Park, though one eastern screech-owl was collected in 1867 in that borough (AMNH # 437303). No 19th-century data regarding the occurrence of this species could be obtained for Queens and Staten Island.

In the Bronx in the early 1900s, eastern screech-owls were reported from Riverdale and Van Cortlandt Park by E.P. Bicknell (see Griscom, 1926). Kuerzi (1926) listed the owl as a “common permanent resident” of the Bronx. In a winter survey in 1953–54, Buckley (1958) found seven owl species in the Bronx (Pelham Bay Park), but he did not find the eastern screech-owl. In a single-night survey for owls on 8 December 1956 (Buckley, Carleton, Post & Scully, 1960), eastern screech-owls were found along the Bronx River on the grounds of the New York Botanical Garden. From 1957 to 1987, this owl was found on 10 of 31 Christmas Bird Counts in Pelham Bay Park (I. Cantor, unpublished data, 2000). Between 1998 and 2005, eastern screech-owls were reported from Riverdale Park (C. Jaslowitz, personal communication, 2004), Van Cortlandt Park (D. Kunstler, personal communication, 2004), and along the Bronx River (E. Edler, personal communication, 2005). The owl is presumed to still be breeding in these three areas of the Bronx, but it is much less common than in the recent past.

In Central Park in 1908, the eastern screech-owl was one of 18 breeding bird species found that year (Griscom, 1925). By 1924, when there were only eight native breeding bird species known in Central Park, there were still “several resident pairs” of eastern screech-owls (Griscom, 1925). In the late 1940s, Carleton (1947), summarizing the status of all

birds in Central Park, wrote that the eastern screech-owl was “seen almost every year. No summer records in recent years.” For the period between 1948 and 1957, Carleton (1958) wrote that the owl was a “permanent resident, occasionally found breeding.” By 1970, Carleton no longer listed this species as part of the avifauna of the park, except for a single eastern screech-owl seen on the 1955 Christmas Bird Count (Carleton, 1970). The last literature citation of extant eastern screech-owls in Central Park was Bull (1964), who stated that the species still nested in the early 1960s, but no specific information was provided. Knowler (1984), in a yearlong survey of Central Park in 1982, does not mention this species as having been seen. Kerlinger and Sanford (1998) could not locate any evidence of eastern screech-owls (or the presence of any owl species) in a comprehensive breeding-bird survey of Central Park conducted from 23 May through 17 July 1998. In northern Manhattan, at Inwood Hill Park, no written historical records could be found that described the status of this species in either the 19th or 20th centuries. However between 1997 and 2005, it was still possible at Inwood Hill Park to attract eastern screech-owls using recordings, with a maximum of six (two adults and four fledglings) seen simultaneously in the first week of September 1997 (M. Feller, personal communication, 2002; see also Hellman, 1998).

In Brooklyn (Kings County), Vietor and Vietor (1909) did not record the eastern screech-owl as a breeding species in their one-year bird survey of Prospect Park, but they do mention that one individual was seen on 20 December 1908. Walsh (1926) considered the species to be a permanent (year-round) resident in the park and wrote that a few pairs were definitely known to have nested within the borders of Prospect Park from 1908 to 1925,

inclusive. Carleton (1958) listed the eastern screech-owl in Prospect Park as “permanent resident, breeds.” However, by 1970 he did not list the species as occurring in the park (Carleton, 1970). The last mention of extant eastern screech-owls in Brooklyn was Bull (1964), who stated that the species still nested in Prospect Park in the early 1960s, but provided no other details.

In Queens, pre-1900 information could not be found. For the period 1915 to 1950, the most detailed information comes from the naturalist Sam Yeaton (1992):

The common nester in our streets and backyards was the [eastern] screech-owl. In 1919, people in Flushing were familiar with owls (barn [*Tyto alba*], long-eared, and screech), and no one disturbed the screech-owls. For example, there was one in a hole in a maple about twelve feet above the ground on the corner of Sanford Avenue and Kissena Boulevard in front of St. Joseph’s Home, and a sign nailed to the tree called it to the attention of all passersby and said, “Please do not disturb this owl.” Squirrels on the other hand were rare. A friend of mine, seeing a squirrel in his neighborhood, made a house and nailed it to a tree in his backyard. Immediately, he got a screech-owl that lived there for many years. A screech-owl also lays four eggs in a well-protected hollow tree and usually fledges all four, much less subject to predation than baby Robins [*Turdus migratorius*]. However in 1919, screech-owls, while perhaps not abundant, were actually plentiful. And this was for many years. I remember one Christmas Count after World War II when Frank and Norton Smithe counted 13 screech-owls in Douglaston alone. There were many more red-morph than gray-morph owls, but both were present. I have a photo I took in 1924 of Harrison Skeuse holding a gray-morph screech-owl, but both were present. These were taken out of two holes in two adjacent apple trees at the south end of the gully at Oakland Lake.

Between 1999 and 2002, one red-morph individual had occasionally been seen in Alley Pond Park (H. Roth, personal communication, 2003), and a pair was seen together in spring 2005 (A. Ott, personal communication, 2005). In Forest Park, a red-morph owl was present in summer to fall 2002, and a gray-morph individual was seen in May 2004 (E. Lam, personal communication, 2004; A. Ott, personal communication, 2004). No eastern screech-owls have ever been seen at the Jamaica Bay Wildlife Refuge since its inception in 1953 through August 2005 (D. Riepe, personal communication, 2005).

On Staten Island (Richmond County), the eastern screech-owl was known to naturalists in the 19th century, but no further data were recorded (Davis, 1892; Siebenheller, 1981). A.C. Bent (1938) wrote that an individual was banded on Staten Island on 27 October 1925 and recaptured in the same place some eight years later, on 11 July 1933. In the 1970s, nests were found in High Rock Park, Lighthouse Hill, and in Sunnyside, but these were only a few pairs of the total breeding population at that time (Siebenheller, 1981). The maximum number of nests reported in one area of Staten Island was five at Blue Heron Park, in 1990 (D. Riepe, personal communication, 2003). Between 2001 and 2005, eastern screech-owls were still known to nest in several areas such as Wolfe’s Pond Park, Blue Heron Park, the Greenbelt, Long Pond Park, William T. Davis Wildlife Refuge, Conference House Park, and the town of Princess Bay (R. Matarazzo, personal communication, 2004; S. I. Wollney, personal communication, 2004). They may still nest on Grymes Hill/Sunnyside, the Silver Mount Cemetery area, the Moravian Cemetery, and scattered locales along the west and south shores of Staten Island (H. Smith, personal communication, 2004; M. Shanley, personal communication, 2004).

However, since the 1990s, eastern screech-owl populations on Emerson Hill and the St. John's/Notre Dame area have probably been extirpated due to development (M. Shanley, personal communication, 2004). The future of this species is more secure on Staten Island than in any other borough.

B. New York City Christmas Bird Count Records 1900–1999 and American Museum Specimens 1867–2005

According to Table 1, Christmas Bird Count (CBC) records for the period 1900–1999 show that eastern screech-owls have been seen in every borough in New York City. The maximum number recorded was 13 on the Bronx-Westchester CBC in 1956. Other single-year-high counts were recorded in Queens (10 in 1950) and Staten Island (11 in 1971). Nonreleased eastern screech-owls have not been found on area CBCs in many years—not since 1955 in Manhattan, 1962 in Brooklyn, and 1965 in Queens.

The majority (83.3%) of 18 eastern screech-owls collected in New York City and held at AMNH have been red-morph individuals (Figure 1). Most of the individuals collected in New York City came from Brooklyn (46.7%), followed by Queens (26.7%) and Staten Island (20%). No AMNH specimens have ever been collected in Manhattan or the Bronx. The earliest AMNH-collected eastern screech-owl came from Brooklyn (1867), and most specimens (61.1%) were collected from 1889 to 1915.

C. Observations of Released Eastern Screech-Owls in Central Park 1998–2005

Of the 1998 group, one owl was injured in a collision with a car approximately 30 days after release and was returned to the Raptor Trust. On 23 December 1999, an owl was found injured and died soon after.

Toxicology analysis showed no detectable (or significant) levels of rodenticides, herbicides, or insecticides (Stone, 2000). Only one eastern screech-owl could be found in Central Park during intensive nocturnal surveys in July 2001. The fate of three others released in August 1998 remains unknown. By August 2002, no evidence could be found in Central Park of any of the original six owls released in 1998.

Of the 18 owls released in September–October 2001, 1 was found dead five days after release; another 2 owls were found dead in December 2001 and January 2002. The first collided with a wall or vehicle, and the second died from poisoning from brodifacoum, an anticoagulant rodenticide (Stone, 2002). In late March 2002, an owl was found dead shortly after release, probably the victim of raccoon predation. At least 4 other owls died in 2002 from starvation. In all, of the 38 eastern screech-owls released in Central Park since August 1998, it is estimated that 7 individuals were still alive (18.4% survival rate) as of August 2005.

In 2001, approximately one month after release, 12 of the 17 eastern screech-owls fitted with backpack transmitters had slipped out of the device. Several were subsequently trapped and refitted with a new design. By August 2002, only 1 of 19 owls fitted with a backpack transmitter in 2001–02 still had a functioning unit attached. The radio-transmitter survey work was discontinued by early 2003. Results from telemetry research indicate that on occasion, a few owls left Central Park at night to forage on nearby streets, and rarely, an individual might roost outside the park during the day.

On 28 March 2002, two fledgling eastern screech-owls were discovered near their nest site west of the Ramble (Forbes, 2002). The parents of these young were a female released in 1998 and a male released in

Table 1. Eastern Screech-Owls (*Megascops asio*) recorded on 100 years of Christmas Bird Counts (CBC) by Borough in New York City from 1900-1999.

Borough (Year CBC Began)	Year First Found (Number)	Year Max. Found (Number)	Year Last Found (Number)	Number of Years Found (%)
Bronx (1902)	1924 (1)	1956 (13)	1999 (3)	68/98 = 69.4%
Brooklyn (1904)	1908 (1)	1960 (3)	1962 (1)	18/96 = 18.8%
Manhattan (1900)	1931 (1)	1948 (1)	1955 (1)	3/100 = 3.0%
Queens (1903)	1933 (6)	1950 (10)	1965 (1)	20/97 = 20.6%
Staten Island (1910)	1914 (1)	1971 (11)	1999 (5)	47/90 = 52.2%

**Figure 2. Fledgling eastern screech-owls, Central Park, New York City, 26 March 2005.
Photo © 2005 Deborah Allen.**



September 2001. Neither parent had a backpack transmitter when observed in 2002. On 19 March 2005, three fledglings were discovered in the northern part of Central Park (Figure 2). Both these fledging dates are more than 30 days earlier than fledging dates previously recorded for this owl species in New York State (Andrle & Carroll, 1988).

None of the owls released in 1998 or 2001–02 were ever found using a cedar nest box for roosting, nor was secondary evidence (e.g., pellets, wash) discovered inside any of the boxes. In Central Park, preferred roost-tree cavities were in native black cherry, hackberry, and (rarely) red oak, as well as nonnative black locust and London plane tree (*Platanus x acerifolia*). In mild weather, eastern screech-owls could often be found roosting on branches of Norway maple, where they were concealed by the foliage, and occasionally on conifers such as eastern hemlock (*Tsuga canadensis*) and white pine (*Pinus strobus*). Most roost sites were between 3 and 6 meters from the ground, and the highest was approximately 21 meters. The lowest diurnal roost site was below a partially fallen tree near a rock outcropping, approximately 15 centimeters off the ground.

Analysis of 10 eastern screech-owl pellets collected from the Ramble area of Central Park from late August 2001 through February 2002 showed that six small birds, four small rodents, one fish, and an arthropod (possibly a crayfish) had been eaten. In late February 2002, analysis of 12 pellets recovered from one individual in the North Woods contained 15 small rodents and 2 birds. From August through October 2002, analysis of 29 pellets recovered near the Ramble showed that at least 13 birds and 22 small mammals had been consumed. Numerous arthropod parts were also recovered from each of these pellets,

and invertebrates were especially common in pellets collected from 3 August through 10 September 2002. In the necropsy of the eastern screech-owl found on 23 December 1999, Stone (2000) found that it had a stomach full of 14 green lepidopteran caterpillars. In the necropsy of an adult female eastern screech-owl found dead in late January 2002, Stone (2002) wrote that the owl was in good flesh and had abundant fat. In July 2002, a pair of red-morph owls were observed capturing flying insects such as fireflies (Coleoptera: Lampyridae) on a lawn on the east side of the Ramble at dusk (see also Sutton, 1929). In March–April 2005, the three fledgling and parent eastern screech-owls were observed feeding upon large, nonnative (Asian) earthworms on lawns in the northwestern section of the park on several occasions (J. Demes, personal communication, 2005).

Discussion

New York City has lost two nocturnal and three diurnal raptors as nesting species in the last century. Both the long-eared owl and the barred owl (*Strix varia*) have been extirpated as breeders since 1900 (Table 2; next page). The eastern screech-owl has also declined throughout much of its former range in New York City, even in areas protected as parkland. Historical information combined with data from CBCs indicates that eastern screech-owls were breeding in every borough in New York City from at least the mid-19th century through about 1955. In the mid- to late 1950s, the eastern screech-owl was extirpated from Central Park, and in the early 1960s, from Brooklyn (Prospect Park). Observations made and reports received from bird-watchers from 2001 to 2005, combined with recent CBC data, suggest that the eastern screech-owl was still breeding annually on Staten Island, and probably breeding annually in

Table 2. Status of nesting and wintering owls throughout New York City from 1995 to 2005

Species	Nesting	Winter Resident
Barn Owl* (<i>Tyto alba</i>)	Common	Common
Eastern Screech-Owl* (<i>M. asio</i>)	Uncommon	Uncommon
Great Horned Owl* (<i>Bubo virginianus</i>)	Common	Common
Snowy Owl (<i>Bubo scandiacus</i>)	---	Rare/Uncommon
Barred Owl (<i>Strix varia</i>)	Extirpated	Rare
Long-eared Owl (<i>Asio otus</i>)	Extirpated	Common
Short-eared Owl (<i>Asio flammeus</i>)	---	Rare/Uncommon
Northern Hawk Owl (<i>Surnia ulula</i>)	---	Extremely Rare ¹
Northern Saw-whet Owl (<i>Aegolius acadicus</i>)	---	Common
Boreal Owl (<i>Aegolius funereus</i>)	---	Extremely Rare ²

Key to Status: Nesting

Common: More than 10 nests known in New York City in a given year; or, nests in several places in two or more boroughs, 1995–2005.

Uncommon: Fewer than 10 total nests known in New York City in a given year; or, a common nesting species in only one borough (e.g., the eastern screech-owl in Staten Island), 1995–2005.

Extirpated: Formerly bred in New York City. The barred owl was last found nesting in New York City in Staten Island in 1908. The long-eared owl was last found nesting in Staten Island in 1947.

Key to Status: Winter

Common: Found from December through February in appropriate habitat at night or known diurnal roosts every year in one and usually more boroughs, 1995–2005.

Uncommon: Not likely to have been found by experienced birders from December through February in 1995–2005 in the appropriate habitat at night or at known diurnal roosts; or, common only in one borough.

Rare: Found fewer than five times per season by experienced birders in appropriate habitat in New York City from 1995 to 2005.

Extremely Rare: Single Records: (1) northern hawk owl—collected in 1863 (no date) in Brooklyn, AMNH Collection # 437332; (2) boreal owl—observed Central Park, Manhattan, from 19 December 2004 until 14 January 2005.

* Nested in New York City in 2001–05.

Inwood Hill Park in northern Manhattan, and in several parks in the Bronx.

It is difficult to determine why the eastern screech-owl was extirpated from several parks in New York City since 1950. Small, isolated populations such as those in Central and Prospect Parks were vulnerable to extirpation due to a variety of causes (often acting in concert), including stochastic (chance) events and reduced gene flow. Local extirpation factors may have included (a) the increased use of anticoagulant rodenticides (primarily brodifacoum and bromadiolone) and insecticides (DDT) beginning in the 1950s; (b) removal of dead trees and snags from city parks; (c) changes in habitat (via succession of meadows to shrubs/forest) and/or conversion of meadows/forest edges to low-cut grass lawns affecting small-mammal populations; (d) collisions with fast-moving vehicles beginning in the 1950s; (e) an increase in competitors for tree cavities such as eastern gray squirrels (*Sciurus carolinensis*), raccoons (*Procyon lotor*), and European starlings (*Sturnis vulgaris*); (f) an increase in predators such as American crows (*Corvus brachyrhynchos*); (g) predation/disturbance by nocturnal mammals such as raccoons at owl nest sites during the breeding season; (h) and the increased use of city parks by people causing undue disturbance near nest sites. Both the eastern screech-owl and the American kestrel (*Falco sparverius*) were extirpated as breeding species from Central and Prospect Parks in the late 1950s or early 1960s (Bull, 1964; Carleton, 1958), but the ecologically similar, cavity-nesting American kestrel was still found breeding within several blocks of these two parks between 1995 and 2005. This suggests that a lack of high-quality nest cavities may be the most important factor limiting the nesting success of eastern screech-owls in Central Park. We

believe that competition for, and disturbance at, tree cavities from high numbers of eastern gray squirrels, combined with predation upon roosting owls by raccoons, were important factors that prevented more owls from nesting successfully in Central Park from 1998 to 2005.

Few studies have been done to determine what happens to released rehabilitated raptors, especially in an intensive program of restoration of first-year birds such as this one. (For information on such releases, see Csermely, 2000.) Long-term results from this study will provide important information to raptor rehabilitators, who frequently do not know what happens to their birds once they are released back into the wild. In order to keep track of the released eastern screech-owls in Central Park, a combination of three types of survey techniques was most effective in locating owls: walking the park on a regular basis during the day; walking the park at night (while playing recordings of owl calls) at least once per week; and radiotelemetry tracking. Color-marking the face of released owls proved invaluable in determining the exact identity of individuals that perched at the entrance of tree cavities (see Figure 3). Information derived solely from radiotelemetry tracking was mixed: Owls often proved difficult to locate precisely because rock outcroppings in Central Park and nearby buildings surrounding the park affected the signal.

One of the great advantages of doing species restorations in urban parks is the opportunity it affords to work with the local community as well as environmental groups such as The Nature Conservancy, the Brooklyn Bird Club, the Wildlife Conservation Society, and New York City Audubon. A cadre of citizen-scientists can monitor owls on a regular basis. More important, regularly scheduled

Figure 3. Eastern screech-owl (*Megascops asio*), gray-morph, in Central Park, New York City. Note color marking above the owl's right eye. Photo © 2001 Deborah Allen.



owl walks put the community of longtime bird-watchers in touch with new (often younger) ones. It is then possible to convey good owling etiquette to newcomers.

That eastern screech-owls have been extirpated from areas of their former metropolitan range is part of a larger issue: the loss of native plants and animals in New York City parks. The most important lesson to be learned in this restoration project is that it is much easier to preserve and protect species already living in parks than it is to reestablish species once they have been eliminated. From a broader perspective, much of New York City's natural heritage is being lost at an alarming rate (DeCandido, Muir & Gargiullo, 2004). Though scientists tend to interpret species extinctions in terms of biological processes, the future of the native fauna and flora of New York City depends on viewing the issue from a different perspective. The critical factor in preserving species diversity is developing public support for natural areas in parks. Much more effort needs to be devoted to explaining why preserving native species is important (Tilman, 2000). The degree to which scientists create opportunities for people to appropriately enjoy the remaining natural areas in urban parks will help determine the future of native species within them, and the natural areas themselves. That several environmental groups and numerous individuals have come together via the eastern screech-owl restoration project points to some measure of hope in this endeavor.

Management Recommendations

Programs to reintroduce eastern screech-owls in New York City should strive to take full advantage of available media outlets, with one important caveat: The restoration must adhere to a plan designed and

supervised by Ph.D. biologists in order to maintain the scientific integrity of the endeavor. Though members of the government might have good intentions, it was my experience in 2001–02 that the restoration project at times was oriented more toward publicity than biology. I recommend that scientists from the Wildlife Conservation Society supervise any future releases in the city.

As part of the restoration plan, the public should be involved in release as well as post-release activities—especially in monitoring the owls. Allowing people in the birding community to participate in the actual release of the birds makes them an integral part of the process and reinforces the notion that they are stewards of the owls (DeCandido & Allen, 2002).

Although radiotelemetry tracking revealed certain interesting facts about the owls, it is questionable whether the data compiled from it were significant compared with other issues. Many eastern screech-owls fitted with backpack transmitters were observed attempting to escape from these devices. The owls would struggle with the wire harness for long periods during the day while perched outside tree-cavity roosts. In future releases, not all the owls should be fitted with telemetry equipment. Also, any owls selected for radiotelemetry should be fitted with the transmitters while they are held in captivity. In this way, problems with the backpack harness can be detected and solved more easily. It will also give the owls an opportunity to become accustomed to flying and hunting with the device while food is still being provided for them.

In New York City, two other areas are appropriate for an eastern screech-owl restoration/introduction: Prospect Park in Brooklyn and the Jamaica Bay Wildlife Reserve (JBWR) in Queens. Efforts to

establish eastern screech-owl populations should focus on these parks, especially JBWR, where the habitat, food base, and interest from bird-watchers and media are optimal. Important landscape-management issues should be discussed with park managers before release, including the use of brodifacoum as a rodenticide, the pruning of dead limbs and trees, and the provision of numerous cedar nest boxes. Consideration should be given to providing food for the owls at feeding station(s) for several weeks after the owls are released.

One difficulty in planning this restoration was determining how many owls should be released, since neither the rate of mortality for first-year (and older) birds could be determined in advance, nor the amount of territory each owl would need in Central Park. In comparing results from 1998 and 2001, it seems that the 18 eastern screech-owls simultaneously released in 2001 were a sufficient and reasonable number. However, in March 2002, owls were released at a time of the year when established pairs would have been defending breeding territories. No further releases should have been made until August 2002, when young owls would normally be dispersing from their natal territories.

If it becomes necessary to release additional eastern screech-owls to augment the population in the park, one method would be to partner with the Central Park Zoo (Wildlife Conservation Society). Since 2001 the zoo has had a captive pair of eastern screech-owls on display, along with a descriptive text of the owl-restoration project in the park. If its two captive owls could breed, and if the young were to fledge directly into Central Park, it would be an easy way to increase the number of young owls each year and to increase genetic diversity of the existing population in the park.

Finally, New York City is the media capital of the world, and this should be used to the advantage of the project and participating organizations. Biologists must be ready with a specific conservation message to impart to the general public. Careful thought should be given to the structure of the message, as well as to the information it provides. Currently, there is no printed information available for the general public describing the Central Park eastern screech-owls or the restoration project. I recommend that an educational brochure containing detailed information about the history of the eastern screech-owl in New York City be developed as quickly as possible.

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Glossary

Arthropod: An invertebrate animal belonging to the phylum Arthropoda, such as an insect or crustacean.

Avifauna: The birds of a particular region or time period.

Gene flow: The spread of genes through populations as affected by movements of individuals and their propagules (e.g., plant seeds). (*Penguin Dictionary of Biology*)

Necropsy: An examination and dissection of a dead body to determine cause of death or the changes produced by disease. (*Wordnet*; Princeton University)