

The  
**KINGBIRD**

New York State  
Ornithological  
Association, Inc.

Vol. 56 No. 3

September 2006



# SPRING 2004 VISIBLE NIGHT MIGRATION OF BIRDS AT THE EMPIRE STATE BUILDING, NEW YORK CITY

## **Robert DeCandido**

Hawk Mountain Sanctuary, Acopian Center  
for Conservation Learning,  
410 Summer Valley Road,  
Orwigsburg, Pennsylvania 17961

## **Deborah Allen**

P.O. Box 1452 Peter Stuyvesant Station  
New York, N.Y. 10009

In North America, reports of passage birds striking illuminated towers and other man-made structures date from the late 19th century (Coues 1876, Gastman 1886, Beebe 1954). Many studies have examined the composition and causes of large kills of night migrants at towers and buildings (e.g., Allen 1880, McAtee 1905, Aronoff 1949, Johnston and Haines 1957, Brewer and Ellis 1958, Kemper 1996, Morris et al 2003). Most nocturnal bird collisions occur on nights with inclement weather primarily from early August through late October at towers with fixed lights. Small nocturnally migrating songbirds, such as warblers and vireos, are the ones most likely to be killed. Here in New York State several studies have been published about night migrants colliding with tall towers (see Able 1963, Eaton 1967, Welles 1978, Clark et al. 2005). For North America, a summary of the extensive literature on the subject is provided by Avery et al. (1980), Trapp (1998) and Kerlinger (2000).

In New York City, ornithologists first reported the deaths of a few (< 25) nocturnal migrants from collisions with the Statue of Liberty beginning in May 1887, several weeks after the installation of electrical lights on that tower (see Anonymous 1889). Many more (~ 1500) were killed on the night of 22-23 August 1887, after the passage of the first autumn cold front that year (Anonymous 1889). Large numbers of birds (~ 750) killed during migration at the Empire State Building (ESB) on the foggy night of 11 September 1948 drew media attention to the problem (Anonymous 1948, Pough 1948, Aronoff 1949). In the mid-1950s, the National Audubon Society negotiated an agreement for night lights to be turned off on the ESB during spring and autumn migration (Anonymous 1957). Beginning in autumn 2001 through spring 2004, lights illuminating the upper floors of the ESB have sometimes remained on after midnight, and occasionally all night. While this situation has concerned birdwatchers, the effect(s) on nocturnal migrants passing the ESB have not been studied. Here we report a spring 2004 count of nocturnal migrants at the ESB, and some observations about the behavior of the birds in regard to the lights of the building.

## Methods

In spring 2004, from 19 April through 25 May (inclusive), a visual count of night migrating birds was made from the 86th floor outdoor observation deck (elevation ~ 325 meters/1050 feet above ground level) of the ESB in New York City. At ~ 450 m (1474 feet) above ground level, the ESB is the tallest structure in New York City, and provides an unobstructed view to the horizon in all directions. The majority of the night migrants were counted from the southwest corner of the observation deck since they primarily passed on the west side of the building. Birds were easily observed via the external metal halide spotlights used to illuminate the upper floors of the building, combined with the internal fluorescent lights of the tower that rises above the observation deck. The tower fluorescent lights were turned off at midnight, while the metal halide lights sometimes remained on all evening. On the observation deck, metal halide spotlights and fluorescent lights are used inside the gift shop to illuminate the store. These lights are easily seen through large, plate glass windows that surround the gift shop.

Migrating birds were counted by one observer using 8-10x binoculars and assisted at times by others who acted as spotters. Observations began at dusk (approximately 8:00 pm DST) nightly and usually ended at 11:45 pm DST when the observation deck was closed to all visitors. Weather conditions (wind speed, barometric pressure, temperature, humidity) were monitored hourly from the observation deck throughout the evening with a hand-held "weather station," the Kestrel 4000 (Nielsen-Kellerman Corporation, USA). Wind direction was determined with a compass. Time of sunset was obtained from data posted on the web site of the local weather service.

Observers scanned primarily south for approaching migrants. An individual was considered a migrant if it passed south-to-north across an imaginary east-west line at the watch site, and continued north out of sight. We were particularly interested in birds that "circled" the tower and/or observation deck. In circling behavior, birds were observed approaching the ESB and then making a complete, though loose, circle (oval) around the building. Sometimes the migrants would go out of sight as they dropped below eye-level or flew away (and out of the light) from the building. Because of the number of birds circling on big flight nights, on three occasions, it was necessary to estimate the actual number of migrants from 10:00 pm to 11:45 pm (DST). On these nights, we counted the number of migrants passing the ESB each hour, and then added to this total the highest number of migrants we observed circling the tower for that hour.

In order to determine if there was any relation between nights when large numbers of migrants were counted and the numbers of birds seen the following day in Central Park, we examined numbers of warbler species reported each day in the park in April-May 2004. Since there was no way to assess overall abundance of migrants in Central Park, we assumed that days when the greatest number of warbler species were reported likely indicated that a large number of individuals were

migrating the previous evening over Manhattan. Conversely, we also wanted to know if nights when large numbers of migrants were counted at the ESB were related to high numbers of warbler species seen the following day in Central Park.

## Results

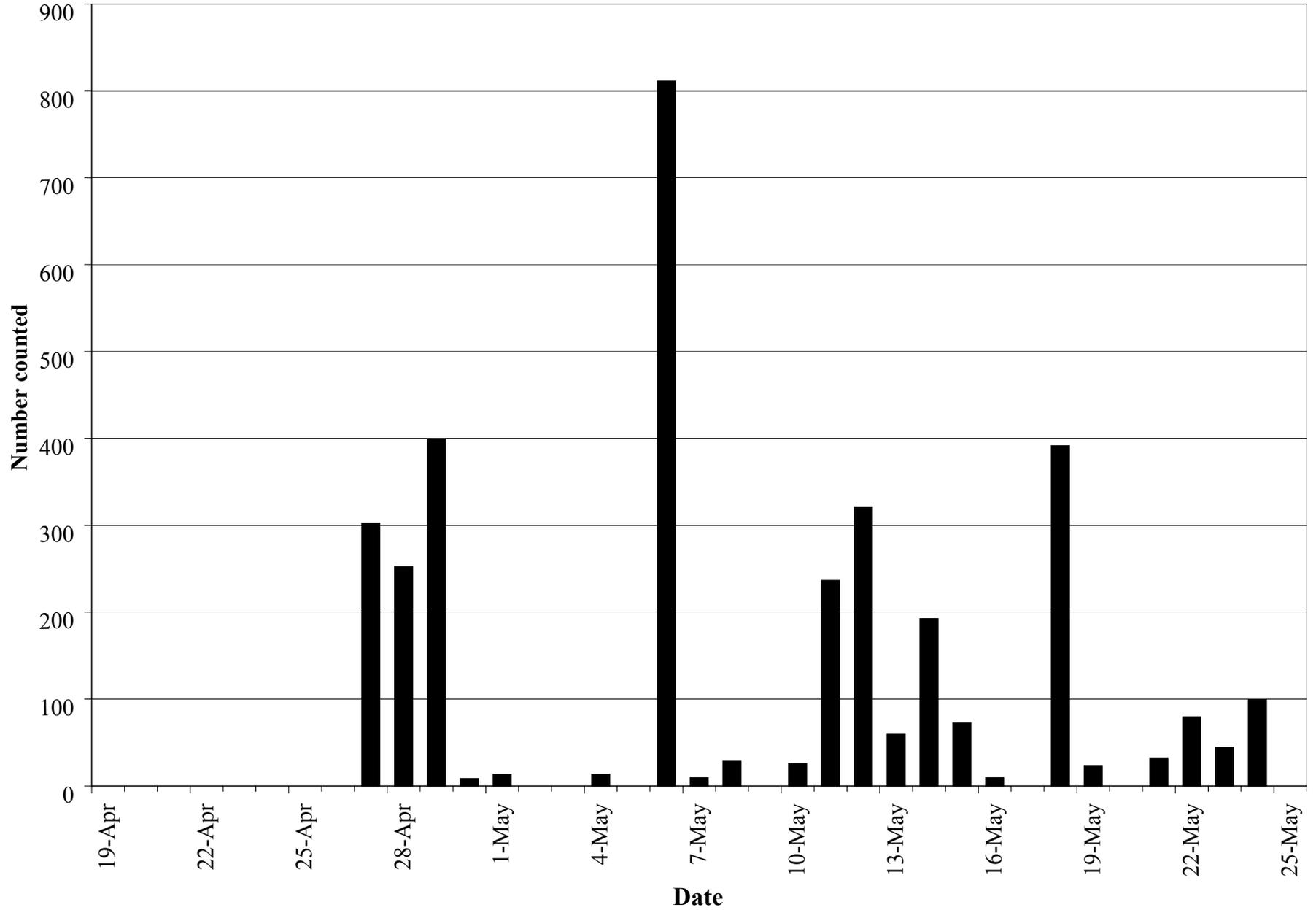
In total, we counted 3,415 migrants in 117 observation hours ( $\bar{Y} = 29.2$  birds/hour;  $s = 52.9$ ) on 33 evenings (Figure 1). Migration was observed on 22 evenings (66% of observation nights), even on nights with rainy weather (e.g., 27 April; 5 May). The upward directed lights of the building as well as the internal tower lights provided enough illumination to detect migrants that flew within 50 m to our left (east) or right (west), and up to approximately 20 m above the top of the tower (1550 feet). Very few (161) migrants could be identified to species or even particular groups of birds. These were shorebirds (103), waterfowl (29), gulls (18), loons (4), as well as Black-crowned Night Heron (5) and Common Nighthawk (2). On two occasions (24 April; 2 May), lone Peregrine Falcons landed after dark on the tower above the observation deck. See DeCandido and Allen (2006) for detailed information regarding nocturnal activities of peregrines at the ESB. See DeCandido et al. (2006) for details about night migrating Ospreys at the ESB. Lone bats were observed migrating on four evenings.

On average, the first migrant was seen 65 minutes past sunset each evening (earliest = 45 min past sunset on 29 April; latest = 112 min. past sunset on 27 April). Our data suggest that the number of migrants passing the ESB peaked after midnight (Figure 2). Significantly more migrants were seen when winds were from the south to west, than when winds were from other directions ( $\chi^2 = 923.1$ ;  $P < 0.05$ ). The majority of migrants (71%) were seen when winds were  $>10$  mph. Significantly more migrants were observed with rising rather than falling or steady barometric pressure ( $\chi^2 = 406.3$ ;  $P < 0.05$ ). On flight nights when more than 50 migrants were seen, significantly more migrants were counted when skies were partly cloudy ( $< 80\%$  cloud cover) or clear, than when it was mostly cloudy (80-100% cloud cover) or foggy ( $\chi^2 = 6.3$ ;  $P < 0.05$ ). Both the highest single hour count (319) and highest evening count of migrants (811) occurred on 6 May with west to southwest winds, rising barometric pressure and mostly cloudy sky conditions.

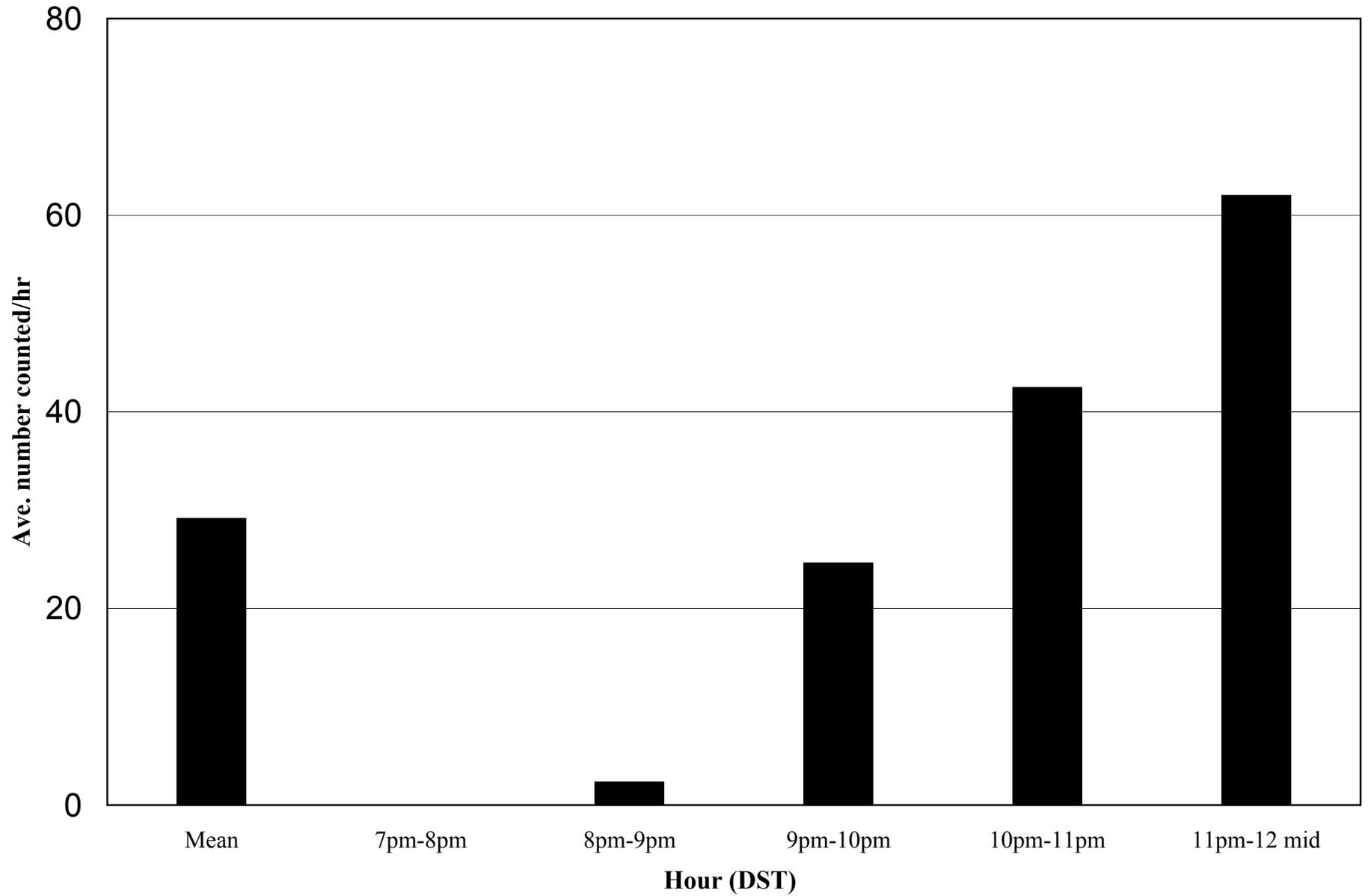
D. Allen (2004) reported for Central Park that observers found 15 or more warbler species in spring 2004 on six days (April 23; Apr. 29; May 4; May 9; May 20; May 26). According to Figure 1, on only one evening (April 28) that preceded these high warbler species counts, were  $\geq 100$  migrants counted at the ESB. However, following the night (May 6) with the highest migration count in spring 2004, large numbers of migrants were seen the next day in Central Park (pers. obs.).

On big flight nights, it was our impression that passerines typically arrived in waves or "loose associations" of 5-15 migrants throughout the evening, and neither randomly nor in tight flocks (see Balcomb 1977 for a similar observation). Migrant birds used "bounding" flight (*sensu* Kerlinger 1995). When winds were light ( $< 15$

**Figure 1. Number of Migrants Counted from 19 April through 25 May 2004 at the Empire State Building, New York, NY.**



**Figure 2. Average Number of Migrants Counted/hr at the Empire State Building, 19 April-25 May 2004, New York, NY.**



mph) migrants tended to fly at higher elevations, with many passing near/above the top of the tower. When winds were stronger (at least 15-20 mph) migrants tended to fly at the level of the observation deck.

No migrants were observed striking the observation deck or the tower of the ESB during this study. Occasionally, until about 10 May 2004, up to 5% of the migrants on big flight nights were observed circling the tower of the ESB for 1-5 minutes before resuming migration. On one occasion, a migrant circled the tower for 25 minutes (8 May 2004). We were able to study this migrant (a wren sized bird) from ca. 10:35pm until 11:00pm since there were only 13 other migrants that hour. The bird remained above the observation deck and within sight for the entire time.

After 10 May, more migrants (up to 25% on big flight nights) circled the tower for longer time periods ( $\leq 15$  minutes). On the evening of 12 May, the greatest number of birds (40) simultaneously circled the ESB after 10:00 pm (DST). Though we could not determine how long an individual bird may have circled the ESB on these big flight nights, it seemed as though the number of birds circling would increase, and then decrease, at intervals. On several occasions we saw birds that had been circling continue north and out of sight. We could not be completely certain if others landed or struck the building below the observation deck. Overall, light winds ( $< 15$  mph) and cloudy skies ( $> 50\%$  cloud cover) were associated with higher numbers of migrants circling the tower. On nights with strong winds ( $> 15$  mph), some migrants attempted to circle the tower, but had difficulty flying back against the wind. Many of these remained aloft on the lee side of the tower, before resuming migration with strong, southerly tail winds.

## Discussion

According to early observations made by J. Dwight, Jr. and others at the Statue of Liberty (see Anonymous 1891), bird collisions with that structure at night were rare in spring and much more common during autumn migration: "Only on a few nights every autumn, however, is there a marked destruction of birds, while in the spring the loss of a feathered life is very rare. The principal sufferers against the hard sides of the Statue have been the little Maryland [common] yellow throats, which have furnished about 75% of the dead fliers, except in the present year [autumn 1891], when the slate-colored junco outnumbers them on the record. A total of 345 birds was recorded in 1890. So far this year [Nov. 1891], the record is 386."

Studies of bird collisions at towers indicate that structures taller than 120-160 m kill many more birds than smaller ones (Kemper 1996; Kerlinger 2000). Illuminated towers with guy lines are particularly hazardous to nocturnal migrants. Since most small, night migrating birds travel with favorable tail winds primarily at altitudes between 200-800 m above ground level (Gauthreaux 1991; Moore et al 1995, Gauthreaux and Belser 2003), the observation deck of the Empire State Building provides a unique opportunity to study this migration, and observe the behavior of the migrants as they approach the building lights.

Our results suggest that the ESB, a lone super-structure rising sharply above the surrounding buildings of mid-Manhattan, is not an important obstacle to nocturnal migrants in spring. We did not see a single bird strike either the building or the tower during this study. However, since we were not able to observe the migration after midnight, we do not know if the behavior of the migrants changed after this time due to fatigue or other (unknown) factors. We also do not know if the illuminated lower floors of the building proved to be hazardous to migrants throughout the night. On the other hand, no dead birds were reported or brought to us by building staff who monitored the observation deck and outdoor terraces on the lower floors during our spring 2004 survey. Though birds have been known to strike the ESB during migration seasons in the past, there have been no reports of large (>100) numbers of migrants striking the building at night since ca. 1980. Why fewer birds now strike the building than in the past may be due to (a) differences in the type of lighting used at the ESB now compared to the 1940-1960s; (b) fewer birds migrating at night in northeastern North America due to overall population declines that have occurred for a variety of reasons; (c) a greater number of illuminated tall structures in the metropolitan area today, so that migrants are not concentrated near one tower. Since at least 2000, more migrant birds are killed each year in New York City after colliding with plate glass windows at or near ground level than are killed at the Empire State Building (Seewagen 2007). Other long-term studies in New York State and elsewhere have also documented that since ca. 1990, fewer birds are now killed by colliding with towers and their associated support structures (guy lines) at night during migration (see Morris et al. 2003).

Migrants reacted differently to the building lights early vs. late in the season. Before 10 May, we rarely saw migrants circling the tower or building. After this date, especially on foggy nights or when skies were 100% overcast with light wind (< 15 mph), small birds were more likely to circle the ESB. It appeared to us that their migration was delayed by up to 15 minutes and not otherwise affected to any great degree. We were able to visually verify that some of the birds that circled the ESB were able to continue their migration. On several occasions, we observed migrants land on the building, especially in inclement weather (e.g., 13 May).

When south to west winds exceeded 15 mph, a few migrants occasionally started to circle the ESB. However, when these birds encountered a head wind on turning a corner of the ESB, they would usually hang in the oncoming wind for a few seconds, and then resume their northward migration with the wind at their backs again. For more information about the effect of strong wind upon halting the circling behavior of birds at the ESB, see DeCandido 2005. In both spring and fall, the vast majority (>99%) of circling birds did so in a counter-clockwise direction around the building (see DeCandido 2005). This is most readily observed from street level (east side of Fifth Avenue between 32<sup>nd</sup> and 35<sup>th</sup> streets) as one looks up toward the tower. On such nights, it is possible to see migrants moving slowly outside of the illuminated area near the tower and into the darkness, and then returning to the illuminated area again. Similar observations to ours about the behavior of small

birds circling illuminated towers at night have been made by Cochran and Graber (1958) and Larkin and Frase (1988).

Studies have also shown that birds collide with towers and buildings principally on foggy evenings or nights with low cloud cover, since the migrants are forced to lower elevations by inclement weather (Seets and Bohlen 1977). In Manhattan in spring, fog occurs with easterly winds that bring in cool, moist air, while most migration was observed when winds were from the south to west. Migrants such as gulls, waterfowl, shorebirds and even bats were not attracted to the lights of the ESB at any time in any weather conditions during this study. Other birds, such as Peregrine Falcons, used the light of the ESB to their advantage (DeCandido and Allen 2005). However, 19<sup>th</sup> century scientists, occasionally found that waterfowl and shorebirds (but not gulls and bats) collided with Lighthouses in North America and Europe (see Dutcher 1889). Reports from other cities indicate that tall, illuminated structures can be hazardous to nocturnal migrants (Overing 1938; Evans Ogden 1996). It is likely that most North America cities, with their unique arrangement of tall buildings each with its own lighting scheme, pose different challenges to migrants. Site specific studies are necessary to determine if, when and how particular skyscrapers pose hazards to birds migrating at night high above the city.

## Recommendations

The observation deck of the Empire State Building offers a unique opportunity to observe and enjoy the night migration of birds during spring and autumn. Persons interested in seeing large numbers of night migrants in spring should visit the Empire State Building on nights when winds are from the south to west, during the last few days of April through the first half of May (see Figure 1). In autumn, the best nights to see the highest number of migrants is during the first two weeks of October, on nights when winds are from the west to northwest after the passage of a “cold front” (see DeCandido 2005; DeCandido and Allen 2006). Check weather forecasts for the New York City area: [www.weatherunderground.com](http://www.weatherunderground.com), and make advanced plans accordingly, including on-line purchase of tickets (\$20/person) to the observation deck of the ESB.

In the past, the management of the ESB kindly agreed to keep the building lights off each night during spring and fall migration seasons (see Anonymous 1957). The current policy is to turn the external, upward directed halogen lights off when significant numbers of birds are observed circling the ESB. We suggest a return to the previous policy of lights out from dusk to dawn on certain evenings during the migration: foggy and rainy nights from 20 April through 31 May, and again on nights with inclement weather from 1 August through 30 October (see recommendations in DeCandido 2005).

We suggest that a descriptive flyer (brochure) providing information about the night migration of birds over New York City be distributed to Security Guards and other personnel who work on the observation deck of the ESB. Readily available information would make these important observers aware of what to look for on potential problem nights. In this way, observers could notify the ESB engineer in

charge of lighting to turn off the lights if birds begin colliding with the ESB. The descriptive brochure could provide accurate information about the night migration, including: Why do birds migrate at night? Why do birds circle the tower of the ESB? Why are Peregrine Falcons seen at the ESB at night? What to look and listen for when studying night migration, etc. Such a brochure that emphasizes the interesting and unique observations that can be made at the ESB would also be of interest to the general public as well. The brochure could be developed by New York City Audubon, New York State Audubon, National Audubon, or the New York State Ornithological Association, or all four organizations in collaboration, and sold at the gift shop of the ESB.

Finally, future studies should be considered from midnight to dawn in order to determine if the number and behavior of migrating birds varies significantly from what we observed from dusk until 11:45 pm (DST).

## ACKNOWLEDGEMENTS

The authors wish to thank Lydia A. Ruth of the Empire State Building Corporation for granting permission to use the observation deck of the Empire State Building in order to do this study. Ms. Ruth and the entire ESB staff have been delightful to work with, and interested in the results of this study. They have been a model for how the private sector and scientists can work together to quickly and effectively achieve shared goals. Discussions with Chad Seewagen of the Wildlife Conservation Society clarified ideas about nocturnal migration, and the general condition of migrants during spring. We also acknowledge the fine work done by Rebekah Creshkoff and the Project Safe Flight team of citizen-scientists from New York City Audubon. They have been instrumental in rescuing migrant birds that have collided with buildings in spring and fall, and simultaneously raising awareness of migratory birds with workers and executives in Manhattan. Jorge Santiago made us aware of several articles about nocturnal bird collisions published in the New York Times since 1888. We thank Daniel Klem, Jr. who critically read versions of this manuscript, and directed the authors to historical references regarding nocturnal bird collisions with towers and buildings. Shai Mitra, Paul Kerlinger, Scott J. Wiley and an anonymous reviewer suggested ideas that significantly improved this publication. We thank the many birdwatchers that came up to the observation deck to help us count (and enjoy) the night migrants, particularly Sandra Critelli, Cindy Meador and S. J. Wiley. Funding for this study came from Alice Barner and Patricia Essler, as well as the authors. We dedicate this publication to Dr. Christine Sheppard and the bird keepers at the World of Birds at the Wildlife Conservation Society (Bronx Zoo). For five generations, the Department of Ornithology has helped make people aware of birds in the metropolitan area and beyond.

## Literature Cited

- Able, K.P. 1963. Television tower mortality in the Niagara frontier during fall 1962. *Kingbird* 13:192-195.
- Allen, D. 2004. Central Park Report – Spring 2004. PDF format. 29 p.
- Allen, J.A. 1880. Destruction of birds by Light-houses. *Bulletin of the Nuttall Ornithological Club* 5: 131-138.
- Anonymous. 1889. Birds and their habits discussed by the Ornithologists' Union. *New York Times* Vol. 38: 4 (14 November 1889).
- Anonymous. 1891. In and about the city: birds and their habits. *New York Times* Vol. 40: 4. (19 November 1891).
- Anonymous. 1948. Fog is blamed as birds die hitting Empire State Building. *New York Times* Vol. 97: 1-3 (12 September 1948).
- Anonymous. 1957. Empire beacon doused to save birds on wing. *New York Times* Vol. 106: 16 (14 April 1957).
- Aronoff, A. 1949. The September migration tragedy. *Linnaean News-Letter* 3: 1-2.
- Avery, M.L., P.F. Springer, and N.S. Dailey. 1980. Avian mortality at man-made structures: An annotated bibliography (revised from 1978 ed.). U.S. Fish and Wildlife Service, Biological Services Program, National Power Plant Team. Spec. Sci Rep. 215:1-16. FWS/OBS-80/54
- Balcomb, R. 1977. The grouping of nocturnal passerine migrants. *Auk* 94:479-488.
- Beebe, W. 1954. Migration Night – 1904. *Animal Kingdom* 57(2): 54-57.
- Brewer, R. and J.A. Ellis. 1958. An analysis of migrating birds killed at a television tower in east-central Illinois, September 1955-May 1957. *Auk* 75: 400-414.
- Clark, A.C., C.E. Bell and S.R. Morris. 2005. Comparison of daily avian mortality characteristics at two television towers in western New York 1970-1999. *Wilson Bulletin* 117:35-43.
- Cochran, W.W. and R.R. Graber. 1958. Attraction of nocturnal migrants by lights on a television tower. *Wilson Bulletin* 70: 378-380.
- Coues, E. 1876. The destruction of birds by telegraph wire. *American Naturalist* 10(12): 734-736.

- DeCandido, R. 2005. Autumn 2004 Visible Night Migration of Birds at the Empire State Building, New York City, New York. PDF format. 25 p. Available from the author: rdcny@earthlink.net
- DeCandido, R. and D. Allen. 2006. Nocturnal hunting by Peregrine Falcons at the Empire State Building, New York City. *The Wilson Journal of Ornithology* 118(1): 53-58.
- DeCandido, R., R.O. Bierregaard, Jr., M.S. Martell and K.L. Bildstein. 2006. Evidence of nocturnal migration by Osprey (*Pandion haliaetus*) in North America and Western Europe. *Journal of Raptor Research* 40(2): 156-158.
- Dutcher, W. 1889. Bird Notes from Long Island. *Auk* 6: 134-135.
- Eaton, S.W. 1967. Recent tower kills in upstate New York. *Kingbird* 17(3): 142-147.
- Evans Ogden, L.J. 1996. Collision Course: The Hazards of Lighted Structures and Windows to Migrating Birds. World Wildlife Fund Canada and the Fatal Light Awareness Program. World Wildlife Fund, Canada.
- Gastman, E.A. 1886. Birds killed by electric light towers at Decatur, Ill. *American Naturalist* 20: 981.
- Gauthreaux, S. A., Jr. 1991. The flight behavior of migrating birds in changing wind fields: radar and visual analysis. *American Zoologist* 31: 187-204.
- Gauthreaux, S. A. and C.G. Belser. 2003. Radar Ornithology and Biological Conservation. *Auk* 120: 266-277.
- Johnston, D.W. and T.P. Haines. 1957. Analysis of mass bird mortality in October 1954. *Auk* 74: 447-458.
- Kemper, C. 1996. A study of bird mortality at a west central Wisconsin TV tower from 1957-1995. *Passenger Pigeon* 58:219-235.
- Kerlinger, P. 1995. How birds migrate. Stackpole Books. Mechanicsburg, PA. USA.
- Kerlinger, P. 2000. Avian mortality at communicating towers: a review of recent literature, research, and methodology. Prepared for the United States Fish and Wildlife Service Office of Migratory Bird Management. Available from: [www.migratorybirds.fws.gov/issues/towers/review/pdf](http://www.migratorybirds.fws.gov/issues/towers/review/pdf) (accessed 7 January 2007).
- Larkin, R. P., and B.A. Frase. 1988. Circular paths of birds flying near a broadcasting tower in cloud. *Journal of Comparative Psychology* 102:90-93.
- McAtee, W.L. 1905. Do migrants fast? *Auk* 22: 320-321.

- Moore, F.R., S.A. Gauthreaux, Jr., P. Kerlinger and T.R. Simons. 1995. Habitat requirements during migration: important link in conservation. Pages 121-144 in T.E. Martin and D.M. Finch, eds. Ecology and Management of Neotropical Migratory Birds. Oxford University Press. New York.
- Morris, S.R., A.R. Clark, L.H. Bhatti, and J.L. Glasgow. 2003. Television tower mortality of migrant birds in western New York and Youngstown, Ohio. 2003. *Northeastern Naturalist* 10: 67-77.
- Overing, R. 1938. The 1937 fall migration at the Washington Monument. *The Wilson Bulletin* 50: 146.
- Pough, R. H. 1948. Out of the night sky. *Audubon Magazine* 50: 354-355.
- Seets, J.W. and H.D. Bohlen. 1977. Comparative mortality of birds at television towers in central Illinois. *Wilson Bulletin* 89: 422-433.
- Seewagen, C.L. 2007. Lipid content of Nearctic-Neotropical migratory passerines killed during stopovers in a New York City park. *Northeastern Naturalist*. In review.
- Trapp, J. L. 1998. Bird kills at towers and other man-made structures: an annotated partial bibliography (1960-1998). U. S. Fish and Wildlife Service web report: [www.fws.gov/r9mbmo/homepg.html](http://www.fws.gov/r9mbmo/homepg.html) (accessed 7 January 2007).
- Welles, M. 1978. TV tower kills at Elmira. *Kingbird* 28(3): 159-161.