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Breeding Birds and Nest Productivity at Green Wing Environmental Laboratory, Northcentral, Illinois

Stephen B. Hager[1]*, Christopher R. Bertram[1], and Katie R. Derner[2]
[1]Department of Biology, Augustana College, Rock Island, IL 61201-2296
*corresponding author: stevehager@augustana.edu
[2]Department of Geography, Augustana College, Rock Island, IL 61201-2296

ABSTRACT

Green Wing Environmental Laboratory (GWEL) is a 170 ha biological field station in northcentral Illinois that is composed of small woodlots, edge habitat, and wetlands, and is found in a landscape dominated by agriculture and fragmented ecosystems. Animal populations at this site may benefit from a relatively high level of habitat diversity. Alternatively, previous studies have demonstrated that birds breeding in small habitat patches surrounded by agriculture experience low reproductive success due to high rates of nest predation and Brown-headed Cowbird (*Molothrus ater*) brood parasitism. We conducted three studies aimed at assessing the reproductive success of birds at GWEL. Study 1 assigned breeding status using the methodology of the Breeding Bird Atlas. We observed 124 species, 97 of which showed evidence of breeding: 66 confirmed, 14 probable, and 17 possible. In Study 2, we estimated abundance of summer birds and found that the Red-winged Blackbird (*Agelaius phoeniceus*), Song Sparrow (*Melospiza melodia*), and Gray Catbird (*Dumetella carolinensis*) were present in the highest numbers. In Study 3, an analysis of nest productivity, daily nest survival (DNS) was high for two edge-breeding species, Red-winged Blackbird (DNS = 0.92±0.016) and Gray Catbird (DNS = 0.96±0.01), which included no evidence of nest parasitism from the Brown-headed Cowbird. These studies suggest that edge species are common at GWEL and may experience high reproductive success. Future work should examine nest productivity of other edge species, forest breeders, e.g., Wood Thrush (*Hylocichla mustelina*) and Ovenbird (*Seiurus aurocapilla*), and species of conservation concern, e.g., Field Sparrow (*Spizella pusilla*).

INTRODUCTION

Green Wing Environmental Laboratory (GWEL) is a biological field station in the Prairie Peninsula Physiographic Area (Fitzgerald et al. 2000) of northcentral Illinois. In the early 1800's, GWEL was embedded in a landscape dominated by prairie and was part of a ~6,000 ha forest, which included isolated wetlands (INHS 2006). Agricultural development post-European settlement has reduced prairie, forest, and wetlands by an estimated 99.9%, 50%, and 91%, respectively (Levin 2000, IILCP 2004, INHS 2006). In the 1930's, the site was managed for row crops (mixed use grasslands), although many small forest patches were present. Despite little management since this time, mature forest area

has increased in size by 62 ha, mixed use grassland area has decreased by 86 ha, and wetlands have become reestablished. Current land use in the immediate vicinity of GWEL includes Conservation Reserve Program (CRP) grasslands, small woodlots and hedgerows, and agriculture. In addition, recent exurban development immediately adjacent to this site has resulted in four new single family residences, which has converted mature forest to edge/early successional habitat.

Today, GWEL consists of 170 ha of forest fragments [black and bur oak, hickory, and walnut estimated at 42 ha based on "core" area in Burke and Nol (2000)], white pine plantations (12 ha), wet meadows (21 ha), old fields and a reconstructed prairie (combined 17 ha), small pot-holes, and streams. The reminder of the site (78 ha) may effectively function as habitat edge, which negatively affects fitness in breeding birds compared to conspecifics in large habitat patches. For example, brood parasitism by the Brown-headed Cowbird (*Molothrus ater*) and nest predation may be high in small woodlots and grasslands resulting in reduced nest productivity (Burke and Nol 2000; Herkert et al. 2003). Small forest patches may also act as sinks for birds, such as Ovenbird (*Seiurus aurocapilla*), Wood Thrush (*Hylocichla mustelina*), Veery (*Catharus fuscescens*), and Rose-breasted Grosbeak (*Pheucticus ludovicianus*), in a metapopulation context (Nol et al. 2005). Donovan et al. (1997) found that birds breeding in early successional and forest edge habitats experience higher nest-depredation rates than in "core" forest habitats. In addition, highly and moderately fragmented sites experience relatively high nest predation rates due to mammalian (raccoon, opossum, and canid) and avian predators. Much of GWEL is immediately surrounded by row crop development, which has indirect negative effects on nest productivity (Heske et al. 2001). Increasing exurban development at the eastern and southern boundaries of the site may reduce survival and reproduction of native birds near homes (Hansen et al. 2005). In addition, as exurban housing density increases, there is a tendency for 1) early successional habitat (edge) to increase, 2) native species richness to decrease, and 3) an increase in abundance of exotic predators (domestic dogs and cats) and human-adapted natives [Brown-headed Cowbird and American Robin (*Turdus migratorius*)].

Previous field studies at GWEL documented 55 summer species and abundance was highest in the Red-winged Blackbird (*Agelaius phoeniceus*), Blue Jay (*Cyanocitta cristata*), and American Crow (*Corvus brachyrhynchos*) (McKay and Hager 2005). This information offers limited insight about the population status of breeding birds. A deeper understanding of the status and short-term demography may be derived from the details of breeding and nest success (Martin 1992, Martin and Geupel 1993, Faaborg 2002). We conducted three field studies to assess those characteristics in the birds of GWEL. In Study 1, we identified species as confirmed, probable, and possible breeders using the methodology of the Breeding Bird Atlas (BBA) (Smith 1990). Although the Illinois BBA was recently published (Kleen et al. 2004), field surveys were completed in 1991 and may not have examined forested areas in the region since this habitat is not well represented. In Study 2, we estimated the abundance and richness of summer species using standardized transects. In Study 3, we quantified breeding productivity via daily nest survival in birds known to reproduce in edge habitat.

METHODS

Study 1

We assessed the likelihood of breeding in the birds of GWEL from late-May through August 2005-2007. The methods were generally consistent with the Breeding Bird Atlas (BBA), which recommends the use of reproductive behavior to assign standardized breeding categories: confirmed, probable, possible, and observed; however, in Appendix 1 we explain how these were synthesized from Smith (1990) and Cutright et al. (2006). We completed approximately one 7-h survey/week, which began at sunrise. Our basic objectives were to document evidence of breeding in at least 75% of species observed and, of these, to confirm at least 50% (Cutright et al. 2006). We also report the full repertoire of breeding classification and codes observed for each species; this provides more detailed and valuable natural history information which is important since GWEL is relatively new (established in 1991). In 2005 and 2007, we conducted BBA surveys in March (2 visits; 9 field-h), April (8 visits; 30 field-h), and May (3 visits; 7 field-h) for early breeding species. Twelve nocturnal BBA surveys (22 field-h) were conducted in 2005-2007 for the American Bittern (*Botaurus lentiginosus*), Least Bittern (*Ixobrychus exilis*), Virginia Rail (*Rallus limicola*), Sora (*Porzana carolina*), American Woodcock (*Scolopax minor*), Eastern Screech-Owl (*Megascops asio*), Barred Owl (*Strix varia*), Common Nighthawk (*Chordeiles minor*), and Whip-poor-will (*Caprimulgus vociferous*). We would occasionally broadcast recordings of bitterns, rails, and owls to elicit responses (McGarigal and Fraser 1985, Ritchison et al. 1988, Conway 2005). Seven artificial nest boxes (entrance hole diameter ~40 mm), placed at the edges (<100 m) of grasslands and wetlands in 2003, were monitored throughout the study.

Poole et al. (1992) and Baicich and Harrison (1997) were consulted for identification of nests, eggs, nestlings, and breeding behavior. Common and scientific names used throughout follow the American Ornithologists' Union (1998). We make qualitative comparisons between our results and the data in surrounding Illinois BBA blocks (Amboy, Dixon East, Franklin Grove, Ashton, Sublette, Mendota West, La Moille, Ohio, and Walton) (Kleen et al. 2004, Breeding Bird Atlas Explorer 2007).

Study 2

In June and July 2007, we estimated abundance of summer birds from 6 fixed-width strip transects (Bibby et al. 2000; 100 m on each side of transect), which averaged (±1SD) 1.9 h (±0.51) and 1.4 km (±0.35) in length. We systematically placed transects so that a representative sample of the site's habitats was obtained. Surveys could not be confined within a habitat because the site is highly fragmented and contains many small habitat patches. Each transect was completed once during favorable weather (PWRC 2001). This survey methodology allowed us to evaluate relative commonness and diversity. We used estimates to categorize species as Abundant (≥6 birds/h), Common (2.00-5.99 birds/h), Fairly Common (1.00-1.99 birds/h), and Rare (<1.00 birds/h and birds documented at times other than during surveys) (Andres et al. 2004). We make qualitative comparisons to previously recorded abundance estimates from the Troy Grove (#68) Breeding Bird Survey route, which was ~19 km south of and the closest route in proximity to GWEL (PWRC 2007).

Study 3

From late May-July 2007, we located and monitored the nests of seven species known to breed in edge habitat: Tree Swallow (*Tachycineta bicolor*), Eastern Bluebird (*Sialia sialis*), Gray Catbird (*Dumetella carolinensis*), Brown Thrasher (*Toxostoma rufum*), Yellow Warbler (*Dendroica petechia*), Northern Cardinal (*Cardinalis cardinalis*), and Red-winged Blackbird (Yasukawa and Searcy 1995, Imbeau et al. 2003, McKay and Hager 2005). We focused on these species since previous work suggested that they were abundant relative to forest-nesting species, such as Ovenbird and Wood Thrush (McKay and Hager 2005).

We located nests by visual inspection of vegetation and adult distress calls, which is an indicator of a nearby nest (Burhans and Thompson 2006). Nests were identified by parent, nest, chick, or egg characteristics (Baicich and Harrison 1997, Sibley 2003, DeVore et al. 2004). We marked nests with a piece of pink plastic flagging (~15 cm) at a distance 5 m to the north of the nest (Johnson and Temple 1990, Galligan et al. 2006) and recorded latitude/longitude via GPS, nest height, and plant genus in which a nest was found. In addition, we monitored breeding in seven nest boxes mentioned previously.

We monitored nests every 3 to 4 days after the initial marking (Martin and Geupel 1993, Brawn 2006). Welfare impacts to nests were minimized by approaching them from different pathways (which would not dead end at the nest) and by minimizing damage to surrounding vegetation. Whenever possible, we visually examined nests using a hand mirror and a pole-mounted mirror (~2.5 m in length), which minimized disturbance.

We recorded nests as successful based on appropriate timing of chick development, intact construction of the nest, presence of fledglings off of nest, fecal sacs in a nest, and flattened edges of the nest, and produced at least one fledgling (Martin and Geupel 1993). Nests were considered depredated if damage to nest construction and remnants of eggs, egg shells, and chicks were observed in or around nests. The timing of nest success or depredation was placed at a date halfway between the previous and final monitoring visits (Johnson and Temple 1990).

Daily nest survival (DNS), the probability of a nest surviving with at least one viable chick on any day of the nesting period, was calculated using the Mayfield Method (Johnson 1979). A minimum of 20 nests per species was required for meaningful estimates of DNS (Martin and Geupel 1993), which was calculated for the Gray Catbird and Red-winged Blackbird. Parasitism by the Brown-headed Cowbird for each species was recorded as the percent of nests parasitized. We used a chi-squared test to evaluate differences in nest location (plant genus) for the Gray Catbird and Red-winged Blackbird. This analysis was restricted only to data gathered in an opportunistic sense; we made no attempt to identify plants available to, but not used, by birds.

We make general statements about regional population status through the use of maintenance fecundity, which may be considered as the annual recruitment of young that balances adult mortality (Burke and Nol 2000). This was calculated using estimates of lifespan and survivorship reported in the literature (Yasukawa and Searcy 1995, DeSante et al. 2001, de Magalhaes et al. 2005). We reasoned that if our estimates of the # offspring/year was greater than maintenance fecundity, then nest productivity at GWEL

contributed to population numbers in 2007. Alternatively, if these estimates were less than maintenance fecundity, then GWEL recruitment failed to add to the regional population. Modeling population trends, per se, was not an objective of our work, and, thus, we make only general conclusions in this context.

RESULTS

Study 1

We observed 124 species, 97 of which showed evidence of breeding at GWEL: 66 confirmed, 14 probable, and 17 possible (Tables 1-4). Standardized behaviors of Singing, Territoriality, Pair, Feeding Young, Fledged Young, and Nests with Eggs were observed often (≥50%) in confirmed breeders (see Appendix 1 for breeding code definitions). We confirmed 25 species not reported as such in the Amboy and surrounding Illinois BBA blocks (Kleen et al. 2004), including Wild Turkey (*Meleagris gallopavo*), Red-bellied Woodpecker (*Melanerpes carolinus*), Veery, Wood Thrush, Ovenbird, and Field Sparrow (*Spizella pusilla*) (Table 1). In contrast, we failed to observe five species that were confirmed by Kleen et al. (2004) in these BBA blocks: Mute Swan (*Cygnus olor*), Gray Partridge (*Perdix perdix*), Horned Lark (*Eremophila alpestris*), Savannah Sparrow (*Passerculus sandwichensis*), and Western Meadowlark (*Sturnella neglecta*).

We documented nest parasitism in 11 species (Table 5) and nest depredation in: Canada Goose (*Branta canadensis*), Eastern Kingbird (*Tyrannus tyrannus*), White-eyed Vireo (*Vireo griseus*), Veery, American Robin, Yellow Warbler, Eastern Towhee (*Pipilo erythrophthalmus*), Northern Cardinal, Indigo Bunting (*Passerina cyanea*), and Red-winged Blackbird. In 2005, a Red-winged Blackbird was observed to consume the first and only egg within a Yellow Warbler nest, after which the female warbler disassembled the nest and, using the same nest material, re-built another nest ~15 m away (A. Wenmacher, unpubl. data).

For the nests we monitored (see Tables 1 and 2), the following observations were at the edge of or beyond known egg or nestling dates for this region: 1) Sora nest with eggs on 23 July 2006; 2) Eastern Phoebe nest with eggs on 7 July 2006; 3) probable re-nest attempt for single-brooded Yellow-throated Vireo, with male and female pair observed making nest on 7 July 2006; and 4) nest with nestlings of Eastern Towhee on 7 September 2005 (Weeks 1994; Greenlaw 1996; Melvin and Gibbs 1996; Rodewald and James 1996).

Study 2

We observed 72 species during abundance surveys: 8 Abundant, 24 Common, 24 Fairly Common, and 16 Rare (Tables 1, 3 and 4; Appendix 2). Dickcissel (*Spiza americana*), Grasshopper Sparrow (*Ammodramus savannarum*), and Rock Pigeon (*Columba livia*) were observed in habitats immediately adjacent to GWEL. We encountered a male Orchard Oriole (*Icterus spurius*) shortly after the end of one survey route on 12 June 2007.

Study 3

We calculated reliable estimates (≥20 nests) of DNS for the Red-winged Blackbird and Gray Catbird (Table 6). Nest loss for all species was attributed to predation, except for

the Red-winged Blackbird in which 13 of 25 nests were lost to flooding after heavy rainfall. Nest loss for the Gray Catbird, Northern Cardinal, and Red-winged Blackbird, was higher for nests with eggs than nests with nestlings. For the Yellow Warbler and Brown Thrasher, we found equal proportions of depredated nests for those containing eggs and those with nestlings. For nest boxes, one depredated Tree Swallow nest resulted in the loss of chicks and adults. House Sparrows (*Passer domesticus*) quickly began nest building on top of the swallow nest, which contained the bodies of both adult swallows.

We observed no direct cause of nest predation for Study 3, although many predators are known from the site, e.g., raccoon (*Procyon lotor*), American mink (*Neovision vision*), squirrels (*Sciurus* spp.), birds, and snakes [northern watersnake (*Nerodia sipedon*), western ribbonsnake (*Thamnophis proximus*), and common gartersnake (*Thamnophis sirtalis*)]. During this study, only one nest (Yellow Warbler) was parasitized by the Brown-headed Cowbird (Table 5). (Parasitized nests of other species reported in Table 5 were observed during Study 1.) A Tree Swallow nest was parasitized by an Eastern Bluebird, although the bluebird egg was not brooded.

Gray Catbirds nested in *Cornus* (N = 11 nests), *Lonicera* (N = 5), and *Rubus* (N = 6), but proportions were not significantly different (χ^2=2.68, DF=2, P=0.26). Significantly more Red-winged Blackbird nests (N = 24) were found in *Phalaris* grass (χ^2=13.54, DF=1, P=0.0002) than in other plants (N = 5, which was a combined group of three plant genera in order to meet assumptions of the test).

DISCUSSION

We set out to document evidence of breeding in at least 75% of species observed and, of these, to confirm at least 50% (Cutright et al. 2006). We achieved these objectives with 78% (97/124) documented evidence and 68% (66/97) confirmed breeders. Probable breeders were easily heard, but in some cases, difficult to visually locate, e.g., American Woodcock. This was exacerbated for the Whip-poor-will, which was heard in all years except 2007. Moreover, we observed the Yellow-breasted Chat (*Icteria virens*) and Eastern Screech-Owl only in 2005. Possible breeders included species that were difficult to confirm because of secretive breeding habits, such as Blue-winged Teal (*Anas discors*), or they were observed infrequently, e.g., Purple Martin (*Progne subis*). To our knowledge we are the first to document depredation on a Yellow Warbler nest by the Red-winged Blackbird and one of the few to report the observation of the female warbler using material from the depredated nest to construct a new one (Lowther et al. 1999).

This and previous work on the birds at GWEL (McKay and Hager 2005) documented (1) 26 summer species considered threatened, declining, or rare at the continental and national scales, (2) 22 priority and declining species in the Prairie Peninsula physiographic area, and (3) six state species of special concern (Fitzgerald et al. 2000, IESPB 2006, Butcher and Niven 2007, Butcher et al. 2007, Sauer et al. 2007). Seven confirmed or probable breeders [Northern Bobwhite (*Colinus virginianus*), Whip-poor-will, Red-headed Woodpecker (*Melanerpes erythrocephalus*), Field Sparrow, Grasshopper Sparrow, Dickcissel, and Eastern Meadowlark (*Sturnella magna*)] are of conservation concern at national and physiographic levels (Fitzgerald et al. 2000, Butcher et al. 2007, Sauer et al. 2007).

Abundance of breeding birds in 2007 was highest in the Red-winged Blackbird, Song Sparrow (*Melospiza melodia*), and Gray Catbird (Appendix 2). These results may more accurately reflect abundance at this site since McKay and Hager (2005) conducted only one point count survey-day during the summer. The Common Yellowthroat (*Geothlypis trichas*) was abundant at GWEL despite a significant average decline of 0.8%/yr in 1966-2006 from BBS work in the Prairie Peninsula physiographic area (Sauer et al. 2007). Results from the closest BBS route, Troy Grove (#68), show that abundance was highest in the Red-winged Blackbird, Common Grackle, and American Robin (PWRC 2007). Although close in proximity, overall differences in richness between sites appear to correspond to the habitats assessed: woodlands, wetlands, grasslands, and edge at GWEL and (presumably) open farmland and rural towns for the BBS route.

The BBS population assessment for the Red-winged Blackbird in the Prairie Peninsula physiographic area reported no significant difference in annual percent change in the number of individuals for 1966-2006 (Sauer et al. 2007). This suggests that reproductive success in local areas was high enough to maintain regional demographic stability. The DNS calculated for this species at GWEL in 2007 was similar to DNS estimates reported elsewhere in the Midwest (Galligan et al. 2006). However, the #offspring/year was only ~50% of the maintenance fecundity for this species (Table 6). This implies that annual recruitment from GWEL failed to contribute new individuals into the population. Nest submersion accounted for over half of the nest losses due to heavy rain events in the summer months. Nesting over water is reported for this species and it may minimize predation risk relative to nests on land (Yasukawa and Searcy 1995). During years of average rainfall nest productivity at GWEL may be high enough to contribute more positively to the regional demography of Red-winged Blackbirds.

We observed no evidence of nest parasitism for the Red-winged Blackbird at GWEL. The incidence of parasitism in this species is reported at 30% across habitats (Galligan et al. 2006). Levels of parasitism may be inversely correlated with high breeding density of adults, which was documented at this site in Study 2, and may be reduced by limited cowbird egg recognition and subsequent removal (Yasukawa and Searcy 1995).

The BBS also reported no significant difference in annual percent change in the number of Gray Catbirds for 1966-2006 (Sauer et al. 2007). Daily nest survival in 2007 was high and was similar to other studies in the region, although year-to-year reproductive success may vary widely (Cimprich and Moore 1995). Moreover, our estimate of the #offspring/year was higher than maintenance fecundity. This suggests that recruitment from GWEL in 2007 may have contributed to the regional population.

Low nest predation for the Gray Catbird may be attributed to several factors. Catbird nests are constructed deep within the shrub interior, which may minimize conspicuousness to predators (Cimprich and Moore 1995). Plant genera (*Cornus*, *Rubus*, and *Lonicera*) used by catbirds at GWEL for nesting match the genera reported elsewhere (Cimprich and Moore 1995). Additionally, aggressive parental behavior in this species may also confer protection of active nests (Cimprich and Moore 1995). Low incidence of nest parasitism was expected since catbirds can recognize and remove cowbird eggs from nests (Cimprich and Moore 1995).

Tree Swallows and Eastern Bluebirds experienced relatively high nest success. One Tree Swallow nest was depredated most probably by House Sparrows (K. K. Hallinger, pers. comm.). Robertson et al. (1992) report that both sexes of Tree Swallows often grapple with avian intruders inside nest cavities. Combatant Tree Swallows have been found injured or dead inside boxes, which we observed, or on the ground after such fights. Intraspecific nest building on top of dead adults has been documented for the White-throated Swift (*Aeronautes saxatalis*) (Rett 1946), but not in an interspecific context (House Sparrows nesting on dead Tree Swallows). Moreover, our observations included recently killed Tree Swallows, whereas the adult swift appeared to die the year prior to being found.

Nest parasitism by Eastern Bluebirds is rare, but known hosts include Carolina Wren (*Thryothorus ludovicianus*), chickadees, and House Sparrows (Gowaty and Plissner 1998). Only one of ~400 monitored Tree Swallow nests in Virginia was parasitized by bluebirds (K. K. Hallinger, unpubl. data). To our knowledge, this is the first published documentation of bluebirds parasitizing a Tree Swallow nest.

Results of Studies 1-3 suggest that GWEL is an important site for breeding birds, although reproductive success appeared to vary among species when viewed along with the abundance data, nest productivity, and anecdotal observations of nest parasitism. Reasons for this may be related to the biological characteristics of the site, including fragmented habitats (Burke and Nol 2000, Herkert et al. 2003, Hansen et al. 2005), many of which are immediately adjacent to developed agricultural land and are known to increase the risk of nest predation and parasitism (Heske et al. 2001). Moreover, high inter-annual variation in weather may have affected our results. In 2004-2007, above average temperatures were recorded in Illinois, except in 2006, when temperatures were much higher than average (NCDC 2008). Precipitation was near or above average in all years, but not in 2005, when Illinois was characterized at much below average (NCDC 2008). This resulted in "extreme" and "severe" drought conditions in northern Illinois in 2005 and 2006, respectively (NCDC 2008). Qualitatively, wetlands in June-August at GWEL were dry in 2005, temporarily filled with water in 2006, and filled in 2007.

SUMMARY

We evaluated the breeding birds at Green Wing Environmental Laboratory (GWEL), which supports small fragments of forest, wetlands, and grasslands. Field work focusing on atlasing birds (Study 1) identified 124 species, 97 of which showed evidence of breeding: 66 confirmed, 14 probable, and 17 possible. In Study 2, coarse estimates of abundance in 2007 suggested that the Red-winged Blackbird, Song Sparrow, and Gray Catbird were present in the highest numbers. In Study 3, an analysis of nest productivity, daily nest survival (DNS) was generally high for two edge-breeding species, Red-winged Blackbird (DNS = 0.92±0.016) and Gray Catbird (DNS = 0.96±0.01), which included no evidence of nest parasitism by the Brown-headed Cowbird. Future work should examine nest productivity of other edge species, forest breeders, e.g., Wood Thrush and Ovenbird, and species of conservation concern, e.g., Field Sparrow.

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Table 1. Abundance and comparison to Kleen et al. (2004) of Confirmed breeders. Asterisks identify species not observed during abundance surveys.

Common Name	Scientific Name	Abundance	Not Confirmed in Kleen et al. (2004)
Canada Goose	*Branta canadensis*	Common	
Wood Duck	*Aix sponsa*	Common	
Mallard	*Anas platyrhynchos*	Fairly Common	
Ring-necked Pheasant	*Phasianus colchicus*	Rare	
Wild Turkey	*Meleagris gallopavo*	Fairly Common	X
Northern Bobwhite	*Colinus virginianus*	Rare*	
Green Heron	*Butorides virescens*	Fairly Common	X
Cooper's Hawk	*Accipiter cooperii*	Rare	X
Red-tailed Hawk	*Buteo jamaicensis*	Rare	
American Kestrel	*Falco sparverius*	Rare*	
Sora	*Porzana carolina*	Rare	X
Killdeer	*Charadrius vociferus*	Abundant	
Mourning Dove	*Zenaida macroura*	Common	
Yellow-billed Cuckoo	*Coccyzus americanus*	Fairly Common	
Great Horned Owl	*Bubo virginianus*	Rare*	
Ruby-throated Hummingbird	*Archilochus colubris*	Rare	X
Red-bellied Woodpecker	*Melanerpes carolinus*	Common	X
Downy Woodpecker	*Picoides pubescens*	Rare	
Hairy Woodpecker	*Picoides villosus*	Fairly Common	X
Northern Flicker	*Colaptes auratus*	Fairly Common	
Eastern Wood-Pewee	*Contopus virens*	Common	X
Willow Flycatcher	*Empidonax traillii*	Rare	
Eastern Phoebe	*Sayornis phoebe*	Rare*	X
Great Crested Flycatcher	*Myiarchus crinitus*	Fairly Common	
Eastern Kingbird	*Tyrannus tyrannus*	Fairly Common	
White-eyed Vireo	*Vireo griseus*	Rare	X
Yellow-throated Vireo	*Vireo flavifrons*	Fairly Common	X
Warbling Vireo	*Vireo gilvus*	Fairly Common	X
Red-eyed Vireo	*Vireo olivaceus*	Common	X
Blue Jay	*Cyanocitta cristata*	Common	
American Crow	*Corvus brachyrhynchos*	Common	
Tree Swallow	*Tachycineta bicolor*	Common	
Black-capped Chickadee	*Poecile atricapillus*	Fairly Common	
White-breasted Nuthatch	*Sitta carolinensis*	Fairly Common	
House Wren	*Troglodytes aedon*	Common	
Sedge Wren	*Cistothorus platensis*	Fairly Common	X
Marsh Wren	*Cistothorus palustris*	Rare	X
Blue-gray Gnatcatcher	*Polioptila caerulea*	Common	X
Eastern Bluebird	*Sialia sialis*	Fairly Common	

Common Name	Scientific Name	Abundance	Not Confirmed in Kleen et al. (2004)
Veery	*Catharus fuscescens*	Fairly Common	X
Wood Thrush	*Hylocichla mustelina*	Fairly Common	X
American Robin	*Turdus migratorius*	Common	
Gray Catbird	*Dumetella carolinensis*	Abundant	
Brown Thrasher	*Toxostoma rufum*	Fairly Common	
European Starling	*Sturnus vulgaris*	Common	
Cedar Waxwing	*Bombycilla cedrorum*	Common	
Yellow Warbler	*Dendroica petechia*	Abundant	
Ovenbird	*Seiurus aurocapilla*	Fairly Common	X
Common Yellowthroat	*Geothlypis trichas*	Abundant	
Scarlet Tanager	*Piranga olivacea*	Rare	X
Eastern Towhee	*Pipilo erythrophthalmus*	Common	X
Chipping Sparrow	*Spizella passerina*	Common	
Field Sparrow	*Spizella pusilla*	Common	X
Lark Sparrow	*Chondestes grammacus*	Rare*	X
Song Sparrow	*Melospiza melodia*	Abundant	
Swamp Sparrow	*Melospiza georgiana*	Abundant	X
Northern Cardinal	*Cardinalis cardinalis*	Common	
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	Common	X
Indigo Bunting	*Passerina cyanea*	Common	
Dickcissel	*Spiza americana*	Fairly Common	
Red-winged Blackbird	*Agelaius phoeniceus*	Abundant	
Common Grackle	*Quiscalus quiscula*	Common	
Brown-headed Cowbird	*Molothrus ater*	Common	
Baltimore Oriole	*Icterus galbula*	Fairly Common	
American Goldfinch	*Carduelis tristis*	Abundant	
House Sparrow	*Passer domesticus*	Fairly Common	

Table 2. Breeding codes of Confirmed breeders. See Appendix 1 for definitions of Breeding Codes and Table 1 for scientific names.

	Breeding Codes															
Common Name	Singing	Pair	Territory	Courtship	Agitated	Building	Carrying Nesting	Nest Building	Distraction Display	Used Nest	Occupied Nest	Fledglings	Fecal Sac	Feeding Young	Nest Eggs	Nest Young
Canada Goose					A						ON				NE	
Wood Duck		P										FL				
Mallard		P										FL				
Ring-necked Pheasant	S		T							UN		FL			NE	
Wild Turkey	S			C					DD			FL			NE	
Northern Bobwhite	S		T									FL				
Green Heron												FL			NE	
Cooper's Hawk		P		C	A				DD			FL		FY		
Red-tailed Hawk					A					UN		FL		FY		NY
American Kestrel											ON	FL				
Sora	S		T									FL		FY	NE	
Killdeer	S											FL				
Mourning Dove	S	P	T		A										NE	
Yellow-billed Cuckoo	S		T									FL		FY	NE	NY
Great Horned Owl	S		T									FL				
Ruby-throated Hummingbird			T				CN									
Red-bellied Woodpecker		P			A						ON	FL		FY		NY
Downy Woodpecker		P			A				DD			FL		FY		NY
Hairy Woodpecker		P			A							FL		FY		NY
Northern Flicker	S	P	T	C								FL		FY		
Eastern Wood-Pewee	S	P	T									FL		FY		
Willow Flycatcher	S	P	T		A									FY		
Eastern Phoebe	S	P	T		A							FL			NE	NY
Great Crested Flycatcher	S	P	T									FL		FY		
Eastern Kingbird	S	P	T		A		CN	NB	DD						NE	
White-eyed Vireo	S	P	T		A									FY	NE	NY
Yellow-throated Vireo	S	P	T				CN	NB				FL		FY		NY
Warbling Vireo	S	P	T		A		CN	NB								
Red-eyed Vireo	S	P	T		A		CN	NB	DD			FL		FY		
Blue Jay	S		T				CN				ON	FL			NE	
American Crow												FL		FY		
Tree Swallow		P		C							ON	FL	FS	FY	NE	NY

	Breeding Codes															
Common Name	Singing	Pair	Territory	Courtship	Agitated	Building	Carrying Nesting	Nest Building	Distraction Display	Used Nest	Occupied Nest	Fledglings	Fecal Sac	Feeding Young	Nest Eggs	Nest Young
Black-capped Chickadee	S		T									FL		FY		
White-breasted Nuthatch	S	P	T								ON			FY		
House Wren	S		T		A				DD					FY	NE	
Sedge Wren	S		T		A	B								FY		
Marsh Wren	S	P	T		A	B									NE	
Blue-gray Gnatcatcher	S	P	T				CN	NB	DD			FL		FY		
Eastern Bluebird	S	P	T	C	A						ON	FL		FY	NE	NY
Veery	S		T		A		CN								NE	
Wood Thrush	S		T		A									FY	NE	
American Robin	S	P	T		A		CN	NB			ON	FL		FY	NE	
Gray Catbird	S	P	T		A		CN					FL		FY	NE	NY
Brown Thrasher	S	P	T		A		CN							FY	NE	NY
European Starling												FL		FY		
Cedar Waxwing	S						CN					FL		FY	NE	
Yellow Warbler	S		T		A		CN	NB		UN		FL		FY	NE	NY
Ovenbird	S	P	T		A							FL		FY	NE	
Common Yellowthroat	S	P	T		A							FL	FS	FY		
Scarlet Tanager	S	P	T				CN					FL		FY		
Eastern Towhee	S	P	T		A				DD	UN		FL		FY		NY
Chipping Sparrow	S	P	T	C	A						ON	FL		FY	NE	
Field Sparrow	S		T		A							FL		FY	NE	NY
Lark Sparrow														FY	NE	NY
Song Sparrow	S		T		A		CN					FL		FY		
Swamp Sparrow														FY		
Northern Cardinal	S	P	T		A							FL		FY	NE	NY
Rose-breasted Grosbeak	S	P	T		A		CN					FL		FY	NE	
Indigo Bunting	S	P	T		A				DD			FL		FY	NE	
Dickcissel	S	P	T									FL		FY		
Red-winged Blackbird	S	P	T	C	A		CN		DD			FL	FS	FY	NE	NY
Common Grackle												FL		FY		
Brown-headed Cowbird	S	P		C								FL		FY	NE	NY
Baltimore Oriole							CN		DD		ON	FL		FY	NE	NY
American Goldfinch	S	P	T				CN		DD		ON	FL		FY	NE	
House Sparrow		P	T				CN	NB		UN			FS	FY	NE	NY

Table 3. Abundance and breeding codes of Probable breeders. Asterisks identify species not observed during abundance surveys. See Appendix 1 for definitions of Breeding Codes.

Common Name	Scientific Name	Abundance	Breeding Codes					
			Singing	Pair	Territory	Courtship	Nest-site	Agitated
Least Bittern	*Ixobrychus exilis*	Rare*	S					
American Woodcock	*Scolopax minor*	Rare*	S		T			
Eastern Screech-Owl	*Megascops asio*	Rare*	S		T			
Barred Owl	*Strix varia*	Rare	S	P	T			
Common Nighthawk	*Chordeiles minor*	Rare*				C		
Whip-poor-will	*Caprimulgus vociferus*	Rare*	S		T			
Chimney Swift	*Chaetura pelagica*	Rare	S					
Carolina Wren	*Thryothorus ludovicianus*	Rare*	S		T			
American Redstart	*Setophaga ruticilla*	Rare*	S		T			
Yellow-breasted Chat	*Icteria virens*	Rare*	S	P	T		N	A
Vesper Sparrow	*Pooecetes gramineus*	Rare*	S					
Grasshopper Sparrow	*Ammodramus savannarum*	Rare	S		T			
Eastern Meadowlark	*Sturnella magna*	Rare*	S					
Orchard Oriole	*Icterus spurius*	Rare*	S		T			

Table 4. Abundance and breeding codes of Possible breeders and species occasionally Observed in late May-July, but which do not breed at GWEL. Asterisks identify species not observed during abundance surveys. See Appendix 1 for definitions of Breeding Classifications.

Breeding Classification	Common Name	Scientific Name	Abundance
Possible	Blue-winged Teal	*Anas discors*	Rare*
	Great Blue Heron	*Ardea herodias*	Fairly Common
	Turkey Vulture	*Cathartes aura*	Fairly Common
	American Coot	*Fulica americana*	Rare*
	Sandhill Crane	*Grus canadensis*	Rare
	Spotted Sandpiper	*Actitis macularius*	Common
	Rock Pigeon	*Columba livia*	Rare
	Black-billed Cuckoo	*Coccyzus erythropthalmus*	Rare*
	Belted Kingfisher	*Megaceryle alcyon*	Rare*
	Red-headed Woodpecker	*Melanerpes erythrocephalus*	Rare*
	Purple Martin	*Progne subis*	Rare*
	Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	Rare*
	Bank Swallow	*Riparia riparia*	Fairly Common
	Cliff Swallow	*Petrochelidon pyrrhonota*	Rare*
	Barn Swallow	*Hirundo rustica*	Fairly Common
	Northern Parula	*Parula americana*	Rare*
	House Finch	*Carpodacus mexicanus*	Rare*
Observed	Green-winged Teal[a]	*Anas crecca*	Rare*
	Double-crested Cormorant[a]	*Phalacrocorax auritus*	Rare*
	Osprey[a]	*Pandion haliaetus*	Rare*
	Red-shouldered Hawk[a]	*Buteo lineatus*	Rare*
	Broad-winged Hawk	*Buteo platypterus*	Rare*
	Semipalmated Plover	*Charadrius semipalmatus*	Rare*
	Solitary Sandpiper	*Tringa solitaria*	Rare*
	Semipalmated Sandpiper	*Calidris pusilla*	Rare*
	Least Sandpiper	*Calidris minutilla*	Rare*
	Baird's Sandpiper	*Calidris bairdii*	Rare*
	Olive-sided Flycatcher	*Contopus cooperi*	Rare*
	Yellow-bellied Flycatcher	*Empidonax flaviventris*	Rare*
	Alder Flycatcher	*Empidonax alnorum*	Rare*
	Least Flycatcher[a]	*Empidonax minimus*	Rare*
	Philadelphia Vireo	*Vireo philadelphicus*	Rare*
	Red-breasted Nuthatch	*Sitta canadensis*	Rare*
	Swainson's Thrush	*Catharus ustulatus*	Rare*
	Tennessee Warbler	*Vermivora peregrina*	Rare*
	Nashville Warbler[a]	*Vermivora ruficapilla*	Rare*
	Magnolia Warbler	*Dendroica magnolia*	Rare*
	Northern Waterthrush	*Seiurus noveboracensis*	Rare*
	Chestnut-sided Warbler[a]	*Dendroica pensylvanica*	Rare*
	Blackburnian Warbler	*Dendroica fusca*	Rare*
	Black-and-white Warbler[a]	*Mniotilta varia*	Rare*
	Mourning Warbler	*Oporornis philadelphia*	Rare*
	Wilson's Warbler	*Wilsonia pusilla*	Rare*
	Canada Warbler	*Wilsonia canadensis*	Rare*

[a]Species was judged as Observed because site does not contain suitable habitat, but future work may describe it as a Possible breeder or higher based on breeding range and behavior.

Table 5. Common names of brood-parasitized species observed in 2005-2007. Most of these data were gathered during Study 1; parasitized nests of the Yellow Warbler and Tree Swallow were documented in Study 3.

Brood Parasite	Species Parasitized	Year(s)	Broods Parasitized	Total Broods Observed
Brown-headed Cowbird	White-eyed Vireo	2007	1	1
	Yellow-throated Vireo	2006, 2007	3	3
	Red-eyed Vireo	2006	2	4
	Yellow Warbler	2007	1	2
	Common Yellowthroat	2007	1	4
	Eastern Towhee	2007	1	2
	Chipping Sparrow	2005, 2007	1	2
	Northern Cardinal	2007	2	7
	Indigo Bunting	2007	2	3
	House Sparrow	2005	2	2
Eastern Bluebird	Tree Swallow	2007	1	4

Table 6. Nest productivity for species monitored in Study 3.

Common Name	Nests observed (# successful)	# Offspring	Offspring/ nest	Offspring/ yr[a]	Maintenance fecundity	ND[b]	DNS[c]	SE[d]
Tree Swallow	4 (3)	-	-	-	-	87	0.989	0.011
Eastern Bluebird	4 (4)	-	-	-	-	72	1	0
Gray Catbird	24 (11)	35	1.46	2.92	1.35	342.5	0.962	0.010
Brown Thrasher	8 (2)	-	-	-	-	93	0.935	0.025
Yellow Warbler	3 (1)	-	-	-	-	45.5	0.956	0.030
Northern Cardinal	3 (0)	-	-	-	-	31.5	0.905	0.052
Red-winged Blackbird	29 (4)	12	0.41	0.83	1.62	295	0.915	0.016

[a]Assuming 2 broods/yr (Martin 1995)
[b]Number of nest days observed
[c]Daily Nest Survival
[d]Standard Error

APPENDIX 1

Breeding classification, codes, and interpretations for Study 1 (Smith 1990, Cutright et al. 2006). We classified birds as Observed, Possible, Probable, or Confirmed breeders. Codes within each category were used to summarize breeding behavior observed during field work and listed in Tables 2-4. Interpretations were used to distinguish among classifications and codes.

Breeding Classification	Breeding Code	Interpretation
Observed	O	A non-breeder or migrant (male or female) *observed* or heard between June 1 and July 31 does not suggest breeding, regardless of habitat. Use this code for species observed in unlikely breeding habitat, out of their normal breeding range, flying over, or with no indication of breeding. This code applies to vultures or raptors flying over, to ducks summering on an urban pond with no breeding habitat, or a heron foraging when no heronry exists in the block. This code records the presence of the species but does not suggest breeding.
Possible	X	A male or female observed in possible suitable nesting habitat within safe dates suggests possible breeding. Note that many species do not have safe dates. Thus, this code can only be used for some species.
Probable	S	*Singing* male detected once in possible suitable nesting habitat indicates probable breeding. If you hear a male of the same species in the same location on another visit determine if code T applies.
	P	*Pair* (male and female) observed in suitable nesting habitat when apparently holding a territory suggests probable breeding. This code is used when it is fairly certain that a mated pair of birds has been observed. Note that two birds of the same species observed together are not always a pair, especially when males and females look alike. In sexually monomorphic species, behavior may indicate a pair.
	T	*Territory* establishment can be based on a singing male observed on at least two different days a week or more apart in the same location. Such repeated observations are a good indication that a bird has taken up residence. Chasing of other birds of the same species often marks a territory and should be recorded using code T. One male American Robin chasing another falls under this code, as would two male owls hooting at each other from opposite sides of a canyon. Caution should be used for some species such as raptors and hummingbirds since they exhibit territorial behaviors in defense of feeding areas and favorite perches while wintering and migrating.
	C	*Courtship* behavior or copulation indicates probable breeding. This code includes courtship displays and food exchanges. Prairie-chickens seen dancing on a lek, hummingbird courtship flights, and the bill tilt or topple-over display of cowbirds would fit this code. Use this code cautiously for ducks and grebes since they often court during migration. For bird banders, this code should be used for females with a brood patch or males with a cloacal protuberance.
	N	Visiting a probable *nest-site* indicates probable breeding when no further breeding evidence is obtained. This code is especially useful for cavity nesters and shrub-nesting species that fly into the same locations and disappear repeatedly. Repeated use of the same probable nest-site must be observed.
	A	*Agitated* behavior or anxiety calls heard from an adult suggests probable breeding. This behavior suggests the probable presence of a nest or young nearby. Do not include agitation that you induce by "pishing" or using taped calls. A goshawk that calls in a distressed fashion falls into this category. If the goshawk swoops at you, you upgrade to the confirmed breeding code DD.

Breeding Classification	Breeding Code	Interpretation
	B	Nest *building* by wrens (Cactus, Bewick's, House, and Marsh), Verdins, or excavation of holes by woodpeckers indicates probable breeding. In Verdins and some species of wrens, unmated males will build nests to attract females. Thus, nests built by these species do not confirm breeding. Also, woodpeckers usually excavate one nest hole and other holes for roosting. Thus, excavation does not confirm breeding in woodpeckers.
Confirmed	PE	*Physiological evidence* of breeding (i.e., highly vascularized incubation (brood) patch or egg in oviduct) based on a bird in hand confirms breeding for bird banders only.
	CN	Birds observed *carrying nesting* material (e.g. sticks, hair, grass, mud, cobwebs) confirms breeding. This applies for all species except for some species of wrens (Cactus, Bewick's, House, March) and Verdins.
	NB	*Nest building* at the actual nest site by all except woodpeckers, Verdins, and wrens, confirms breeding.
	DD	*Distraction display* or injury feigning for defense of an unknown nest or young confirms breeding. This code is used if an adult bird is seen trying to lead people away from a nest or young. A Killdeer giving a "broken wing" act fits this code. The difference between this code and agitated behavior is that the adult bird puts its own life in danger with a distraction display.
	UN	A *used nest* confirms breeding. Caution: This must be carefully identified if it is to be used, and requires a written verification form. Some nests such as those of orioles are persistent and characteristic, but others are more difficult to identify. Be sure that the nest was used during the atlas period. Do not use this code for species that build multiple nests in a breeding season, such as Verdins and Cactus Wrens. Do not collect nests because some species roost in them all year and it is also illegal to collect nests or eggs without a permit.
	ON	Adults entering or leaving a nest site in circumstances indicating an *occupied nest* confirms breeding. This code is not generally used for open-cup nesting birds, unless the nests are high above the ground and the contents cannot be seen. This code should be used mainly for cavity nesting birds that enter a hole and remain inside, leave a hole after having been inside for some time, or for adults that exchange occupancy of a cavity.
	FL	Recent *fledglings* (of altricial species) or downy young (of precocial species such as galliformes, shorebirds or waterfowl) confirm breeding. Fledged young should be incapable of sustained flight. This code does not apply to mobile immatures. This code should be used with caution for species such as starlings and swallows that may move relatively great distances soon after fledging. Use of this code should be used only for recently fledged passerines in the natal areas that are still dependent on parents. A young cowbird begging for food confirms both the cowbird and the host species. If feeding of young by adults is observed use code FY.
	FS	An adult observed carrying a *fecal sac* confirms breeding. Many passerine adults keep their nests clean by carrying away membranous, white fecal sacs.
	FY	*Feeding young*, carrying food for young, or feeding recently fledged young confirms breeding. Be especially careful on the edge of a block. Some birds, such as birds of prey, continue to feed their young long after they've fledged and may move considerable distances. Some birds, such as Common Ravens, may carry food long distances to young in a neighboring block. Also, care should be taken to avoid confusion with courtship feeding, code C.
	NE	A *nest* with *egg(s)*, undisturbed nest with a bird in incubation posture, or eggshells found below the nest confirms breeding. Finding a cowbird egg in a nest is coded NE for both the cowbird and the host. Be careful not to disturb the vicinity of any nests.
	NY	A *nest* with *young* seen or heard confirms breeding. The presence of a cowbird young is coded NY for both cowbird and host species. Caution must be used in approaching nest sites to minimize disturbance. Most confirmations can be accomplished without locating actual nests.

APPENDIX 2

Abundance estimates for Green Wing Environmental Laboratory (72 species) in 2007 and the Troy Grove Breeding Bird Survey (BBS) route #068 (75 species) in 1989-1998 (PWRC 2007).

Green Wing Environmental Laboratory			**Troy Grove BBS Route #068**		
Common Name	Species	Birds/h	Common Name	Species	Birds/2.5 h
Red-winged Blackbird	*Agelaius phoeniceus*	13.85	Red-winged Blackbird	*Agelaius phoeniceus*	175.09
Song Sparrow	*Melospiza melodia*	9.61	Common Grackle	*Quiscalus quiscula*	105.82
Gray Catbird	*Dumetella carolinensis*	8.84	American Robin	*Turdus migratorius*	101.09
Swamp Sparrow	*Melospiza georgiana*	8.4	European Starling	*Sturnus vulgaris*	63
Common Yellowthroat	*Geothlypis trichas*	7.67	House Sparrow	*Passer domesticus*	61.55
American Goldfinch	*Carduelis tristis*	7.02	Song Sparrow	*Melospiza melodia*	27.73
Yellow Warbler	*Dendroica petechia*	6.26	Mourning Dove	*Zenaida macroura*	23.45
Killdeer	*Charadrius vociferus*	6.18	Western Meadowlark	*Sturnella neglecta*	23
Wood Duck	*Aix sponsa*	5.96	Barn Swallow	*Hirundo rustica*	22.91
Tree Swallow	*Tachycineta bicolor*	5.81	Rock Pigeon	*Columba livia*	21.36
House Wren	*Troglodytes aedon*	5.18	American Crow	*Corvus brachyrhynchos*	21.36
Cedar Waxwing	*Bombycilla cedrorum*	4.26	Brown-headed Cowbird	*Molothrus ater*	16
Brown-headed Cowbird	*Molothrus ater*	4.02	Killdeer	*Charadrius vociferus*	15
Field Sparrow	*Spizella pusilla*	3.55	Chimney Swift	*Chaetura pelagica*	12.18
Chipping Sparrow	*Spizella passerina*	3.4	Vesper Sparrow	*Pooecetes gramineus*	10.09
Indigo Bunting	*Passerina cyanea*	3.26	Horned Lark	*Eremophila alpestris*	7.18
Mourning Dove	*Zenaida macroura*	3.22	Ring-necked Pheasant	*Phasianus colchicus*	7.09
American Robin	*Turdus migratorius*	3.14	Northern Cardinal	*Cardinalis cardinalis*	7
Eastern Wood-Pewee	*Contopus virens*	3.1	American Goldfinch	*Carduelis tristis*	5.36
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	3.04	Brown Thrasher	*Toxostoma rufum*	4.09
Blue Jay	*Cyanocitta cristata*	3.02	Chipping Sparrow	*Spizella passerina*	2.73
Northern Cardinal	*Cardinalis cardinalis*	2.94	Mallard	*Anas platyrhynchos*	2.55
Canada Goose	*Branta canadensis*	2.88	House Finch	*Carpodacus mexicanus*	2.55
European Starling	*Sturnus vulgaris*	2.61	Common Yellowthroat	*Geothlypis trichas*	2.36

Green Wing Environmental Laboratory

Common Name	Species	Birds/h
Common Grackle	*Quiscalus quiscula*	2.45
Red-eyed Vireo	*Vireo olivaceus*	2.45
American Crow	*Corvus brachyrhynchos*	2.36
Solitary Sandpiper	*Tringa solitaria*	2.29
Spotted Sandpiper	*Actitis macularius*	2.29
Eastern Towhee	*Pipilo erythrophthalmus*	2.18
Blue-gray Gnatcatcher	*Polioptila caerulea*	2.16
Red-bellied Woodpecker	*Melanerpes carolinus*	2.04
Ovenbird	*Seiurus aurocapilla*	1.9
Warbling Vireo	*Vireo gilvus*	1.66
Great Blue Heron	*Ardea herodias*	1.64
Brown Thrasher	*Toxostoma rufum*	1.63
Eastern Kingbird	*Tyrannus tyrannus*	1.56
Green Heron	*Butorides virescens*	1.56
Bank Swallow	*Riparia riparia*	1.5
Black-capped Chickadee	*Poecile atricapillus*	1.46
White-breasted Nuthatch	*Sitta carolinensis*	1.4
Hairy Woodpecker	*Picoides villosus*	1.38
Veery	*Catharus fuscescens*	1.38
Great Crested Flycatcher	*Myiarchus crinitus*	1.31
Mallard	*Anas platyrhynchos*	1.31
Sedge Wren	*Cistothorus platensis*	1.27
Turkey Vulture	*Cathartes aura*	1.27
Baltimore Oriole	*Icterus galbula*	1.25
Dickcissel	*Spiza americana*	1.25
Northern Flicker	*Colaptes auratus*	1.23
Eastern Bluebird	*Sialia sialis*	1.2
House Sparrow	*Passer domesticus*	1.13
Wild Turkey	*Meleagris gallopavo*	1.12
Yellow-throated Vireo	*Vireo flavifrons*	1.12
Yellow-billed Cuckoo	*Coccyzus americanus*	1.11

Troy Grove BBS Route #068

Common Name	Species	Birds/2.5 h
Indigo Bunting	*Passerina cyanea*	2.36
Gray Catbird	*Dumetella carolinensis*	2.27
Eastern Meadowlark	*Sturnella magna*	2.27
Red-tailed Hawk	*Buteo jamaicensis*	2.18
House Wren	*Troglodytes aedon*	1.91
Dickcissel	*Spiza americana*	1.73
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	1.64
Baltimore Oriole	*Icterus galbula*	1.64
Eastern Kingbird	*Tyrannus tyrannus*	1.36
Blue Jay	*Cyanocitta cristata*	1.27
Northern Flicker	*Colaptes auratus*	1.18
Great Blue Heron	*Ardea herodias*	1.09
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	0.82
American Kestrel	*Falco sparverius*	0.73
Eastern Bluebird	*Sialia sialis*	0.73
Savannah Sparrow	*Passerculus sandwichensis*	0.73
Red-bellied Woodpecker	*Melanerpes carolinus*	0.64
Warbling Vireo	*Vireo gilvus*	0.64
Canada Goose	*Branta canadensis*	0.55
Northern Bobwhite	*Colinus virginianus*	0.55
American Coot	*Fulica americana*	0.55
Red-headed Woodpecker	*Melanerpes erythrocephalus*	0.55
Bobolink	*Dolichonyx oryzivorus*	0.55
Turkey Vulture	*Cathartes aura*	0.45
Wood Duck	*Aix sponsa*	0.45
Cliff Swallow	*Petrochelidon pyrrhonota*	0.45
Pied-billed Grebe	*Podilymbus podiceps*	0.36
Great Crested Flycatcher	*Myiarchus crinitus*	0.36
Tree Swallow	*Tachycineta bicolor*	0.36
Cedar Waxwing	*Bombycilla cedrorum*	0.36
Downy Woodpecker	*Picoides pubescens*	0.27

Green Wing Environmental Laboratory

Common Name	Species	Birds/h
Wood Thrush	*Hylocichla mustelina*	1.1
Barn Swallow	*Hirundo rustica*	0.94
Chimney Swift	*Chaetura pelagica*	0.94
Scarlet Tanager	*Piranga olivacea*	0.94
Willow Flycatcher	*Empidonax traillii*	0.93
White-eyed Vireo	*Vireo griseus*	0.84
Ring-necked Pheasant	*Phasianus colchicus*	0.81
Downy Woodpecker	*Picoides pubescens*	0.8
Marsh Wren	*Cistothorus palustris*	0.75
Sandhill Crane	*Grus canadensis*	0.75
Sora	*Porzana carolina*	0.75
Cooper's Hawk	*Accipiter cooperii*	0.5
Rock Pigeon	*Columba livia*	0.5
Red-tailed Hawk	*Buteo jamaicensis*	0.44
Ruby-throated Hummingbird	*Archilochus colubris*	0.44
Barred Owl	*Strix varia*	0.25
Grasshopper Sparrow	*Ammodramus savannarum*	0.25
-	-	-
-	-	-
-	-	-

Troy Grove BBS Route #068

Common Name	Species	Birds/2.5 h
Willow Flycatcher	*Empidonax traillii*	0.27
Willow/Alder Flycatcher	*Empidonax traillii/E. alnorum*	0.27
Northern Mockingbird	*Mimus polyglottos*	0.27
Green Heron	*Butorides virescens*	0.18
Gray Partridge	*Perdix perdix*	0.18
Belted Kingfisher	*Megaceryle alcyon*	0.18
Yellow-throated Vireo	*Vireo flavifrons*	0.18
Red-eyed Vireo	*Vireo olivaceus*	0.18
Tufted Titmouse	*Baeolophus bicolor*	0.18
White-breasted Nuthatch	*Sitta carolinensis*	0.18
Wood Thrush	*Hylocichla mustelina*	0.18
Northern Harrier	*Circus cyaneus*	0.09
Sora	*Porzana carolina*	0.09
Yellow-billed Cuckoo	*Coccyzus americanus*	0.09
Ruby-throated Hummingbird	*Archilochus colubris*	0.09
Eastern Wood-Pewee	*Contopus virens*	0.09
Eastern Phoebe	*Sayornis phoebe*	0.09
Loggerhead Shrike	*Lanius ludovicianus*	0.09
Yellow Warbler	*Dendroica petechia*	0.09
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	0.09