

HABITAT USE AND MIGRATION CHRONOLOGY OF WATERFOWL ON THE UPPER HUDSON RIVER, NEW YORK

Guy A. Baldassarre¹ and Joshua Stiller²

SUNY College of Environmental Science and Forestry
Syracuse, NY 13210

ABSTRACT—We studied waterfowl use and migration chronology along New York's upper Hudson River (Baker's Falls to Troy) in relation to waterfowl use in the rest of the state. Biweekly or monthly surveys were conducted from mid-June 2007 to mid-May 2010 ($n = 48$), during which time we detected 20 species of ducks, two species of geese, and one species of swan. Excluding Canada Geese (*Branta canadensis*), we tallied 29,863 individual waterfowl: primarily Mallards (*Anas platyrhynchos*; 45.3%), Common Goldeneyes (*Bucephala clangula*; 21.5%), Common Mergansers (*Mergus merganser*; 11.3%), and American Black Ducks (*Anas rubripes*; 7.2%); the remaining 18 species were <4% each, with 15 species <1.5% and 12 species <0.25%. Of the four most common species, Mallards (5,814 mean annual sightings) occurred year-round, but were most abundant during winter and spring migration (63.1%). Their numbers, however, were low in comparison to the lower Hudson River and other areas of the state. Breeding pair estimates varied from 39–48, and were only 0.05% of the 10-year (2001–10) statewide average. Common Goldeneyes (3,003 mean annual sightings) occurred as migrant and wintering ducks (91.6%) and were disproportionately distributed along the river: 28.9% were immediately above and below the Fort Miller Dam associated with Lock 6, and 11.9% were immediately below the Lock 5 Dam in Stillwater. Common Mergansers (3,371 mean annual sightings) were also primarily migrant and wintering birds (83.2%), with very few observed during the breeding season; no broods were observed. Black Ducks (866 mean annual sightings) were largely migrant and wintering ducks (87.9%). Only 2.1% occurred during the breeding season, but some of those were likely late migrants. Wood Ducks (*Aix sponsa*; 475 mean annual sightings) were the only other waterfowl species observed that also are a common breeding species in New York. Most (81.4%) were observed as spring migrants or during the breeding season. Our highest breeding pair estimate was 36, which is 0.08% of the 10-year (2001–10) statewide average. Overall, the upper Hudson River provided habitat for an array of waterfowl species, but none were in abundance, except for the Canada Goose (47,398 mean annual sightings), which mostly occurred during spring migration (51.0%) in commercial sod fields adjacent to the river. Our study shows that the upper Hudson River is utilized by waterfowl primarily as a short-term stopover during migration and infrequently as breeding habitat due to an absence of prime waterfowl habitat.

¹Deceased, August 2012

²Present address: 5196 Shero Road, Hamburg, N.Y. 14075; Joshua.Stiller@gmail.com

INTRODUCTION

Documentation of migration chronology and seasonal use of a particular area by waterfowl is an essential prerequisite to assess conservation importance. However, although major waterfowl habitats have long been recognized (e.g., Prairie Pothole Region, Gulf Coast, Central Valley of California), much less information exists for other areas that may be regionally or locally important. In addition, habitat importance may vary seasonally throughout the waterfowl annual cycle. For example, a specific habitat may be important for a given species or group of species during winter and migration, but comparatively unimportant as a breeding area, and yet those habitat functions are not assessed for many areas.

The Hudson River is a dominant landscape feature in the eastern portion of New York. Situated below Lake Champlain in New York and adjacent Vermont, the Hudson provides habitat for breeding, wintering, and migrating waterfowl. However, little information exists for waterfowl use of the Hudson River, except for an annual winter waterfowl survey that has been conducted throughout New York since 1955 (excepting 1968-72) by the New York State Ornithological Association (<http://www.nybirds.org/ProjWaterfowl.htm>), and the recently updated Breeding Bird Atlas for New York (McGowan and Corwin 2008). The Midwinter Waterfowl Survey of the U.S. Fish and Wildlife Service included an annual survey of much of the Hudson River, but was discontinued in 1997, although parts of the survey are still conducted elsewhere. Hence, the purpose of this study (2007-10) was to document the species composition and number of waterfowl using this portion of the Hudson River in relation to the annual cycle (i.e., winter, migration, and breeding).

STUDY AREA

The Hudson River extends 315 river miles (507 km) from its source at Lake Tear of the Clouds in the Adirondack Mountains to its terminus at the Battery on Manhattan Island. The associated watershed encompasses 34,680 km² in New York and four other states (Moran and Limburg 1986). The upper third of the Hudson River extends undisturbed through the Adirondack State Park at a relatively steep gradient of 3.1 m/km to the first major settlements of Glens Falls, Hudson Falls, and Ft. Edward, 10 km south of the Adirondack Park boundary. The river gradient then reduces to 0.62 m/km south of the Adirondacks and passes through a surrounding landscape mixture of farmland and eastern deciduous forest. South of Hudson Falls/Ft. Edward, the river contains a series of locks and dams associated with the Champlain Canal system (Locks 1-7), before reaching the Federal Dam in Troy at river mile 149. South of the Federal Dam, the Hudson River is influenced by tidal activity, contains no dams, and falls only 0.006 m/km to its mouth. Marshes and tidal mudflats are an important feature along this section of the Hudson (Moran and Limburg 1986).

Our study encompassed the section of river from the Baker's Falls Dam in the village of Hudson Falls to the Federal Dam in Troy; about 50 river miles (80 km; Fig.1). The various locks and dams in this section enable significant control

of water levels and flows, which has dramatically reduced overbank flooding and promoted lake-like conditions during much of the year, especially summer. The locks and dams also form nine distinct reaches or sections of the river. Reach 9 extends 2.1 miles (3.4 km) from Baker's Falls Dam to the former Fort Edwards Dam and totals 117 acres (47 ha). Reach 8 extends 6.8 miles (11.0 km) from about river mile 195 (the former Ft. Edwards Dam) just above Lock 7 to the Thompson Island Dam and totals 547 acres (222 ha). Reach 7 extends 2.2 miles (3.5 km) from the Thompson Island Dam to the Fort Miller Dam (Lock 6) and totals 237 acres (96 ha). Reach 6 extends 2.8 miles (4.5 km) from the Fort Miller Dam to the Northumberland Dam just above Lock 5 and totals 274 acres (111 ha). Reach 5 extends 15.3 miles (24.6 km) from the Northumberland Dam to the Stillwater Dam (Lock 4) and totals 1,356 acres (549 ha). Reach 4 extends 2.3 miles (3.7 km) from the Stillwater Dam to Lock 3 and totals 368 acres (149 ha). Reach 3 extends 2.6 miles (4.2 km) from Lock 3 to Lock 2 and totals 291 acres (118 ha). Reach 2 extends 4.1 miles (6.6 km) from Lock 2 to Lock 1 and totals 443 acres (179 ha), and Reach 1 extends 5.9 miles (9.5 km) from Lock 1 to the Federal Dam in Troy and totals 856 acres (347 ha).

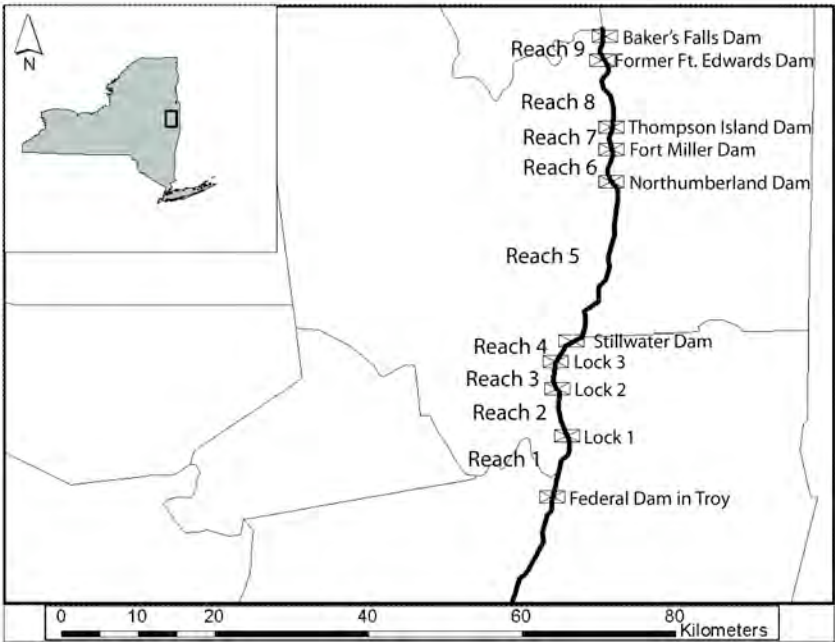


Figure 1. Map of the area surveyed on the upper Hudson River in New York showing the 9 sections (Reaches) in which waterfowl were observed.

METHODS

We surveyed waterfowl from mid-June 2007 to mid-May 2010. Observations were made with binoculars and a 60× spotting scope from and between 77 survey points established along the shoreline, which allowed visibility of virtually 100% of the river, especially during winter. This section of the Hudson is very road accessible from both the east and west sides. We tallied all waterfowl seen on the river, as well as on wetlands in the adjacent floodplain, which was generally within 400-500 ft (364-455 m) of the river. However, floodplain wetlands were few, and almost all were seasonal in nature, drying by mid- to late spring. We also tallied flying birds (<0.5%) when they were moving upriver to sections already surveyed. Common names follow those of the American Ornithologists' Union, which also lists the scientific names (American Ornithologists' Union 1998).

Surveys ($n = 48$) were conducted monthly (mid-month) during the summer period, May to September. Surveys became biweekly from October 2007 through April 2008 to assess peak waterfowl migration and breeding and the possible need for future biweekly surveys during those months. We also did bi-weekly surveys from October-December 2008 after which monthly surveys (mid-month) were deemed sufficient (mid-April to mid-Mar). A single observer with over 30 years of professional experience as an ornithologist and waterfowl biologist (Baldassarre) conducted all surveys. Almost all surveys were conducted over a two-day period, beginning just below the Baker's Falls Dam in Hudson Falls and ending at the Federal Dam in Troy. Surveys generally began about noontime on day one and finished by early to mid-afternoon on day two. Surveys were not conducted during periods of heavy rain or snowfall.

All waterfowl were identified and tallied by sex when conditions and numbers allowed.

We recognized a priori that many factors affect waterfowl detectability during ground-based surveys, but most of those effects are small (2-5%) as Pagano and Arnold (2009) noted during surveys of breeding waterfowl in North Dakota. They also noted that detection probability was 0.91 for an experienced observer. Hence, given the comparatively small number of waterfowl using this stretch of the Hudson River (see Results and Discussion) and the number of years we surveyed (three), our approach was deemed adequate to assess year-round waterfowl use along this section of the river. We estimated the number of Mallard and Wood Duck pairs, during the late March and mid-April surveys of 2009 and 2010, using the criteria reviewed by Brasher et al. (2002) and modified by site tenacity and isolation, which were clearly exhibited by locally breeding pairs as compared to migrants. Canada Geese were readily identified as pairs on breeding territories during these sample periods, although yearling pairs do not nest (Moser and Rusch 1989).

We compared our results, in part, to the 10-year average (1998-2007) winter waterfowl count in Regions 8 and 9 during the annual statewide survey conducted under the auspices of the New York State (NYS) Ornithological Societies. Region 8 includes a large part of the upper Hudson River from Green and Columbia Counties north through Warren County, whereas Region 9

includes a large part of the lower Hudson River from Ulster and Dutchess Counties south. Not all individuals of all species tallied in the regions are necessarily on the Hudson River, but the long-term database provides a valid comparison with our results, especially for species like Common Goldeneye and Common Merganser, where most birds recorded in these regions were very likely on the Hudson River. We also compared our data on breeding pairs of Mallards and Wood Ducks to the 10-year average (2001-10) number of breeding pairs reported from the Atlantic Flyway (AF) Breeding Waterfowl Plot Survey for New York and for its Stratum 13 that included the Hudson River from Orange and Putnam counties north to Washington County; the extent and associated techniques of which are outlined by Heusmann and Sauer (2000).

RESULTS AND DISCUSSION

We detected 20 species of ducks, two species of geese, and one species of swan during our three-year study. Excluding Canada Geese (132,322 individuals), we detected 29,863 waterfowl of which Mallards were the most abundant species (45.3%), followed by Common Goldeneyes (21.5%), Common Mergansers (11.3%), and American Black Ducks (7.2%; Table 1). Hooded Mergansers (*Lophodytes cucullatus*), Ring-necked Ducks (*Aythya collaris*), and Wood Ducks each comprised only 3.3-3.8%, while the remaining 15 species comprised <1.5% each; 12 species were <0.25%.

Mallards. Mallards (5,814 mean annual sightings) occurred year-round on the river, but they were most abundant during winter and spring migration, mid-December to late March (63.3%), followed by 29.5% from mid-July through late November; 92.8% combined (Fig. 2a). The most Mallards were recorded on the only late February survey, which was conducted in 2008 (15.7%), followed by late January (9.4%), mid-February (8.6%), and mid-March (6.1%). Mallards were relatively concentrated from mid-December through late March, with 20.9% observed above and below the Stillwater Dam, where they were often fed by local residents.

The number of Mallards seen in any one survey ranged from 295-910. The number of Mallards as determined during the NYS Ornithological Association's winter waterfowl survey in New York (1998-2007) was only 1,556 for Region 8 (upper Hudson River) and 3.8% of the statewide total. In comparison, the average number in Region 9 (the lower Hudson River) was 3,291 or 8.0% of the statewide total. The most Mallards (10,197; 24.8%) were tallied in Region 10, which is New York City and Long Island. Hence, these comparative data support a conclusion that the upper Hudson River does not provide an important wintering or migration habitat for Mallards.

The estimated number of Mallard pairs was 43-48 in 2009 and 39-42 in 2010. Most pairs were in Reach 5 (10-15), followed by Reach 8 (8-12), and Reach 1 (5-13). The average number of breeding pairs from the AF Breeding Waterfowl Plot Survey (1998-2007) was 93,785 for New York and 5,277 for Stratum 13; hence our estimate of 39-48 pairs on the upper Hudson River is only

0.04-0.05% of the statewide average and 0.7-0.9% of the Stratum 13 average. Given this small number of breeding pairs, the number of young produced would be very low, especially after nest success, hen success, and brood survival are considered.

Mallard harvest in the counties along the upper Hudson River (Saratoga, Washington, Schenectady, Rensselaer, Albany) averaged 4,569 from 1987 through 2006, in comparison to 84,448 harvested in the entire state during the 2006-07 waterfowl hunting season; about 5.4% of the statewide harvest (U.S. Fish and Wildlife Service). The actual harvest on the river would likely be much lower because of the low numbers of ducks present, and the inaccessibility to hunters of the many birds associated with towns and municipalities.

Common Goldeneye. Common Goldeneyes (3,003 mean annual sightings) occurred as migrant and wintering ducks on the river, with 91.6% tallied from late December through late March as compared to only 7.6% from mid-November through mid-December (Fig. 2a). Overall, Common Goldeneyes were disproportionately distributed along the river, with 24.5% occurring on Reach 6, followed by 21.6% in Reach 4, 18.8% in Reach 7, and 15.2% in Reach 8 (80.1% total). Common Goldeneyes also were concentrated at two specific locations during the peak period of abundance: 28.9% immediately above and below the Fort Miller Dam, Lock 6, and 11.9% immediately below Lock 5. Birds were always observed feeding in the outflows and pools below these dams, because these areas were always ice free. The well-oxygenated water also probably enhanced habitat for populations of mollusks, crustaceans, and aquatic insects, which are the preferred foods of the Common Goldeneye (Eadie et al. 1995).

The average number tallied during the seven survey periods associated with migration and winter ranged between 244 and 640 birds, which is small in comparison to the NYS Ornithological Association's 10-year average of 2,172 for Region 8 (1.5% of the state total) and 3,898 in Region 9 (2.6%). The most Common Goldeneyes (32,982) were tallied in Region 2 (22.0%), which is in western New York and includes much of the south shore of Lake Ontario.

Hence, the number and distribution of Common Goldeneyes we tallied during our surveys indicate that the upper Hudson provides consistent wintering and migration habitat, but not for large numbers of individuals. Further, nearly all of the peak use period on the river was outside the hunting season.

Common Merganser. Common Mergansers (1,464 mean annual sightings) were primarily migrant and wintering ducks on the river, with 83.2% occurring between mid-December and mid-March (Fig. 2a). The most Common Mergansers occurred in late February (16.9%), followed by mid-February (13.2%). Only 3.9% were detected during the breeding season (mid-April through mid-August). During midwinter, Common Mergansers occurred wherever open water prevailed, even if only small openings occurred among larger ice-covered areas.

During mid-December to mid-March, the average number tallied per survey ranged between 147 and 247 birds. In comparison, the 10-year average from the NYS Ornithological Association's winter waterfowl survey was 398 for Region 8, which was 4.5% of the statewide total, and 1,108 (13.2%) in Region 9. The largest average number (24,482) occurred in Region 1 (27.4%), which includes the shores of Lakes Erie and Ontario, a known winter concentration site for Common Mergansers in New York. Hence, although widely distributed during winter and migration, the upper Hudson River does not support large numbers of Common Mergansers during this time in comparison to other areas of the state. Additionally, because of their poor taste, Common Mergansers are not widely sought by hunters.

Common Mergansers likely do not commonly breed on the upper Hudson River, if they breed there at all. The 2000-2005 data in the New York State breeding bird atlas shows only a few probable and 2-3 confirmed breeding records on the Hudson River, with the Adirondacks as the primary breeding area in New York. Indeed, we only observed 3-9 Common Mergansers on surveys from late April through mid-August, and suspect those individuals were late migrants and/or nonbreeding birds. We never observed any Common Mergansers with broods. Statewide, the 2001-10 average was 5,493 breeding pairs, with an average of 77 in Stratum 13.

American Black Duck. Black Ducks (866 mean annual sightings) also occurred primarily as migrant and wintering ducks on the river, with 87.9% occurring between mid-December and late March (Fig. 2a). The most Black Ducks (54.1%) were recorded during winter (mid-December through late February), followed by 33.8% during spring migration (mid- and late March). Only 2.1% were detected during the breeding season (mid-April through mid-August), of which 1.4% occurred in mid-April and thus may have been late-spring migrants.

The average number tallied per survey during mid-December to late March ranged between 88 and 179 birds. In comparison, the 10-year average from the NYS Ornithological Association's winter waterfowl survey was 483 for Region 8, which was 3.4% of the statewide total. Region 9 averaged 3,291 or 8.0% of the statewide total. The largest average number (10,067) occurred in Region 10 (27.4%), which is New York City and Long Island. Hence, the upper Hudson River is not a significant wintering area for Black Ducks.

We never observed male/female Black Duck pairs, but did occasionally observe mixed pairs of a male Mallard with a female Black Duck. However, the New York Breeding Bird Atlas does show three confirmed Black Duck breeding records on the Hudson River in Ulster/Dutchess Counties and many possible and probably breeding records along the length of the river. One Black Duck brood also was observed during our surveys. Nonetheless, the main breeding range in New York is clearly the Adirondacks. Statewide, the 2001-10 average from the AF Breeding Waterfowl Plot Survey was 4,619 breeding pairs, with an average of only 119 in Stratum 13 (2.6%). Hence, the upper Hudson River is clearly not an important breeding area for Black Ducks.

Hooded Merganser. Hooded Mergansers (475 mean annual sightings) were primarily migrants and wintering ducks on the river, with 23.9% occurring during fall migration (mid-November to mid-December) and 35.8% during spring migration (mid- and late March; Fig. 2b). Some (36.5%) occurred during winter (late December to late February). The most Hooded Mergansers were recorded during mid-March (21.4%), followed by late March (14.4%), mid-December (12.4%), and mid-February (11.3%). The 10-year average from the NYS Ornithological Association's winter waterfowl survey was 37 for Region 8, which was 2.3% of the statewide total. Region 9 averaged 150 or 9.4% of the statewide total. The largest average number (1,152) occurred in Region 10 (72.0%), which is New York City and Long Island.

Hooded Mergansers were rarely recorded during the breeding season, with only one bird seen in late April (2008), eight in mid-May, and three from mid-June to mid-September. Such results are not surprising because breeding Hooded Mergansers prefer smaller streams and rivers as well as beaver (*Castor canadensis*) ponds and other wooded wetlands (Dugger et al. 2009). Statewide, the AF Breeding Waterfowl Plot Survey 2001-10 average was 6,474 breeding pairs, with an average of only 69 (1.1%) in Stratum 13. The New York Breeding Bird Atlas shows only a few confirmed and probable breeding records for Hooded Mergansers on the upper Hudson River (Saratoga/Washington County). Thus, our data and available comparative information indicates this section of the Hudson River does not provide significant habitat for breeding Hooded Mergansers, and only a small number use this section during winter and migration.

Ring-necked Duck. Ring-necked Ducks (363 mean annual sightings) were primarily spring migrants, with 94.3% tallied between mid-March and mid-April (Fig. 2b). We only observed three Ringed-necked Ducks between late April and late November. In New York, the breeding distribution of the Ring-necked Duck is largely in the Adirondacks (McGowan and Corwin 2008). They are not common wintering ducks in New York, with the 10-year average from the NYS Ornithological Association's winter waterfowl survey highest for Region 10 (Long Island) at only 520 birds (45.4% of the statewide total). The average for Region 8 was only 8 birds, which was 0.7% of the statewide total. Region 9 averaged 162 or 14.2% of the statewide total.

Wood Duck. Most (81.4%) of the 385 mean annual sightings of Wood Ducks we observed occurred as spring migrants or breeding birds (mid-March to mid-May; Fig. 2b). Only 0.5% occurred during winter (mid-December to late February). Lock 2 Pool had the highest percentage of Wood Ducks observed during spring migration (14.2%), followed by 6.7% at Lock 7, and 6.4% at or below Lock 6. Wood Ducks rarely winter in New York State, with the statewide 10-year NYS Ornithological Association's winter waterfowl survey averaging only 42 Wood Ducks. The average was only one bird for Region 8 (1.7% of the statewide total), and seven in Region 9 (16.8%).

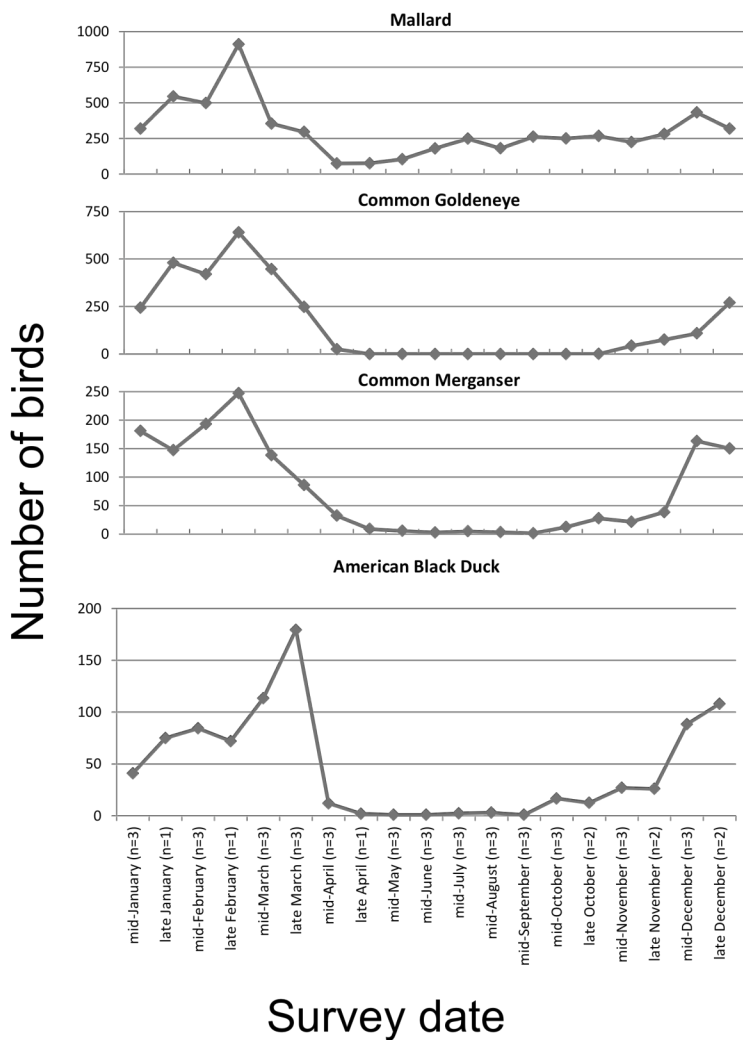


Figure 2a. Number of birds recorded during monthly or bimonthly surveys ($n = 48$) on the upper Hudson River, New York from June 2007 through May 2010. Numbers in parentheses are sample sizes; values for $n > 1$ are means.

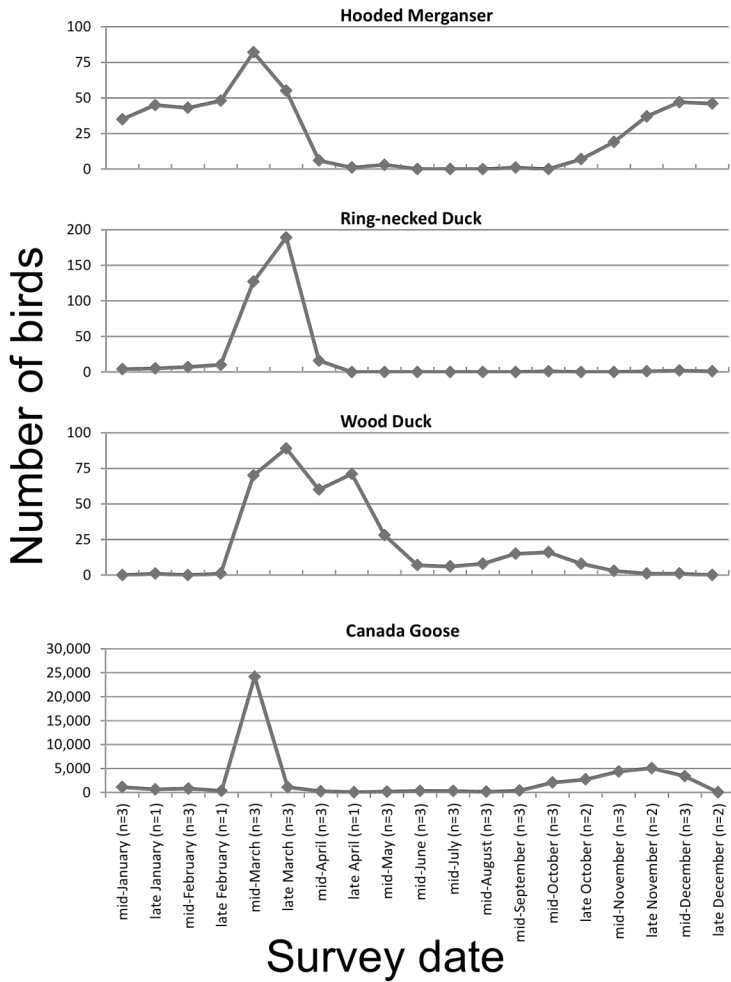


Figure 2b. Number of birds recorded during monthly or bimonthly surveys ($n = 48$) on the upper Hudson River, New York from June 2007 through May 2010. Numbers in parentheses are sample sizes; values for $n > 1$ are means.

The estimated number of Wood Duck breeding pairs was 28-36 in 2009 and 16-28 in 2010. The AF Breeding Waterfowl Plot Survey (2001-10) averaged 45,685 breeding pairs of Wood Ducks for the entire state, and 3,470 for Stratum 13; hence, our largest estimate of 36 pairs on the upper Hudson River is only 0.08% of the statewide average and 1% of the Stratum 13 average. However, our breeding pair estimates may be minimal because Wood Ducks are notoriously crepuscular and prefer visually occluded wooded wetlands; hence, some individuals and pairs

The Kingbird 2014 June; 64 (2)

are often overlooked during surveys (see Bellrose and Holm 1994). Nonetheless, our data indicate the upper Hudson River does not provide important habitat for a large number of breeding Wood Ducks.

Canada Goose. Canada Geese (47,398 mean annual sightings) were by far the most abundant waterfowl species using this section of the Hudson River. They occurred year-round, but were dramatically most abundant during spring migration, which peaked in mid-March when 51.0% of all Canada Geese were observed as compared to 37.2% during fall migration (mid-October to mid-December; Fig. 2b). Canada Geese were not common in midwinter when ice-cover and snowfall were at their peaks, with only 6.2% detected between late December and late February. Only 0.7% occurred in late February and 2.3% in late March. Reach 5 had 77.5% of all Canada Geese observed during mid-March, primarily because they foraged in large flocks on commercial sod fields adjacent to the river.

The 10-year average from the NYS Ornithological Association's winter waterfowl survey was 9,378 for Region 8, which was 6.2% of the statewide total. Region 9 averaged 14,755 or 9.8% of the statewide total. The largest average number (55,932; 37.3%) occurred in Region 3, the Finger Lakes Region, followed by 38,331 (25.5%) in Region 10, New York City and Long Island. Thus, this section of the Hudson River appears to be an important spring migration corridor for Canada Geese, but is not an important wintering area. Our estimated number of Canada Goose breeding pairs was 38-42 in 2009 and 39-42 in 2010, which is only 0.04-0.05% of the 10-year AF Waterfowl Breeding Plot Survey statewide average and 0.4% of the Stratum 13 (Hudson River) average.

CONCLUSION

The upper Hudson River from Fort Edward to the Federal Dam in Troy provides habitat for an array of waterfowl species, but none occurred in comparative abundance, except for the Canada Goose. The Mallard is of particular interest because it is the most abundant and the most heavily harvested duck species in New York, but the upper Hudson River is not an important Mallard production area in New York or an important area for Mallard harvest by hunters. Winter population estimates from the NYS Ornithological Societies also indicate that the lower Hudson River (Region 9) provides habitat for more waterfowl than the upper Hudson River (Region 8). Specifically, the 10-year (1998-2007) average number of all ducks was 3,234 in Region 8 (only 1.6% of the statewide total) as compared to 10,176 in Region 9 (5.3% of the statewide total). Similarly, the three major breeding species in the state (Canada Goose, Mallard, and Wood Duck) each accounted for <0.1% of the 10-year AF Waterfowl Breeding Plot Survey statewide average, attesting to the absence of quality breeding habitat along this section of the river. The upper Hudson does provide consistent wintering and migration habitat for comparatively small numbers of Common Mergansers and Common Goldeneyes, and along with associated uplands, clearly functions as a significant spring migration corridor for Canada Geese.

ACKNOWLEDGMENTS

Funding for this study was provided by the General Electric Company. All methodologies, results, and conclusions, however, are the sole product and opinion of the authors.

LITERATURE CITED

- American Ornithologists' Union. 1998. Check-list of North American birds. 7th edition. American Ornithologists' Union, Washington, D.C.
- Bellrose, F. C., and D. J. Holm. 1994. Ecology and management of the Wood Duck. Stackpole Books, Mechanicsburg, Pennsylvania.
- Brasher, M. G., R. M. Kaminski, and L. W. Burger, Jr. 2002. Evaluation of indicated breeding pair criteria to estimate Mallard breeding populations. *Journal of Wildlife Management* 66:985-992.
- Dugger, B. D., K. M. Dugger, and L. H. Fredrickson. 2009. Hooded Merganser (*Lophodytes cucullatus*). *The Birds of North America* 98.
- Eadie, J. M., M. L. Mallory, and H. G. Lumsden. 1995. Common Goldeneye (*Bucephala clangula*). *The Birds of North America* 170.
- Heusmann, H. W., and J. R. Sauer. 2000. The northeastern states' waterfowl breeding population survey. *Wildlife Society Bulletin* 28:355-364.
- McGowan, K. J., and K. Corwin. 2008. The second atlas of breeding birds in New York State. Cornell University Press, Ithaca.
- Moran, M. A., and K. E. Limburg. 1986. The Hudson River ecosystem. Pages 6-39 in K. E. Limburg, M. A. Moran, and W. H. McDowell, editors. *The Hudson River ecosystem*. Springer-Verlag, New York.
- Moser, T. J., and D. H. Rusch. 1989. Age-specific breeding rates of female Interior Canada Geese. *Journal of Wildlife Management* 53:734-740.
- Pagano, A. M., and T. W. Arnold. 2009. Detection probabilities for ground-based breeding waterfowl surveys. *Journal of Wildlife Management* 73:392-398.

