The effect of ground cover and proximity to neighborhood parks on bird diversity in San Francisco's Mission District

Abel P. Mouton

ABSTRACT

Urban biodiversity improves city dwellers' lives by providing ecosystem services. Urban bird diversity is valuable because birds help control insect populations and regulate seed dispersal, as well as make cities more beautiful places to live. I examined the relationship between bird diversity and the physical landscape in the Mission District of San Francisco. I chose a study area in the Mission, conducted point counts at random points within it, and used this data to calculate a Shannon diversity index for each point. I then measured the distance from each point to edge of the nearest park and used linear regression to test this distance's relationship to the Shannon indices. I found that the distance to the nearest park had a significant positive correlation with the Shannon diversity index. I used data from the San Francisco Department of Public Works that categorized the ground cover to figure out the percentage of vegetation cover at each site and used linear regression to test the effect of the amount of vegetation cover on the Shannon indices. I found that there was a significant positive correlation between percentage vegetation cover and bird diversity. The most important implication of my results is that proximity to neighborhood parks is the dominant influence on bird diversity in my study area, except in instances where the percentage of bare soil exceeds 0.794%, bare soil is the most important influence on bird diversity. More study is needed to determine why bare soil has this effect.

KEY WORDS

Urban biodiversity, landscape ecology, Google Earth, ArcGIS, conditional inference tree

INTRODUCTION

Urban biodiversity improves the quality of life for all city dwellers by providing a number of ecosystem services (Alberti 2008). A city's parks, trees, various kinds of cultivated land, and bodies of water provide services like air purification, noise reduction, mitigation of the urban heat island effect, aesthetic pleasure, and opportunities for social interaction amongst residents (Davis et al. 2012, Gunnarsson et al 2009). Furthermore, urban residents learn to appreciate their non-human neighbors through contact with these green spaces and the many different species that live in them (Davis et al. 2012). As we study the ways that non-human residents of cities live their lives, we come to see how we impact these systems that sustain us, and learn how we may sustain these systems (Pyle 2003).

Bird diversity, in particular, is valuable because birds not only help control insect populations and regulate seed dispersal within urban environments, but also make cities more beautiful and interesting places to live (Davis et al. 2012). However, human activities and built environments diminish bird diversity, even if some species are better adapted to these kinds of pressures than others. For instance, studies that counted city birds correlated diminishing abundance and richness with the level of habitat disturbance and proximity to humans (Fraterrigo and Wiens 2004, Burhans and Thompson 2006, Husté and Boulinier 2007, Schlesinger et al. 2008, Weber et al. 2008). Diminished bird diversity, as a symptom of overall loss of biodiversity, decreases humans' sense of connection with their natural environments, which in turn leads to more environmental destruction (Pyle 2003). The clear implication is that if city dwellers want to improve the quality of their lives, they should take steps to conserve and restore bird habitat. The flip side of this observation is that, because birds are so visible, sensitive, and require only a minimum of inexpensive equipment to study (Chace and Walsh 2003), they can also help humans understand how to mitigate and reverse the damage they have caused the world. Consequently, an understanding of bird habitat needs can prove invaluable guideposts for how best to restore and conserve green space in cities (Lin et al. 2011). Furthermore, by studying not only the way birds live in cities, but also the impact that cities have on birds, one begins to integrate the study of the "ecology of cities" with the study of the "ecology in cities" as Pickett et al. (2001) recommend.

Although there are many surveys of birds to draw on, relatively few surveys are specifically concerned with city birds. Furthermore, these studies tend to compare abundance and diversity in patches, rather than looking at the abundance and diversity at the landscape scale (Fraterrigo and

Wiens 2004, Burhans and Thompson 2006, Husté and Boulinier 2007, Schlesinger et al. 2008, Weber et al. 2008). Finally, of all of the urban bird studies I could find, none of them focused on San Francisco.

In this study, I examine the relationship between bird diversity and the physical characteristics of the landscape in the Mission District of San Francisco. My central research question was: What is the effect of proximity to neighborhood parks on bird diversity in San Francisco's Mission District? As a corollary to that, what is the effect of the neighborhood's vegetation on bird diversity? In order to answer these questions, I counted birds at points in the Mission District that I selected at random, rather than just counting in the more densely vegetated areas. I expected increased bird diversity as my point count sites got closer to the parks.

METHODS

Study system description

To survey the birds of San Francisco's Mission District, I first staked out a study area of roughly 2.2×10^6 ft^2. Using Google Earth, I identified a semi-rectangular region of the Mission bordered by Cesar Chavez Street to the south; Mission Street to the west; Sixteenth Street to the north; and Potrero Avenue to the east (Figure 1). I selected my study area to be a size that was appropriate for studying birds. Also, I wanted the study area to include a representative variety of the neighborhood's habitat types. Therefore, I chose my boundaries to encircle eight city parks that vary in size, ground cover, and tree canopy cover, as well as two BART stations, which are almost entirely covered in concrete.

Figure 1: Study area border.

Data collection methods

To determine the diversity and abundance of birds in the Mission, I conducted point counts at selected locations within my study area. I first selected the points. Starting at the southwest corner of the study area, I chose one point every three blocks, going first south to north through the study area, and then going west to east through the study area. This gave me 75 random points established roughly at the midpoint of city blocks that were a distance of roughly three city blocks from one another (Figure 2).

Figure Two: Study area border with point count sites.

To count the birds, I went to each point between the hours of 6AM and 11AM. I took a pair of binoculars, data sheets adapted from forms provided by Point Blue Conservation Science, and a pocket notebook to record any field observations not covered on the data sheets. Immediately upon arriving at each point, I began a five-minute period during which I recorded every bird seen or heard on the site on the data sheets. I collected both quantitative and qualitative information about the birds. Quantitatively, I counted every species and every individual of every species observed on the site during the five minute counting period. Qualitatively, I marked whether the bird was heard at the site, seen on the site, or seen flying over the site. In order to convert my diversity and abundance values into a figure that would reflect both the diversity and evenness of my sites, I input my data into Microsoft Excel and used this software to calculate Shannon diversity indices for each of the 75 random points in the study area.

Data analysis methods

To evaluate the impact of the proximity to parks on bird diversity, I measured the distance from each point to edge of the nearest park in ArcGIS. I included parks within the study area and within a distance 1400 feet from the study area. I then input these data into Microsoft Excel and plotted the Shannon diversity index of each point as a function of the distance to the nearest neighborhood park to determine the correlation between bird diversity and the distance to the nearest city park from each point.

To evaluate the ground cover in the neighborhood, I used data generously supplied by the San Francisco Department of Public Works (SFDPW) (Figure 3). This data layer breaks the ground cover in the neighborhood down to seven variables: trees, shrubs, grass, bare soil, concrete (or sidewalk), and asphalt (streets). In order to get a more accurate and complex depiction of the ground cover in my study area, I used ArcGIS to combine the ground cover layer with a building footprint layer also supplied by SFDPW. I then took this combined ground cover layer and used ArcGIS' "Tabulate Intersection" function to calculate what percentage of each ground cover was contained within a 200' radius of each point at which I counted birds. I then summed the percentages of ground covered by trees, grass, and shrubs to get an overall percentage of vegetation cover for each of my sites. I then combined this data with my bird count data in Excel, and exported it to R. Once in R, I plotted the Shannon diversity index of each point as a function of the percentage of ground at each site covered by vegetation. In order to see if percentage of vegetation cover increases as our points approach the parks, I used another linear model to test the interaction between the distance to neighborhood parks and percentage of vegetation cover. Finally, in order to determine which of my ground cover variables had the greatest overall influence on bird diversity, I combined all of the ground cover variables with the distance variables in a conditional inference tree.

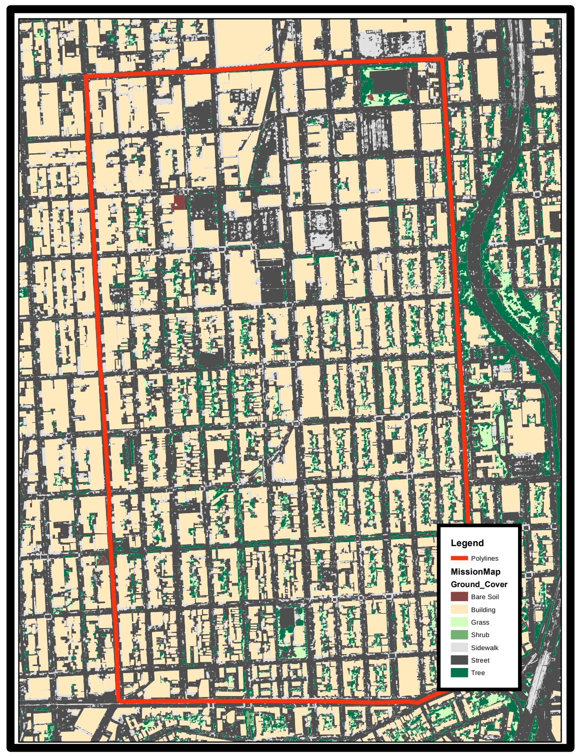

Figure 3: Study area data from SFDPW.

RESULTS

Bird abundance and richness

In my study area, I counted 2,317 individual birds from 25 different species (Appendix 1). The maximum number of birds (bird abundance) observed at any one site was 68, and the minimum number of birds at any one site was 7. I calculated the mean abundance to be 24.29 and the median abundance to be 21. The maximum number of species of birds—species richness, in other words—that I observed at any one site was 12, and the minimum species richness that I observed at any one site was 7. I calculated the mean richness to be 5.53, and found the median richness to be 5. The Shannon diversity index ranged from 0 (at sites with only one bird species) to 1.97. The mean Shannon index value for all sites was 1.18, the maximum Shannon diversity index that I calculated was 1.97, and the minimum Shannon diversity index that I calculated was 0—meaning that I observed only one species of bird at that site. I calculated the mean Shannon diversity index to be 1.18 (Table 1).

Table One: Descriptive statistics of abundance and richness. I counted birds in the Mission and calculated the minimum, maximum, the mean, and the median of abundance and richness, as well as the Shannon diversity indices.

	Minimum	Mean	Median	Maximum
Abundance	7	24.29	21	68
Richness	1	5.53	5	12
Shannon Index	0	1.18	N/A	1.97

Results of proximity to parks analysis

I found that the distance to the nearest park had a significant positive correlation with the Shannon diversity index ($R^2 = 0.157$; $p < .005$) (Figure 4).

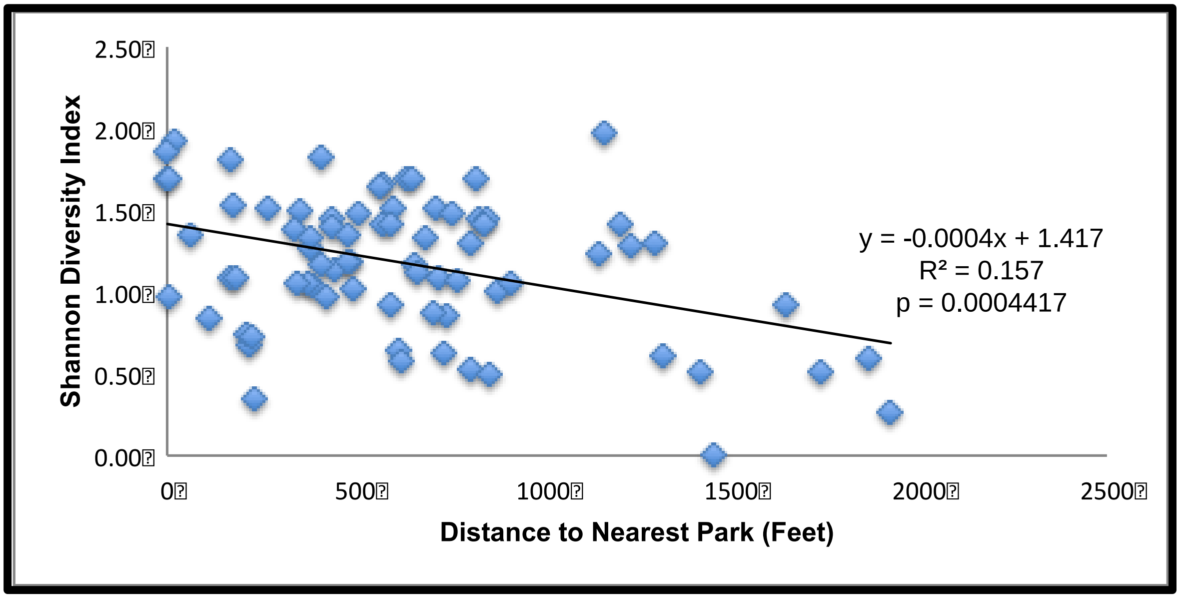

Figure 4: Plot of Shannon diversity index as a function of distance to nearest neighborhood park.

I found that the average distance to the nearest neighborhood park, while positively correlated with the Shannon diversity index, was not statistically significant (R^2 = 0.0217; p = 0.2075) (Figure 5).

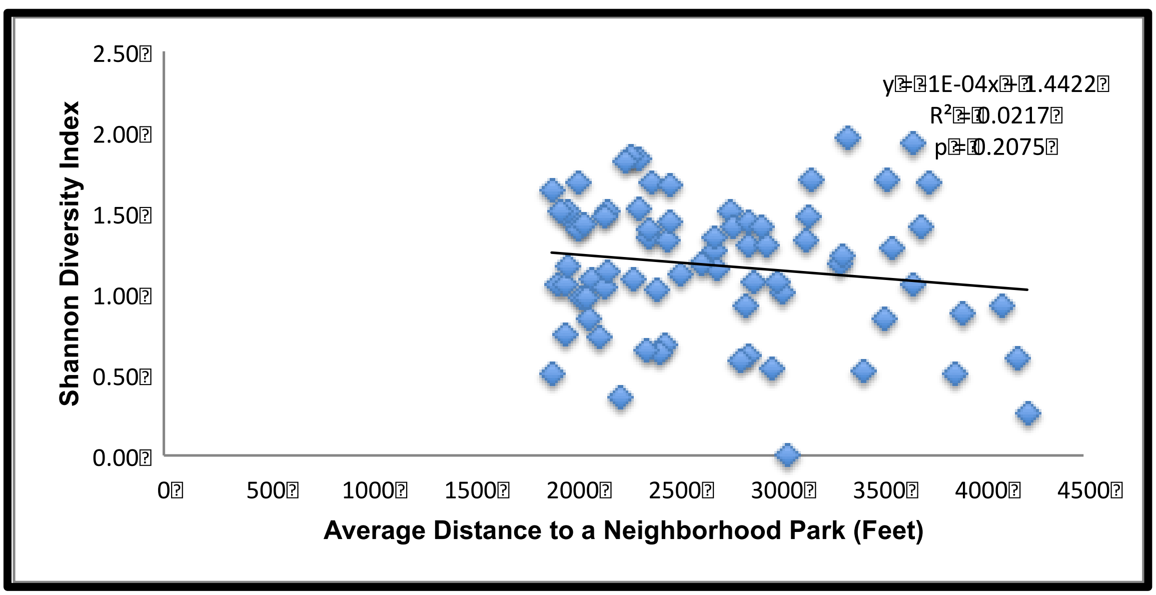

Figure 5: Plot of Shannon diversity indices as function of average distance to a neighborhood park.

Results of the vegetation analysis

I found that there was a significant positive correlation between percentage vegetation cover and bird diversity (R^2 = 0.126; p = 0.001731) (Figure 6).

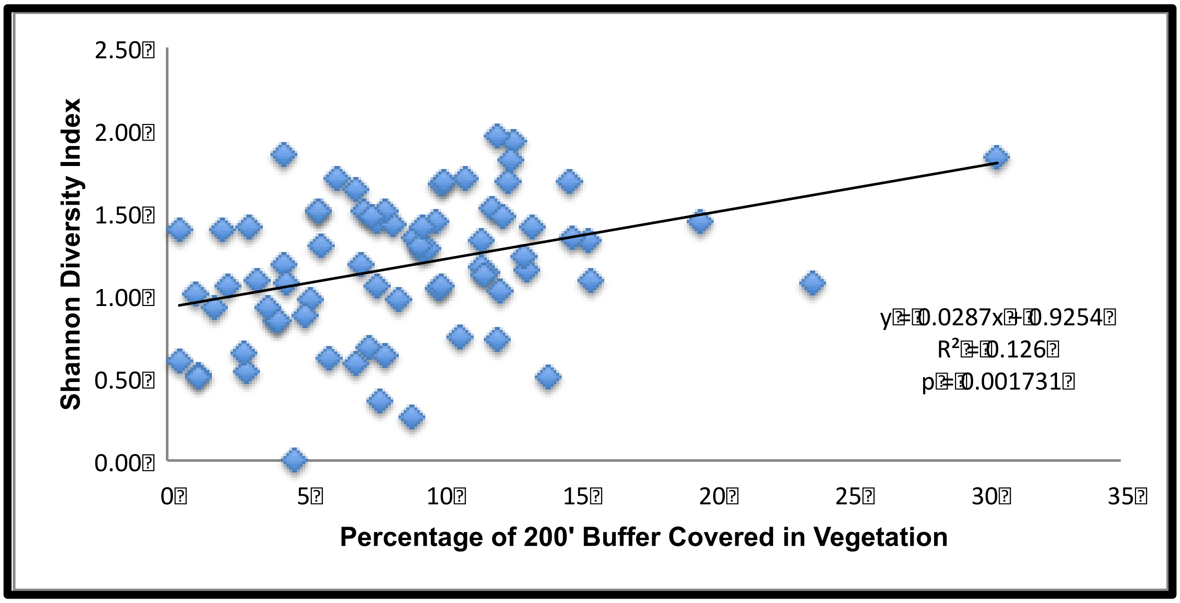

Figure 6: Plot of Shannon diversity indices as function of percentage of vegetation cover at each point count site.

I

I found that there was a significant negative correlation between the percentage of vegetation cover and the distance to the nearest neighborhood park (R^2 = 0.0746; p = 0.01778) (Figure 7).

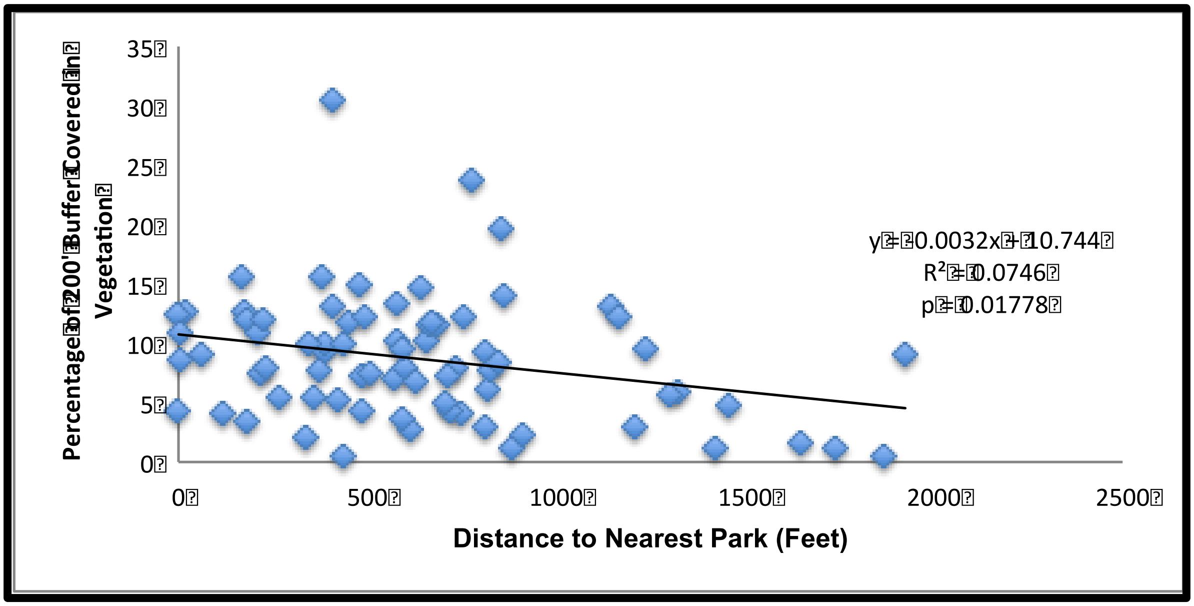

Figure 7: Plot of vegetation values as a function of the distance to the nearest neighborhood park.

Results of conditional inference tree

I found that distance to nearest park, bare soil, buildings, grass, sidewalk, shrubs, streets, and trees were correlated with one another (Appendix 2). Nevertheless, I found that of all of these factors, the distance to the nearest park was the most significant influence on bird diversity, except for in fifteen instances where the percentage of ground covered in bare soil exceeded 0.794%. In places where the percentage of ground covered in bare soil exceeds 0.794%, the bare soil is the most important influence on bird diversity (Figure 8).

```
         Conditional inference tree with 3 terminal nodes

Response:  H
Inputs:  PercentVeg, NEAR_DIST, PERCENTAGE_BareSoil, PERCENTAGE_Building, PER
CENTAGE_12, PERCENTAGE_Shrub, PERCENTAGE_Sidewalk, PERCENTAGE_Street, PERCENT
AGE_Tree, Shape_Area
Number of observations:  75

1) PERCENTAGE_BareSoil <= 0.7936418; criterion = 0.997, statistic = 13.063
  2) NEAR_DIST <= 1297.051; criterion = 0.981, statistic = 9.601
    3)*  weights = 53
  2) NEAR_DIST > 1297.051
    4)*  weights = 7
1) PERCENTAGE_BareSoil > 0.7936418
  5)*  weights = 15
```

Figure 8: Results of conditional inference tree.

DISCUSSION

The most important implication of my results is that proximity to neighborhood parks is the dominant influence on bird diversity in my study area. Even though many of the variables are correlated with proximity to neighborhood parks, with amount of vegetation cover increasing and amount of concrete, building, and asphalt cover decreasing as distance to the nearest park decreases, the correlation with distance to neighborhood parks is still the strongest predictor of bird diversity. The surprising influence of bare soil on diversity is likely to have something to do with some other variable we did not explore, possibly proximity to other parks, or park area, or some other variable at the larger landscape scale.

Proximity effect

The results of the comparison of proximity to neighborhood parks with bird diversity in the neighborhood suggest that proximity to neighborhood parks is the most important predictor of bird diversity. This finding is supported by the results of the test of the effect of average distance to neighborhood parks on diversity, which showed no significant effect, suggesting that it is the nearest park affecting diversity and not all of the parks. This is supported in Husté and Boulinier, which found that as they counted birds in parks closer to the city center, bird diversity decreased, even as abundance increased (Husté and Boulinier 2007). However, my hypothesis was based on the assumption that the parks represented less urban areas solely on the basis of the increased vegetation cover relative to the rest of the neighborhood (Chace and Walsh 2003, Burhans and Thompson 2006, Sandstrom et al. 2006). However, I looked at areas that are urbanized, rather than areas where vegetation was the dominant characteristic. This may be a key factor about the parks that causes them to influence bird diversity beyond what the vegetation alone can do.

Vegetation effect

The results of the comparison of the vegetation values with bird diversity in the neighborhood suggest that the effect of the amount of vegetation cover on bird diversity is also significant. This result is consistent with two key features in the literature on urban bird studies, namely the area effect and the effect of wilder, more vegetated areas. The area effect refers to the finding that bird diversity tends to increase with the size of the patch where birds are counted (Gavareski 1976, Tilghman 1987, Jokimäki et al. 1999, Mortberg et al. 2000, Husté and Boulinier 2007). This is consistent with our results that show that the percentage of ground covered with vegetation increases. This increase in ground covered with vegetation can be said to effectively increase the size of vegetated areas as we approach parks. The effect of wilder, more vegetated areas on bird diversity is also well documented (Fraterrigo and Wiens 2004, Burhans and Thompson 2006). If we adopt increased vegetation cover as an indicator of "wildness" then the relationship between increased vegetation values and increased park proximity can be taken to mean that the land becomes "wilder" as we get closer to the parks (Fraterrigo and Wiens 2004, Burhans and Thompson 2006). However, the fact that the p-value associating bird diversity with vegetation values is four times larger than the p-value associating bird diversity with proximity to neighborhood parks demonstrates that the vegetation values are not as important of an influence as park proximity. This indicates that there is something about the parks aside from the amount of vegetation that makes them more attractive to birds.

Bare soil effect

The results of the conditional inference tree show that while in most cases, the proximity to the nearest neighborhood park is the most important influence on bird diversity, in instances where the percentage of bare soil exceeds 0.794%, bare soil is the most important influence on bird diversity. Although bare soil could be the factor influencing bird diversity beyond the vegetation values, this possibility is contradicted by studies in vineyards that showed that rows of grapes with bare soil in between them had less bird diversity than those in vineyards that had vegetation planted between rows (Duarte et al. 2014). Another possibility is that the additional influence could somehow be related with the area effect, if, for instance, increased percentages of bare soil were correlated with increases in park size (Gavareski 1976, Tilghman 1987, Jokimäki et al. 1999, Lee and Park 2000, Mortberg et al. 2000, Husté and Boulinier 2007). However, it seems likely that scale of these birds' habitats suggests that this mysterious factor is something at the landscape scale, rather than the actual patches themselves. The possibility that the position of patches in the landscape is associated with different degrees of development at a larger scale has elsewhere been advanced to explain findings that the position in the landscape of the patches where birds were counted was a more important influence on bird diversity than the degree of urbanization around them (Husté and Boulinier 2007). In any case, the question of what factor besides percentage or type of vegetation cover could make parks more appealing to birds remains open.

Confounding

The difficulty in determining what is influencing bird diversity as we approach the parks has much to do with the results of the comparison between the vegetation values and proximity to neighborhood parks, which indicate that the percentage of ground covered by vegetation also increases as we approach the neighborhood parks. As described above, this could effectively increase the vegetated area or "degree of wildness" around parks from a bird's perspective. The mysterious X-factor is likely located in some specific aspect of this "degree of wildness." For instance, studies that considered degrees of wildness found that degree of wildness associated with percentage of dead wood, creating feeding and nesting opportunities (Clergeau et al. 2001, Chace and Walsh 2003, Fraterrigo and Wiens 2004, Burhans and Thompson 2006, Sandstrom et al. 2006, Husté and Boulinier 2007). However, the Mission District, as an urban residential neighborhood, does not offer very much in the way of dead wood, leaving an important gap in the understanding of what influences bird diversity in this region. In order to expand this study, I need to develop a method that will allow me to more specifically evaluate what this x-factor might be.

Limitations and Future Directions

Experimental design and hypothesis limitations

One way to increase the explaining power of my study might be to have fewer points and do more visits to them, and create a density-based diversity metric that would take into account the birds' home ranges (Blair 1996). This would allow a diversity metric of which one could be more confident, as it indicates the likely density of birds on the landscape, as well as decreasing errors that might have been introduced by things like the weather causing one species to go somewhere else that day. Given the results, another important place to strengthen the study would be to determine how to evaluate which park is most influencing bird diversity, and then consider the specific characteristics of that park could be the main influence on diversity. Essentially, this would mean increasing the resolution of the site characterizations, especially things like the ratio of the area to the perimeter (Tilghman 1987, Husté and Boulinier 2007). Another place where it may be possible to increase the explaining power of the study would be to evaluate the diversity in the parks in the study area as well as in the adjacent landscape and use this to weight the parks for their potential influence on diversity (Clergeau et al. 2001). Both of these enhancements could allow for a more accurate evaluation of the effect of the other parks on diversity in my study area. All of which brings us to a discussion of the future directions of the evaluation of birds in the Mission.

Future directions

For future directions, it seems important to identify the factor that is associated with the parks that causes the proximity to them to influence bird diversity beyond the effect of vegetation alone. This means exploring why areas with increased bare soil were better predictors of bird diversity than other things. We should test the area effect (Gavareski 1976, Tilghman 1987, Jokimäki et al. 1999, Lee and Park 2000, Mortberg et al. 2000, Husté and Boulinier 2007). We should take a look the effect that the adjacent landscape has on bird diversity (Clergeau et al. 2001, Chace and Walsh 2003, Burhans and Thompson 2006, Sandstrom et al. 2006, Husté and Boulinier

2007). This would allow us to see if it is the nearness to other large parks that are sources of birds that causes the diversity to rise dramatically in parks with more bare soil. Finally, we should also test the relationship between the larger percentages of bare soil and decreased levels of human activity, which have been seen to have a positive effect on bird diversity (Fraterrigo and Wiens 2004, Burhans and Thompson 2006).

Broader Implications

In order to consider the broader implications of the study, we can think about what the key issues in the field of urban bird studies are as they relate to the study of urban biodiversity. One of the most important of these key issues is the impact of cities themselves on bird diversity. The increasing of diversity as we approach the parks fits in with the findings of many other studies that find that more densely vegetated areas will have more bird diversity (Gavareski 1976, Tilghman 1987, Jokimäki et al. 1999, Lee and Park 2000, Mortberg et al. 2000, Clergeau et al. 2001, Chace and Walsh 2003, Burhans and Thompson 2006, Sandstrom et al. 2006, Husté and Boulinier 2007). My study contributes to this discussion to this by concentrating on a greater urban landscape rather than just patches, and finding that the degree of urbanization influences bird diversity at a smaller scale as it does at a larger scale, increasing abundance where there is more urbanization, but increasing diversity where there is more vegetation. I certainly helped fill the gap with respect to the study of birds in San Francisco. I also helped fill gap with respect to study of birds in urban landscape outside of vegetated/wooded patches—studied the city as an ecosystem, not just a place where ecosystems happen to be located (Pickett 2001). As such, this study could be seen as a beginning to find out how to improve diversity in San Francisco. To wit: if we can ID this x-factor, and get more of it in San Francisco, then we can better support diversity. This will have a consequence of improved quality of life for people in the city, as well as the birds and other species that depend on them.

ACKNOWLEDGEMENTS

Thanks be to my mentor, Professor John Battles, for all of his encouragement and hands-on support over the last eighteen months, and thanks to his lab for listening to a very long, detailed rough draft of my oral presentation. The feedback they gave ne had a profound impact on the final version of this paper. Rachael Marzion, 175B graduate student instructor, was similarly supportive and encouraging, especially in terms of helping me identify people with the wisdom I needed to characterize my sites properly. Rachael recommended I consult Professor John Radke and Professor Joe McBride, who both provided excellent suggestions regarding my site characterizations. Martin Alexander, a fellow student and transfer from City College of San Francisco gave me indispensable technical help with the ArcGIS analysis for my pilot study. Amber Hasselbring, Executive Director of Nature in the City, actually came out and counted birds with me on several occasions, and I cannot thank her enough. The Beissinger Lab, especially Kelly Iknayan and Nathan Van Schmidt provided me with useful conceptual assistance early in the project. Finally, John Seagrave at the San Francisco Department of Public Work supplied me with the data that I eventually used for all of my site characterizations, which really helped me stay on schedule.

REFERENCES

Alberti, M. 2008. Advances in urban ecology: integrating humans and ecological processes in urban ecosystems. Springer, New York.

Blair, R.B. 1996. Land use and avian species diversity along an urban gradient. Ecological Applications 6(2): 506-519.

Burhans, D. and F. Thompson III. 2006. Songbird abundance and parasitism differ between urban and rural shrublands. Ecological Applications. 16: 394-405.

Chace, J.F., and J.J. Walsh. 2003. Urban effects on native avifauna: A review. Landscape and Urban Planning 74: 46-69.

Clergeau, P., J. Jokimåki, and Savard, J.-P. 2001. Are urban bird communites influenced by the bird diversity of adjacent landscapes?. Journal of Applied Ecology 38: 1122-1134.

Davis, A., A. Belaire, M. Farfan, D. Milz, E. Sweeney, S. Loss, and E. Minor. 2012. Green infrastructure and bird diversity across an urban socioeconomic gradient. Ecosphere 3: 1-18.

Duarte, J., M. A. Farfán, D. Milz, E. Sweeney, S. Loss, and E. Minor. 2014. Soil conservation techniques in vineyards increase passerine diversity and crop use by insectivorous birds. Bird Study, 61:2, 193-203.

Fraterrigo, J.M. and J.A. Wiens. 2004. Bird communities of the Colorado Rocky Mountains along a gradient of exurban development. Landscape and Urban Planning 71:263–275.
Gavareski, C.A. 1976. Relation of park size and vegetation to urban bird populations in Seattle, Washington. The Condor 78(3): 375-382.

Gunnarsson, B., E. Heyman and T. Vowles. 2009. Bird predation effects on bush canopy arthropods in suburban forests. Forest Ecology and Management 257: 619-627.

Husté, A. and T. Boulinier. 2007. Determinants of local extinction and turnover rates in urban bird communities. Ecological Applications. 17:168-180.

Jokimäki, J. 1999. Occurrence of breeding bird species in urban parks: Effects of park structure and broad scale variables. Urban Ecosystems 3: 21-34.

Lin, Y.-P., C.-R. Chang, H.-J. Chu and B.-Y. Cheng. 2011. Identifying the spatial mixture distribution of bird diversity across urban and suburban areas in the metropolis: A case study in Taipei Basin of Taiwan. Landscape and Urban Planning 102:156–163.

Mortberg, U., and H.-G. Wallentinus. 2000. Red-listed forest bird species in an urban environment—assessment of green space corridors. Landscape and Urban Planning 50: 215-226.

Park, C.-R., and W.-S. Lee. 2000. Relationship between species composition and area in breeding birds of urban woods in Seoul, South Korea. Landscape and Urban Planning 51: 29-36.

Pickett, S.T.A., M.L. Cadenasso, J.M. Grove, C.H. Nilon, R.V. Pouyat, W.C. Zipperer, and R. Costanza. 2001. Urban ecological systems: linking terrestrial ecological, physical, and socioeconomic components of metropolitan areas. Annual Review of Ecology and Systematics. 32:127–157.

Pyle, R.M. 2003. Nature matrix: reconnecting people and nature. Oryx 37: 206-214.

Sandstrom, U.G., P. Angelstam, and G. Mikusinski. 2006. Ecological diversity of birds in relation to the structure of urban green space. Landscape and Urban Planning 77: 39-53.

Schlesinger, M.D., P.N. Manley, and M. Holyoak. 2008. Distinguishing stressors acting on land bird communities in an urbanizing environment. Ecology. 89: 2302-2314.

Tilghman, N.G. 1987. Characteristics of urban woodlands affecting breeding bird diversity and abundance. Landscape and Urban Planning 14: 481-495.

Weber, T.C., P.J. Blank, and A. Sloan. 2008. Field validation of a conservation network on the eastern shore of Maryland, USA, using breeding birds as bio-indicators. Environmental Management. 41:538–550.

Appendix A: Bird Abundance and Occurrence by Species in Study Area

Bird Species	Number of Individuals	Number of Presences
Rock Pigeon	976	78
House Sparrow	630	92
Mourning Dove	112	49
Unidentified Gull	111	52
House Finch	110	46
American Robin	88	39
Bushtit	82	30
European Starling	66	8
Common Raven	42	21
American Crow	25	13
Lesser Goldfinch	13	6
Unidentified Hummingbird	12	8
Brewers Blackbird	11	7
Western Gull	6	1
Unidentified Chicken	5	1
Chestnut-Backed Chickadee	4	2
Western Scrub Jay	4	4
Dark-Eyed Junco	3	2
Northern Mockingbird	3	2
Unidentified Parrot	2	1
Yellow-Rumped Warbler	2	1
Allen's Hummingbird	1	1
Anna's Hummingbird	1	1
Great Blue Heron	1	1
Unidentified Hawk	1	1

APPENDIX B: Correlation Matrix of Ground Cover Types With Distance From Each Point Count Site to Nearest Neighborhood Park

	Near Distance	Percent Vegetation	Bare Soil	Building	Grass	Shrub	Sidewalk	Street	Tree
Near Distance	1.0000	0.2731	0.1529	0.4358	0.4467	0.0141	0.2478	0.1982	0.3114
Percent Vegetation		1.0000	0.1327	0.6036	0.1422	0.0032	0.1221	0.1789	0.3374
Bare Soil			1.0000	0.3904	0.4392	0.0155	0.1438	0.1465	0.1112
Buildings				1.0000	0.5432	0.0607	0.0061	0.8046	0.0184
Grass					1.0000	0.0891	0.3915	0.0844	0.2390
Shrub						1.0000	0.0243	0.1661	0.0197
Sidewalk							1.0000	0.0972	0.2318
Street								1.0000	0.1453
Tree									1.0000