

AVIAN BIOGEOGRAPHY OF THREE MAN-MADE WETLANDS

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ABSTRACT

This study applies the theory of island biogeography and Darlington's Rule to the avifauna of wetlands. Darlington's rule has held true for many naturally occurring environments, such as islands. Our results show that the rule may also apply to birds inhabiting man-made wetlands.

Keywords: birds, Darlington's Rule, species-area relationship, wetlands

INTRODUCTION

For many years highway construction has been destroying naturally occurring wetlands. Organizations, such as the Pennsylvania Department of Transportation (Penn DOT), have begun to become involved in saving these natural habitats. Penn DOT and other organizations have begun projects to reconstruct, and relocate wetlands that were destroyed by human development and highway construction. In this light, we wished to examine whether biogeographic rules applied to natural habitats may also apply to man-made wetlands.

We specifically asked whether Darlington's Rule is applicable to manmade wetlands. According to this rule, as habitat area increases ten-fold, species richness should increase two-fold (Darlington, 1957). This species-area relationship can be described by the equation

$$S = cA^z,$$

where S is the number of species, A is habitat area, and c and z are empirical constants (Gotelli 2001). This equation and Darlington's Rule have typically been used to describe the species richness of oceanic islands of different area. We tested the applicability of these relationships to man-made wetlands by recording the number of bird species observed in three different sized wetlands.

FIELD SITES

Wetlands are defined as marshes or swamps that are saturated with moisture. Three such sites recently constructed by humans within the last 10 years were censused: the Muddy Run Wetland, Old Crow Wetland and the Grazerville Wetland. Muddy Run Wetland, the smallest wetland (0.5 acres), was constructed by Juniata College to lessen the speed of the water in Muddy Run especially during floods, and trap sediment from storm runoff to help clarify the water. This wetland includes native sedge grasses and

aquatic plants. The construction of this site includes several islands in the middle of the wetland and several small jutting peninsulas (Wall 2001).

Old Crow is a fairly new medium-sized wetland (~ 15 acres) located near Rt. 22 in Huntingdon, Pennsylvania. This wetland was constructed by Penn DOT as a bird observatory, and therefore has a lot of open water, and relatively little vegetation, such as cattails.

The Grazerville Wetland located near route I-99 in Pennsylvania is the largest one studied (~ 22 acres). It is one in a series of wetlands between Bald Eagle and State College that were reconstructed in 1997 by Penn DOT to replace the high number of wetlands that were lost with the construction of I-99. This wetland is full of cattails and vegetation that give wildlife extensive cover. Estimates of the acreage of our study sites were obtained from Penn DOT and the Huntingdon County Conservation District

METHODS AND MATERIALS

Data collection at each site began at approximately 1:30pm and lasted 1 h, during March and April, 2002. After the time change due to day-light savings on April 7, 2002, our observations began at 2:30pm. We recorded all birds observed on the edges of each wetland, no more than 10 feet from water. We also included birds that were flying directly above the area either looking for food, or who eventually found a perch. The acreage that we obtained may have been the exact area that we collected data from. This could lead to some error in our results but these were the measurements that were available.

RESULTS

We observed 5 bird species at the Muddy Run Wetland, 15 at the Old Crow Wetland, and 17 at the Grazerville Wetland (Table 1). Log number of species increases regularly with log wetland area with a slope of 0.323 (Fig. 1). This slope is close to that expected from Darlington's Rule (0.3; see Fig. 2).

Table 1. Lists of the total number and names of species found at each wetland.

| | | |
|-----------------------|-------------------------|-----------------------|
| Muddy Run (5) | Hooded Merganser | Crow |
| Robin | Mallard | Eastern Blue Bird |
| Song Sparrow | Barn Swallow | Red Winged Black Bird |
| Chipping Sparrow | Spotted Sandpiper | Chipping Sparrow |
| Red Winged Black Bird | Sparrow | English Sparrow |
| Killdeer | Robin | Field Sparrow |
| | Canvas Back | Song Sparrow |
| Old Crow (15) | Green Winged Teal | Barn Swallow |
| Tree Swallow | Pintail Duck | Tree Swallow |
| Red Winged Black Bird | | Mallard |
| Canada Goose | Grazerville (17) | Red Tailed Hawk |
| Killdeer | Great Blue Heron Common | House Finch |
| Field Sparrow | Loon | American Kestrel |
| Great Blue Heron | Canada Goose | Mourning Dove |

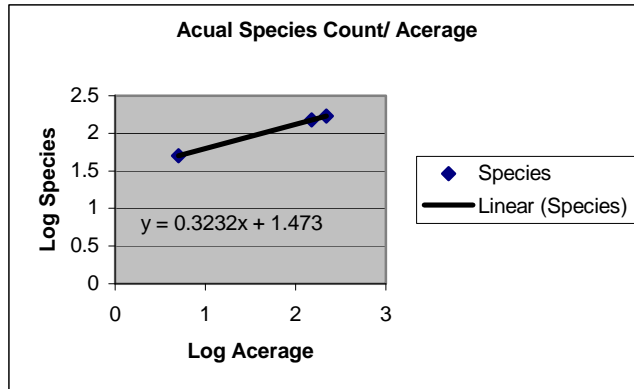


Figure 1. Number of bird species versus wetland area in acres, each multiplied by 10 before log transformation.

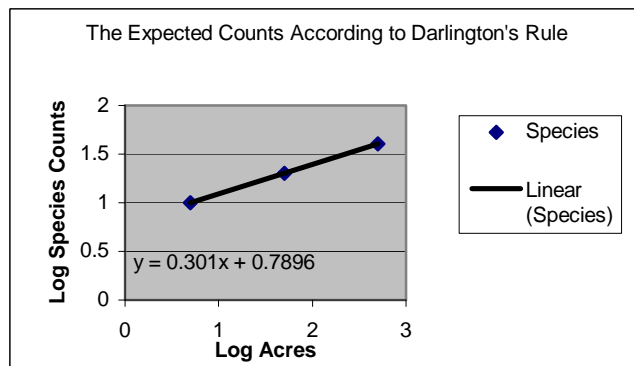


Figure 2. Number of species versus wetland area as expected from Darlington's rule (data log-transformed as in Fig. 1).

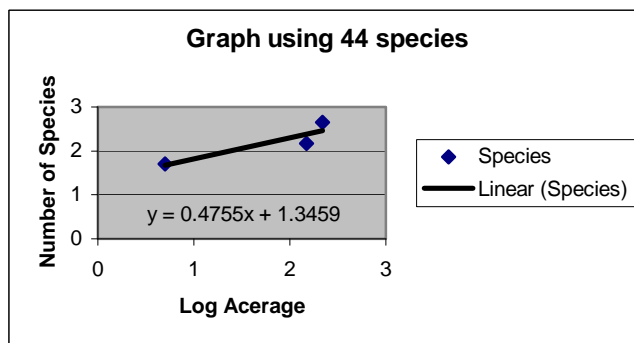


Figure 3. Same as Fig. 2, except the bird species count at Grazerville Wetland is based on that (44 species) determined by Penn DOT.

Table 2: *The list of species found at Grazerville Wetland by the Environmental Unit of Penn DOT.*

| | | |
|-------------------|--------------------|-----------------------|
| Barn Swallow | Flicker | Purple Martin |
| Belted Kingfisher | Goldfinch | Red Tailed Hawk |
| Black Duck | Goshawk | Red Winged Blackbird |
| Blue Winged Teal | Great Blue Heron | Red Shouldered Hawk |
| Bluebird | Grebe | Robin |
| Blue jay | Green Heron | Sanderling |
| Bohemian Waxwing | Hooded Merganser | Sandpiper |
| Canada Goose | Hummingbird | Snipe |
| Catbird | Killdeer | Song Sparrow |
| Chickadee | Mallard | Tree Swallow |
| Chipping Sparrow | Marsh Hawk | Vulture |
| Common Heron | Mockingbird | Woodcock |
| Coot | Mourning Dove | Wood Duck |
| American Crow | Osprey | Yellow throated Vireo |
| English Sparrow | Pheasant | Yellow Legs |
| Egret | Pied-Billed Grebe | |
| Field Sparrow | Pilated Woodpecker | |

DISCUSSION

Our results show that Darlington's Rule appears to apply to man-made wetlands. According to our results, the two larger wetlands were more than ten times larger than the Muddy Run Wetland. This means that they should have had at least two times as many species as Muddy Run. This is actually the case; the slopes of our observed species-area relationship and that predicted by Darlington's Rule are very close (0.323 vs. 0.301).

However our results are not without problems. First, the Environmental Unit of Penn DOT for found many more bird species at the Grazerville Wetland than we did (44 vs. 17). If we use the Penn DOT data the slope between species richness and wetland area now becomes much steeper (0.476) than that predicted by Darlington's Rule. This analysis suggests that more careful work is needed to determine the number of bird species actually inhabiting the wetlands we studied. We had too little time to carry out this study and we often were not able to identify birds that we spotted at a distance or in thick vegetation.

Another factor that could have affected our bird counts is the relative ages of the wetlands. That we studied. Muddy Run is the youngest wetland, followed by Old Crow, and then Grazerville. We cannot be sure how age may have affected the number of resident bird species. But the young age of the Muddy Run Wetland (only 2-3 years old) may have caused bird species richness to be lower than expected according to Darlington's Rule. To correct this, future investigators should examine wetlands of approximately the same age.

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