DELAWARE RUN FLOODPLAIN:
PRESERVING NATURE IN AN URBAN LANDSCAPE

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Abstract: The floodplain of the Delaware Run is unusual geologically and biologically. Geologically the Delaware Run, unlike other tributaries of the Olentangy River which flow through narrow, deep ravines, has carved a wide floodplain despite being a narrow stream. This wide floodplain provides the only naturally vegetated corridor into the city of Delaware, Its mix of eastern deciduous forest, brushy edges, and fields are host to an unusually diverse assemblage of birds. These are permanent residents, summer residents, winter residents and seasonal migrants. As a collection of birds they are the most abundant and diverse assemblage in the city, which is a strong reason for preserving the flood plain intact. Furthermore, the corridor also boasts diverse communities of butterflies, mammals and other vertebrates. Delaware Run flows east from a spring in Gallant Woods Metro Park. Extending Lexington Blvd. through the flood plain to connect Williams St. and Central Ave will disrupt the flow and create a substantial barrier to the movement of species along the natural corridor bordering the Delaware Run. Several alternatives to building a road through the floodplain are possible. Not building the road is the least expensive possibility. A second, expensive alternative is to build a road down into the flood plain clear cut the berms and put in a low culvert for the Run. The third, more expensive alternative is to build an elevated roadway over the flood plain thereby allowing free flow of the Run and the animals of the flood plain, leaving the habitat largely undisturbed. The advantages and disadvantages of these alternatives are discussed.

INTRODUCTION

The impact of habitat alteration on plant and animal diversity deeply concerns naturalists and conservation biologists (Terborgh 1989, Askins et al. 1990, Hagan and Johnston 1992, Gill 1995, Leopold 2013). To illustrate the effect of human development on native species in central Ohio the ornithology class identified and counted birds of residential and urban Delaware and the Delaware Run every spring semester from 1981 through 1998. We used line transects, which offer a quantitative approach to habitat comparison (Bibby et al. 1992, Silveira et al. 2003). Based on statistical and comparative analysis of our census results the value of the Delaware Run Natural Corridor is discussed.

Notes on the animals of the Delaware Run corridor contributed by several individuals are compiled and presented in appendices. These notes on the total diversity of butterflies, birds, and other animals written over thirty years of visiting the area to observe life in this ecological jewel emphasize its unique importance to natural life in Delaware.

The proposed extension of Lexington Blvd. through the corridor is discussed along with evaluation of the alternatives.

METHODS

The Ohio Wesleyan ornithology class censused all birds seen and heard on three habitats near campus:

Blue Limestone and Delaware Run Floodplain - This strip of land runs along both sides of the Delaware Run between Central Ave. and Williams St. The dominant vegetation is deciduous forest, but there are also fields and some lawns, which create substantial edge habitat. Blue Limestone Park has two sink holes that are filled with water and provide habitat for waterfowl. The vegetation is predominantly native to the eastern deciduous forest that has characterized the eastern United States since the last glacier receded northward. The land is bordered on the north by Central Ave., Grady Hospital and residential development, all of which are above the floodplain. To the east the corridor is bordered by Elizabeth St. and the dense residential area west of downtown. To the south, the corridor is bordered by Williams St., Hidden Valley Golf Course, and Willow Brook at Delaware Run. Most of this area, like that north of the Run, is above the floodplain. Some of the golf course and Willow Brook are in the Flood Plain, but these areas are mixed fields and deciduous forest. To the west the Run flows through a culvert at Houk Rd., which constricts the flow of the stream and creates a wide break in the flood plain habitat. West of Houk Rd. the Run flows through suburban development, but west of that the Run is largely unimpeded as it flows past agricultural fields and through woods to its source in Gallant Woods Preservation Park. The census route was along the south side of Blue Limestone Park to the large sink hole, north to the CSX bridge over the Run, under the bridge and about 100 m further west then back along the north side of the Run to the Park entrance on Elizabeth St.

Residential . – This census area was adjacent to the Blue Limestone and Delaware Run Floodplain. The transect began at the corner of Williams and Liberty streets and followed Williams St. west to Elizabeth St. North to Central Ave and west to Darlington St., north to Griswold St. where the transect turned south and proceeded to Liberty St.. There the transect turned south and returned to the corner of Liberty and Williams streets. The area is characterized by residential homes on small lots which are planted to native and ornamental trees, some in flower during the census period; shrubs, largely ornamental, but some native; and lawn. A few homes had bird feeders, but these were not consistently present or filled.

Downtown - This area was adjacent to the residential census and within a short distance of the Blue Limestone and Delaware Run Floodplain census. The transect began at the corner of Williams and Liberty streets and went east along Liberty St. to Washington St. where it turned north and proceeded to Central Ave., east on Central to Union St. where the transect turned south. At the corner of Union and Winter streets, the line turned west for a block then south again on Henry St. The transect ended at St. Mary's Church at the corner of Williams and Henry streets. The area included four busy streets and several quieter, one way streets. Stores, office buildings, and parking lots cover most of the area. Crab apple trees were recently planted along two of the streets and a few buildings had patches of grass with yew bushes and spruces close to the buildings. A few large trees could be found behind some of the buildings.

Birds were counted along each transect six times during the spring semester (1988-1998). The order of censuses was random, except that no area was censused a second time until all had been censused once, no area was censused a third time until all had been censused twice, etc.

Birds were identified by walking along a transect and counting all birds seen or heard within 50 m of the transect, all parts of which were at least 50 m from the edge of the habitat. Birds seen more than 50 m in front or behind were counted as long as they were within 50 m perpendicular to our transect. Time and weather conditions were recorded at the start of each census. Species were identified and counted as seen. Additional birds were added to the total for the species whenever they were seen. Birds flying over the habitat were recorded separately from birds using the habitat.

ANALYSIS

Data for a given year were compiled at the end of the semester and analyzed in the following ways (see Tables 1-8) :

- mean number of species/census and total number of species
- numbers of resident and visitor species
- species diversity - Several diversity indices are available, but I used the Shannon index which is calculated from the formula:

  $$H = - \Sigma P_i \ln P_i$$

  where H is the Shannon diversity index, P_i is the proportion of total individuals in the *i*th species. See Begon et al. (1990) for discussion of diversity indices and other measures of community structure.
- three most common resident species
- proportion of introduced to native species and individuals

RESULTS

During eleven years (1988-1998) of censuses with the ornithology class, we recorded 92 different species in the combined areas: 86 species in the Blue Limestone/Delaware Run Floodplain, 62 in the residential area, and 32 in the downtown. There can be no question that the floodplain had the most species of the three areas, but our data provide a more detailed picture of the importance of the floodplain than the simple totals.

The t-test for calculating the likelihood that two means are the same (average number of species as adjusted for the abundance of each) shows that in 1998, a representative year, the diversity of the three areas differs significantly (Table 1, $t = 21.02$, $df = 2$, $p < 0.01$). What is even more interesting is that the Blue Limestone/Delaware Run Floodplain has a significantly greater diversity than the residential or urban areas and that the difference between the latter two areas is not statistically different.

One might argue that the difference is because more species of birds visit the floodplain forest and fields than visit the residential and downtown areas and the number of visiting species, not

the number of resident species, is the reason for the large difference in diversity. However, table 2 shows that twice as many species visit the floodplain area as the other areas, but there are also twice as many resident species. In fact, the number of visiting species as a proportion of the total in each habitat is almost identical. The floodplain simply has a more diverse assemblage of bird species.

One might argue that 1998 was an unusual year, but Table 3 shows data from all years and the patterns across all years are similar. Whether using the number of birds/census or the total number of individuals seen in all censuses for that habitat in that year, downtown Delaware had the most birds, residential Delaware was in the middle and the floodplain had the fewest birds/census and total for the year. Interesting as these totals are they do not change the diversity picture. As shown in Table 4, in all years of the census the floodplain was the most diverse habitat, the residential area moderate, and the downtown least diverse.

If you consider tables 3 and 4 together the picture of bird life in the downtown becomes quite bleak. There are a lot of birds, but they represent a few introduced species. As shown in Table 5 the proportion of introduced species in downtown Delaware is 24-40 % (0.24-0.40). In the residential neighborhood the proportion of introduced species is 14-25% (0.14-0.25). In the floodplain the proportion drops even further to 8-12% (0.08-0.12). Non-native species of birds are a sizeable proportion of the species seen downtown and a much smaller proportion of the species seen in the neighborhood and the floodplain. In fact the proportions are essentially non-overlapping (Table 5)

The pattern is essentially the same if, instead of species, the proportion of individuals of introduced species is considered. Most of the individual birds seen downtown are members of introduced species, 65-82% (Table 5). The proportion is less in the neighborhood, 44-75%, but plummets in the floodplain where only 10-24% of individuals belong to introduced species.

The pattern is similar if we consider the number of different species that were among the three most common species seen during the year of the census (Table 6). The species vary some from year to year, but in the downtown only four species (Table 7) were among the three most common in at least one year during the eleven years of censuses and all of them were introduced species. There were no native species among the most common. In the neighborhood there was a little more variation in the three most common species from year to year (Table 6), but over the eleven years only five species were among the three most common (Table 7) and three of those five were non-native. In the floodplain the three most common species varied from year to year (Table 6) with ten species among the three most common in at least one of the eleven years. Furthermore, only two of the common species in the floodplain were non-native.

From 1988 through 1998 the census transects and the time spent walking them were the same in Blue Limestone Park / the Delaware Run, the adjacent neighborhood, and downtown Delaware. Prior to that the class counted birds in the three areas, but we were not careful to walk the same distance and spend the same time in each habitat. Nonetheless, one interesting pattern emerged that is unaffected by the lack of complete comparability. In 1952 an illegal shipment of House Finches for the pet trade was released illegally in New York City. When I began the censuses in 1981 there were no House Finches in any of the habitats, but the population was expanding west

and we were able to document their arrival in central Ohio (Table 8). None were seen in 1981. One was seen in each area in 1983 and subsequently House Finches increased more rapidly and reached higher numbers in the downtown and neighborhood than in the floodplain (Table 8).

DISCUSSION

Ecological Significance: Several excellent examples of the use of line transects can be found in the ornithological literature. Hilden (1986, 1987) has monitored population levels of wintering and breeding birds in Finland since 1956. In North America, breeding birds of the shrub-steppe habitat have been censused using line transects (Rotenberry and Wiens 1980, Wiens 1985). The very nature of ocean travel favors use of the line transect as a means of counting birds. Diamond *et al*. (1986) discuss the use of line transects at sea and their use to calculate densities of seabirds. In short it is a technique with a long history of unbiased assessment of bird populations in very different habitats (Silveira, L. *et al*. 2003).

That being so, what do the transect censuses tell us about Delaware and the value of the Delaware Run Flood Plain? The floodplain from Blue Limestone west is a diverse and stable habitat. The diversity index alone tells us that, but the index is supported by the number of species seen or heard along the floodplain transect, which is 2-3 times the number found along neighborhood and downtown transects. The diversity difference is important because a high diversity tends to stabilize the habitat. This can be seen when an invasive species such as the House Finch arrived in central Ohio in the 1980s. Initially it invaded all three habitats, but became much more abundant in the downtown and neighborhood areas than in the flood plain. It is still less common in the floodplain than in the other areas thirty years after its arrival. The three most common species in each habitat by year (Table 6) and overall (Table 7) also illustrate the importance of diversity. In the downtown area only four species show up as one of the three most common species in at least one of the eleven years of rigorous transect censuses. Pigeons are the most common in 7 years, starlings in 3 years, and House Sparrows in one year. All are introduced European species. Individuals of native species are uncommon to rare downtown.

The floodplain with its diversity of native trees, shrubs, vines, and native and introduced plants offers a diverse habitat that is attractive to permanent residents, summer residents, winter residents and seasonal migrants (Appendix 1). For all of these species, the floodplain offers food and shelter in a variety of habitats to which they are adapted. For migrants it is an essential resting place where they can stop and replenish their depleted energy reserves. For permanent and summer residents it includes the habitats in which they breed and raise their young. For the winter residents it is the “south” where they can find the food and shelter to overwinter in a climate that has milder winters than in the winters in their northern summer range. For human residents along the Run it provides an exciting kaleidoscope of birds that changes with the seasons, but it provides even more.

In the summer the floodplain is populated by a diverse array of butterflies (Appendix 2) that accent our flowers with moving color and by a fascinating collection of dragonflies and damselflies. Throughout the year there are native mammals (Appendix 2) that offer the elegance of White-tailed Deer and the excitement of a coyote hunting and catching meadow voles. For those with a taste for the subtle excitement of nature there are frogs, snakes, and turtles

(Appendix 2). All of these groups of animals can be found in the floodplain corridor of the Delaware Run and many of these have limited mobility, which makes the preservation of undisturbed floodplain forest and fields vital to their survival.

The low diversity of the downtown and its dominance by a few introduced species mean that there is the possibility of invasion by non-native species, such as happened with the zebra mussel (*Dreissena polymorpha*) in the Great Lakes. This happened in Delaware and throughout the eastern United States with the invasion of urban and suburban habitats by House Finches. The ornithology class documented the invasion and spread of House Finches as they arrived in Delaware County and established residence, most commonly in urban and suburban areas, less commonly in rural areas. The pattern of distribution is the same now, 31 years after their arrival as in those first years. Such an invasion illustrates the importance of species diversity to maintaining the ecological health and stability of our environment. Despite our many technological advances we still depend on the environment to provide us with clean air and water and a climate that nurtures life.

Planning for Preservation

Maintaining Biodiversity: In a world that is increasingly threatened with loss of its stabilizing biodiversity we have a few acres of habitat that encourages and protects diversity because it offers about 1.5 miles of natural floodplain, an uninterrupted corridor in which animals from turtles to birds can live and roam. We can observe and enjoy them, which enhances our lives, but we need to protect them. We can do that by protecting their habitat. What is the price of protecting the habitat?

Nothing. We can protect the Delaware Run corridor by doing nothing. Just let it be.

The city plans to connect Williams St. to Central Ave at Lexington Blvd. by building a road across the Delaware Run. The cross road will be about 0.5 miles closer to town than Houk Rd. which will save residents of Willowbrook and the developments around Rockcreek Rd. on Williams St. opposite Willowbrook about 5-10 minutes getting from their residences to Buehlers, Grady Hospital, or Panera Bread. If you live on the Central Avenue side of the Delaware Run corridor it is not clear why you would cross to Williams St., which has few commercial establishments far enough west to be worth crossing in the area of Lexington Blvd. If you live closer to town than Willow Brook or the Rockcreek development, you would probably cross at Elizabeth or Liberty streets and, if you lived further west, you would probably use Houk Rd. The users of the new road would seem to be relatively few.

What would the road do ecologically? It would probably disrupt movement of frogs, snakes, and especially turtles as the approximately 30 foot wide cleared area, similar to that at Houk Rd., would be difficult for these animals to cross. Cars on the road would increase the mortality of mammals and birds. How important are a few more avian or mammalian deaths? Hard to attach a number to the effect, but the populations are already stressed. The habitat of the Delaware Run flood plain is limited and the native populations that live in it are already limited (see tables for birds based on the censuses) and stressed. How many more deaths before we push the species beyond the point where they can sustain a population in the Delaware Run habitat? The realistic answer is, we just do not know, but we do know there is a limit at which a population cannot

sustain itself. That is why we have no Carolina Parakeets today. North America's only native parrot was the victim of habitat destruction as was our largest woodpecker, the Ivory-billed Woodpecker.

Economic value: The high numbers of a few species in residential and urban Delaware mean that there is a risk of disease invading and spreading among one of the abundant species. This is not a theoretical possibility. It has happened. An eye disease, *Mycoplasma gallisepticum,* infected House Finches in 1994. The disease was previously known only from poultry. It is usually fatal in House Finches since it blinds them (and poultry) and they are killed by predators they cannot see. We have too few data to really know what happened to the House Finch population, but House Finches in central Ohio have become a reservoir for the infection which increases the risk of its spread to poultry such as those at the Delaware County Fair.

A very different perspective on the flood plain corridor is its effect on property values. Homes and land that overlook the floodplain are more valuable than homes elsewhere in Delaware that look at other houses or streets. The properties overlooking the Delaware Run provide an economic benefit to the community, a benefit that will continue as long as we are good custodians of the floodplain ecosystem.

Then there is the cost of the proposed road itself. Several options are possible:

1. The simplest and least expensive alternative is to not build a road through the floodplain forest. The money saved could be used to repair and resurface existing roads or to make DATA bus service more frequent or to reduce city taxes.

2. If a road must be built, the simplest and least expensive option would be the "Houk Rd." option. Cut down a wide swath of floodplain forest, bring in enough gravel and fill to stabilize the road bed, put in a low culvert, and pave a road down into the flood plain, over the culvert, and link to the dead-end road west of Willow Brook and south of the Run. That option will more or less isolate about 0.5 miles of the Run between Houk Rd. and the extension of Lexington Blvd. The effect on the ecology of the Run will vary with the specific animal. For those with limited mobility the effect may be to isolate them in a small piece of habitat and limit their breeding options. For those with greater mobility, the separation will increase the stresses. Occasionally a cardinal or deer will be hit by a car, just one more source of mortality. The road may also be subject to flooding since it is in a flood-plain and the culvert will disrupt the flow of the Run. Repeated flooding could undermine the road bed and require expensive repairs in the future.

3. If a road must be built, a less damaging, but more complex and expensive alternative would be to build an elevated road over the flood plain. The construction of either road will have ecological effects, but after an elevated road is built and the forest has had time to grow back, the damage could be minor. With an elevated road the mobility of animals would be only slightly impeded by the support posts. There would still be the possibility that birds flying over the road would collide with cars, but deer would move through the forest below the road and many birds would fly under the elevated roadway.

Clearly the first alternative will be the least expensive, whereas the third alternative is the most expensive. Equally clear the first alternative is the best ecologically, whereas the second alternative is the worst. Ecologically the third alternative is somewhere between the two extremes. While never as good ecologically as not building the road, an elevated road will have a large initial impact which would lessen with time as the forest grew back and the wildlife got used to the noise.

The first alternative looks even better in a cost-benefit analysis. The city could:

1. not spend the money required to build the road;

2. could spend some of the money the road would have required to repair and resurface existing city roads thereby improving the roads for everyone;

3. could expand DATA service providing a more user friendly network of public transportation that would reduce wear and tear on local roads thereby reducing the future need for repair and resurfacing. Expanded service would also help reduce traffic in Delaware, which is becoming a problem.

Not building the road is the best alternative ecologically, financially, and in terms of quality of life for all residents of Delaware.

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TABLE 1

STATISTICAL COMPARISON (1998)

	Semi-Natural (Blue Limestone/ Delaware Run)		**Suburban** (Residential Neighborhood)		**Urban** (Downtown Delaware)
Mean species/Census	21.8 ± 2.8	>	11.7 ± 2.6	=	10.2 ± 1.2
Total species	36		19		16

TABLE 2

RESIDENT AND VISITING SPECIES (NON-FLYING) BY HABITAT (1998)

	Semi-Natural (Blue Limestone/ Delaware Run)	**Suburban** (Residential Neighborhood)	**Urban** (Downtown Delaware)
Resident (seen on 3 or more censuses)	24	13	10
Visitor (seen on 1 or 2 censuses)	12	6	6
Proportion of visiting species	0.33	0.31	0.37

TABLE 3

HABITAT COMPARISON

Year	Semi-Natural (Blue Limestone/ Delaware Run)	Suburban (Residential Neighborhood)	Urban (Downtown Delaware)
Birds/census			
1988	83.3	114.3	212.7
1989	73.3	147.0	352.7
1990	69.3	132.0	153.7
1991	82.3	122.4	176.7
1992	82.8	135.3	162.2
1995	71.0	162.5	158.5
1996	74.3	114.8	124.8
1997	54.8	142.8	135.1
1998	70.5	117.0	151.7
Total birds			
1988	250	343	638
1989	221	441	1058
1990	208	396	461
1991*	247 (494)	367 (734)	530 (1060)
1992*	248 (497)	406 (812)	486 (973)
1995*	213 (426)	487 (975)	476 (951)
1996*	223 (446)	345 (689)	375 (749)
1997*	164 (329)	428 (857)	415 (830)
1998*	212 (423)	351 (702)	455 (910)

*Six censuses were conducted in 1991, 1992, and 1995-1998. The number of birds in three censuses is listed since only three censuses were conducted in 1988-1990, but the 1991, 1992, and 1995-1998 totals for six censuses are listed in parentheses.

TABLE 4

SPECIES DIVERSITY INDEX BY HABITAT

Year	**Semi-Natural** (Blue Limestone/ Delaware Run)	**Suburban** (Residential Neighborhood)	**Urban** (Downtown Delaware)
1988	4.43	3.72	2.33
1989	4.48	3.63	2.20
1990	4.58	3.21	2.76
1991	4.36	3.15	2.46
1992	4.41	3.22	2.78
1995	4.62	3.31	2.88
1996	4.44	3.10	2.15
1997	4.45	2.59	2.63
1998	4.56	2.81	2.51

TABLE 5

PROPORTIONS OF INTRODUCED/NATIVE BIRDS

Year	**Semi-Natural** (Blue Limestone/ Delaware Run)	**Suburban** (Residential Neighborhood)	**Urban** (Downtown Delaware)
1988			
species	0.10	0.20	0.30
individuals	0.10	0.55	0.65
1990			
species	0.12	0.25	0.40
individuals	0.12	0.52	0.79
1991			
species	0.12	0.18	0.27
individuals	0.24	0.44	0.78
1992			
species	0.08	0.14	0.24
individuals	0.23	0.59	0.77
1995			
species	0.11	0.18	0.28
individuals	0.22	0.58	0.75
1996			
species	0.09	0.20	0.33
individuals	0.17	0.66	0.69

1997			
species	0.12	0.21	0.27
individuals	0.17	0.75	0.82
1998			
species	0.11	0.21	0.25
individuals	0.19	0.68	0.81

TABLE 6

THREE MOST COMMON RESIDENT SPECIES

Year	Semi-Natural (Blue Limestone/ Delaware Run)	Suburban (Residential Neighborhood)	Urban (Downtown Delaware)
1985	starling robin grackle	house sp. starling mourning dove	starling house sp. rock pigeon
1987	robin starling cardinal	starling house sp. mourning dove	rock pigeon starling house sp.
1988	robin grackle cardinal	house sp. starling mourning dove	rock pigeon house sp. starling
1989	grackle starling mourning dove/ house finch	starling house sp. mourning dove	rock pigeon starling house finch/ house sp.
1990	grackle junco cardinal	house sp. starling mourning dove	rock pigeon starling house sp.
1991	house finch cardinal starling	starling house sp. mourning dove	rock pigeon starling house finch
1992	starling cardinal song sp.	starling house sp. mourning dove	rock pigeon starling house sp.
1995	mourning dove starling/cardinal/song sp.	house sp. starling house finch	rock pigeon starling house sp.

1996	starling	house sp.	starling
	cardinal	starling	house sp.
	blue jay	mourning dove	rock pigeon
1997	cardinal/starling	house sp.	house sp.
	song sp./crow	starling	starling
		mourning dove	rock pigeon
1998	starling	house sp.	starling
	cardinal	starling	house sp.
	Canada goose	crow	rock pigeon

TABLE 7

SPECIES THAT WERE AMONG THE THREE MOST COMMON IN 1 OR MORE YEARS

Semi-Natural (Blue Limestone/ Delaware Run)	**Suburban** (Residential Neighborhood)	**Urban** (Downtown Delaware)
European Starling	**House Sparrow**	**European Starling**
American Robin	**European Starling**	**House Sparrow**
Common Grackle	**Mourning Dove**	**Rock Pigeon**
Mourning Dove	**House Finch**	**House Finch**
House Finch	**American Crow**	
Dark-eyed Junco		
Song Sparrow		
Blue Jay		
American Crow		
Canada Goose		

1. In 11 years 10 different species appeared among the three most abundant along Delaware Run in Blue Limestone Park, 5 species appeared among the three most common in the Delaware neighborhood adjacent to the park, and only four species appeared among the three most common in the downtown.

2. Among the most common species along Delaware Run in Blue Limestone Park, only two (20%) were introduced species. In the residential area adjacent to the park, 3 species (60%) were introduced, and in the downtown all 4 species (100%) were introduced. There were no native species that regularly frequented the downtown.

TABLE 8

HOUSE FINCHES (INTRODUCED SPECIES)/CENSUS

Year	**Semi-Natural** (Blue Limestone/ Delaware Run)	**Suburban** (Residential Neighborhood)	**Urban** (Downtown Delaware)
1981	0	0	0
1983	0.3	0.3	0.3
1984	0	0	0.3
1985	0.5	2.5	2.8
1987	2.0	10.3	8.0
1988	0.3	10.0	11.7
1989	5.3	17.0	36.3
1990	3.0	9.3	15.0
1991	12.6	9.2	16.0
1992	2.5	8.3	14.8
1995	4.8	17.3	13.3
1996	2.3	6.0	4.7
1997	0.8	2.8	5.2
1998	0.8	5.5	10.8

A = Abundant (many seen on all trips)
C = Common (seen on all or most trips)
U = Uncommon (one or a few sightings on most trips, but not every trip)
R = Rare (one or a few sightings each year)

Appendix 1

Birds of Blue Limestone and Delaware Run

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Students and professors have collected the data in these tables as part of weekly censuses done during the ornithology course. Censuses were done twice weekly from January to May from 1981-2014 from Blue Limestone Park through downtown Delaware to where the Run empties into the Olentangy. Intensive counting was done by Williams during 2007-2011 and included the area already mentioned, but extended west along the run into the Willow Brook community.

The twelve columns give the abundance for the months of the year.

MONTHS	J	F	M	A	M	J	J	A	S	O	N	D
Cackling Goose	R										R	R
Canada Goose	U	U	C	C	C	C	C	C	C	C	C	C
Wood Duck			U	U	U	U	U	U	U	R	R	R
American Black Duck	R	R	R								R	R
Mallard	U	U	C	C	C	C	C	C	C	C	C	C
Lesser Scaup			R	R							R	
Hooded Merganser	R	R	R	R								
Wild Turkey	*											
Pied-billed Grebe	R	R	R	R					R	R	R	R
Horned Grebe			*									
Great Blue Heron	U	U	C	C	C	C	C	C	C	C	C	C
Green Heron				R	R			R	R	R		
Black Vulture			R	R								
Turkey Vulture				U	C	C	C	C	C	C	C	U
Osprey				R	R				R	R		
Bald Eagle	R	R	R	R	R			R	R	R	R	R
Sharp-shinned Hawk				U	U				U	U	U	U
Cooper's Hawk	C	C	C	C	C	C	C	C	C	C	C	C
Red-shouldered Hawk		R	R	R				R	R			
Broad-winged Hawk				U	U			U	U			
Red-tailed Hawk	C	C	C	C	C	C	C	C	C	C	C	C
American Kestrel	R	R	R	R	R			R	R	R	R	R
American Coot		R			R					R	R	
Killdeer			U	C	C			U	C	C	U	
Spotted Sandpiper				C	C			C	C			
Solitary Sandpiper				U	U			U	U			
Greater Yellowlegs				U	U			U				
Lesser Yellowlegs				U	U			U				
Pectoral Sandpiper				R	R			R	R	R	R	
Bonaparte's Gull			R							R	R	R
Ring-billed Gull	C	C	U	U	U			R	U	U	U	U
Herring Gull	R	R	R	R								R
Iceland Gull	*											
Rock Pigeon	A	A	A	A	A	A	A	A	A	A	A	A
Mourning Dove	A	A	A	A	A	A	A	A	A	A	A	A
Barn Owl (historical breeder)												
Eastern Screech-Owl	C	C	C	C	C	C	C	C	C	C	C	C
Great Horned Owl	U	U	U	U	U	U	U	U	U	U	U	U
Common Nighthawk					C	C	C	C	U			
Chimney Swift				U	C	C	C	C	C	U		
Ruby-throated Hummingbird				U	U			U	U			
Belted Kingfisher	U	U	U	U	U	U	U	U	U	U	U	U

MONTHS	J	F	M	A	M	J	J	A	S	O	N	D
Red-headed Woodpecker								R	R	R		
Red-bellied Woodpecker	C	C	C	C	C	C	C	C	C	C	C	C
Yellow-bellied Sapsucker	R	R	U	U	U				U	U	U	R
Downy Woodpecker	C	C	C	C	C	C	C	C	C	C	C	C
Hairy Woodpecker	U	U	U	U	U	U	U	U	U	U	U	U
Northern Flicker	C	C	C	C	C	C	C	C	C	C	C	C
Pileated Woodpecker		R	R	R					R			
Eastern Wood-Pewee					C			U	C	R		
Yellow-bellied Flycatcher								U	U	R		
Least Flycatcher				U	U				U			
Eastern Phoebe			U	C	C	C	C	C	C	U	R	R
Eastern Kingbird				U	U			U				
Yellow-throated Vireo				U	U				U			
Blue-headed Vireo				U	U				U	U	R	
Warbling Vireo				U	U			U	U			
Philadelphia Vireo					U				U	U		
Red-eyed Vireo				U	C	C	C	C	C	U		
Blue Jay	A	A	A	A	A	A	A	A	A	A	A	A
American Crow	A	A	A	A	A	A	A	A	A	A	A	A
Horned Lark	U	U	U						U	U	U	U
Purple Martin			R	R	R			R	R			
Tree Swallow			R	C	C		C	C	U			
Northern Rough-winged Swallow		U	C	C	C	C	C					
Barn Swallow				U				U				
Carolina Chickadee	A	A	A	A	A	A	A	A	A	A	A	A
Tufted Titmouse	C	C	C	C	C	C	C	C	C	C	C	C
Red-breasted Nuthatch**	U	U	U	U	R					U	U	U
White-breasted Nuthatch	C	C	C	C	C	C	C	C	C	C	C	C
Brown Creeper			R	U	U	R				U	U	R
Carolina Wren	C	C	C	C	C	C	C	C	C	C	C	C
House Wren				U	C	C	C	C	C	U		
Winter Wren			U	U						U	U	
Golden-crowned Kinglet	U	U	U	C					R	C	C	U
Ruby-crowned Kinglet				C	U				R	C	U	R
Blue-gray Gnatcatcher				C	C	C	C	C	U			
Eastern Bluebird	R	R	U	U	C	C	C	C	C	U	U	R
Veery				U	U							
Gray-cheeked Thrush				U	U				U	U		
Swainson's Thrush				U	U				C	U		
Hermit Thrush			R	U	U				U	U	R	R

MONTHS	J	F	M	A	M	J	J	A	S	O	N	D
Wood Thrush				U	C				U			
American Robin	A	A	A	A	A	A	A	A	A	A	A	A
Gray Catbird				C	C	C	C	C	C	C		
Northern Mockingbird	R	U	U	U	U	U	U	U	U	U	U	R
Brown Thrasher			U	U	U			U	U	U		
European Starling	A	A	A	A	A	A	A	A	A	A	A	A
American Pipit				R	R			R	R	R	R	
Cedar Waxwing	U	U	U	U	C	C	C	C	C	C	C	U
Tennessee Warbler				U	U			R	U	U		
Orange-crowned Warbler										*		
Nashville Warbler				U	U			R	U	U		
Northern Parula				U	U				R	R		
Yellow Warbler				U	C	C	C	C	U			
Chestnut-sided Warbler				U	U			R	U			
Magnolia Warbler					U			U	C	U		
Cape May Warbler					U			R	C	U		
Black-throated Blue Warbler									U	R		
Yellow-rumped Warbler	R	R	U	C	C				R	C	U	R
Black-throated Green Warbler			U	U			U	U	U			
Blackburnian Warbler				R					U			
Yellow-throated Warbler					U	U						
Pine Warbler									*			
Palm Warbler				U	U				U			
Bay-breasted Warbler					U				U			
Blackpoll Warbler					U				U	U		
Black-and-white Warbler				U	U			R	U			
American Redstart					U			U	C	U		
Ovenbird				R	U				U	R		
Northern Waterthrush					R				R			
Louisiana Waterthrush			R	U	U							
Common Yellowthroat				U	U			U	U	U		
Hooded Warbler				R	R				R			
Wilson's Warbler					U			R	C	U		
Canada Warbler									R			
Eastern Towhee			R	U	U			U	U	U	R	R
American Tree Sparrow	U	U	U							R	U	U
Chipping Sparrow			R	C	A	A	A	A	C	C	R	R
Field Sparrow			R	U				U	U	U	R	R
Vesper Sparrow				R	R							

* Only record for the Delaware city area.

**Irruptive species absent most years (occurrence for irruption years)

Updated 11 April 2014

MONTHS	J	F	M	A	M	J	J	A	S	O	N	D
Lark Sparrow				R	R			R				
Savannah Sparrow				U	U			C	U	U		
Grasshopper Sparrow				R	R							
Fox Sparrow			U	U						U	U	
Song Sparrow	C	C	C	C	C	C	C	C	C	C	C	C
Lincoln's Sparrow				R	R				U	R		
Swamp Sparrow	R	R	R	U	C	C	C	C	C	C	U	R
White-throated Sparrow	C	C	C	C	R				R	C	C	C
White-crowned Sparrow				U	U				R	U	U	R
Dark-eyed Junco	C	C	C	C						U	C	C
Snow Bunting		*										
Scarlet Tanager					U			U	U			
Northern Cardinal	A	A	A	A	A	A	A	A	A	A	A	A
Rose-breasted Grosbeak				U	U			R	U	R		
Indigo Bunting				U	U			U	U	R		
Bobolink					R			R	R			
Red-winged Blackbird			U	U	U			U	U	U	R	R
Eastern Meadowlark			R	U	U			R	R	R	R	
Rusty Blackbird			R								R	
Common Grackle	R	R	U	U	U			U	U	U	R	R
Brown-headed Cowbird			U	U	U			U	U	U	R	R
Orchard Oriole				R	R							
Baltimore Oriole				U	U			U	U			
Purple Finch			R	R				R	R	R		
House Finch	A	A	A	A	A	A	A	A	A	A	A	A
White-winged Crossbill**	R	R										R
Common Redpoll**	R	R										R
Pine Siskin**	U	U	U	U	R					U	U	U
American Goldfinch	C	C	C	A	A	A	A	A	A	A	C	C
House Sparrow	A	A	A	A	A	A	A	A	A	A	A	A

Appendix 2

Non-birds of Blue Limestone and Delaware Run

Butterflies

American Painted Lady
Banded Hairstreak
Black Swallowtail, Eastern
Cabbage White
Clouded Sulfur
Comma
Common Wood Nymph
Dun Skipper
Eastern Tailed-Blue
Juvenal's Duskywing
Giant Swallowtail
Great Spangled Fritillary
Hackberry
Least Skipper
Little Glassywing
Little Wood Satyr
Meadow Fritillary
Monarch
Northern Broken-dash
Orange Sulphur
Pearl Crescent
Peck's Skipper
Question Mark
Red Admiral
Red-spotted Purple
Silver-spotted Skipper
Snout
Spring Azure
Striped Hairstreak
Tawny-edged Skipper
Tawny Emperor
Tiger Swallowtail

Amphibians

American Toad
Spring Peeper

Reptiles

Northern Water Snake

Mammals (grouped by family)

Meadow Vole

Eastern Chipmunk
Eastern Fox Squirrel
Eastern Gray Squirrel
Red Squirrel

Eastern Cottontail

Common Raccoon

Coyote

White-tailed Deer