How people and wildlife use urban nature parks in Los Angeles

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How people and wildlife use urban nature parks in Los Angeles

A dissertation submitted in partial satisfaction of the

requirements for the degree

Doctor of Environmental Science and Engineering

by

Jeniffer G. Aleman-Zometa

2023

ABSTRACT OF THE DISSERTATION

How people and wildlife use urban nature parks

in Los Angeles

by

Jeniffer G. Aleman-Zometa

Doctor of Environmental Science and Engineering

University of California, Los Angeles, 2023

Professor Richard F. Ambrose, Chair

Urban nature parks have the potential to connect urbanites with nature and also to serve as habitat for wildlife. Today over 50% of the world's population lives in cities so urban nature parks are where people will most often interact with nature. Urban green spaces provide habitat for migratory bird species and serve as linkage habitats between larger open spaces. At the same time ecological literature shows that humans can negatively impact wildlife, from direct trampling of organisms to indirect effects from noise or the mere presence of humans. Park planners need more guidance on how to design nature parks meant for conservation and for people to enjoy biodiversity. More information is needed about how people and wildlife use urban nature parks currently to inform future planning. I studied three former brownfields in Los Angeles that were transformed into urban nature parks. At each park, I studied the primary activities and amenities that people were using. I conducted bird surveys at each park and collected abundance and species data. Finally, I took a closer look at one of the parks to better understand how both people and birds were using particular park features. This study shows that

certain park features are highly used by both people and wildlife. For example, having walkways with bushes and trees on both sides yields high use by both people and birds. But other park features have tradeoffs. People heavily use lawns at parks however lawn area is negatively correlated with bird abundance, thus balancing lawn with shrubs and trees is important. Also, shrubs seem to be just as important as trees for birds and this relationship between trees and birds needs more study in southern California urban nature parks.

The dissertation of Jeniffer G. Aleman-Zometa is approved.

Jon Allan Christensen

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2023

Dedicated to my mom who sacrificed so much for me.

Contents

List of Figures

List of Tables

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SELECT RESEARCH EXPERIENCE

Graduate Student Intern, LENS *2017 - 2018*

LENS is the Laboratory for Environmental Narrative Strategies at UCLA. I participated in a collaboration with KCET to produce a series of innovative environmental storylines focused on Los Angeles and California.

Graduate Student Researcher, University of California Los Angeles *2016 - 2017*

Worked on three projects with Dr. Richard Ambrose analyzing the impact of sea level rise on coastal habitats. I served as the project manager for the Seal Beach National Wildlife Refuge monitoring work. I proposed and conducted a collaborative project with another graduate student analyzing the impacts of sea level rise and coastal development on Southern California rocky intertidal habitats.

Masters Thesis Research, California State University Los Angeles *2010 - 2014*

Thesis title: "Landscape disturbance regimes: pattern and process in the mussel bed paradigm". Analyzing intrinsic factors affecting the disturbance mechanism that explain mussel bed gap patterns. I also spearheaded the data collection of a long-term photomosaic project.

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Aleman-Zometa, J.G. (2012, October). *Governing a Sustainable City: The Case of Los Angeles.* Talk presented at the ISA West Conference, Pasadena, CA

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Chapter 1: Introduction and Background

For the first time in the of history of *Homo sapiens*, our main habitat is the city. Most of the human population lives in an urban area and that percentage is projected to increase. Recent generations have had less experiences growing up in nature and generally spend more time indoors (Hofferth and Sandberg 2001, Malone 2007). In fact, cities are where many people will have their first nature experience (Seto et al. 2013). Numerous philosophers and researchers propose that nature is deep-rooted and essential for our well-being. Richard Louv hypothesized that less exposure to nature leads to "nature deficit disorder" a metaphor used to express a child's disconnectedness with nature. At the same time, public health review articles point to parks and access to nature as improving both physical and mental health (Frumkin et al. 2017). Edward O. Wilson hypothesizes that humans have a biophilia instinct: "the innate tendency to focus on life and lifelike processes." In urban environments, space is often a limited resource and thus decision makers must figure out how to restore nature in the city for people, wildlife, or both through balancing a variety of values.

One strategy to restore nature in the city is to convince people that biodiversity is important and thus we should prioritize creating habitats for native plants and animals around our homes, on our streets, and in our neighborhoods. Biodiversity appears to be one of the main ecological and restoration narratives worldwide and also in Los Angeles. In 2017 the city of Los Angeles passed a motion to enhance biodiversity policies, including the Bureau of Sanitation investing in developing a Biodiversity Index for the city. The Natural History Museum has several projects aimed at collecting and furthering the knowledge of biodiversity in Los Angeles. Phone applications like iNaturalist and eBird are tools for laypeople to learn and document species of animals they encounter wherever they are. Every year there is a competition between Los Angeles, San Francisco, and other cities around the world to see which city can document the most observations. Many organizations, people, and politicians refer to Los Angeles as being within a biodiversity hotspot as a reason for preserving our city's biodiversity. The National Park Service is installing camera traps scattered around the city to count mammal species. Much of this enthusiasm is geared at increasing appreciation for nature in the city, particularly from the Natural History Museum's perspective, and some is also for educating people about the value of native species in particular.

The problem is that studies show that people do not easily understand biodiversity, at least not in the way conservationists do. Generally, people have more of a morphological understanding of biodiversity, meaning they detect differences between individual organisms based on characteristics like height or color and not whether individuals belong to the same taxon (Qiu et al. 2013, Muratet et al. 2015, Hoyle et al. 2018) or ecosystem (Kiley et al. 2017). For example, if there are flowers of the same species that are different colors, people tend to categorize them as different species, and bushes that look the same in color and height may be categorized as the same species. At the same time, many people do not cite biodiversity and its ecological functions as reasons for visiting parks (Schipperijn et al. 2010, Muratet et al. 2015). This does not mean they do not value biodiversity in parks; some people do show preferences for certain habitats, but many assign similar conservation values to all habitats, meaning they value the existence of different habitats (Kiley et al. 2017). It is obvious that people value nature because they visit it; in fact, park visitation increased dramatically during the 2019 COVID-19 pandemic when people had more free time (Volenec et al. 2021).

Decades of research shows the importance of biodiversity to ecosystem functions, such as productivity, nutrient cycling, biomass production, and concludes that biodiversity is a driver of environmental change (Cardinale et al. 2012). Human activities threaten biodiversity through habitat loss (resulting from land clearing), overhunting and harvesting, and urbanization, threatening 25% of all mammal species, 13% of bird species, and 21,000 other species of plants and animals with extinction as of 2017 (Tilman et al. 2017). Human activities can also benefit biodiversity through restoration. One way cities can do this is through transforming brownfields, lands contaminated by former commercial uses, into parks. Particularly in places with limited space and where the land has been extensively used, this type of habitat creation is a real opportunity. Habitat amount is directly related to bird species abundance (De Camargo et al. 2018) and small mammal species richness (Melo et al. 2017), but this relationship also depends on surrounding habitats (Fahrig 2017). Cities are turning to nature-based solutions and are seen as key to solving some growing environmental concerns, including the biodiversity crisis (Schewenius et al. 2014). All three parks studied here are former brownfields, further highlighting the possibilities of this type of habitat creation.

Another strategy to support biodiversity in cities is for government to either create new habitat or protect existing habitat, though for cities like Los Angeles opportunities for habitat protection are few. Creating new natural habitat in urban environments is tough because there is not much helpful research available to do that. Planners often rely on historical maps of what existed before colonization or aim to bring back habitats in decline, like grasslands or riparian habitat. Published articles often analyze global trends to understand the relationship between urbanization and wildlife. Some studies show that biodiversity is higher in cities in spite of urbanization (Kühn et al. 2004); however, other studies conclude that is because of global urban homogenization (Clergeau et al. 2006, McKinney 2006, Conole and Kirkpatrick 2011, Chong et al. 2014). Similarly, some studies show that urban areas are dominated by generalist species (Evans et al. 2011, Owens & Bennett 2000, Shutl et al. 2005), that is species adapted to eating a wide variety of food sources, but other studies show no correlation between urbanization and bird community composition (Korányi et al. 2021). Some studies show that tree cover does not correlate with increased bird abundance, while many other studies show that old and dense tree stands do support more sensitive species. Looking at patterns globally shows how complex this relationship is and how for park planning purposes, it may be more helpful to examine the local conditions instead of thinking on a global perspective in order to create parks for wildlife conservation (Evans et al. 2009). It is clear that urban green spaces do provide habitat for wildlife (Carbó-Ramírez and Zuria 2011, Strohbach et al. 2013, Gallo et al. 2017) but how do we make the best use of urban green space, such as parks, to enhance wildlife use and people's connection with nature?

The overarching question addressed in this dissertation is: How do people and wildlife use urban parks that have been created with conservation in mind? The goal is to inform future park planning for urban nature parks.

This dissertation is organized into five chapters. After this Introduction chapter, there are three chapters discussing different aspects of how people and birds use urban nature parks in Los Angeles, followed by a Conclusion chapter. The three middle chapters are described below.

In "Studying people's use of urban nature parks," the objective was to understand how people use urban parks designed for nature appreciation/conservation. I performed observational studies using the SOPARC method to derive quantitative information of who goes to these parks, which activities are primarily taking place, and where people do them. I determined which park amenities were critical for people's enjoyment of the park for purposes of future park planning.

In "Bird distribution within urban nature parks in Los Angeles," the objective was to describe bird habitat use at restored parks. I quantified bird species richness and abundance by conducting field surveys at each park at pre-determined polygons. Then I compared bird use at each polygon within and between different parks. The ultimate goal was to shed light on how a park space could be designed to for birds.

In "Avian and human use of an urban nature park in Los Angeles," the objective was to figure out which park elements contributed to both high bird and people use. I compared different park elements by quantify vegetation, people use, and bird use. The purpose was to understand some basic park elements that could be integrated into urban nature parks that would increase both people and bird use.

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Chapter 2: Studying people's use of urban nature parks

Introduction

Nature parks are important for urban communities (Kareiva 2008, Baur and Tynon 2010), they have the potential to improve air and water quality, mitigate flooding, enhance physical and mental health, and promote social and cultural well-being (Faivre et al. 2017). In urban communities with a history of industrial uses and pollution, re-developing brownfields into parks is a good investment. In general, parks are seen as "Smart Investments for America's Health, Economy, and Environment" (City Parks Alliance report, 2022).

Having nature parks in cities is important because cities are the places where 80% of the world population will live by the end of this century and many of our greatest environmental challenges, including climate change, will be experienced in cities (Barbose 2020). At the same time, people often have their first nature experience in a city (Seto et al. 2013) and fostering nature-based recreation and a sense of place may lead to pro-environmental behavior (Larson et al. 2018). Having urban nature parks in cities where many people live, can serve as conduits for developing an attachment with nature. Research shows that place attachment is influenced by frequency of use and proximity, so the closer and more frequently an outdoor recreation space is used, the more attached someone is to it (Williams et al. 1992, Moore and Graefe 1994) and the more sensitive they are about its degradation (Eder and Arnberger 2012). Years of research have shown a downward trend for nature-based recreation in the U.S., Spain, and Japan (Pergams and Zaradic 2008), although the COVID-19 pandemic may have inspired people to visit parks more.

American parks were originally built as an antidote to the problems of city life, places that resembled the country side and thus brought fresh air, meadows, lakes, and thus relief (Cranz 1982). Some of the original public spaces that resemble parks include the undesigned and informal “common open space” where people played sports and games (Low et al. 2009). European royal gardens were highly designed with meandering pathways, expansive lawns, and bodies of water and they inspired some of the early landscape parks in American cities in the second half of the nineteenth century, such as New York’s Central Park (Carr et al. 1992). The birth of the playground and recreation facilities in the 1920s and 30s placed an emphasis on play spaces primarily for children and active recreation in dense cities; municipal governments embraced the playground and also greatly increased ball fields and game courts at parks (Carr et al. 1992). There is a rich history and literature of park planning; however usually these studies look at park planning from the human recreation perspective. Here my focus is on multi-functional parks that are planned for both people and wildlife because parks present a tremendous opportunity to increase biodiversity for the benefit of people (Fuller et al. 2007) and ecosystems (Cornelis and Hermy 2004). Previous work has touched on the conflict between park planning for both people and wildlife, from highlighting people’s tension and desire for natural features in parks (Burgess et al. 1988), to people feeling disregarded by urban park planners whose focus is on restoration (Low et al. 2009), to limiting recreation to preserve natural areas (Cole 1993). In contrast, this work aims to inform how to facilitate the use of urban parks by both people and wildlife.

Los Angeles has taken steps towards creating a more biodiverse city and some organizations have developed brownfields into parks in racially and ethnically diverse parts of the city. Thus, I am interested in understanding who goes to these nature parks, what do they do there, and which areas of the park are most used. For the purpose of this work, I am interested in inner city parks that are accessible to people daily. A person’s urban park use and attachment can depend on their ethnic background. For example, some studies show that Latino and

Asians/Pacific Islander (API) families go to parks for social reasons as well as for physical activity (Derose et al. 2015). People's attachment to these natural spaces may depend on their socioeconomic background and/or on culture. Homeowners may feel a stronger sense of attachment than renters. And Latino people generally feel stronger attachment than other ethnic groups (Romolini et al. 2019). A park's ability to serve a variety of needs matters in a city with a diverse population. Can nature-based parks planned for passive recreation do that?

I conducted observational studies exclusively at urban nature parks to understand how these parks can serve people as a space for leisure while also attracting wildlife and thus providing multiple benefits. If these urban nature parks are successful at both, they could become models for building multi-use parks. The specific questions I address are: Who goes to urban nature parks and what do they do? And which parts of these parks are most used and how?

Methods

This chapter focuses on assessing how people use nature parks through an observation-based data collection protocol called a System for Observing Play and Recreation in Communities (SOPARC). This tool is commonly used to asses physical activity for active recreation at parks (Evenson et al. 2016). I studied parks designed for passive recreation and appreciation of natural resources. The California Department of Parks and Recreation (California State Parks) developed two of these urban parks and the Mountains Recreation and Conservation Authority built one. The SOPARC assessment framework was used to determine who used the parks, what they were doing, and which features of the parks were used. The observations provided insight into how people interact with nature parks in urban environments specifically.

Study sites

I chose parks in the City of Los Angeles that were relatively close to one another, were developed for passive recreation and nature appreciation, and were formerly brownfields. The parks were chosen to be roughly similar in size to be able to compare the types of activities found at these parks.

I sampled three parks: Rio de Los Angeles State Park (Rio), Los Angeles State Historic Park (LASHP), and Vista Hermosa Park (Vista Hermosa). These parks are all between 2 to 10 hectares in size and are located in urban areas (Table 1). I also considered Augustus F. Hawkins Nature Park and the South Los Angeles Wetlands Park. However, during this study Augustus F. Hawkins was closed as a result of COVID-19 pandemic restrictions, and thus I was not able to survey it. I visited the South Los Angeles Wetlands Park during the middle of the day and the park was desolate and I felt unsafe, thus I did not feel comfortable surveying this park. There are a few other nature parks along the Los Angeles River, but they are all less than half a hectare in size. The three parks I studied had between 7 and 12 target areas. These target areas were chosen based on either distinctive characteristics or natural separations that were part of the park design.

While Rio is a co-managed by the City of Los Angeles Department of Recreation and Parks and California State Parks, the park is mostly managed by the city, with half of the park space devoted to active recreation, where families bring their children to participate in youth sports such as soccer, baseball, basketball, and tennis. My survey only encompassed the area maintained by California State Parks, which was designed for passive recreation. There is a circular walking path around the passive recreation part of the park (Figure 1, Table 2). The walking path is adjacent to dense foliage, large cottonwood and sycamore trees, and a variety of well-established shrubs; however, the path itself is rarely shaded. There is seating and lighting around the perimeter of the walking path. Target area 7 is mainly grass and is an informal divide between the natural area and the active recreation area; this area has little shade. Rio runs parallel to an active rail line where the trains run regularly.

LASHP has a variety of features (Figure 2, Table 2), including a 1-mile loop around the park that people use for exercise, a pedestrian bridge in the middle of the park in target area 4 that provides views of the downtown L.A. skyline, and two large lawns with maturing trees around the perimeter (target areas 2 and 5). Most of the walking loop is not shaded and the areas around the bridge are also not shaded. The ecological features include a bioswale running alongside target areas 6, 8, and 9 and a seasonal wetland in the north end of the park in target area 1. The whole park is generally flat with one big hill in the second largest lawn and some smaller mounds throughout the park, some of which have been planted with coyote bush (*Baccharis pilularis*). LASHP is parallel to an active light rail line with a station at the south end of the park.

Vista Hermosa is located on a hill in a dense urban area adjacent to downtown L.A. and has spectacular views of the Los Angeles skyline in target areas 4 and 6 (Figure 3,Table 2). The park is composed of various grassy areas covered by tree shade, picnic benches, and a circular short path around the entire park. There is a children's play area with a rubber snake, cushioned floor, and some rocks to climb in target area 7. Additionally, in target area 10 there is an amphitheater area composed of rocks for seats and arranged in tiered rows. There are a few water features throughout the park but they were non-functional at the time of the survey. There is a soccer field that is part of the park, but I did not survey this feature.

Table 1. The parks studied and their characteristics.

Name	Area (hectares)	Year opened	Park elements	Habitat description	Management
Rio de Los Angeles State Park	8 hectares total; 4 hectares are for passive recreation	2007	Walking trails, benches, amphitheater, BBQ pits.	Has “oxbow” area that has water and serves as wetland/riparian habitat. Native desert flowers, cottonwood trees, oak trees.	Los Angeles City & California State Parks
Los Angeles State Historic Park	10	2017	Walking trails, picnic grounds, fields, picnic tables, a viewing bridge.	Seasonal wetland area, scattered oak trees, cottonwoods, and other California native plants.	California State Parks
Vista Hermosa Park	2	2008	Walking trails, picnic grounds, nature-themed playground, outdoor amphitheater.	Streams, meadows, oak savannahs, California native vegetation.	Mountains Recreation and Conservation Authority

Figure 1. Satellite image of Rio de Los Angeles State Park.
Rio is surrounded by industrial developments, light industry, and housing, as well as a large brownfield and railroad tracks, and is partially composed of athletic fields. The numbers represent the target areas 1 to 7 and show the part of the park that was designed for passive recreation in comparison to active recreation.

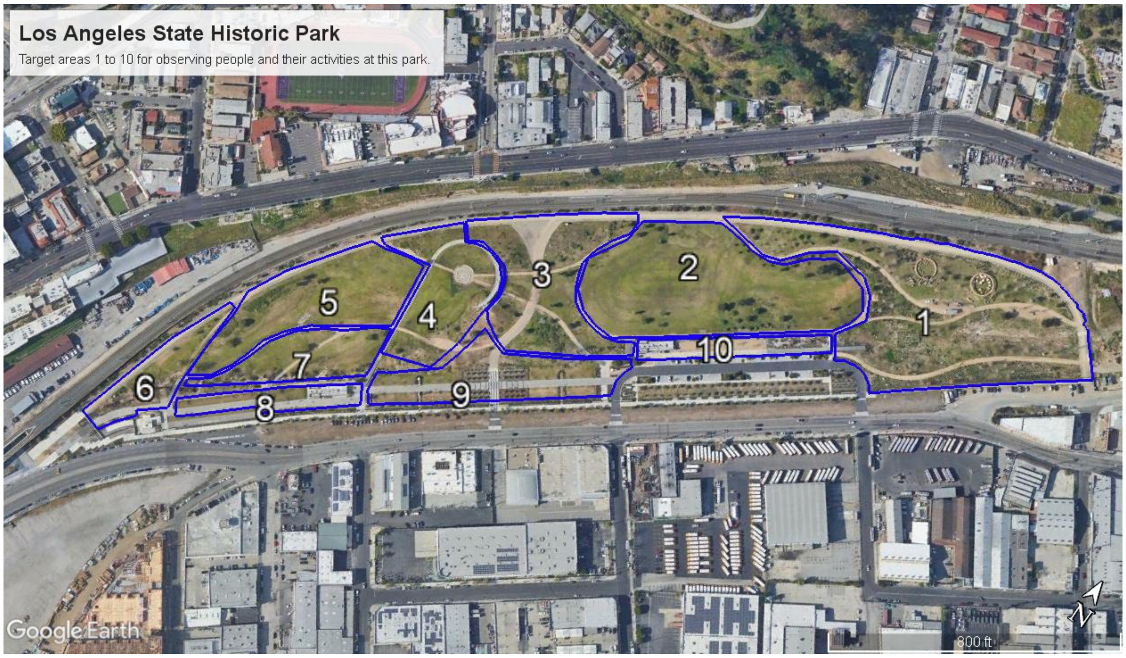

Figure 2. Satellite image of Los Angeles State Historic Park.
LASHP is surrounded by industrial development, light rail, and housing. The numbers represent the target areas from 1 to 10 and are each outlined in blue. The target areas vary in size and were drawn to represent unique park features and amenities.

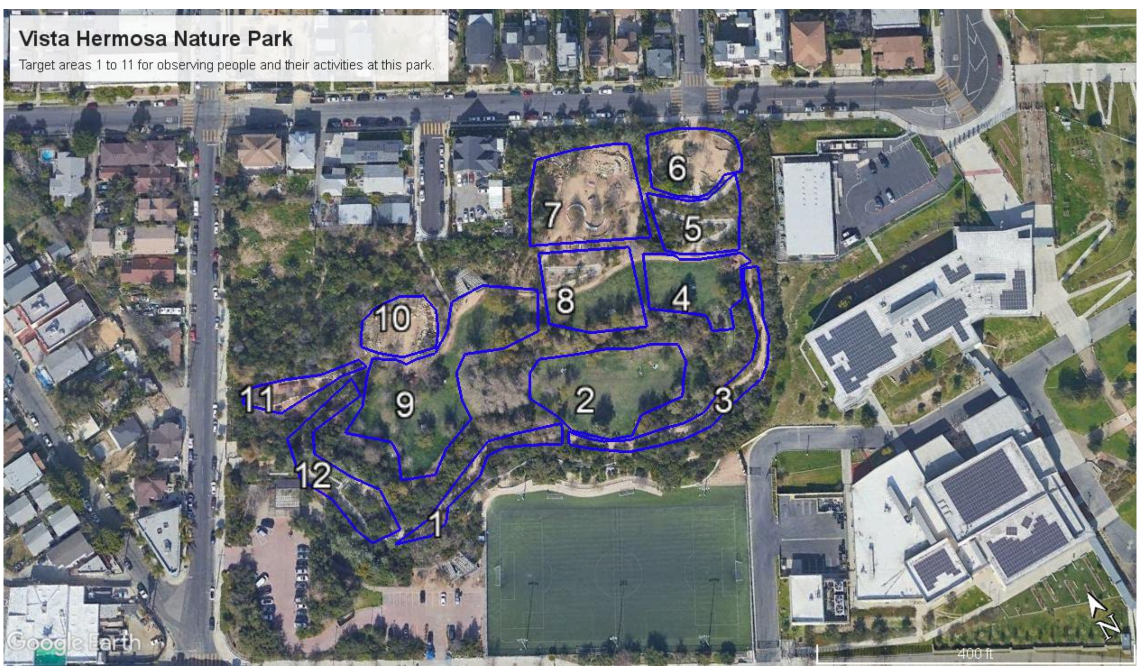

Figure 3. Satellite image of Vista Hermosa Park.
Vista Hermosa's surroundings include housing, a soccer field, and an adjacent school. The numbers represent the target areas from 1 to 12. Although this park is much smaller than the other two parks, I used more target areas because the park is hilly and composed of dense vegetation.

Table 2. Park features in each target area.
The lawn and trees features were estimated using satellite imagery as well as personal experience of target area, amounts were divided into 0, 25, 50, 75, and 100 percent. Walking paths were measured using the Google Earth measure tool. The seating and tables features are binary, a 0 is absence and a 1 is presence. These features were used for the canonical correlation analysis.

Park	**Target area**	**Lawn (%)**	**Trees (%)**	**Walking path (meters)**	**Benches/picnic tables (Total #)**
Rio	1 & 2	25	25	377.1	0
Rio	3 & 4 & 5	0	50	765.9	6
Rio	6	25	25	146.1	1
Rio	7	50	25	0	1
LASHP	1	25	25	984.8	4
LASHP	2	100	25	0	0
LASHP	3	25	25	425.9	1
LASHP	4	50	25	451.4	4
LASHP	5	100	25	205.3	0
LASHP	6	75	50	250.6	4
LASHP	7	75	50	264.1	0
LASHP	8	25	50	329.1	10
LASHP	9	25	50	298.0	16
LASHP	10	0	50	345.2	5
Vista	1 & 3 & 12	0	75	310	5
Vista	2	100	25	0	0
Vista	4	100	25	43.8	3
Vista	5	0	100	99.3	0
Vista	6	0	75	0	0
Vista	7	0	75	0	2
Vista	8	75	50	87.9	0
Vista	9	100	100	70.5	1
Vista	10	0	75	0	1
Vista	11	0	75	0	4

Data collection and instrument

I used a standardized momentary time sampling protocol called a System for Observing Play and Recreation in Communities (SOPARC) to perform systematic observations of park user characteristics, behaviors, and use of park space. SOPARC was developed in 2006 and was designed to “obtain direct information on community park use, including relevant concurrent characteristics of parks and their users" and has proven to be a reliable method (McKenzie et al. 2006). A study analyzing park visitors to state parks in Georgia found that SOPARC was a useful tool for gathering baseline data on park visitors and their site use patterns and that it could have wider management applications (Whiting et al. 2012).

For each park, I established pre-determined target areas, measured activity types, noted demographic information (age, gender, and ethnicity), and set a schedule for visiting the parks to obtain a representative sample of park use during the weekdays and weekends. The SOPARC method has a fixed observation point in each target area. I used fixed observation points as well as an established walking route to count visitors.

I scanned and walked through each target area and counted the number of people performing each of these activities: sitting, walking, running, standing, or on a bicycle. When possible, notes were taken when individuals were engaged in activities not captured by the instrument, such as climbing a tree or riding scooters. These notes were taken to provide more context for the activities at urban nature parks. For each target area, I counted the number of males and females observed. I also categorized people by age group: baby (not able to walk or in a stroller), child (<12years old), teen (between 13 and 20 years of age), adult (between 21 and 59 years of age), and senior (60+ years of age). Finally, I coded individual's ethnicities when possible, using the categories Asian, Black, Latino, or White. However, ethnicity determinations were difficult to make. Often people were far away, appeared to be of mixed-race, did not fall into one of these categories, or it was unclear what their ethnicity was, so I did not categorize everyone I observed. Similarly, it was sometimes difficult to determine age (particularly if an individual was close to the margins of a category), and the male/female category was determined using stereotypical characteristics. It was usually possible to determine if an individual had been counted already based on characteristics such as their clothing; however, if the parks were particularly busy then some users may have been counted more than once. Each category was counted in stages; first, I counted the total number of people sitting, then standing, then walking, then the total number of men, then the total number of women, etc. When there were many people, it was not possible to associate the demographic characteristics with the activities and thus the total number of individuals per category varies.

Observations were conducted during three pre-established time frames throughout the day. Morning (before 10:30 am), Midday (10:30am to 4pm) and Evening (after 4pm). Observations were performed during Summer 2020 beginning July 8th and ending September 26th for a total of 27 observations (Table 3). During the pandemic, Rio de Los Angeles State Park adjusted its hours and the park was closed often, closing at around 5pm every day and not opening on Sundays. This greatly limited my ability to survey the site and likewise limited park availability to users. Vista Hermosa was observed for 182 minutes, Rio was observed for 157 minutes, and LASHP was observed for 355 minutes (Table in Appendix); LASHP was observed for more minutes because it is larger. SOPARC recommends making observations at least two weekdays and two weekend days at 3-4 times per day for a total of 12-16 observations (McKenzie et al. 2006). In total, I sampled each park 8-9 times, with less coverage during the weekends.

Table 3. Total number of observations at each park.

	Weekday			Weekend		
Park	Morning	Midday	Evening	Morning	Midday	Evening
Rio	2	2	2	1	1	0
LASHP	2	2	2	1	1	1
Vista Hermosa	2	2	2	1	1	1

To answer my question "which parts of these parks are most used and how?", I used the total number of people observed at the park and at each target area to calculate proportion and density. The proportion calculation shows the percentage of people who did a particular activity at that polygon in comparison to the total number of people doing that activity at the entire park. However, simply looking at proportion can obscure which features were the most used at this park because a larger target area can accommodate more people than a smaller target area. Thus, I also calculated the density to know which areas accommodate a higher number of people per area. For the entire park and for each target area, I calculated density which is the total number of people found doing a particular activity per area. Density calculations favor small areas so looking at both proportion and density provides a better overall understanding.

Results

Park visitation

In total, I counted 822 people at LASHP, 710 people at Vista Hermosa, and 98 people at Rio. These totals are approximate because counting for each category (demographics and activity type) was assessed independently of each other. Although LASHP was the most visited park, Vista Hermosa was a more heavily used park for its size. Rio was the least visited park.

Park user demographics

All three parks were slightly different from each other in terms of demographics. Both LASHP and Rio had similar percentages for male visitors (57.4% for Rio and 54% for LASHP) and approximately 40-45% female visitors; at Vista Hermosa, the pattern was reversed, with about 58.4% female to 41.6% male.

For all three parks, the majority of visitors were Latinos, making up between 32% and 56% of the park visitors (Table 4), however this data may not be reliable given the difficulty of determining race and ethnicity by sight in general. For about 20% of the visitors at each park, I was not able to categorize their ethnic background or race. Although the values associated with the race and ethnicity information may not be accurate, there appears to be a diversity of people visiting the parks. It is possible that the percentage of Rio visitors that were white was skewed by the habitat restoration volunteer work day that I randomly captured during my survey and the fact that during the time I surveyed the park, the active recreation portion of Rio was inactive due to the COVID-19 pandemic restrictions.

The majority of visitors at all three parks were adults (people 21 to 59 years of age) (Table 4). Rio had the highest percentage of seniors, Vista Hermosa had the highest percentage of teenagers, and all three parks had relatively equal numbers of children (Table 4).

Table 4. Park Demographics

	Rio	**LASHP**	**Vista Hermosa**
Latinx	39.5% (34)	32.0% (247)	56.0% (312)
White	30.2% (26)	22.3% (172)	11.1% (62)
Asian	5.8% (5)	19.6% (151)	8.1% (45)
Black	1.2% (1)	4.4% (34)	5.4% (30)
Undetermined	23.3% (20)	21.7% (167)	19.4% (108)
Adult (21-59 yrs)	74.4% (67)	76.2% (631)	76.4% (501)
Child & baby (<13yrs)	12.2% (11)	10.9% (90)	12.8% (84)
Senior (>59 yrs)	11.1% (10)	6.6% (55)	2.0% (13)
Teen (13-20 yrs)	2.2% (2)	6.3% (52)	8.8% (58)

Park user activities

The primary activities varied by park. Rio was very active (44.9% walking) with almost nobody sitting (8.2% sitting), Vista Hermosa was very sedentary with most people sitting

(66.3%) and few people walking (19.0%), and LASHP was in between with some people walking (36.6%) and some sitting (34.5%) (Table 5).

There were many activities that I noted, when possible, to provide context to the results. These included: soccer playing, skateboarding, boxing, scooter use, frisbee play, hammock use, push-ups, using benches for exercises, working on a laptop on a park bench, photography, observing plants at gardens, rolling down hills, walking through bushes, climbing trees, and bouldering. These observations show the diversity of activities taking place at these parks.

Table 5. Park user activities.
Rio and LASHP had more active users in comparison to inactive users. In contrast, Vista Hermosa visitors were predominantly inactive.

	Inactive			**Active**			
Park	Sit	Stand	Total	Walk	Run	Bike + Other	Total
Rio	8	29	37	44	12	5	61
LASHP	284	98	382	301	107	32	440
Vista Hermosa	471	84	555	135	11	9	155

Park uses by feature

A canonical correlation analysis using the two sets of variables found in Table 2 (Set 1) and Table 5 (Set 2) for all three parks highlights some of the important features. This type of analysis explores the relationship between two datasets and highlights the variables that influence those sets the most. The canonical variate with the highest eigenvalue is the relationship that explains the most variance, which is the canonical variate 1 ($p = 0.002$). It is the only significant one and thus the only one explained here.

Looking at the standardized canonical correlation coefficients for Set 1, lawn and trees are negatively correlated to the canonical variate, although lawn is the largest contributing variable. Looking at Set 2, sitting is the largest variable and is also negatively correlated to the canonical variate (standing, running, biking, and other are small). Thus, lawns and sitting are highly related variables; sitting is also related to trees but less so. Walking paths are positively correlated to the canonical variate and so is walking (Table 6). Thus, walking paths and walking are highly related variables, benches and picnic tables are also related to walking, but less so.

Table 6. Canonical Correlation Analysis.
Canonical variate 1 had a correlation of 0.853 and was significant (p=0.002). Below are the results for the standardized canonical correlation coefficients, canonical loadings, and cross loadings for each set (sample size of 24). The most important variables are in bold.

	Variables	Standardized canonical correlation coefficients	Canonical Loadings	Cross Loadings
Set 1 (park characteristics)	**Lawn/Grass**	**-.743**	**-.802**	**-.684**
	Trees	-.241	-.061	-.052
	Walking Path	**.397**	**.724**	**.618**
	Bench/table	.188	**.541**	**.462**
Set 2 (activity type)	**Sit**	**-.929**	**-.882**	**-.752**
	Stand	-.034	-.249	-.212
	Walk	**.619**	**.384**	**.328**
	Run	-.031	**.285**	.243
	Bike & other	-.191	**.299**	.255

Park uses per area

Rio de Los Angeles State Park

At Rio, I combined Target areas 1 and 2 because they have the same features and are essentially the same area. I also combined areas 3, 4 and 5, which are areas within the more formal loop and natural area, since these target areas have essentially the same features and are interrelated. The areas with the largest number of people were target areas 3, 4 and 5 (Table 5). People were essentially there to use the walking path for walking, running, and biking. People also were standing in these areas, primarily areas 4 and 5. Target area 4 has a bench with a shelter that provides shade. Target area 5 has a small amphitheater where I sometimes observed people socializing. These areas all have benches alongside the walking path; however, people were seldom observed using them. Target area 6 had the highest number and density of people sitting (a total of 3 people); however, the sample size is small with the total number of people observed sitting being 8. The least used target area was 7; this area is a large lawn without any shade or seating. Usually the people seen walking in this area were walking across the lawn to get to target area 5, which is part of the large walking loop.

The areas with the highest density are target areas 3, 4 and 5 (Table 6); these are the areas with the walking path. The areas with the lowest density and number of people observed were areas 7 and 6,which do not have shade trees or seating. Target area 6 has a picnic shelter and some small trees with grass underneath where a limited number of people were observed relaxing.

Rio was the least visited park even though it has a walking path and is located in an urban area. Studies do show that programming impacts visitation. On the most heavily visited day there was a Park Champions program, which is a volunteer habitat restoration program initiated by the California State Parks Foundation and California State Parks staff. At the same time, youth sports were not allowed because of the COVID-19 pandemic during the time of my observations, which could have affected the number of people visiting the park and the natural area. For example, it is possible that more people visiting the park for organized sports may spill over into the natural area.

Table 7. Rio de Los Angeles SP activities by target area.
Proportion values of peoples' distribution by target area at Rio de Los Angeles State Park. The percentage represents a proportion of the total number of people doing a particular activity. The number in parentheses is the total number of individuals observed.

Target Area	**Sit**	**Stand**	**Walk**	**Run**	**Bike + other**	**Proportion**
1 + 2	37.5% (3)	10.3% (3)	13.6% (6)	41.7% (5)	0	17.3% (17)
3 + 4 + 5	12.5% (1)	**89.7% (26)**	**70.5% (31)**	**58.3% (7)**	**80.0% (4)**	**70.4% (69)**
6	**50.0% (4)**	0	9.0% (4)	0	0	8.2% (8)
7	0	0	6.8% (3)	0	20% (1)	4.1% (4)
Total number of people	8.2% (8)	29.6% (29)	44.9% (44)	12.2% (12)	5.1% (5)	98

Table 8. The average density of people by target area at Rio de Los Angeles SP.

Target area	Sit	Stand	Walk	Run	Bike + other	Total # of people	Density (hectares)	Hectares
1+2	0.59	0.59	1.19	**0.99**	0	17	3.37	0.63
3+4+5	0.07	**1.82**	**2.16**	0.49	0.28	69	**4.82**	1.79
6	**1.25**	0	1.25	0	0	8	2.5	0.40
7	0	0	0.82	0	0.27	4	1.09	0.46
Average density	0.30	1.11	1.68	0.46	0.19	98	3.73	3.28

Los Angeles State Historic Park

At LASHP, the area with the greatest number of people was target area 2, which is a large lawn with some trees (less than 15% tree cover) around the perimeter. About 20% of park visitors were found in this area (Table 7). Target area 2 was also the area with the highest proportion of people sitting and standing. Target area 10 had the highest proportion of people walking, biking, and doing other activities. This area is next to the parking lot and serves as an entrance to the park and so all of the tracked activities were taking place here (sitting, standing, walking, running, biking, and other). This area has a number of trees, benches, and a walking path alongside the length of the target area. Target area 1, with the highest proportion of people running, is the large natural area to the north of the park composed of an ephemeral wetland with shrubs, trees, walking paths, some lawn, and some picnic benches. The least visited area in terms of total number of people was target area 4, which features a pedestrian bridge with a view of the downtown LA skyline; this area also has little shade.

In terms of density, target area 10 was the most intensely used for its size (Table 8); it had the highest density of people standing, walking, running, biking, and doing other activities. Target areas 7 and 2 had the highest density of people sitting. At Target area 2, as mentioned above, there is a large lawn with scattered trees where people picnic. Target area 7 is mostly grass, with about 15% tree cover, walking paths, and informal benches (cement blocks that serve as benches but are not obviously so). Target area 6 was the second most dense target area in general and for people running. This area has plenty of benches, walking paths, and a relatively large amount of shade (about 25%). In terms of density, the least dense target area was number 1, but it was closely followed by areas 3 and 4. However, the density measure may skew against larger target areas. Although target area 1 was not dense, it still accommodated 106 people which was the second largest amount in comparison to other target areas. Target areas 3 and 4 did not have many people and were not intensely used. These areas are in the middle of the park, they have walking paths but not many trees and lack seating.

Target area 8 had the third highest density of people and had the most people standing. This area is a long narrow strip with numerous benches, trees, and walking paths. The area with the highest density of walkers was target area 10, followed by 8 and 6, all of which have a walking path. The highest density of runners was relatively equally distributed between target areas 6 and 10, both of which have a path (the same is true for cyclists). Target area 5 had a higher than average density of people sitting, standing, and running. This area is composed of grass, walking paths, and a small hill; however, it has only 6 small trees and thus shade is limited. Finally, target area 9 had a lower number of people using this space for its size and was close to average for density of people walking in this target area. This area is called the "promenade"; it is composed of a wide concrete walking path lined with trees on both sides, some lawn, some ornamental fruit trees, and seating that is not shaded.

Table 9. Los Angeles State Historic Park activities by target area.
The percentage represents the proportion of the total number of people doing a particular activity. For example, close to 40% of the people that were counted as "sitting" were sitting in target area #2. A high proportion, about 26%, of people counted as "running" were running in target area #1. The number in parentheses is the total number of individuals observed.

Target Area	**Sit**	**Stand**	**Walk**	**Run**	**Bike + other**	**Proportion of all users**
1	5.3% (15)	7.1% (7)	16.9% (51)	**26.2% (28)**	19.2% (5)	12.9% (106)
2	**40.8% (116)**	**22.4% (22)**	7.6% (23)	10.3% (11)	16.7% (1)	**21.0% (173)**
3	2.5% (7)	4.1% (4)	10.6% (32)	8.4% (9)	0	6.3% (52)
4	2.8% (8)	6.1% (6)	5.3% (16)	4.7% (5)	11.5% (3)	4.6% (38)
5	16.2% (46)	14.3% (14)	6.0% (18)	20.6% (22)	15.4% (4)	12.6% (86)
6	5.3% (15)	12.2% (12)	12.6% (38)	14.0% (15)	18.8% (6)	10.5% (86)
7	12.0% (34)	12.2% (12)	2.7% (8)	0.9% (1)	0	6.7% (55)
8	4.6% (13)	4.1% (4)	8.6% (26)	0.9% (1)	11.5% (3)	5.7% (47)
9	6.7% (19)	6.1% (6)	9.6% (29)	4.7% (5)	0	7.2% (59)
10	3.9% (11)	11.2% (11)	**19.9% (60)**	9.3% (10)	**31.3% (10)**	12.4% (102)
Total number of people	34.5% (284)	11.9% (98)	**36.6% (301)**	13.0% (107)	3.9% (32)	Total # of people: 822

Table 10. The average density of people by target area at LASHP.

Target Area	**Sit**	**Stand**	**Walk**	**Run**	**Bike+ Other**	**Total # of people**	**Density (hectares)**	**Hectares**
1	0.68	0.32	2.31	1.27	0.23	106	4.81	2.45
2	**7.24**	1.37	1.44	0.69	0.06	173	10.80	1.78
3	0.80	0.45	3.64	1.02	0	52	5.25	1.10
4	1.35	1.01	2.70	0.84	0.51	38	6.42	0.74
5	5.32	1.62	2.08	2.55	0.46	104	12.04	0.96
6	4.07	3.25	10.30	**4.07**	1.63	86	23.31	0.41
7	**7.87**	2.78	1.85	0.23	0	55	12.73	0.48
8	5.35	1.65	10.70	0.41	1.23	47	19.34	0.27
9	2.81	0.89	4.30	0.74	0	59	8.74	0.75
10	4.53	**4.53**	**24.70**	**4.12**	**4.12**	102	**41.98**	0.27
Average density	3.43	1.18	3.63	1.29	0.39	822	9.92	9.21

Vista Hermosa Nature Park

Target area 9 had the most people at close to 200 individuals observed as well as the highest number of people sitting and walking (Table 9); it is composed of a lawn surrounded by trees that shade approximately 75% of the area and a walking path that runs alongside the lawn. Target area 2 also had a high proportion of people sitting. Similar to area 9, area 2 is composed of a large lawn with trees that provide ample shade. The highest proportion of people standing was in target area 4. This area has lawns, trees, and two benches with an iconic view of the downtown Los Angeles skyline and thus is a popular photography area. The highest proportion of people running were found along target areas 1, 3, and 12 which are all composed of a path surrounded by native vegetation. The area with the highest proportion of people biking or doing other activities was target area 7; this area is the informal playground with a large rubber snake, boulders, and a rock slide. Target area 5 had the least amount of activity and the lowest number of people; this area is primarily a walking ramp that connects the park lawns with one of the main entrances. Target area 6 was the second lowest in terms of density of activity; this is one of the entrances, but at this entrance street parking is difficult to come by. This area is primarily composed of informal cement benches and a view of the downtown Los Angeles skyline and thus is one of the areas where people take pictures.

The areas with the most use in terms of density in general and density of people sitting were target areas 2 and 11 (Table 10). Target area 2 is a large lawn surrounded by trees and vegetation whereas target area 11 is composed of multiple picnic benches shaded by trees and surrounded by vegetation. Target area 11 was rarely used: only 12 people were observed there, so it is possible that its small size may be skewing the density results. Target area 4 had the highest density of people standing and walking. Target area 8 had the highest density of people walking; this area is composed of a lawn with trees and a walking path. The areas with the highest density of people walking, running, and biking were target areas 1, 3, and 12, which is the same result as for proportion described above. These areas are composed primarily of a walking path surrounded by natural habitat. The area with the highest density of people doing "other" activities was target area 7, which is the same result as for proportion described above. The area with the lowest density was also the area with the least amount of people, target area 5.

Target area 10 is a circular area with an amphitheater where rocks were designed to be benches and there is a walking path nearby. In this area, people were primarily walking; the amphitheater was rarely used. This survey was done during the COVID-19 pandemic and thus perhaps large gatherings were not happening, although large gatherings were observed in the nearby lawn areas.

Table 11. Vista Hermosa activities by target area.
Proportion values of peoples' distribution per target area at Vista Hermosa Nature Park. The percentage represents a proportion of the total number of people doing a particular activity. For example, of the people that were there to sit, the majority were sitting in target areas 2 and 9. The numbers in parentheses are the total number of individual people observed there.

Target area	**Sit**	**Stand**	**Walk**	**Run**	**Bike + Other**	**Proportion**
1 + 3 + 12	0.8% (4)	4.8% (4)	19.3% (26)	**36.4% (4)**	11.1% (1)	5.5% (39)
2	**30.8% (145)**	8.3% (7)	12.6% (17)	0	0	23.8% (169)
4	10.8% (51)	**34.5% (29)**	11.1% (15)	0	0	13.4% (95)
5	0	0	2.2% (3)	9.1% (1)	0	0.6% (4)
6	0.8% (4)	11.9% (10)	7.4% (10)	0	0	3.4% (24)
7	7.4% (35)	19.0% (16)	3.7% (5)	27.3% (3)	**44.4% (4)**	8.9% (63)
8	13.8% (65)	2.4% (2)	13.3% (18)	9.1% (1)	11.1% (1)	12.2% (87)
9	**30.6% (144)**	15.5% (13)	**23.0% (31)**	18.2% (2)	33.3% (3)	**27.2% (193)**
10	2.5% (12)	2.4% (2)	7.4% (10)	0	0	3.4% (24)
11	2.3% (11)	1.2% (1)	0	0	0	1.7% (12)
Total # of people	**66.3% (471)**	11.8% (84)	19.0% (135)	1.5% (11)	1.3% (9)	Total # of people: 710

Table 12. The average density of peoples by target area at Vista Hermosa.

Target area	Sit	Stand	Walk	Run	Bike + other	Total # of people	Density (hectares)	Hectares
1 + 3 + 12	2.22	2.22	14.44	**7.78**	0.56	39	21.67	0.20
2	**94.77**	4.58	11.11	0	0	169	**110.46**	0.17
4	56.67	**32.22**	**16.67**	0	0	95	105.56	0.10
5	0	0	3.33	1.11	0	4	4.44	0.10
6	4.44	11.11	11.11	0	0	24	26.67	0.10
7	22.88	10.46	3.27	1.96	**2.61**	63	41.18	0.17
8	60.19	1.85	**16.67**	0.93	0.93	87	80.56	0.12
9	66.67	6.02	14.35	0.93	1.39	193	89.35	0.24
10	13.33	2.22	11.11	0	0	24	26.67	0.10
11	**122.22**	11.11	0	0	0	12	**133.33**	0.01
Average Density	39.95	7.12	11.45	0.93	0.76	710	60.22	1.31

Discussion

People visit nature parks with family, friends, or alone to relax, socialize, or exercise on lawns or along walking paths. They could run or walk in their neighborhoods (and perhaps they do), but they also choose to come to a park. When they visited these nature parks, they engaged in primarily two activities: sitting (42%) and walking (34%), followed by standing (15%) and running (9%). A study that examined 50 southern California parks, all of which had recreation centers, used the SOPARC method and found that in general park visitors were engaged in the following activities: sedentary behavior, which includes standing (68%); walking (17%); and vigorous activity, which includes organized sports and running (14%) (Cohen et al. 2012). In comparison, the work presented here yielded 57% sedentary behavior, 34% walking, and at least 9% vigorous activity (other active forms of recreation are not included in this 9%, such as biking). The nature parks visitors engaged in less sedentary behavior and walked more, which is correlated with some key park features such as walking paths.

Park user activities and features

The primary activity in these nature parks was sitting, which took place in grassy lawn areas. Most of the people sitting were doing this at Vista Hermosa in areas with grass and trees (Target areas 2, 9, 8, 4) and at LASHP in the large lawn with trees around its perimeter (Target area 2). Grass is used to sit, picnic, socialize and it was where the majority of people were observed at LASHP and Vista Hermosa. Yang et al. (2019) also found that lawns were used primarily for sitting and resting (although interview results revealed people expressed that they used lawns "to experience nature") in Xi'an, China. This study found that young people were more likely to use the lawns than the elderly. This may be because seniors may have joint pain or a difficult time getting up and down without help. A study of adult residents in Oslo, Norway found that when fatigued and looking for a place to rest, the amount of grass, trees, and other people mattered the most when choosing a place to sit (Nordh et al. 2011). A study in Sweden found that lawns were valued as places where a variety of activities could take place, such as playing, resting, picnicking, walking, socializing (Ignatieva et al. 2017). Lawns, particularly well-kept lawns that are light green, dense, and that have minimal weeds are aesthetically preferred (Yue et al. 2017). In the public plaza literature grass is named as the best feature for sitting because it does not limit people's sitting configuration; it is more flexible than fixed seating structures (Whyte 2012). A place to sit, primarily lawn, is a critical park amenity. Shade may also be important for sitting. Particularly during the hot summer months. People were often seen sitting under the shade of a tree during surveys. At the same time, shade is context dependent and may matter more when shade is necessary.

Grass is a critical park feature for people but grass may also be in conflict with restoration goals, such as increasing urban species biodiversity. One of the reasons is their intensive management of lawns, including frequent mowing and watering (Chollet et al. 2018). Additionally, over-fertilization, high watering needs, and high herbicide and insecticide use could negatively impact the ecosystem (Fissore et al. 2012, Ramer et al. 2019). LASHP has numerous areas where California native plants seem to be overtaken by grass. There are some low-maintenance turfgrass species that may be good alternatives (Hugie and Watkins 2016, Ramer et al. 2019) and some places such as Berlin, Germany, areas of Sweden and the United Kingdom are experimenting with grass-free alternatives to green lawns in hopes of creating a new norm for urban vegetation design (Ignatieva and Hedblom 2018). Researchers have explored how reducing mowing can increase biodiversity because the grass is able to grow taller and thus support a diversity of pollinators (Lerman et al. 2018). However, people like short-cut lawns and prefer it over tall grass meadows and they also think that greenspaces should be well kept and tidy (Fischer et al. 2020). Additionally, grass provides numerous recreational benefits; it not only provides flexibility for sitting but also for a diversity of activities, such as playing soccer or frisbee, and for some this is the way they connect with nature.

Walking is the second most popular activity and based on the canonical correlation analysis, walking paths are correlated with walking. Studies show that having walking loops in parks increased the number of users in general and also increased the levels of moderate-to-vigorous physical activity; this increased usage occurred both along the walking loops and also throughout the park (Kaczynski et al. 2008, Cohen et al. 2017). Numerous studies show that seniors in particular benefit from having walking paths in parks (Zhai and Baran 2017). However, it is unclear how long a path needs to be to entice park visitors to walk it regularly. A study looking at senior citizens found that seniors in parks with larger surface area, longer trails, larger natural area and outdoor fitness equipment took more steps (measured via pedometer)

(Zhai et al. 2020); there are similar results for a study at a retirement community (Joseph and Zimring 2007). A study in Missouri found that users of a trail longer than 0.25 mile (0.4 km) are more likely to report an increase in physical activity (Brownson et al. 2000); however, this study conducted interviews over the phone and in rural counties so the conclusions regarding trail length may not be relevant to urban parks. In my results, nine out of the top 10 target areas that had walkers have a walking path. The path at Vista Hermosa was less often used for exercise, perhaps because its walking path is short, roughly 0.5 km, whereas the path at LASHP is 1.8 km and at Rio it is 1.1 km. This could also be because Vista Hermosa attracts people who are more interested in socializing due to the grass covered by good shade, although these uses are not mutually exclusive. Benches and picnic tables are also positively correlated with walking according to the canonical correlation analysis, though much less than walking paths. A study of elderly Chinese people found a strong preference for benches with backs and arm rests to be able to take breaks while walking (Wang and Rodiek 2019).

In his study, Cohen et al. (2012) found that activities at 50 parks were relatively similar, regardless of poverty level. The biggest difference was that high poverty areas had smaller parks and those parks were more densely used (meaning more people per unit of space). The parks I studied had similar trends. The 1-mile radius around both LASHP and Vista Hermosa has a large low-income population and both parks were more densely used in comparison to Rio. The population surrounding LASHP is 52% low-income and is 55% low-income at Vista. This is in comparison to the population surrounding Rio, which is 32% low-income. The average people per hectare at LASHP is 9.92 and at Vista is 60.22. In comparison the people per hectare at Rio is 3.73.

Demographics

Generally, males use these nature parks more than females, regardless of age group. Males are typically more physically active than females, youth are generally more active in the park than adults, and older adults are infrequently observed in parks (Evenson et al. 2016). However, Vista Hermosa was female dominated, possibly due to the social nature of the park's design. This park is primarily composed of several shaded grassy fields and also has a children's playground; published works show that playgrounds tend to be female dominated (Loukaitou-Sideris 1995, Silver et al. 2014). LASHP does not have a playground and although Rio does, it is not located within the natural area.

Cohen et al. (2012) study of southern California parks found that 32.5% of park visitors were children, versus an average of 10% in these nature parks, 15.2% were teens, versus less than 10% in these parks, and 4.2% seniors, versus approximately 7% in these parks. It is possible that the age structure of the neighborhoods surrounding the parks studied here explains these differences. A study in Australia found that children, particularly 9 to 11 year olds, most frequently visit parks with sports facilities, playground equipment, toilets, drinking fountains, BBQs and landscaping (Flowers et al. 2020), even when these parks were further away from their home. The nature parks that I studied do not have many of these facilities, with the exception of toilets, drinking fountains, and landscaping. This may be a situation where park programming can help enhance visitation by children (Cohen et al. 2010), such as school field trips, campfires, plantings, among others. More work would need to be done to determine whether urban nature park visitors are less visited by children.

People of different ethnic groups tend to use parks similarly, though there are slight differences. For example, Latinos tended to engage in more sedentary behavior than white visitors, keeping in mind that all groups largely engage in sedentary behavior at parks (Cohen et al. 2012). A reason for Latinos engaging in slightly more sedentary behavior is possibly because Latinos may have different motivations for visiting parks. Several studies show that Latinos go to parks to be with family, to celebrate, and be in large groups (Loukaitou-Sideris 1995). Although Latinos may tend to be in larger groups, many people across ethnic groups tend to visit parks to be with family and friends. A study in Europe found that the main motivation for people visiting parks there is also to be with other people followed by enjoying the environment (Vierikko et al. 2020). A Malaysian study interviewed users who said their primary reason for visiting parks was to "get fresh air" and the majority visited parks in groups of family or friends rather than alone (Sreetheran 2017). In contrast, a study in China found people there primarily visit parks for relaxation and walking (Lee and Kim 2015). A Hong Kong study found that people visited parks to exercise and take leisure walks (Wong 2009). In the nature parks that I studied, the proportion of Asians visiting the parks is much lower than the proportion of Asians in the population that lives within a 1-mile radius. About 15% of the population surrounding Rio is Asian but only 6% of park visitors were Asian, at LASHP the figures are 31% versus 20% in the park, and at Vista Hermosa it was 22% versus 8% in the park (See Appendix for demographics table).

Ideas and values dominate and determine design and programming in parks (Loukaitou-Sideris 1995), so knowing about the park's demographics and the surrounding neighborhoods can be an important management tool. At the same time, neighborhood demographics do change and so allowing for flexibility in park use can be important. In Loukaitou-Sideris's work, Latinos were often seen changing the park space to fit their needs, such as bringing goal posts to play soccer, or bringing items from home during family gatherings. Low et al. (2005) found that having management that is responsive to constituents and their changing needs can contribute to a park's success.

SOPARC as a tool for park managers

SOPARC seems to be a good tool for understanding general demographics and activities of park visitors. It can be a relatively easy and cost-efficient way to collect data and could be useful for figuring out how to target programming to encourage certain populations of people to visit parks. For example, within a half mile of Los Angeles State Historic Park, the senior population makes up roughly 16% of the population (Community Fact Finder tool) yet only about 5% of park visitors are seniors. Thus, having programs geared towards seniors could increase their representation at the park. For example, in Loukaitou-Sideris (1995)'s work, Roxbury Park in Los Angeles was able to significantly increase senior park visitors by having an active senior citizen center.

SOPARC can help us understand where people are found at a park and capture the primary activities taking place; however, one limitation is that the SOPARC tool skews towards capturing physical activity and thus is not great at capturing the complexities of sedentary behavior, which is the activity most commonly seen. Consequently, this tool may not capture some of the values that nature parks provide. At nature parks, many of the primary activities are centered around socializing. Using the tool, much of the activity falls under sedentary activity, which is sitting or standing, but in reality, it is groups of friends and/or families engaged in picnics or relaxing under trees on blankets or hammocks. The tool also does not capture people interacting with nature, such as rolling down a hill, climbing a tree, or observing plants. There are also many people walking and playing with their dogs at these parks. Future research on urban nature parks may consider changing the categories to the following: Sitting/socializing, exercising (running, walking, push-ups, etc.), playing (chasing each other, soccer, frisbee, climbing, etc.), and dog walking. The "other" category is also necessary because there are other activities, such as photography, that are observed but not as frequently and that also provide an understanding of park assets and features. Although few of the activities are obviously indicative of people enjoying nature (such as bird watching would be), it seems clear that a natural setting is critical to leisurely recreation (Low et al. 2005).

Conclusion

Many different kinds of parks exist, yet people use parks similarly. A study in Portland, Oregon found relatively few difference between the number of people visiting nature-based parks, active recreation parks, and multi-use parks (Talal and Santelmann 2021). In places where ecological restoration is an important element of a park's design, having nature-based parks can serve some of the same basic functions of other more traditional recreation parks such as having grass for sitting and/or walking paths for walking. Urban nature parks appear to be used in similar ways as parks more oriented towards sports showing that nature-based parks are as good as other types of parks at supporting a range of activities.

Nature parks are most often used to socialize with friends, family, and/or to relax, and whether visitors are thinking about it or not, to be in or appreciate nature. This may often look like people just sitting on grass. In terms of park design, lawns are an integral feature in these urban nature parks and should be used in future park designs. Nature parks are also often used to walk either alone, with friends or family, either as exercise or possibly as a way to decompress or get away from the city life. This is mostly done along walking paths. The nature parks that I studied were used primarily by Latinx people, possibly because close to half of the population around these parks is Latinx. It was notable that the Asian American population was not represented proportionally at the park in comparison to the surrounding Asian American population. Future studies could look at parks located in parts of the city with larger Asian American populations to see how parks are used there. Finally, these nature parks are primarily used by adults, while children are less present and particularly in comparison to other kinds of recreation parks. Future studies could look at how children use nature parks in comparison to other kinds of parks. Urban nature parks could be designed and built with careful consideration of the elements people need.

Appendix

Table 13. Park observation details by time of day

Park name	**Date**	**Day of week**	**Time of day**	**Start time**	**End time**	**Minutes**	**Temp. (°F)**	**Number of people observed**
		WEEKDAY						
Vista	12-Aug	Wednesday	Morning	8:23	8:40	17	68	16
Vista	14-Aug	Friday	Morning	7:53	8:07	14	72	23
Rio	7-Aug	Friday	Morning	9:14	9:32	18	66	14
Rio	2-Sep	Wednesday	Morning	7:51	8:10	19	62	9
LASHP	7-Aug	Friday	Morning	9:52	10:24	32	70	56
LASHP	28-Aug	Friday	Morning	8:11	8:46	35	66	60
Vista	28-Jul	Tuesday	Midday	2:33	2:53	20	78	62
Vista	12-Aug	Wednesday	Midday	1:04	1:24	20	86	64
Rio	12-Aug	Wednesday	Midday	12:31	12:45	14	84	5
Rio	24-Aug	Monday	Midday	3:18	3:37	19	81	2
LASHP	24-Jul	Friday	Midday	3:09	3:55	46	77	91
LASHP	19-Aug	Wednesday	Midday	1:27	2:00	33	94	22
Vista	8-Jul	Wednesday	Evening	6:05	6:31	26	76	95
Vista	4-Sep	Friday	Evening	5:42	6:00	18	77	83
Rio	8-Jul	Wednesday	Evening	4:33	4:56	23	80	13
Rio	12-Aug	Wednesday	Evening	5:28	5:46	18	81	18
LASHP	12-Aug	Wednesday	Evening	4:29	5:10	39	83	103
LASHP	19-Aug	Wednesday	Evening	6:10	6:58	48	83	167
		WEEKEND						
Vista	3-Oct	Saturday	Morning	9:16	9:29	13	75	25
Rio	26-Sep	Saturday	Morning	8:40	9:11	31	66	32
LASHP	26-Sep	Saturday	Morning	9:40	10:16	36	68	123
Vista	8-Aug	Saturday	Midday	3:13	3:47	34	80	199
Rio	22-Aug	Saturday	Midday	11:05	11:20	15	89	1
LASHP	16-Aug	Sunday	Midday	12:33	1:07	34	94	76
Vista	23-Aug	Sunday	Evening	5:37	5:57	20	84	137

Rio	16-Aug	Sunday (closed)	Evening	NA	NA	NA	93	NA
LASHP	16-Aug	Sunday	Evening	5:52	6:44	52	84	209

Table 14 Population demographics for a 1-mile radius around each park.
Data is from the Environmental Protection Agency's Environmental Justice Screening and Mapping Tool which uses the U.S. Census Bureau's American Community Survey data (2016-2020).

Variable	Rio	LASHP	Vista
Low-income population	32%	52%	55%
Population	31,361	44,490	91,652
Population density (people per square mile)	7,957	11,063	26,169
Average # of people per park hectare	3.73	9.92	60.22
Hispanic	58%	43%	56%
White	22%	13%	13%
Black	1%	11%	7%
Asian	15%	31%	22%
Male	50%	59%	52%
Female	50%	41%	48%
Age 0-4	6%	4%	6%
Age 0-17	17%	13%	19%
Age 18+	83%	87%	81%
Age 65+	14%	11%	12%

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Chapter 3: Avian abundance and diversity within urban nature parks in Los Angeles

Introduction

There is a global trend of converting natural areas into agricultural fields and cities (Ellis et al. 2010) and this has led to a decline in biodiversity (IPBES 2019). In addition to the direct impact of habitat loss, cities impact biodiversity indirectly through contributing to climate change, pollution, and through other kinds of resource demands (such as food consumption); furthermore McDonald argues that the affected area is greater for indirect than direct impacts (McDonald et al. 2020). Cities can be detrimental to biodiversity because of habitat loss, the introduction of nonnative species that sometimes displace native species, habitat fragmentation, and the expansion of city suburbs (McKinney 2002), which is expected to increase by between 30% and 180% by 2100 (Chen et al. 2020). Urban ecological research is necessary to inform policy, management, and conservation in light of rapid urbanization and habitat change (Knapp et al. 2021).

At the same time, researchers and conservationists are seeing cities as places of opportunity for biodiversity. For example, German cities are often found in areas of rich geological diversity and thus have habitat heterogeneity and higher than expected levels of species richness in spite of urbanization (Kühn et al. 2004). Cities provide a variety of different green spaces, including public and private spaces; a U.K. study found that domestic private gardens made up between 21.8% and 26.8% of the urban area (Loram et al. 2007). However, the type of urban green space greatly influences species colonization and persistence rates (Gallo et al 2017).

The type and biological features of urban green spaces greatly influences species richness (Gallo et al. 2017, Korányi et al. 2021). In Gallo et al. (2017) city parks had fewer mammal species than golf courses, cemeteries, and natural areas. Parks containing manicured habitats also differ from those managed for passive recreation; one study found that passive recreation parks supported mammalian assemblages similar to those in mature riparian forest sites (Mahan and O'Connell 2005). Sometimes urban green spaces can attract even more wildlife; a study shows that bees are abundant and diverse in urban landscapes and in some cases are more abundant than in nearby rural landscapes (Hall et al. 2017). Additionally, certain bird species and rodents use remnant habitat strips or revegetated highway right of ways as linkages between green spaces within cities (Bolger et al. 2001).

An important predictive factor of species richness is area; the larger the green space, the more it positively impacts species richness and biodiversity (Cornelis and Hermy 2004, Chamberlain et al. 2007, Callaghan et al. 2018, Mayorga et al. 2020, Pirzio Biroli et al. 2020), and larger areas can support increased abundance by expanding habitat available to species already present (Shanahan et al. 2011). Although larger parks are better, they cannot always be created in highly developed urban cities; furthermore small parks do positively influence bird species richness (Strohbach et al. 2013).

Even small urban green spaces provide connectivity and promote colonization of urban green space (Shanahan et al. 2011). A study in the city of Pachuca, Mexico, found that small parks (less than 2 hectares in size) had higher bird species richness than roadside green strips or land areas with a high percentage of building cover (Carbó-Ramírez and Zuria 2011). Birds in urban parks are sensitive to the composition and structure of plant communities (Chace and Walsh 2006), but it is unclear how. Avian species richness is possibly influenced by tree cover

(Palomino and Carrascal 2006, Taylor et al. 2016, Callaghan et al. 2018, Morelli et al. 2018), presence of grass-shrubs (Garizábal-Carmona and Mancera-Rodríguez 2021), shrub richness (Paker et al. 2014), and native vegetation (Jasmani et al. 2017). At the same time, we do know that there is a negative association between bird species richness and lawn cover (Shwartz et al. 2008, Paker et al. 2014). Urban green spaces such as small parks, gardens, and urban riparian forests do seem to also support native migrating birds (Atchison and Rodewald 2006, Carbó-Ramírez and Zuria 2011, Paker et al. 2014). However, their design can impact bird species richness.

This study uses parks analyzed in Chapter 2 to understand bird use of these same parks because we know that these parks are heavily used by people, particularly Vista Hermosa and Los Angeles State Historic Park, in certain areas. This chapter aims to answer the following specific question: is there a difference between and within parks in terms of bird abundance and diversity?

In this study I took a close look at three urban parks designed with native species in mind to understand which bird species thrive and where they are in the park. The goal is to provide information that is useful for urban nature park planning by gaining a detailed understanding of species distributions in these urban parks.

Methods

I conducted bird point counts at pre-determined polygons at the same three urban parks used in Chapter 2: Rio de Los Angeles State Park, Los Angeles State Historic Park, and Vista Hermosa. The bird polygons overlap with the target areas determined for park visitor counts in Chapter 2, but they are not the exact same shape. The polygon shapes for this chapter were drawn to align with Degraaf's (1991) urban bird survey method. Additionally, the polygons were drawn to be more similar in size so they could be surveyed more equally and using the same method. See maps of study areas for LASHP (Figure 1), Vista (Figure 2), and Rio (Figure 3).

Bird surveys

Since these parks are located in an urban environment, I used a method proposed by DeGraaf et al. (1991) for assessing bird populations in urban areas. The polygons surveyed are approximately 91m x 91m, as proposed by DeGraaf et al. 1991, since people were typically able to pick out birds about 45 meters away and so the 91m x 91m boundary reduces overlapping observations. At each polygon, bird species were recorded for a period of between 5 and 10 minutes, with the surveyor recording birds by sight and sound. DeGraaf et al. (1991) found that the majority of birds were recognized in the first few minutes; additional minutes did not significantly increase the number of birds observed. The surveyor recorded birds while slowly walking, since DeGraaf et al. found that standing at a fixed point versus walking did not significantly change observations. To capture the time of highest bird activity, surveys occurred within 2.5 hours after sunrise.

I conducted monthly bird surveys at each park for the winter migration (October, November, December, January) and spring migration (March, April, May), being mindful to count birds during the weekdays and weekends. Each park was surveyed 6 times during each season for a total of 12 observations per park and a total of 36 survey days. During each observation I identified the bird to species (if possible), noted whether the bird was seen or heard, noted where it was observed (ground, mid-canopy, high canopy) and estimated the number of individuals observed. Although this method was generally straightforward, some birds (such as ravens) were seen flying throughout the park and through various polygons, making the tying of observations to specific polygons looser. At the same time, these individual observations make up less than 5% of the total observations. Generally, birds that were observed high up in the air were removed from the analysis. Additionally, these parks are heavily used and maintained and thus grooming, watering, construction, and event pop-up tents disturbed my surveys on occasion. Since all parks experienced some type of disturbance (perhaps Rio a little less so), I don't believe these impacted the observations of one park more than the other.

Analysis

To analyze the abundance and diversity data, I used two statistical software tools. To compare abundances across parks and polygons, I ran an analysis of variance (ANOVA) in SPSS. Primer statistical software was used to calculate the Shannon Diversity index and to run the non-metric multidimensional scaling (nMDS). Approximately 30% of the bird abundance was made up of white-crowned sparrows and this is true for all three parks (Table 1). At LASHP, non-native species composed up to 12% of the individuals. White-crowned sparrows and non-natives introduce large amounts of variation and thus these were excluded from Figure 4, 5, and 6 and from the ANOVA analysis. When white-crowned sparrows were included in the ANOVA, the homogeneity of variance assumption was not met and thus those results are not reliable. White-crowned sparrows and non-natives were not taken out of the nMDS analysis because it did not impact the results. The Shannon diversity index is reported as an H' value and typically the value ranges from 1.5 to 3.5: the higher the index number, the more biological variability there is (Ortiz-Burgos 2016). I used native bird species for the Shannon diversity index calculation, however all other analyses included both native and non-native species.

To further understand the diversity H' values, I categorized the bird species observed into several categories (Table 1). The bird species were classified with the aid of the Cornell Lab of

Ornithology's website "All About Birds" (www.allaboutbirds.org) and e-bird observations for these specific parks. Some species' migratory behavior varies geographically, thus species sometimes did not fall clearly into one category. In these cases, I used my observations to put the species into a category. For example, if a bird species such as the black-throated gray warbler is classified as either "migrating through" or "migratory and possibly breeding," I would categorize them as breeding if they were observed on multiple occasions during the breeding season. This was done to understand which bird species were at the parks and to further understand the differences and similarities between the parks.

Table 15. Bird species observed at all of the parks.
Species were categorized based on whether the species could possibly be breeding at the park, be migrating, or be present year-round. A species is categorized as "wintering" when they were observed consistently in the Winter months and "migrating" means a species is only seen a couple of times. Breeding migrants are only seen in the Spring months.

Native bird species	Breeding	Migratory	Category
Acorn woodpecker	Yes	No	Resident
Allen's hummingbird	No	Yes	Migrating
American crow	Yes	No	Resident
American goldfinch	Yes	No	Resident
American kestrel	Yes	No	Resident
American pipit	No	Yes	Winter
Anna's hummingbird	Yes	No	Resident
Ash-throated flycatcher	Yes	Yes	Breeding migrant
Barn swallow	Yes	Yes	Breeding migrant
Least bell's vireo	Yes	No	Resident (rare)
Bewick's wren	Yes	No	Resident
Black phoebe	Yes	No	Resident
Black-chinned hummingbird	Yes	Yes	Breeding migrant
Black-throated gray warbler	Yes	Yes	Breeding migrant
Blue-gray gnatcatcher	Yes	Sometimes	Breeding migrant
Brewer's blackbird	No	Yes	Migrating
Brown-headed cowbird	Yes	No	Resident
Bushtit	Yes	No	Resident
California towhee	Yes	No	Resident
Cassin's kingbird	Yes	No	Resident
Common raven	Yes	No	Resident
Common yellowthroat	Yes	No	Resident
Cooper's hawk	Yes	No	Resident
Hairy woodpecker	Yes	No	Resident
Hermit thrush	No	Yes	Winter
House finch	Yes	No	Resident

Killdeer	Yes	No	Resident
Lark sparrow	No	Yes	Winter
Lawrence's goldfinch	Unclear	Seen once/nomadic	Migrating
Lesser goldfinch	Yes	No	Resident
Lincoln sparrow	No	Yes	Winter
Loggerhead shrike	No	Yes	Resident (rare)
Mourning dove	Yes	No	Resident
Northern mockingbird	Yes	No	Resident
Nuttall's woodpecker	Yes	No	Resident
Orange-crowned warbler	Yes	No	Resident
Phainopepla	No	Yes	Migrating
Ruby-crowned kinglet	No	No	Winter
Rufous hummingbird	No	Yes	Migrating
Savannah sparrow	No	Yes	Winter
Say's phoebe	No	Yes (based on observations)	Resident
California Scrub jay	Yes	No	Resident
Sharp-shinned hawk	Yes	No	Resident
Song sparrow	Yes	No	Resident
Townsend's warbler	No	Yes	Winter
Vermilion flycatcher	No	Yes	Migrating
Western tanager	Unclear	Yes	Migrating
Western wood-peewee	Yes	Yes	Breeding migrant
White-crowned sparrow	No	Yes	Winter
White-throated sparrow	No	Yes	Winter
Wilson's warbler	No	Yes	Migrating
Yellow breasted chat	Yes	Yes	Breeding migrant
Yellow warbler	Yes	Yes	Breeding migrant
Yellow-rumped warbler	No	Yes	Winter

Figure 4. Bird observation polygons at Los Angeles State Historic Park.
The polygon boxes are not exactly the same, however the areas were surveyed similarly. The polygon sizes are as follows: 1-7,689m^2, 2-7,289m^2, 3-6,598m^2, 4-8,631m^2, 5-6,838m^2, 6-7,563m^2, 7-5,088m^2.

Figure 5. Bird observation polygons at Vista Hermosa Nature Park.
This park is so small that 3 polygons did not fully fit within the park. Polygon 1 is smaller than the other three. The polygon sizes are as follows: 1-4,443m^2, 2-7,784m^2, 4-6,021m^2.

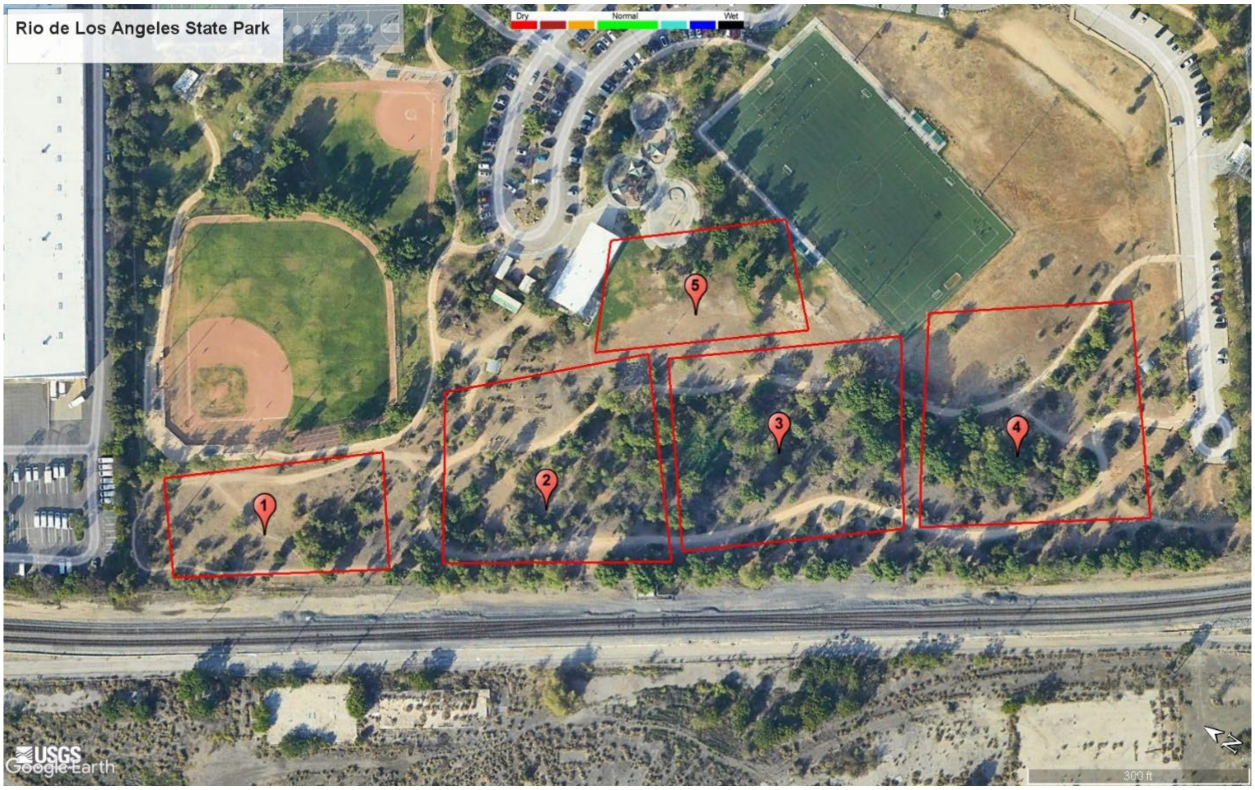

Figure 6. Bird observation polygons at Rio de Los Angeles State Park.
The polygons were drawn to be roughly similar, however there are some differences. The polygon sizes are as follows: 1-3,959m^2, 2-6,951m^2, 3-7,483m^2, 4-7,993m^2, 5-3,728m^2.

Results

Abundance

Overall

Although Rio had slightly higher abundances in comparison to LASHP and Vista, the difference between the parks is not statistically significant. On average the total number of individuals observed per polygon at Rio was 228 versus 191 at LASH and 190 at Vista (Table 2). The raw total abundances have uneven variation between polygons and thus the homogeneity of variance assumption to run an ANOVA was not met (p=0.004). This was partly due to white-crowned sparrows making up approximately 30% of individuals and the fact that this species tended to be observed in very large numbers, sometimes up to 50 individuals. Removing white-crowned sparrows and non-natives from the data set reduces the variability in the data (Figure 4).

Then, the homogeneity of variance assumption is met (p=0.146) and the ANOVA results show that the abundance differences between polygons are significant (p= 0.032). The Tukey HSD post-hoc test shows that LASHP polygon 2 has significantly lower abundances in comparison to Rio polygons 2 (p=.023) and 4 (p=.043). Rio polygon 2 had the highest mean per survey at close to 15 individual birds whereas LASHP polygon 2 had the lowest mean per survey at 5 individuals.

Table 16. Total number of birds per park and polygon.
Approximately 30% of bird abundance was made up of white-crowned sparrows and this is true for all parks. At LASHP, non-native species composed up to 12% of the individuals.

	Total number of birds (all bird species)	**Total number of White-crowned sparrows**	**Total number of non-native birds**
Rio-1	252	96	0
Rio-2	260	82	1
Rio-3	164	37	0
Rio-4	226	54	1
Rio-5	240	100	17
Rio total	**1,142**	**369 (32%)**	**19 (2%)**
LASHP-1	290	154	9
LASHP-2	135	42	30
LASHP-3	132	11	59
LASHP-4	180	43	20
LASHP-5	179	48	27
LASHP-6	216	63	21
LASHP-7	205	63	0
LASHP total	**1,337**	**424 (32%)**	**166 (12%)**
Vista-1	134	16	5
Vista-2	278	126	11
Vista-3	157	34	10
Vista total	**569**	**176 (31%)**	**26 (5%)**

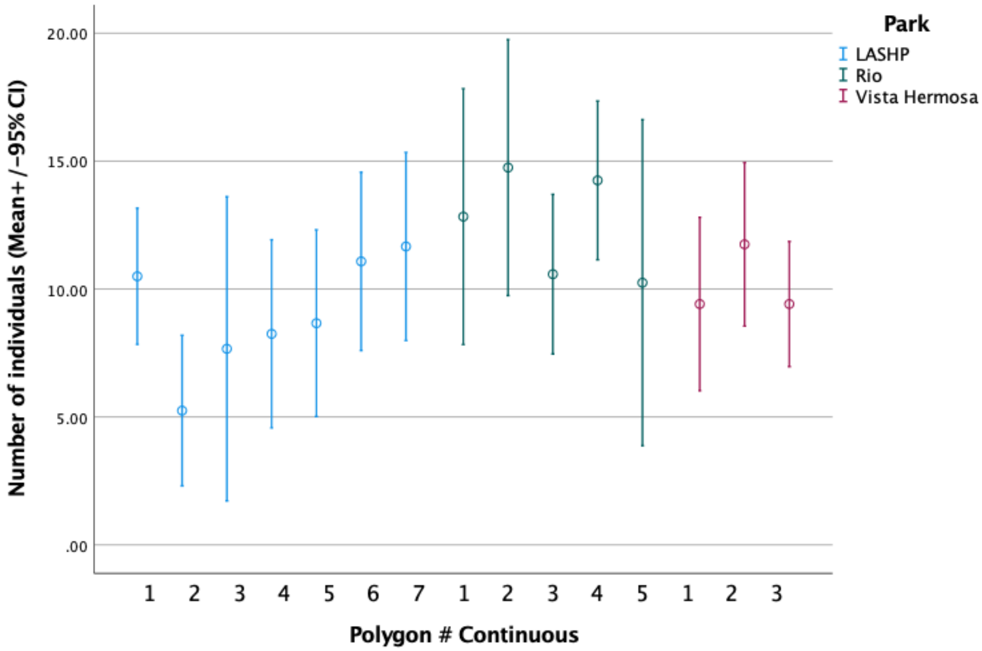

Figure 7. The average number of individuals observed per survey by polygon. Although Rio shows slightly higher abundances, the abundances for the park as a whole are not significantly higher. White-crowned sparrows and non-natives are not included in this figure because of the large amount of variation they introduce. At the same time the removal of white-crowned sparrows and non-natives does not impact the general patterns observed.

In general, bird abundance across all three parks is similar despite the differences between each park. To estimate total abundances for each park, I used Google Earth to calculate the square meters for each polygon and entire study area for each park. Then the following calculation was performed.

Total number of birds per park=

(Average number of birds seen per day per polygon)/(polygon area (m^2)) X park area (m^2)

Rio= (12.6/30,114m^2) X 44,332m^2 = 19

LASHP= (9.57/49,696m^2) X 114,136m^2=22

Vista= (10.33/18,248m^2) X 27,161m^2=15

On average Rio has a higher number of birds per polygon and scaling it up to the entire park we see that approximately 19 birds would be counted at this park in any given day. In comparison at LASHP, approximately 22 birds would be expected because the study area was much larger, and only 15 birds would be expected at Vista because it is much smaller.

Seasonal abundance

In general, bird abundance is slightly higher during winter in comparison to spring (Table 3). A total of 1,845 birds were observed during the wintertime versus 1,229 in the spring. If white-crowned sparrows are removed from the data, abundances were very similar between seasons. If we compare numbers without white-crowned sparrows and non-native species, then the difference goes back up to 240 individuals showing that there are more non-native individuals in the springtime. Approximately 16% of the total abundance during spring is attributed to non-native species.

Table 17. Avian abundances per season for all three parks combined.

Season	Total	Total number of white-crowned sparrows	Total number of non-native individuals
Winter	1845	759	28
Spring	1229	210	201

Although the total winter abundance number is higher, the confidence intervals associated with the data are large, and larger than the confidence intervals for spring numbers (Figure 8). Although the white-crowned sparrows and non-native individuals were removed from Figure 8, large variations still exist. These large winter variations could also help explain the variation and large confidence intervals seen in Figure 7. For example, LASHP polygon 3 and Rio polygon 5 both have large confidence intervals in Figure 7, those variations largely come from winter samples since the confidence intervals for the spring samplings is small as shown in Figure 8.

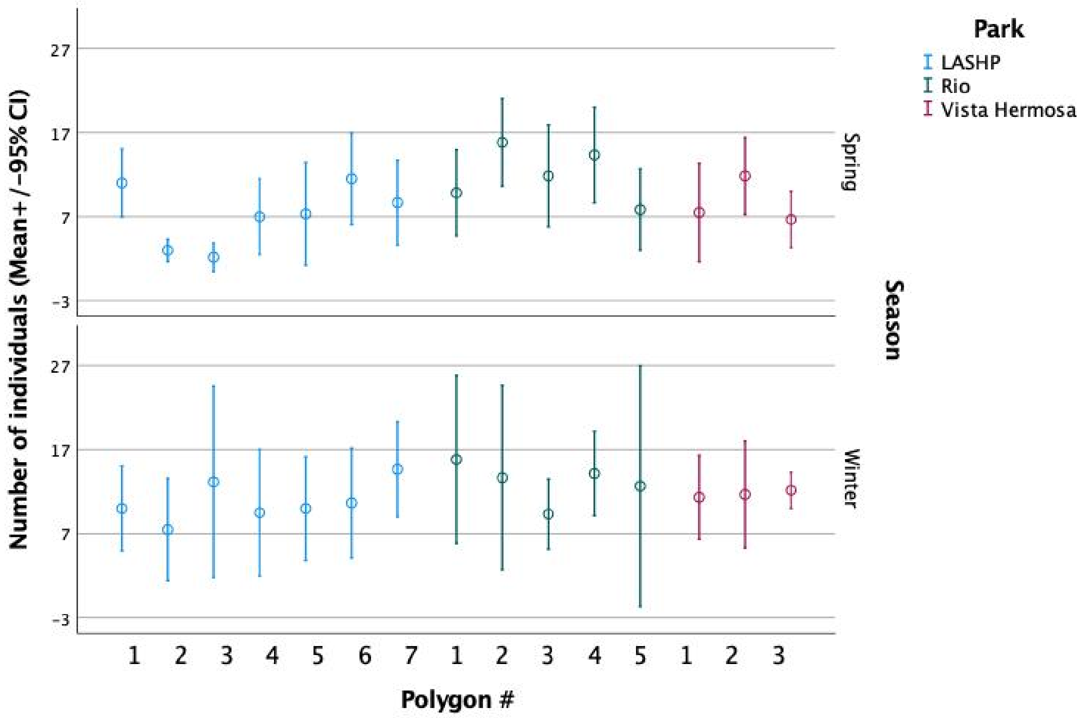

Figure 8. Bird abundances by season.
This figure does not include white-crowned sparrows or non-native species.

During the winter, all polygons are relatively similar to each other and have large confidence intervals. The total numbers of individuals for certain species vary greatly in the winter; some of the species exhibiting these great fluctuations include American pipit, bushtit, yellow-rumped warbler, and lark sparrow. Bird species in spring seem to arrive to the parks in smaller numbers, thus contributing to lower variation. During the spring, the confidence intervals are smaller and Rio seems to have slightly higher abundance averages in comparison to the rest of the parks. LASHP polygons 2 and 3 have the lowest abundances.

Habitat use

Among the three habitat locations, birds on the ground fluctuated the most (Figure 9). Birds found in middle or high canopy locations have similar abundances ranging between 0 and 10 individuals observed and there is little difference among polygons. Birds that are typically found on the ground exhibit much higher abundances in general, with the highest average being close to 20 at Rio polygon 5. Although some polygons have slightly higher averages, the confidence intervals are large and uneven.

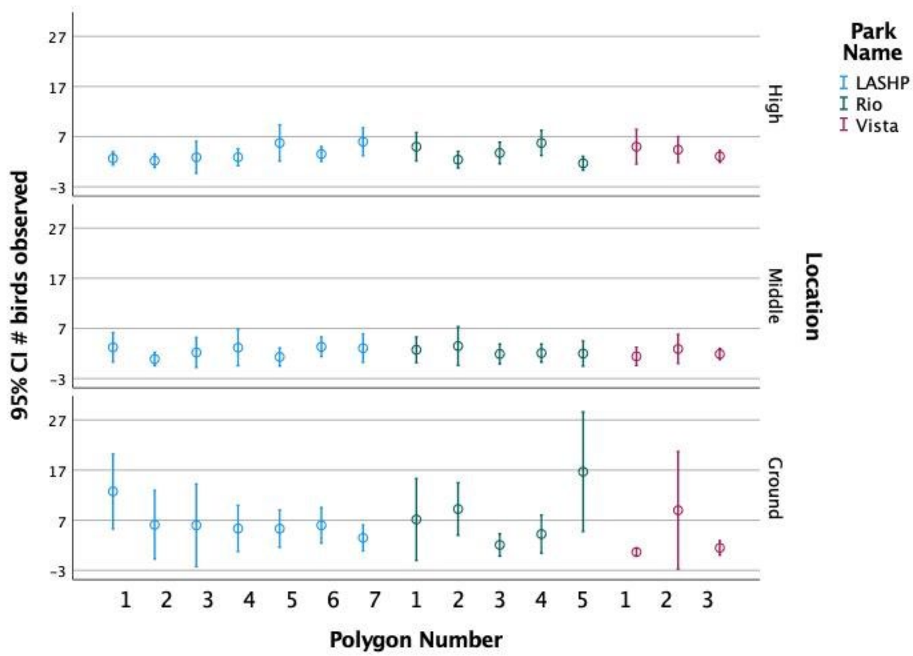

Figure 9. The average number of birds observed per location.
This figure does not include white-crowned sparrows or non-native species. This figure also only includes those individuals that were seen, not heard.

Diversity

In general, Rio hosts a larger number of species richness density in comparison to LASHP and Vista. At Rio the total number of bird species found at each polygon is above 20 (except for polygon 5) whereas LASHP and Vista are all 20 or below and as low as 8 species at LASHP polygon 3 (Table 2). Generally, LASHP and Vista host more non-native bird species. The Shannon Diversity Index, calculated based on only native species, shows that Rio polygons 1 to 4, LASHP polygons 4, 6, and 7 and Vista polygons 1 and 3 are all above 2. Although Vista polygon 2 had an H’ value of less than 2, this seems to be largely due to a high amount of white-crowned sparrow individuals, a total of 119 observed. This amount is far more than the amounts for any other bird species, contributing to a low H’ value for the winter and thus bringing the overall H’ number down. Rio polygon 3 had the highest overall H’ value at 2.6. Additionally, the H’ values are higher during spring in comparison to winter, and this is true for most polygons except for LASHP polygon 3 and Vista polygon 1.

Table 18. Diversity statistics for each polygon.
The Shannon diversity index (H’) calculated per season. H’ was calculated only using data from California native bird species.

Polygon	Total # native bird species	Total # non-native bird species	Overall H’	Spring H’	Winter H’
Rio-1	22	0	2.156	2.142	1.811
Rio-2	21	1	2.11	1.975	1.631
Rio-3	25	0	2.652	2.5617	2.059
Rio-4	24	1	2.274	2.502	1.696
Rio-5	13	2	1.786	1.963	1.476
LASHP-1	15	3	1.626	2.026	1.197
LASHP-2	14	3	1.842	2.415	1.463
LASHP-3	8	3	1.737	1.31	1.669
LASHP-4	16	3	2.101	2.056	1.982
LASHP-5	13	2	1.864	1.964	1.553
LASHP-6	20	2	2.139	2.133	1.852
LASHP-7	16	0	2.193	2.162	2.001
Vista-1	19	2	2.127	1.941	2.011
Vista-2	15	2	1.726	2.179	1.294
Vista-3	17	3	2.256	2.267	1.785

The total number of different bird species at Rio was 45, versus 41 at LASHP and 28 at Vista (Table 19). The high species richness at Rio may be due to Rio hosting more migratory bird species, particularly breeding migrants, than the other two parks (Table 19). The breeding bird species found at Rio that were not found at the other parks are black-chinned hummingbird, western wood-peewee, yellow breasted chat, and yellow warbler.

Table 19. Total number of bird species by migration status.
Observed bird species classified by breeding migrant, migrating through, non-breeding migrant (wintering), non-native, and resident. See table in methods for species categorization.

	Breeding Migrant	Migrating through	Wintering migrant	Resident	Non-natives	Total
Rio	**8**	**4**	**9**	**20**	**4**	**45**
1	3	0	4	14	0	22
2	3	2	3	12	1	22
3	5	2	5	14	0	25
4	4	2	4	14	1	25
5	1	0	4	8	2	15
LASHP	**3**	**5**	**7**	**21**	**5**	**41**
1	1	0	3	11	3	18
2	1	3	2	8	3	16
3	0	0	3	5	3	11
4	1	0	3	12	3	19
5	0	4	2	7	2	14
6	0	1	4	15	2	22
7	1	1	4	10	0	16
Vista Hermosa	**3**	**3**	**5**	**13**	**4**	**28**
1	0	1	5	12	2	21
2	1	1	3	10	2	17
3	2	2	3	10	3	20
Total for all 3 parks	**11**	**9**	**10**	**24**	**5**	**59**

Community structure

Non-metric multidimensional scaling was used to compare the bird community structure in the three parks. In general, the polygons for each park clustered together and there is separation between the parks, but there were some polygons for Rio and LASHP that were distinct from the other polygons for those parks (Figure 10). Rio polygons 1 to 4 are clustered closer together, but R5 is much further apart. This is not surprising given that R5 is mostly composed of lawn with some trees on its perimeter whereas Rio polygons 1 to 4 are composed of California native bushes and trees throughout with no lawn. LASHP polygons fell into three groups: 1, 6, and 7 are clustered and separate from LASHP polygons 2, 3, 5 and all of these are different from L4. LASHP polygons 1, 6, and 7 are composed of large California native trees, large bushes, and some lawn, with polygon 6 having a large amount of lawn. LASHP polygons

2, 3, and 5 are composed of mostly lawn, some trees, and polygon 5 has a small patch of short bushes. The nMDS plot placed polygon 4 separate from 1, 6, and 7 but it is unclear why. Polygon 4 has dense, large patches of bushes like coyote bush similar to polygons 1, 6, and 7; however, polygon 4 has slightly fewer trees. Polygon 4 has patches of shrubs of various sizes, some trees and lawn, and many walkways. All of the Vista Hermosa polygons are clustered together. Vista polygons 1 and 3 are more similar to each other than they are to polygon 2, which is slightly farther apart. This polygon has more lawn grass in comparison to V1 and V3. The nMDS plot shows polygons clustering even though, in general, the abundances between polygons were not significantly different. The nMDS uses species-specific data and the associated abundances to show that there are other community characteristics clustering polygons together.

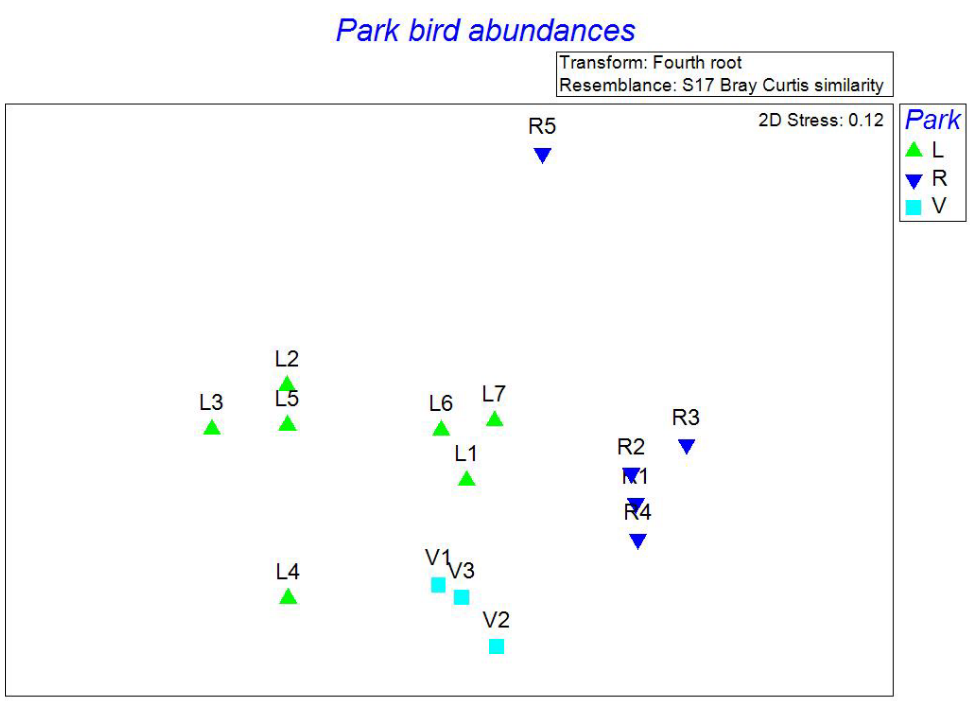

Figure 10. Non-metric multidimensional scaling plot.
This plot was created using all of the species-specific data, including white-crowned sparrows and non-native species. White-crowned sparrows and non-natives were not taken out of the nMDS analysis because they did not impact the results. (L=LASHP, R=Rio, V=Vista).

The nMDS plot shows that the polygons found further to the bottom and to the right are more similar to each other than the polygons in the rest of the plot. These polygons are the best at attracting birds. All of these polygons have California native large shrubs, trees, and mostly minimal grass (with the exception of LASHP 6, which has a large amount of grass).

Discussion

Habitat loss, climate change, and overexploitation are leading to declines in bird species richness and abundance globally (Northrup et al. 2019, Lees et al. 2022). Creating urban parks can support greater biodiversity (Aida et al. 2016) by providing refuge for birds in highly urbanized environments (Vasquez and Wood 2022), including for migrant species (Tzortzakaki et al. 2018), and serving as corridors to other green spaces. There is a need for urban park design recommendations that use science for enhancing biodiversity (Lepczyk et al. 2017). This work examined avian species richness and abundance in small urban parks with varying amounts of lawn and vegetation.

Previous work shows that lawns have low ecological value (Chollet et al. 2018); however, the presence of lawn did not automatically yield low richness values. This study also shows that higher lawn cover is related to low biodiversity. At LASHP, polygon 3 is mostly composed of lawn with a small number of trees and this polygon had 11 species, which was the lowest total number of bird species out of all three parks. Similarly, Vista polygon 2 has the most grass out of all three polygons and it had the lowest number of bird species: polygon 1 has zero grass and 21 species versus polygon 2 which had 17 species. Studies show that bird species richness is negatively associated with lawn cover (Shwartz et al. 2008, Paker et al. 2014), however, the presence of lawn does not necessarily deter birds. LASHP polygons 6 and 7 have grass and also attracted a high number of bird species, and particularly in comparison to LASHP polygon 1, which has less lawn cover. Paker et al. (2014) found that most "bird species were found where trees and shrub species richness was high, and tree and lawn cover were medium or low." These findings suggest that there may be a percentage of lawn cover that minimally impacts species presence. Additionally, it is possible that the lawn cover for LASHP polygons 1, 6, and 7 is similar enough and perhaps the bird species richness values have less to do with the lawn cover and more to do with tree and shrub species richness. This finding is based on comparisons of polygons and further work would be necessary to confirm these findings, such as experimental addition or removal of lawn to compare its impact on bird richness.

Plant community composition and structure, shrub richness, and tree cover are critical indicators and predictors of avian species richness (MacArthur and MacArthur 1961, Chace and Walsh 2006, Paker et al. 2014, Morelli et al. 2018). The presence of a variety of bushes directly adjacent to lawn or in close proximity could be contributing to higher bird species richness in those areas. For example, although Rio polygon 5 is composed mainly of grass it was still able to host 15 species, and this is possibly because it is in close proximity to other polygons with large bushes. Although Vista is the smallest park, it did not have the lowest number of bird species per polygon, possibly because of the park's abundance of large bushes and trees. Bushes may provide more habitat for birds in comparison to trees alone, perhaps because they can provide more microhabitat heterogeneity, which has been shown to influence urban park species richness (Nielsen et al. 2014). Rio polygons attracted the greatest number of bird species possibly because they had the best habitat; Rio polygons were mostly composed of mature trees and bushes throughout.

Larger areas provide more habitat for wildlife, but this work, as well as other published works, show that even small spaces contribute to biodiversity. Habitat size has been found to be an important factor for biodiversity in reserves; larger reserves generally have higher biodiversity (Donnelly and Marzluff 2004). Studies show species richness increases with increasing park area (Cornelis and Hermy 2004, Schütz and Schulze 2015, Callaghan et al. 2018). At the same time, a study specifically looking at urban greenspaces less than 2 hectares found that 39 species, including 15 migratory bird species, depended on these habitats; these small spaces contribute to regional diversity (Carbó-Ramírez and Zuria 2011). Additionally, the study found that approximately 40% of the bird species surveyed were migratory. All of the study areas within the parks studied here are relatively small, less than 10 hectares, yet a total of 59 different bird species were found overall. Approximately 50% of the bird species observed in this study were migratory, demonstrating that city parks can be important for migrating birds. Additionally, the parks studied here were home to some bird species that the California Department of Fish and Wildlife considers 'species of special concern,', meaning species with declining populations, ranges, or facing other threats. These species include Vermilion Flycatcher, Loggerhead Shrike, Yellow Warbler, Bell's Vireo, and Yellow-breasted Chat. Even though fewer species might be supported in small parks, these parks can still provide important biodiversity benefits.

There is a need to understand how to promote biodiversity at urban parks through conscious habitat design (Nielsen et al. 2014) and also for research that provides guidance on ecological targets for restoration of urban habitats (Klaus and Kiehl 2021). Lawn grass does not seem to be a bird deterrent because the presence of grass does not automatically yield low abundance values. Many ecological studies propose transforming turf lawn into grasslands (Garfinkel et al. 2022) or meadows (Aronson et al. 2017), which are shown to have higher ecological value, and these strategies definitely make sense in places like powerline corridors or bioswales. Although lawns may not contribute to biodiversity, they support human use and in conjunction with bushes and trees still support bird species. Thus, similar to Paker et al. (2014), I would recommend balancing open lawn with shrubbery nearby and also planting a variety of tree and shrub species in general.

Although larger parks yield higher biodiversity, in urban areas acquiring large lots is not always possible. I suggest considering small urban parks in overall conservation strategies for cities. Finally, I would recommend performing bird surveys at nearby parks and particularly looking at species richness to aid in designing a new park that is ecologically inviting to birds. In this study, the abundance metric on its own was not enough to differentiate park use since abundance was not significantly different across parks. Collecting richness data provided a more detailed understanding of migratory bird use and overall bird richness at each park. Looking at specific bird species could provide insight into which bushes or tree species are most beneficial and should be considered when putting together the planting pallet. To further shed light on habitat design, future work should examine how much lawn is necessary for human use and the ratio of lawn to bushes that best serves bird species.

In conclusion, even small parks foster biodiversity and this study and many others have shown. Shrubs are as important for bird species as trees and thus should be considered when designing park elements for birds. Based on results from Chapter 2, lawn is a necessary element for humans and results from this chapter show that lawn can be balanced with shrub and tree habitat to provide suitable bird habitat.

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Chapter 4: Avian and human use of an urban nature park in Los Angeles

Introduction

Urban green spaces have gained attention in the past decades and are increasingly challenged to be multifunctional (Klaus and Kiehl 2021); that is, to be spaces for people to connect with nature and also to preserve biodiversity. Nature provides social and psychological benefits to people, serving as a relaxing and peaceful environment that results in positive feelings (Chiesura 2004). Urban parks harbor biological richness and serve numerous functions for wildlife, such as providing nesting habitat or serving as corridor habitat (Cornelis and Hermy 2004, Carbó-Ramírez and Zuria 2011, Aida et al. 2016, Gallo et al. 2017). However, much of the available literature does not analyze people and wildlife together; they are seen as having opposing needs (Graviola et al. 2021). Therefore, there is a need to provide guidance on park design that analyzes and finds synergy in the needs of both people and birds.

Urban parks can positively contribute to wildlife and biodiversity and at the same time the ecological literature shows that the presence of people can negatively impact wildlife; urban parks are no different. For example, many studies show that the amount of human activity present negatively impacts bird presence and behavior (Campbell 2006, Paker et al. 2014, Kang et al. 2015). Kang et al. (2015) showed that diversity of forest bird communities was predicted by the amount of human disturbance, second in importance to habitat size, followed by vegetation complexity. Thus, many studies recommend reducing human disturbance. However, this is contrary to the purpose of urban public parks designed for human nature appreciation. Furthermore, people do report happier moods when they perceive there is higher avian and habitat biodiversity (Cameron et al. 2020). People value neighborhood birds, they enjoy looking at them and appreciate that they are part of the ecosystem (Belaire et al. 2015). Also, many people live in the urban environment and so this is where people are more likely to have nature experiences (Fuller and Gaston 2009), where biodiversity can have the biggest impact in people's lives, and where conservation values can be fostered (Fuller et al. 2007). Therefore, to design multifunctional urban nature parks, we need a holistic approach that is inclusive of humans.

Much of the urban park ecological literature suggests excluding an important human amenity: lawns. Many studies show that lawn cover is negatively correlated to bird species richness (Shwartz et al. 2008, Paker et al. 2014) and that lawn alternatives, such as grasslands or meadows, should be tested in parks (Aronson et al. 2017, Garfinkel et al. 2022). But people love lawns (Nordh et al. 2011, Ignatieva and Hedblom 2018) and Chapter 2 shows they are heavily used in parks. Although experimenting with lawn alternatives should be considered in places like bioswales or business parks, in places where people are expected to "hang out" short-cut lawns are important (Yue et al. 2017). Studies show that urban parks can have a positive impact on biodiversity even though their primary role is recreational (Cornelis and Hermy 2004), and that it is possible to manage parks for both people and animals (Boone et al. 2008, Nielsen et al. 2014). Thus, it is possible to figure out designs that could work well for both people and wildlife, however, more work is needed to figure out how.

Many studies suggest urban park size, vegetation, and arthropod abundance are needed to have high species richness. Park size seems to be the most important factor positively associated with avian species richness (Oliver et al. 2011, Jasmani et al. 2017, Yang et al. 2020, Garizábal-Carmona and Mancera-Rodríguez 2021), including migratory (La Sorte et al. 2020), and breeding birds (Jokimäki 1999, Chang and Lee 2016). Parks with native vegetation also had high bird diversity (Petrova and Irikov 2012, Williams et al. 2017). In China, vegetation complexity and structure, specifically horizontal vegetation coverage (woodland with shrubs), positively affected bird community composition (Yang et al. 2015). In Beijing foliage height diversity influenced avian species richness (Xie et al. 2016). And trees, particularly native trees, can be important for birds in the city (Wood and Esaian 2020). A Tokyo study showed that tree cover impacted avian species composition (Katoh and Matsuba 2021), as did a study in Sacramento, California (Haas et al. 2020) and another in Switzerland (Fontana et al. 2011). At the same time, other studies show a neutral effect (Williams et al. 2017) or a negative correlation between tree canopy cover and bird species richness (Jasmani et al. 2017). Finally, abundance of arthropods is also important and can help counteract anthropogenic disturbances (Planillo et al. 2021). Additionally, when arthropods, like caterpillars, are limited, it can lower avian reproductive success in cities (Seress et al. 2018). Park needs to provide appropriate food and shelter to be attractive to birds.

In this chapter I will analyze the spatial use of both humans and birds at Vista Hermosa Nature Park using targeted and randomly selected points. The goal is to understand which park features are associated with high people and/or bird use and which features are not conducive to their use. This research aims to inform park design elements in highly urban nature parks and to shed light on the outcome of transforming a brownfield into a park.

Based on results from Chapter 2, I know people heavily use areas with lawns and trees and also walkways. And based on results from Chapter 3, I know that although birds are not altogether deterred by lawn, they need bushes and trees. Thus, I am looking at targeted points that have lawn, trees, walkways, and bushes. I have assembled the points into three categories based on what habitat types are found at Vista Hermosa Park: walking paths with bushes on both sides, trees with lawn underneath, and ecotone areas that are half lawn and half bushes and trees.

The specific questions to be addressed focus on the overall question: Are there park features that are used by both people and birds concurrently, that is, are there points with both high bird use and high people use? And if so, do those points have similar features?

Methods

This study was conducted at Vista Hermosa Nature Park, a former brownfield. Vista Hermosa is a small park that based on Chapters 2 and 3 was able to meet both needs of people and birds in the same geographic area. Rio de Los Angeles State Park had a high bird diversity but did not have many visitors. Los Angeles State Historic Park, similar to Vista Hermosa, had high people visitorship and also high numbers of individual birds. LASHP had an average of 195 birds observed per polygon and Vista Hermosa had 190 birds and so the average number of birds per polygon was similar. Initially, I planned to include LASHP along with Vista Hermosa but some of the primary design characteristics I aimed to survey were not abundantly present at LASHP. For example, LASHP lacked walkways with shrubs and trees directly adjacent, which seemed to be an important feature. There are numerous walkways at LASHP, but they often only have habitat on one side or the walkway is so wide that it seems like a different feature from those found at Vista Hermosa. Additionally, LASHP lacked "ecotone" features because many of the areas had trees interspersed within the grassy area. Vista Hermosa is small yet had a large number of people and bird visitors, based on Chapters 2 and 3, and thus seemed like the best choice of park to focus on for this chapter.

In order to assess design practices for building a park that can benefit both birds and people, I surveyed specific park elements, called the “targeted” points, and points chosen at random (Figure 1).

Three park elements were targeted:

“**W**”- walking path: paths surrounded by shrubs (1-5 feet tall) on both sides, each side was at least 5 meters wide with shrubs. Shrub area had trees intermixed. The walking paths sampled were all made of decomposed granite (DG). It was assumed that a DG walking path would provide marginally more habitat than a cement walking path. At the same time, most walking paths in this nature park are made up of DG.

“**E**”- Ecotone: grassy areas for sitting directly adjacent to dense trees with a shrub understory. No trees directly overhead to minimize confusion with the “T” element. The area within these points was roughly 50% grass and 50% trees and shrubs.

“**T**”- Tree: Areas with a large tree (more than 10-feet tall) with grass underneath and shade cover present.

There were seven sample points for each of the three target categories, for a total of 21 targeted points.

To select the random points, a rectangular grid was laid on top of a satellite image of the Vista Hermosa Nature Park. I used a random number generator to choose coordinates by which to select the points. There were 21 random points.

At each of the 42 sampling points, the sample area was approximately a 10m x 10m square. Each point was sampled for the presence of birds, people, and vegetation. Surveys were not conducted during inclement weather, such as rain, high-heat, wind, or other factors that may limit bird or people activity.

Bird survey: Surveys were conducted no more than 2 hours after sunrise to collect data on species, total number of individuals observed per species, and where the individuals were observed (ground, shrub, tree). I surveyed each point for a minimum of 1 minute and up to 4 minutes if there was a lot of bird activity to capture.

People survey: The surveys were done in the afternoon and evening hours before sunset. The survey was conducted from a distance and each point was surveyed within a matter of seconds. At each point I counted the total number of people and the activity the people were engaged in (sitting, walking, standing, or other activity).

Vegetation survey: Surveys were conducted using remote tools, such as Google Earth, as well as in-person for points with more complex vegetation. For each point, I noted percent cover of lawn grass, tree canopy, shrubs between 1-3 feet, shrubs between 3-5 feet, and walking path cover of the point. These estimates were placed into broad categories: 0%, 25%, 50%, 75%, 100%.

Figure 11. Sample point locations at Vista Hermosa.
A total of 42 survey points at Vista Hermosa Nature Park. Satellite imagery from September 2022.

I collected data in the months of October/November 2022 and April/May 2023. For the bird surveys, a total of 12 surveys were done for the targeted points and 13 for the random points for a total of 25 bird surveys. For the people surveys, a total of 15 surveys were done at targeted points and 14 at the random points for a total of 29 people surveys.

Results

The most numerous birds were the bushtit, white-crowned sparrow, and yellow-rumped warbler, which made up approximately 52% of the total individuals observed. Other commonly found species, making up about 32%, were the California towhee, hermit thrush, house finch, lesser goldfinch, scrub jay, and Trochilidae spp. (hummingbirds). The remaining species were the black-throated gray warbler, Cooper's hawk, Hammond's flycatcher, northern mockingbird, ruby-crowned kinglet, sooty fox sparrow, and Townsend's warbler.

Random

The randomly selected points show that 3 points were used only by people, 6 points only by birds, and 12 points by both (Figure 2). For most points, especially those with higher mean values, there was a lot of variability among samples resulting in large confidence intervals.

Point number 10 had the highest average number of people (3.7) as seen in Figure 2. Points 12 (2.1), 13 (1.8), 17 (1.9), and 4 (1.2) were also high people-use points. Point 10 is composed of a large grassy lawn and is near a popular photography spot. Point 12 is composed of large sycamore trees, a picnic bench, and grass, and is often a popular site for large groups. Point 17 is a grassy area with trees overhead and Point 13 is a shaded walkway leading from the parking lot into the park.

Point 4 had about 20% of the total birds surveyed, with an average of 2.3 birds per survey. This point is composed of a walkway with a large willow tree overhead and adjacent to large bushes on one side and a grassy lawn on the other. Points 4 and 7 (1.9 average) were the most frequenty used with birds being sighted 9 out of 13 survey days. Point 7 is composed of dense trees and shrubs, without typical human amenities.

Some of the points that both people and birds use were points 5, 16, 19, and 20. Point 5 is a walkway with bushes and trees on both sides. Points 16, 19, and 20 have grass and trees and additionally 19 and 20 have bushes nearby. The average number of birds and people for these points is as follows: 5-birds (0.7), people(1.1), 16- birds (0.6), people(1.1), 19- birds (0.7), people(0.4), 20- birds (0.5), people (0.9).

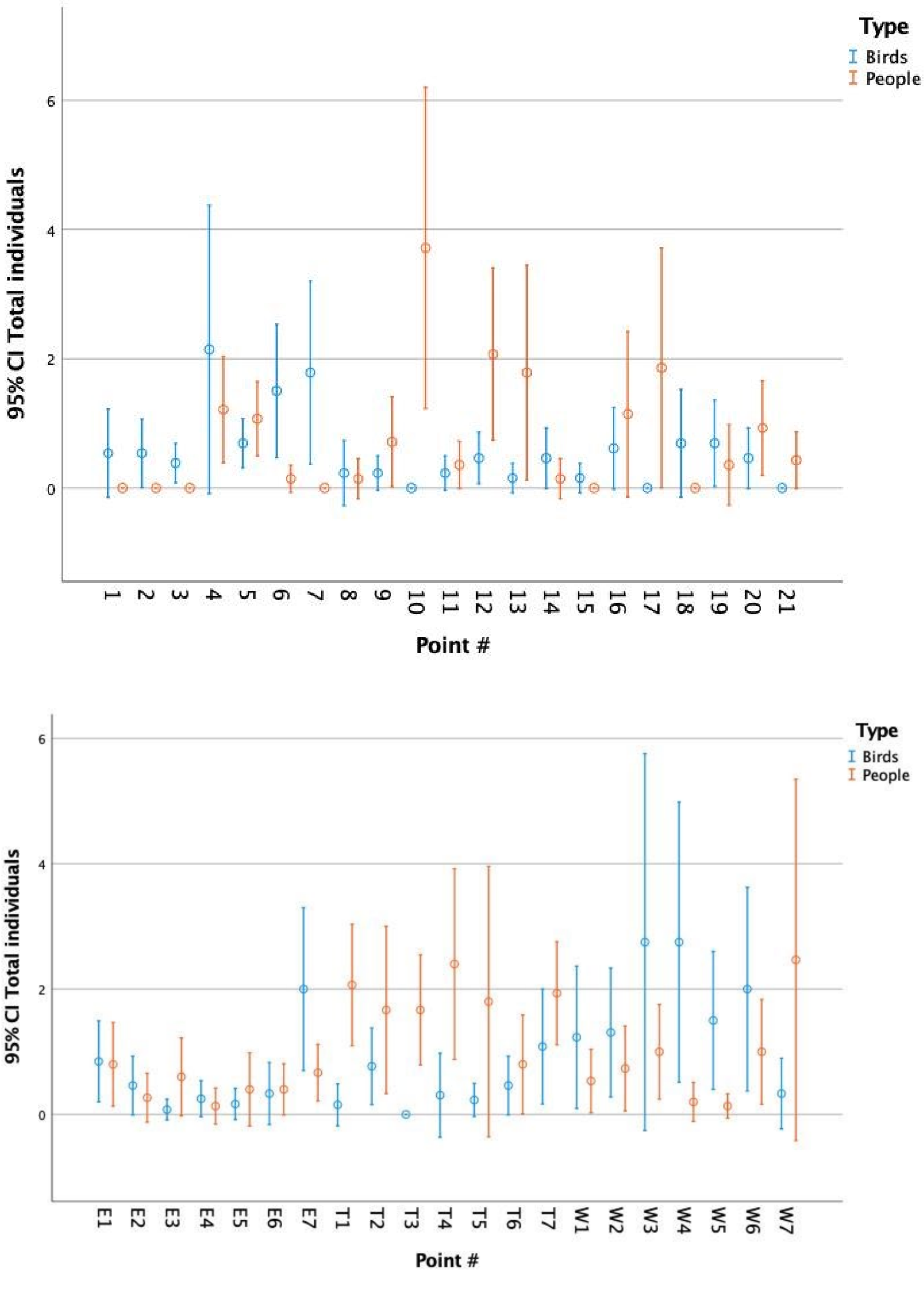

Figure 12. The total number of people and birds per point.
For the random points, n=274 for birds and n=294 for people. For the targeted points, n=262 for birds and n=314 for people. f

Targeted

The targeted points show both birds and people at all but one of the points, although some points are used more by birds and others more by people (Figure 2). As with the random points, for most points, especially those with higher mean values, there was a lot of variability among samples resulting in large confidence intervals.

The most people were found at W7, with an average of 2.5 people per survey. Point W7 is a walkway with a bench, surrounded by dense trees and bushes providing ample shade. Removing the 20 people observed associated with a large party during one sample reveals that W7 was not usually heavily used; the average without the 20 individuals is 1.1. The second highest average was at T4 with 2.4 people per survey; this point is in the middle of sycamore and oak trees with grass underneath. Points T2, T3, and T7 were also frequently used. These sites are composed of large trees with grass underneath; T7 also has a picnic bench. The third highest point used was T1, which is a tree with grass underneath. Most of these points had low bird use; the point with the highest bird use was T7, and it only had an average of only 1.1 birds. The average number of birds and people for these points is as follows: W7-birds (0.3), people (2.5), T4- birds (0.3), people (2.4), T2- birds (0.8), people (1.7), T3- birds (0), people (1.7), T7- birds (1.1), people (19).

Points W3 and W4 had approximately 30% of the total number of birds surveyed; both had an average of 2.8 birds per survey. Both of these points are within a walkway that is surrounded by large bushes and trees. Points W6 and E7 also had high bird averages; both had an average of 2 birds per survey. Point W6 is a walkway with large bushes and trees on both sides. Point E7 is half lawn, half large bushes and trees.

Targeted vs. Random trends

For both randomly selected points and targeted points, there is an inverse relationship between birds and people (Figure 3). Areas with many birds usually have fewer people, and those with more people have fewer birds. For the targeted points the top four bird sites had low to average human presence and the top five human sites had low bird use. For these targeted points, although the sites are not used evenly, both people and birds are found there. Although there are many low values, only one site had zero birds and none of the sites had zero people. The habitat with zero birds was T3, which is a large oak tree with grass underneath and nearby bushes and trees. For the randomly selected points, birds and people did not tend to use the same sites. The top four sites for people had zero or close to zero birds. Two out of the top three bird sites had close to zero people. There are six sites with zero people and three sites with zero birds.

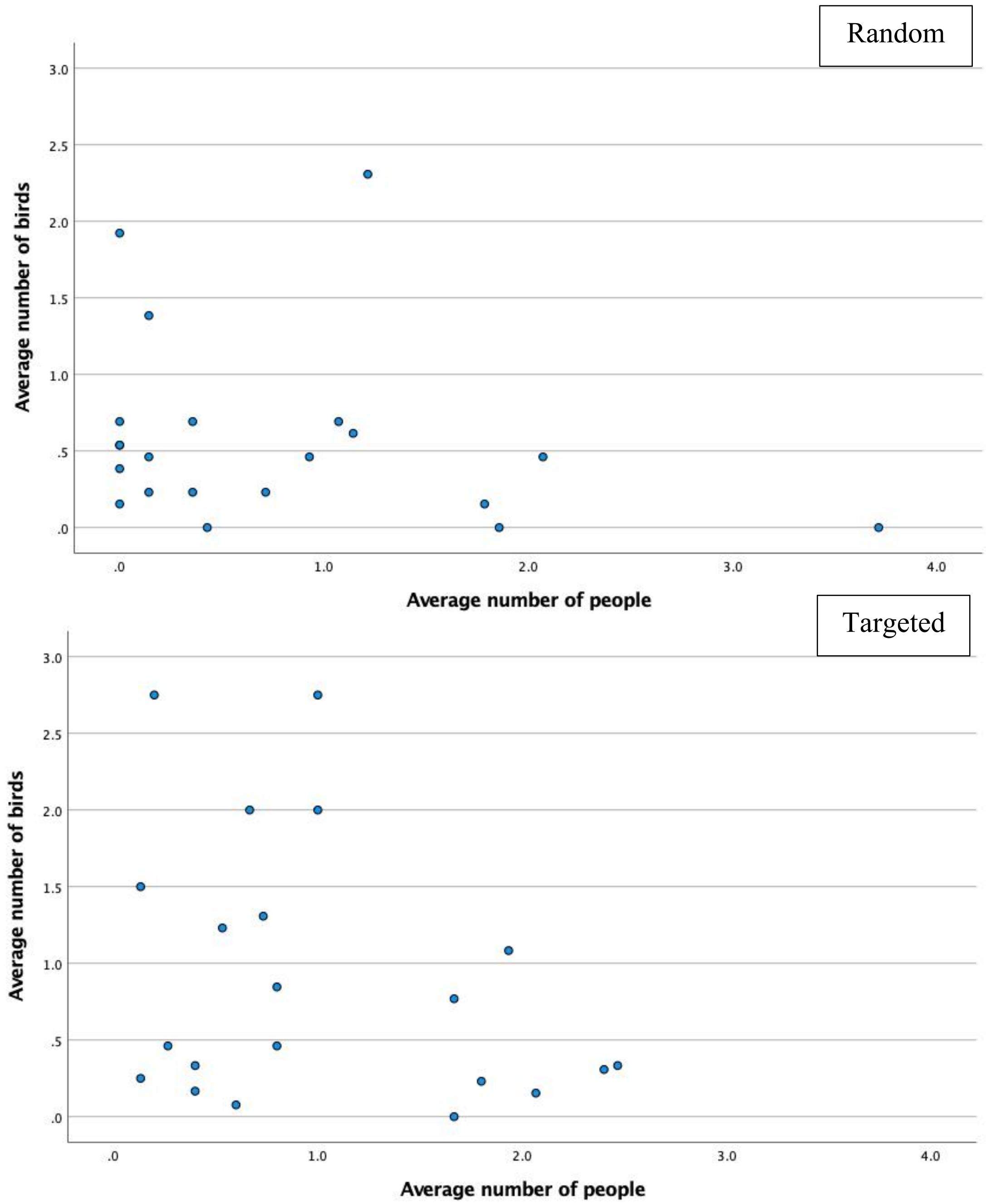

Figure 13. Scatterplot of the average number of birds and people.
Top is randomly selected points and bottom is targeted points. Both show that the total number of birds decreases with increasing numbers of people.

The targeted points had more overlap in use by both people and birds whereas the use by people and birds was more segregated at the randomly selected points (Table 1). Both people and birds used 95% of the targeted points. For the targeted points, 100% of them were used by people and only 5% were used exclusively by people. Birds have similar trends: 95% of the points were used by birds and none were used exclusively by birds. These statistics accentuate the overlap of usage by birds and people at the targeted points.

In contrast, only 57% at the randomly selected points were used by both people and birds. People used most of the areas sampled, with 71% of the randomly selecting points used by people. Birds also used most of the areas sampled, with 86% of the points used by birds. There are some randomly selected points that are exclusively used by one group and not the other, accentuating the division of use. No birds were found at 14% of the points and no people were found at 29% of the points. For randomly selected points, there is not as much overlap of habitat use by both people and birds as there was with the targeted points. There also were about 30% fewer total people and birds at the random points than at the targeted points.

Table 20. Comparing targeted versus random points.

	Total number of surveys conducted	% of points used by both people and birds (overlap)	% of points used by people (% used only by people)	% of points used by birds (% used only by birds)	% of points used by neither people nor birds	Total # of people	Total # of birds
Targeted	Bird-12 People-15	95	100 (5)	95 (0)	0	325	234
Random	Bird-13 People-14	57	71 (14)	86 (29)	0	225	158

Target categories

Tree points, which were trees with grass underneath, had a higher average number of people observed (1.8) in comparison to walking paths (0.9) and ecotone points (0.5) (Figure 14). The tree point average was twice as high as walking paths though in total the difference was only 16 individuals. The walking path points had the highest average number of birds (1.7) in comparison to tree points (0.4) and ecotones (0.6). The ecotone category had low numbers of both birds and people. The tree category had high numbers of people but low numbers of birds.

The walking path had the most birds, but it also had a fairly high number of people, so it was the target category with the most balanced use of both people and birds.

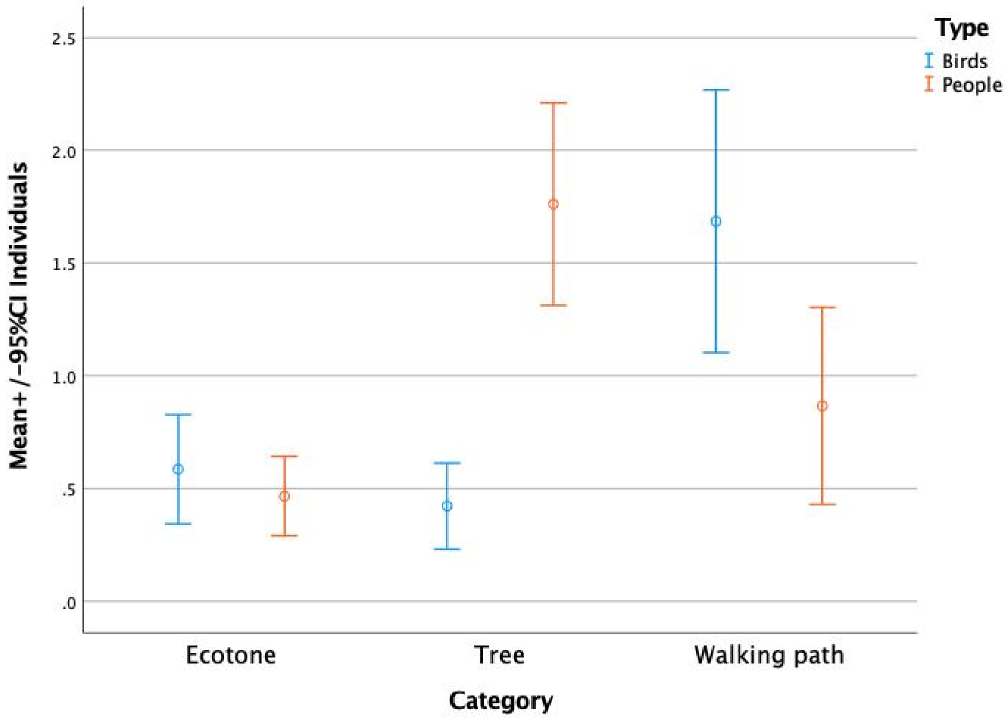

Figure 14. The mean number of birds and people per target category.
Walking paths had generally high numbers of birds and people. The tree category only had a high average number of people. In total, tree points had 147 people, 131 at walking paths, and only 49 people in ecotone. In total 143 birds were observed in walking paths, ecotone habitats had 49 individuals and tree categories had 36 total individuals.

Habitat analysis

I studied the vegetation characteristics of all of the points (target and random) by grouping the points by key features: lawn/trees, lawn/trees/shrubs, trees/shrubs, and trees/shrubs/walking path (Figure 15). Walking paths (with trees and shrubs) had the highest bird abundance. The majority of the birds were seen on top of trees and in bushes with much fewer on the ground. The species observed on the ground were white-crowned sparrow, California towhee, hermit thrush, sooty fox sparrow, and California scrub jay. For humans, points with lawn and tree characteristics had the most number of individuals, followed by trees, shrubs, and walking path. The second most used habitat for people was the walking path (with trees and shrubs). In places where trees and shrubs exist, those with lawns are preferred over those without any lawn.

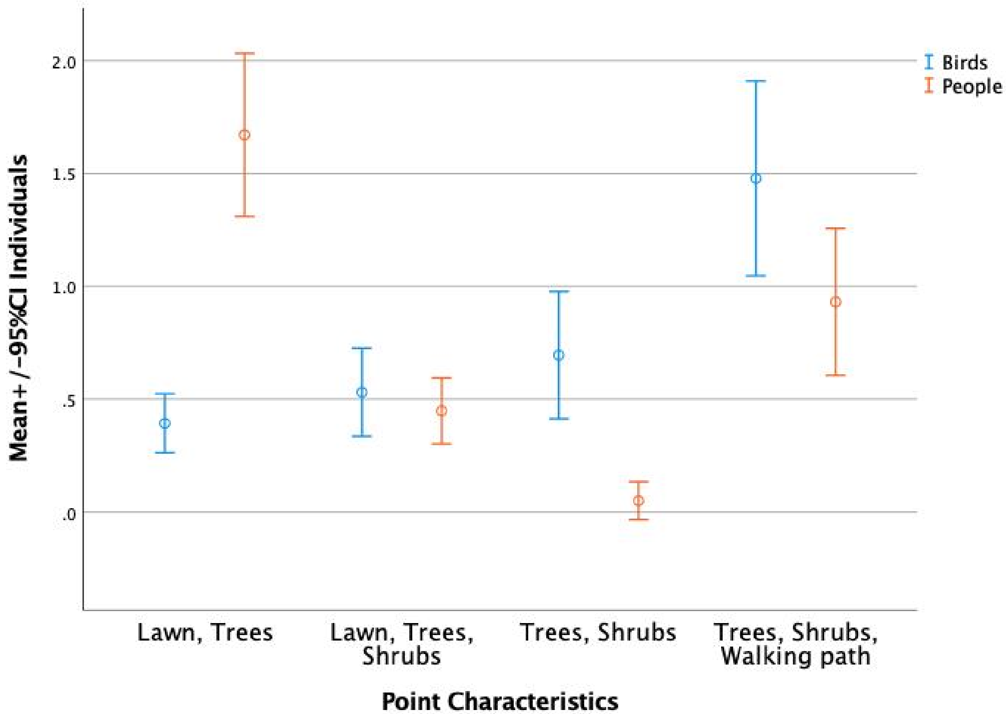

Figure 15. The average number of birds by point characteristics.
All points (random and targeted) were placed into habitat categories using habitat characteristics at each point. More birds are found at points with trees, shrubs and walking paths. However, the sample size is not even. Lawn, Trees=12 points (9, 12, 16, 17, 20, T1-T7). Lawn, trees, shrubs=9 points (11, 14, E1-E7). Trees, Shrubs=7 points (1, 2, 3, 7, 15, 18, 19). Trees, shrubs, walking path= 11 points (4, 5, 6, 13, W1-W7).

The categories on Figure 15 show a trend of less lawn and more trees and shrubs leading to higher bird abundance. Additionally, the categories with lawn had a total of 12 bird species whereas the tree, shrub category had 14 species and the trees, shrubs, and walking path category had 17 total species. If we look at each characteristic, we see that lower lawn cover was associated with higher bird abundance (Figure 16A). For tree cover, we see that 0% tree cover had the lowest bird abundance, so there needs to be some tree cover, but otherwise there was no relationship with the amount of tree cover (Figure 16B). We see a similar pattern for shrubs: 0%

shrubs was associated with the lowest bird abundance (Figure 16C), but abundances with 25% cover and above were similar. Furthermore, it seems clear that the shrubs need to be more than 3-feet tall because shrubs between 1 to 3 feet tall had the same bird abundance as having 0% shrubs, and some large shrubs supported a similar abundance to having both large and small shrubs (Figure 16D).

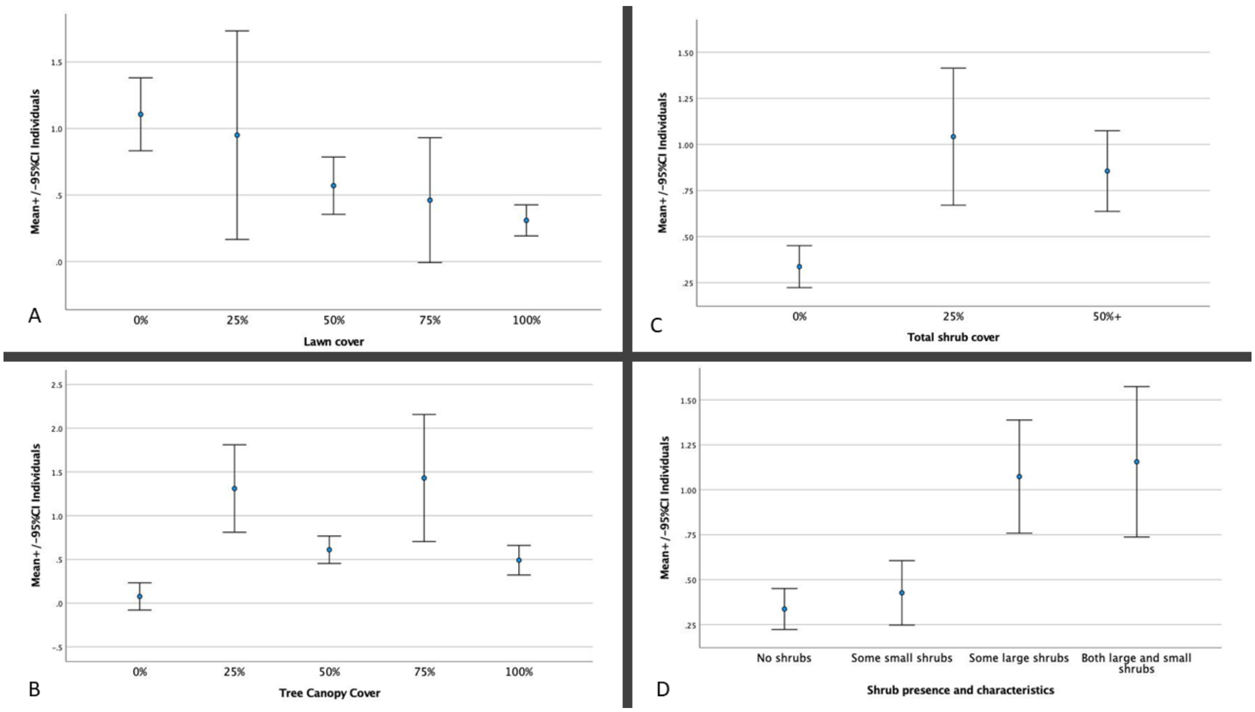

Figure 16. The average number of birds by vegetation characteristics.
A: Relationship between lawn cover and bird abundance. Sample sizes: 0% (217), 25% (40), 50% (100), 75% (13), 100% (168). B: Relationship between tree canopy cover and bird abundance. Sample sizes: 0% (75), 25% (190), 50% (65), 75% (169), 100% (39). C: Relationship between shrub and bird abundance. Sample size: 0% (181), 25% (141), 50%+ (216). D: Relationship between shrub type and bird abundance. Sample size: No shrub (181), some large shrubs (191), some small shrubs (89), both large and small shrubs (77).

Discussion

Parks provide habitat for birds and a space for people to connect with nature, but birds and people use parks differently. For example, lawns would attract more people and bushes would attract more birds, while walking paths with bushes attract both people and birds. Park planners and designers need to understand how birds and people use different park elements, and the tradeoffs associated with each element, so they can optimize the mix of park elements to achieve park goals.

Walkways with bushes on both sides had the highest bird count and the second highest people count in this study, showing the importance of this feature for both people and birds. Similar to Chapter 2, this study shows that walkways are an important feature for people and are used for walking and running. When comparing walkways with bushes to those without (such as points 8 and 13), we see that the points without bushes have little bird use. Large bushes increase habitat complexity and are related to higher biodiversity (Fontana et al. 2011, Nielsen et al. 2014), so high bird use of this park element is not surprising. For example, Bushtits were primarily found on trees whereas both White-crowned Sparrows and Yellow-rumped Warblers were found everywhere (ground, mid-canopy/bushes, tree) and other species like California Towhee and Hermit Thrush were primarily found on the ground and in bushes. The bushes and trees provide habitat complexity. At the same time, it is unclear why walkway habitats had higher bird abundance than points just composed of trees and bushes. This work shows that shrubs should be large but they don't have to be dense, since there was little difference between 25% cover and 50+% cover. Based on observations, the ground habitat created by the walkway is not what is commonly used by birds. It is possible that the openness the walkway creates is an attracting feature. Bird species such as Lark Sparrow or California Towhee may use these open areas because they are similar to former shrublands that were found in Los Angeles (Vasquez and Wood 2022). More work is needed to determine the best walkway designs, but it is clear that incorporating walkways with adjacent bushes into urban park designs increases use for both people and birds. It creates habitat for birds and it facilitates active recreation for people.

Based on the literature and results from Chapter 2, trees with grass underneath seemed to possibly be another feature good for both birds and people, and it was the highest used type of point for people but not for birds. The top points for people were all composed of grass and trees (12, 16, 17, T1 to T5). It was surprising that more birds were not found in the targeted "Tree" locations. For example, point T3 was a large oak tree with grass underneath yet zero birds were seen there. Birds use trees and many studies show the importance of trees, and particularly local and native tree species, for birds (Wood and Esaian 2020), but this relationship does not always hold true (Paker et al. 2014). Point 15 was composed of large trees and an understory of bushes yet only 1 bird was seen there. Looking at tree cover, it is clear that having some trees is good; however, above 25% cover it is not clear how much tree cover is best for birds. Since birds are very mobile, it is possible I observed these areas during times that birds were not present. Many of the trees were tall, making observation tough as well. It is also possible that it is important to consider either historic habitat or the surrounding undeveloped lands as context for future park designs (Yang et al. 2020). The majority of the trees at Vista are California native trees, like Western Sycamore, Oak trees, and Willows, but these tree species may not have been common in this exact location. Taking a look at the topography using USGS's 'topoview' with historic maps of the early 1900's, there is evidence to show this area was hilly and not riparian. Thus, sycamores and willows may not have been common there. Looking at large nearby parks we can see the types of habitat that may have inhabited this space. Deb's Park, which is less than 5 miles away and is hilly, is composed of large patches of Black Walnut and Oak trees. Nearby Griffith Park has more of a sage scrub habitat with large bushes like Laurel Sumac, Lemonade Berry, Sugar Bush, Mountain Mahogany, California Lilac, Buckwheat, Deerweed, etc. Future studies should further explore the role of trees in urban nature parks particularly in geographic areas where trees may not have been as common historically or where another type of habitat, like an oak woodland, would have made more sense.

Lawns are an important feature for people and do not automatically deter birds; however, lawns are associated with lower avian biodiversity, thus careful consideration of their placement is needed. From Chapter 2 we know that people heavily use lawns for relaxing, sitting, laying down, or picnicking with friends and family. Results from this chapter show that not all lawn is created equal. For example, point 10 had a lot more people than point 21 and both points were composed of lawn. The tradeoff of lawns in parks is that fewer bird species use this habitat, although some species, such as White-crowned Sparrows and European Starlings, do use it. In Chapter 3, LASHP polygons 1, 6, and 7 all had lawn, trees, and bushes and all had amongst the highest number of bird species for LASHP. Lawn does not automatically deter birds, so knowing how much lawn is "too much" is important and needs more study. Additionally, lawn in proximity to native bushes or trees may have higher ecological value. In Chapter 3, Rio polygon 5 had a large number of bird species even though the polygon only had grass. This is possibly because of the polygon's proximity to other natural habitat composed of native bushes and trees. Rio polygon 5 attracted birds such as the American Pipit, White-crowned Sparrows, Lark Sparrows, etc. Lawn needs to be thoughtfully placed because it is not used equally and is negatively associated with bird diversity. It is also possible to figure this out by trial and error through making observations of which lawn is not used, and thereby being able to change un-used lawn to wildlife friendly spaces. The aforementioned suggestions are assuming park planners have a goal of increasing avian biodiversity. It is possible that people enjoy large expanses of lawn and that filling in those areas with vegetation may make the park less desirable so this may also need to be monitored.

People did not generally use points with only bushes and trees and so these points would be considered primarily bird habitat. However, these points did not have the highest bird abundances. Points with trees and shrubs did not have a higher bird abundance compared to points with lawn, trees, and shrubs. Additionally, more birds were observed in the habitats adjacent to the walkways than in the points with trees and shrubs. One of the noticeable differences is that the walkway with shrubs habitat had 3 different hummingbird species and the tree, shrub habitats had zero. There is a difference in the vegetation structure that makes the tree, shrub category less attractive to hummingbirds. At the same time, many of the bird species were similar and were found at all of the categories. The fact that these points are not used by people, especially kids, is a little surprising. Although there is not a fence to stop people from going into these points, people generally did not use these wilder spaces. If these areas are in reality only going to be used by wildlife and you are a planner in a city that aims to improve biodiversity, then planners should aim to attract as many bird species as possible through conducting bird surveys and understanding the species and their needs.

This work aimed to better understand established urban nature parks to gain insight into what features work well at attracting people and birds, and also to highlight the tradeoffs. Additionally, Vista Hermosa is a former brownfield that has been successfully turned into a flourishing park and serves as an example for future projects of this type. Trees are an important feature for shade and particularly trees with lawn attract people; however, trees were not associated with as many birds as expected. More research is needed to understand if this association is true and why. I would recommend that walkways with large bushes be incorporated as much as possible into urban nature park designs. I would recommend that lawns and trees be placed where they are most likely to be used by people. Additionally, I would recommend monitoring visitor use so that lawns that are not used by people could be converted to more ecologically valuable habitat. The composition of vegetation needs to be studied more. Urban nature parks are important because they are an integral part of conserving urban biodiversity, and also serve as conduits for enabling those benefits natural settings provide to people.

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Chapter 5: Conclusion

Anthropogenic disturbance is an inherent element in urban nature parks, yet these parks are still able to attract wildlife and provide benefits to people. Human direct and indirect impacts on wildlife are well-documented. There are numerous studies looking at how humans negatively impact animals, not just at parks but also other ecosystems like the rocky intertidal. Studies look at how human trampling can negatively impact density and diversity of invertebrates and algae in the rocky intertidal (Beauchamp and Gowing 1982, Brown and Taylor 1999), and how human presence scares away birds (Ikuta and Blumstein 2003, Campbell 2006, Paker et al. 2014, Kang et al. 2015). Urban nature parks are in the city and thus will always have anthropogenic disturbances such as city noises, light and air pollution, and human presence. Additionally, many parks in the city are built for people and, thus, from an ecological perspective, these parks may not be considered ‘wild’ spaces. The goal of creating urban nature parks is to make cities better for biodiversity and wildlife than they otherwise would be (Schewenius et al. 2014) and in the case of the parks studied here, in places that used to be brownfields. Urban nature parks, particularly those created in previous brownfield sites, show the way anthropogenic impacts can be positive. It is understood that urban nature parks will never be equivalent to far-away land specifically designated for wildlife. At the same time, the birds, arthropods, and mammals that I observed and that inhabit these urban nature parks were not placed there by people. These animals and insects were attracted to whatever the park had to offer in its urban context. Urban nature parks are about bringing nature and the ‘wild’ closer to people for their benefit (Cheesbrough et al. 2019, Lev et al. 2020). Urban parks provide the opportunity to foster this beautiful co-habitation and even instill some understanding and respect for the natural things humans cannot control.

My research found that the urban parks I studied are able to attract 54 different bird species, including migratory birds. Still, the management of the ecosystems of these parks could be improved. These parks are maintained by maintenance departments. Although the maintenance crews are very knowledgeable about plants, trees, and lawn in general, they did not have as much practice with California native plants and were not necessarily thinking about the life cycle of plants and their synchronization with bird activities. For example, I once observed lesser goldfinches heavily feeding on a patch of coastal goldenbush (*Isocoma menziesii*) one week and the next time I visited the park, the goldenbush patch had been completely pruned. From an avian perspective, this pruning was poorly timed and eliminated a source of food for this species during that time. Organizations that develop and/or manage parks may be able to best preserve or even attract more biodiversity through having staff whose focus is wildlife and habitat management. From my observations at the parks I studied, the leadership to integrate native plants into the landscape seemed to be left up to park "interpreters." I observed interpreters providing that type of training and expertise. However, technically park interpreters are primarily responsible for interpretation of park space and thereby education, so they are not working on habitat maintenance regularly. The fact that upper management is flexible enough to allow park interpreters and stewards to fill in that responsibility is positive. On the other hand, if staff happen to not be as passionate or knowledgeable about habitat, then this kind of land management may not happen. Similar to cities hiring a tree canopy maintenance crew, I would suggest hiring an urban ecology maintenance crew that develops and implements maintenance guidelines that are in line with the urban ecology of parks.

Urban nature parks could possibly benefit from being treated a little more like restoration projects. Under the Clean Water Act, the 2008 Compensatory Mitigation for Losses of Aquatic Resources Rule (40 CFR Part 230) results in mitigation sites, areas that are "restored, established, enhanced, or preserved." In order to deem a site adequately restored, established, enhanced, or preserved, people must prepare Habitat Mitigation and Monitoring Plans. These plans establish performance metrics to make sure the habitat is performing the way it was intended to. For example, if we were to apply this compensatory mitigation model to urban nature parks, one of the performance metrics could be the establishment and maintenance of 50% cover of shrubs that are more than 3-feet tall. Compensatory mitigation sites are evaluated semi-regularly to measure their progress towards the intended restoration goals. Although these urban nature parks are not compensatory mitigation sites, they are touted as places created to increase biodiversity in the city and more broadly. Setting up metrics and evaluating whether these urban nature parks are attracting avian biodiversity may improve their ability to do so. Additionally, regularly measuring a park's progress can help trouble shoot in instances where the park is not meeting the intended goals. Monitoring urban nature parks would not need to be as rigorous or extensive as for mitigation sites. This kind of formal monitoring would ensure important aspects of the parks are being maintained when they would otherwise be overlooked.

Although I do think bringing a more ecological lens to the creation of urban nature parks could be helpful, there is also a drawback in some respects and particularly in the value-laden ideas of native and non-native species. Much of my dissertation did focus on native bird and plant species because much of the published ecological literature points to the positive correlation between species richness and native plants (Wood and Esaian 2020). The Wood and Esaian (2020) study pointed to some non-native trees that are used by native bird species.

However, since we don’t have as much information on the role of non-native tree or plant species, it seems like a good rule-of-thumb to err on the side of planting native species over non-native ones. In protected parks and even in compensatory mitigation sites, ecologists have been dogmatic about non-native species and their negative role in changing our natural landscapes. In urban nature parks, I think ecologists should be careful not to automatically rip out plants or trees for being non-native or casting these species in a negative light simply because of this label. Additionally, in multi-cultural cities it is also important to consider the community’s relationship to particular plants. During my time working at some of these parks, I discovered that Chinese and Latvian people had found some non-native shrubs in the park that they particularly connected with. I observed some Chinese people gathering these herbs to eat. And I observed a native plant volunteer not being able to pluck a “non-native shrub” because it reminded her of her birth country. Fostering this connection is important if we want to bring people closer to nature.

More broadly speaking, there can sometimes be a tension between creating parks that focus too much on wildlife and not enough on the community’s needs. I spoke with a prominent community member who was critically involved in the creation of Rio and also LASHP. He was skeptical of urban nature parks, not because he did not like nature, but because he believes that organized sports are the best use of park space. In areas where parks are limited and where other urban issues like gang violence are the norm, he believes soccer is a way to improve the community. And during the creation of Rio this was in conflict with other community members desiring space for urban wildlife. Rio is the result of a compromise where multiple needs were met. At the same time, this tension needs further exploration, particularly since some researchers are also questioning the relationship between urban nature parks and improved human well-being

(Marvier et al. 2023). Marvier et al. (2023) found that the published literature available is mostly correlational, subjective, and difficult to implement. Much of the literature shows that people do have a hard time understanding biodiversity (Qiu et al. 2013, Muratet et al. 2015) and sometimes don't even know they are "in" nature. There is an opportunity cost associated with building urban nature parks, such as building these types of facilities, over active recreation centers, or even affordable housing. This dissertation cannot help answer this tension except to say that all park elements have tradeoffs, so it is important to consider those. Additional studies could help tease apart this tension. For example, future studies could look at having sports facilities outdoors versus indoors to see potential benefits of greenery surrounding facilities. Future research could compare urban nature parks to more traditional sports centered parks to gain an understanding of the trade-offs in building these facilities and possible ways to integrate the different uses. Like the creation of Rio, it seems possible to create multi-functional parks by engaging with the community and designing a park that also meets their needs.

As is seen in this work, urban nature parks are able to serve both people and wildlife with the recognition that there are tradeoffs in trying to meet multiple needs. Further work to understand the tradeoffs of different urban nature park elements is needed. Future research should consider designing experiments to further explore park elements and their use. For example, park elements could be changed, such as adding bushes where there previously were not any, to see how people or wildlife respond to it, if at all. Another study could look at how removing grass impacts use, perceptions, or comfort at a park. By simply observing people at a park, as was done in my research, it is not possible to know how people would have used different elements not found in that park. Thus, it may be interesting to take the same group of people to different types of parks to see the types of activities people engage in. Alternatively, interviewing people about why they do not go to a nearby park could also help inform which park elements are missing for those people.

Park space is hard to come by in cities with expensive real estate so one way to improve parks is through retrofitting parks that already exist. For example, many already established parks could possibly benefit from adding a path or loop around the park since my work shows walkways are a heavily used park element. The SOPARC method is a good tool to understand human park use and also to see which areas are not used by people. These lesser used spaces could be targeted for improving wildlife use. Parks do not necessarily need to be "urban nature parks" to have more plants for wildlife. Figuring out how to increase wildlife is tricky but from my work here it seems like a good rule of thumb is to increase habitat complexity. Adding more native species of bushes and trees could be a good start. Finally, this work shows the potential of building parks in former brownfields; these parks continue to be used by countless people and have attracted close to 60 different species of birds.

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