

# **IMPACT ON AVIAN POPULATIONS OF URBAN AND SUBURBAN DEVELOPMENT**

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## **INTRODUCTION**

The impact of habitat alteration on avian populations deeply concerns ornithologists and conservation biologists (Terborgh 1989, Askins et al. 1990, Hagan and Johnston 1992, Gill 1994), but may not be evident if you are unfamiliar with birds or have little personal historical perspective. During the semester we will census three habitats that differ in the extent to which they have been altered by humans. We will use line transects which offer a quantitative approach to habitat comparison (Bibby et al. 1992) while providing ample opportunity for you to learn species identification. At the end of the semester we will analyze our data and discuss the effect of urban and suburban development on the number and diversity of species, the number of individuals, and the types of species present in the different habitats.

## **LEARNING OBJECTIVES**

You will:

- discover the multiple effects of human habitat alteration on avian populations
- use one or more census techniques
- experience the process of conducting a quantitative field study
- learn to identify birds by sight and sound
- learn to analyze numerical data

## **MATERIALS**

**Necessary:**

binoculars  
sturdy field notebook  
thermometer  
watch  
pen or pencil

**Optional:**

map of each area censused  
forms for recording species, number of individuals, and observations  
clipboard

## METHODS

We will census three habitats near campus:

**Olentangy Floodplain** - This strip of land runs along the Olentangy River behind the water treatment plant, the city parking garage, and the police auto impoundment. The site was once a landfill. It has been covered and native plants have been allowed to grow in the area, although there is still seepage from the underlying dump. The land is bordered on the north and east by the Olentangy River and on the west by the facilities already mentioned. To the south is more second growth similar to what we will census.

**Campus.** – We will census birds on campus starting from the Hamilton-Williams Campus Center and walking west along Spring St. into the residential area of campus, by the residence halls and onto “The Hill”, then return along Park St. to the Academic end of campus. The area consists of buildings and walks with a variety of plantings that form the Decker Arboretum.

**Downtown** - This area is adjacent to the campus census and within a short distance of the river census. The area includes 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 have patches of grass with yew bushes and spruces close to the buildings. A few large trees can be found behind some of the buildings.

We will census each area three times during the semester. The order of censuses will be random, except that no area will be censused a second time until all have been censused once, no area will be censused a third time until all have been censused twice.

We will census each area by walking along a transect and counting all birds seen within 50 m of the transect, all parts of which will be at least 50 m from the edge of the habitat. We will count birds seen more than 50 m in front or behind as long as they are within 50 m perpendicular to our transect. Record the time and weather conditions at the start of each census. Write each species in your notebook and tally each bird as you see it. Do not rely on your memory. If you are not sure of the identity of the bird, check with your instructor or the lab assistant. Birds flying over the habitat should be recorded separately from birds using the habitat.

## ANALYSIS

At the end of the semester you will have an opportunity to analyze all the census data. Feel free to compare the three habitats in any way that you can explain to the class. However, I would like to suggest some comparisons:

- mean number of species/census and total number of species
- numbers of resident and visiting species
- species diversity - Several diversity indices are available, but we will use the Shannon diversity index which is calculated from the formula:

$$H = - \sum P_i \ln P_i$$

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, same comparison for individuals
- number of individuals of a particular species (your choice)

Keep in mind that the line transect technique makes a number of assumptions (Bibby et al. 1992). We assume that we see all birds within 50 m of our route. Is this likely? How will its violation affect our data and our comparison of habitats? We assume that birds are randomly distributed with respect to distance from our route. If they respond to us by fleeing, this assumption will be invalid. How might that affect our data and our analysis? We assume that we have correctly estimated 50 m from the transect, but how might violations of the distance affect our data and subsequent analysis? We assume that we count individual birds only once. Is this assumption equally likely for all species? For example, is it equally likely for abundant species and for rare species? How does this problem affect our data and analysis? We assume that the probability of detecting one bird is independent of the probability of detecting another of the same species, but is this likely? What effect will violation of this assumption have on our comparison? Finally we assume that observer skill, season, and weather are constant. How might these variables affect our data and your analysis? Were these variables controlled in our study? Can we analyze their effects on the data? What other questions can you ask of the data? Be inquisitive.

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.

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**APPENDIX: SAMPLE REPORT ON THE IMPACT OF URBAN  
DEVELOPMENT ON AVIAN POPULATIONS  
IN DELAWARE OHIO**

(prepared for the city of Delaware and Ohio Wesleyan University)

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**Introduction**

The impact of habitat alteration on avian populations deeply concerns ornithologists and conservation biologists (Terborgh 1989, Askins et al. 1990, Hagan and Johnston 1992, Gill 1995), but may not be evident if you are unfamiliar with birds or have little personal historical perspective. During the semester the ornithology class censused three sites that differed in the extent to which they had been altered by humans. We used line transects which offer a quantitative approach to habitat comparison (Bibby et al. 1992) while providing ample opportunity for students to learn species identification. At the end of the semester the students and I analyzed our data and looked at the effect of urban development on the number and diversity of species, the number of individuals, and the types of species present at the different sites.

**Study Sites**

**Olentangy Floodplain** - This strip of land runs along the Olentangy River behind the water treatment plant, the city parking garage, and the police auto impoundment. The site was once a landfill. It has been covered and a mix of native and introduced (e.g., honeysuckle) plants have colonized the area, although there is still seepage from the underlying dump. The land is bordered on the north and east by the Olentangy River and on the west by the facilities already mentioned. To the south is more second growth similar to what we will census.

**Ohio Wesleyan University campus.** – We censused birds on campus starting from the Hamilton-Williams Campus Center and walking west along Spring St. into the residential area of campus, by the residence halls and onto “The Hill”, then return along Park St. to the Academic end of campus. The area consists of buildings and walks with a variety of plantings, many that are non-native, that form the Decker Arboretum.

**Downtown Delaware** - This area is adjacent to the campus census and within a short distance of the river census. The area includes 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 have patches of grass with yew bushes and spruces close to the buildings. A few large trees grow behind some of the buildings.

The three sites were in close proximity and birds could easily move from one to another. All sites were disturbed, but the Olentangy flood plain was covered with second growth trees, an understory of brush, and an herbaceous and grass ground cover. Both the campus and the downtown were artificial habitats, but the campus had far more plantings and the height and spread of its trees was substantially greater than any vegetation in the downtown. Lawn was extensive on campus and restricted to a few small strips in the downtown, which was mostly pavement and buildings.

### Methods

Each of two classes censused each area three times as shown:

Olentangy flood plain	Ohio Wesleyan campus	Downtown Delaware
28 February	21 February	14 February
29 February	22 February	15 February
21 March	6 March	7 March
22 March	28 March	31 March
10 April	11 April	17 April
20 April	Rained out	18 April

All censuses began at 07:15 and ended at 08:45. 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.

We censused each area by walking along a transect and counting all birds seen within 50 m of the transect, all parts of which were at least 50 m from the edge of the habitat. We counted birds seen more than 50 m in front or behind as long as they were within 50 m perpendicular to our transect. We recorded the time and weather conditions at the start of each census. Birds flying over the habitat were recorded separately from those using the habitat.

### Results

Only species that perched on the site are included in the comparison of sites. Whether measured as total species or species/census the Olentangy flood plain had twice as many species as the Ohio Wesleyan campus and three times as many as in downtown Delaware (Table 1).

We considered resident species to be those seen on three or more censuses and species visiting a site to be those seen on only one or two censuses. The flood plain had twice the number of resident species as the campus and three times the number seen in the downtown (Table 2), but the proportion of visiting species was similar at all three sites (Table 2). Six species, not seen perched on the site, were seen flying over the flood plain, seven flying over campus, and eight species over the downtown. Some of these species,

for example Common Goldeneyes (*Bucephala clangula*) over the flood plain and Chimney Swifts (*Chaetura pelagica*) over the downtown, may be part of the avian community at the site. Other species, for example Turkey Vultures (*Carthartes aura*), were seen flying over all sites. Because I cannot be sure they are part of the avian community at the site and because inclusion of species seen flying only would not greatly change the diversity they have been omitted from analysis.

The number of individuals seen at the three sites varied markedly. Along the Olentangy flood plain we saw 105.7 individuals/census (Table 3), whereas the numbers were 50% higher on campus and in the downtown. Only five censuses were conducted on campus accounting for the lower total (Table 3) than seen in the downtown despite similar numbers of individuals/census.

The species diversity index, which is a combined measure of the number of species and how evenly the individuals are divided among the species, was highest for the flood plain (Table 4). The diversity on campus was less than on the flood plain, but substantially greater than in the downtown. Since the campus and downtown had similar numbers of species, the diversity difference suggests that a few species were more dominant in the downtown than on campus. Put another way, species had more similar populations on campus than in the downtown.

The most common species (Table 5) on the flood plain were Canada Goose (*Branta canadensis*), Song Sparrow (*Melospiza melodia*), and Common Grackle (*Quiscalus quisqualis*), all of which are native species. The European Starling (*Sturnus vulgaris*), an introduced species, was the most common species on campus and in the downtown. The second most common species on campus was the House Sparrow (*Passer domesticus*) and in downtown it was the Rock Dove (*Columba livia*), both introduced. In both sites the American Robin (*Turdus migratorius*), a native species, was the third most common. As this comparison suggests introduced species and individuals of these species make up a larger proportion of the birds on campus and in the downtown than on the flood plain (Table 6).

## Discussion

As expected the Olentangy flood plain, which was the most natural of the sites, had the most diverse community of birds. Furthermore the most common species were those native to this area with introduced species playing a relatively small role in the diversity of the community. The campus had a lower diversity of birds than the flood plain and the downtown a still lower diversity. Introduced species were the most abundant species in the latter, highly altered habitats and accounted for almost 60% of all individuals at both sites. The downtown may be even less diverse than the index and most common species suggest because the status of robins is strongly influenced by one flock of 139 individuals seen feeding on crab apples along Winter St. on 14 February. If that single flock is considered a chance event and eliminated from consideration, House Sparrows, an introduced species, would be the third most common species. Prior to the comparative censuses of 2000, we have completed 12 years of censuses of downtown Delaware. Over

these 12 years House Sparrows have consistently been among the three most abundant species in the downtown and robins have never been among the top three. Thus with only one exception in thirteen years of censuses downtown, the three most common species have all been introduced. The habitat most altered by humans is populated most abundantly by so-called anthropogenic species, those that associate closely with humans and accompany them to all parts of the globe.

In general the results confirm previous studies that a few anthropogenic species are abundant in severely altered human habitats whereas number of individuals is substantially lower, but diversity much greater in more natural habitats. Despite its history as a landfill and its current use as a water treatment facility and parking garage, the flood plain site supports a relatively diverse avifauna. Were the censuses to continue through the spring and into the summer the difference might well increase as migrants followed the riparian corridor north. Additionally the flood plain offers a diversity of nesting sites that would attract both summer residents and permanent residents.

If the city and university wish to increase the diversity of birds in any of these areas, increased diversity of plantings would be the best solution. Fruit-bearing shrubs and trees would be the best choice, although anything that provides vertical layering of foliage would help. Lawns should be broken up with patches of bushes and flowering trees. In the downtown the vacant lot at the corner of Sandusky and Williams streets could be planted to fruit-bearing shrubs and seed-bearing wildflowers under the supervision of local garden clubs. Garden clubs might also be invited onto campus for the same purpose. Nesting boxes and shelves could be placed in all three sites to encourage nesting of additional species (e.g., martin houses at the landfill site). This has been done with considerable success at the treatment plant where Eastern Bluebirds (*Sialia sialis*) and Tree Swallows (*Iridoprocne bicolor*) are using boxes placed along the fence line.

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- Terborgh, J. W. 1989. *Where Have All the Birds Gone?* Princeton University Press, Princeton, N. J.

**TABLE 1**

NUMBER OF SPECIES (NON-FLYING) BY HABITAT

	Olentangy Flood Plain	Ohio Wesleyan Campus	Downtown Delaware
Mean species/Census	27.5 ± 2.88	16.0 ± 2.24	9.2 ± 1.97
Total species	42	21	14

**TABLE 2**

## RESIDENT AND VISITING SPECIES (NON-FLYING)

## BY HABITAT

	Olentangy Flood Plain	Ohio Wesleyan Campus	Downtown Delaware
Resident (seen on 3 or more censuses)	29	15	9
Visitor (seen on 1 or 2 censuses)	13	6	5
Proportion of visiting species	0.31	0.28	0.36

**TABLE 3**

NUMBER OF BIRDS

Year	Olentangy Flood Plain	Ohio Wesleyan Campus	Downtown Delaware
<b>Birds/census</b>			
2000	105.67	163.80	166.16
<b>Total birds</b>			
2000	634	819	997

**TABLE 4**

SPECIES DIVERSITY INDEX BY HABITAT

Year	Olentangy Flood Plain	Ohio Wesleyan Campus	Downtown Delaware
2000	5.04	3.72	2.33

**TABLE 5**

THREE MOST COMMON RESIDENT SPECIES

Year	Olentangy Flood Plain	Ohio Wesleyan Campus	Downtown Delaware
2000	Canada Goose Song Sparrow Common Grackle	European Starling House Sparrow American Robin	European Starling Rock Dove American Robin

**TABLE 6**

PROPORTION OF INTRODUCED/NATIVE BIRDS

Year	Olentangy Flood Plain	Ohio Wesleyan Campus	Downtown Delaware
2000			
species	0.09	0.19	0.27
individuals	0.15	0.56	0.58