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Bird Paper

**Life on the Edge: Using Avian Diversity to Quantify Differences Between Core**

**and Edge Sites at Bruce B. Purdy Nature Preserve in Appleton, Wisconsin**

**Introduction:**

Native forests have suffered drastic habitat degradation due to human-led intensification of both housing and agriculture development in the United States (e.g. Pidgeon et al. 2007). Primarily, this has resulted in a landscape littered with isolated forests surrounded by a human-derived matrix (Kupfer et al. 2006). This phenomenon is known as forest fragmentation, and it has been focal to many ecological studies concerning biodiversity loss (Fahrig, 2003). As a result of these studies, several factors have been identified as plausible causes for the biodiversity loss in forest fragments. Namely, examples include reduced forest size, isolation, and edge effects (Zuidema et al. 1996). In this study, the factor of edge effects was of focal importance as it related to difference between forest edges and interior cores.

As forests fragments emerge from development, new and often extensive boundaries are created. These boundaries are known ecologically as edges, and almost immediately, they become clear separation points between two distinct environments (Cadenasso et al., 2003). Over time, the forest-core habitat characteristics which these edges previously featured fade, as the edges become distinguishably unique. Often, this involves extensive increases in understory vegetation (Ries et al. 2004). It is this change from a forests original core habitat to a new edge habitat that necessitates comparative research on differences between the two.

A key difference quantification can be obtained through measuring diversity at each habitat. We utilized birds as diversity indicator species because they are an integral part of forest ecological networks, and they show highly selective habitat preferences (Schuldt et al. 2022). Therefore, quantifying their richness and abundance allowed for investigative comparisons between edge and core sites at the Bruce B. Purdy Nature Preserve in Appleton, Wisconsin. Interestingly, the impacts of edge effects have shown mixed results across previous studies (e.g. Laurance et al. 2007; Murcia 1995; Ries et al. 2004). However, Brands (2004) found extensive evidence that birds requiring mesic conditions are likely to experience negative responses to forest edges. Since Wisconsin forests are primarily mesic in nature, we hypothesize that both bird richness and abundance will be higher in the forest core than on the edge.

**Methods:**

Located on the Appleton’s developing north-side, the Bruce B. Purdy Nature preserve was created through a donation of 104 acres of land in 2005. At the time of our study, the site featured a core of wooded hills, ravines, ponds, and pine plantations littered with recreational hiking trails. Alternatively, its edges featured open fields, restored prairies, and wetlands (Figure 1). Utilizing the full range of edge and core environments, we dispersed a total of 18 study sites at each level. Each site was approximately contained within a 50-meter by 50-meter square, with edge site centers being 25 meters inward from forest perimeters and core sites centers at least 75 meters from perimeters. By defining these placements, we ensured we had true replicates because there were no site overlaps and we had at least 50-meters between centers. From each center, we defined an evaluation until as a circle with a 25-meter radius. Within this circle, 10-minute point counts were carried out by groups of 2 to 3 individuals according to standard practices.

However, only observed birds were recorded, and to minimize the risk of double counting individual birds, group counts were conducted approximately simultaneously. In full, point counts were conducted across a two-week period in early spring (April) 2023. Specifically, counts were performed on Tuesday and Thursday of each week from 1 until 4 PM CST, which controlled for temporal variability in bird activity. Additionally, we controlled for observer skill-levels by randomly assigning sites to each group. Naturally, additional variability between sites was a cause of concern, so we recorded covariates on understory density and noise level. Understory density ranged from 0 to 5 and represented the total number of woody stems observed, in increments of 10 per 1 unit increase, within a 5 by 5-meter square from the center of each site. Meanwhile, noise level ranged from 0 to 1, with a 1 denoting any anthropogenic noise heard at the site prior to or during recording.

Ideally, we aimed to achieve two sub-samples per site, but limitations in time and individuals resulted in only sites 1 through 15 at the core level and 1 through 16 at the edge level achieving this mark. Therefore, core sites 16, 17 and 18 in addition to edge sites 17 and 18 were excluded from final data analysis. All analysis was performed using R software. Initially, summary statistics, namely mean, standard deviation, min, max, and sample size, were calculated by habitat type for abundance and richness respectively. Similar summaries were also produced for the understory density and noise level covariates (Figure 2). Prior to formal testing, boxplots of abundance and richness by habitat type were also created (Figure 3). For formal statistical testing of abundance and richness differences between edge and core sites, normality and equality of variance was first checked using Shapiro-Wilk’s Test and Levene’s Test respectively. Based on these results, habitat differences in mean abundance were compared using a Student’s T-Test, while median richness differences were compared using a non-parametric Wicoxon Test (Figure 3).

Sources

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Schuldt: Our class paper

[e.g. Laurance et al., 2007; Murcia 1995; Ries et al., 2004](https://www.jstor.org/stable/pdf/23525330.pdf?casa_token=Kc0Y2-RIxxQAAAAA:Cs553Sa-EHG0Q1O1st1zTkwHVS1G4RKy9bVkcQKgGjKfrf3S1WyFKvUeAup0lVgh0OlL7oLRtETRq5I-IJnLxtjin1cfv5X5C30NisAJ3bfp0wNBI7c)

Brand 2004: <file:///Users/adam.bruce/Downloads/Riesetal2004AnnReview.pdf>