Assessing Public Park Tree Canopy Diversity in Fort Collins, CO

Honors Thesis

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By

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Abstract

The urban canopy of Fort Collins provides tens of thousands of dollars to the city in the form of decreased heating/cooling costs, reduced stormwater runoff, and increased property value for residents. To preserve these benefits, these trees should be managed with diversity and potential disturbances in mind. Specifically, public parks should be closely examined as they are areas of high recreational traffic, which could mean diseases are more likely to be introduced here. This paper describes how publicly available data was used to examine the tree species diversity and adherence to the 10/20/30 rule for 53 public parks across Fort Collins. Despite Fort Collins' assessment of the state of their urban canopy in their Urban Forest Strategic Plan, only 2 of the 53 parks adhere to the 10/20/30 rule. Parks which are particularly diverse or non-diverse for their size are highlighted, and potential actions that the town can take to manage these parks are suggested based on these findings.

Introduction

The importance of urban tree canopies is clear for a multitude of reasons both economic and environmental. According to the Fort Collins Urban Forest Strategic Plan, trees are investments that provide numerous benefits ranging from economic to human health. They are also investments which appreciate in value over time, meaning the incentive to keep them healthy and growing is even higher (City of Fort Collins, 2025). These benefits are most keenly experienced in the public parks of Fort Collins, which provide green spaces for recreation that break up the continuous urban and suburban infrastructure. These public parks are carefully managed because of the economic and recreational value they provide.

There are multiple ways to quantify this value. According to Davey Resource Group, who maintains the onlineTreekeeper-8 database which contains tree inventory data for the city of Fort Collins, the monetary value provided by Fort Collins' urban canopy over just 1 year could be as much as $118,924.74 (Davey, 2025). The USDA Forest Service also performed a cost-benefit analysis on the money spent to maintain these urban trees. For every $1 that the town spent, around $2.18 in value is provided to residents in the form of lower heating and cooling costs, increased property value, and reduced stormwater runoff. As of 2003, 22% of this benefit came from large old trees (McPherson, 2003). This incredible value should be carefully managed and protected.

In 2025, Fort Collins released their Urban Forest Strategic Plan, which is, a comprehensive plan for protecting, managing, and improving the city's urban canopy, while also summarizing its current state (Fort Collins, 2025).This document outlined many statistics about the urban canopy of the town, the health of its trees, and how the canopy is to be managed moving forward. For Fort Collins, relying on relatively few species to produce future benefits is risky, and so they have been planting and evaluating many species in order to make their canopy more diverse and stable (McPherson, 2005).

However, this document encompasses all trees within city limits that are managed by the city, meaning it examines the whole canopy as one entity despite the fact that residents recreate differently within these spaces. For instance, a person recreating in a park might stop beneath a tree or lean against it, increasing the likelihood that they might introduce a pathogen of some

kind to this tree. In addition, recreators wouldn't act this way in a golf course, with large open spaces and little chance of interacting with a tree when compared to a public park.

This project aims to examine a smaller subset of the trees in the Fort Collins urban canopy which face more direct contact with residents: park trees. These parks are crucial spaces for recreation, and the trees present there provide numerous benefits to both residents and visitors. Because people recreate in these parks and interact with the trees so much, their importance is heightened, and care should be taken to keep them healthy and resistant to disease.

Disease resistance is increased if the urban canopy is diverse. It makes sense that, if all the individuals in a population are remarkably similar genetically, then a disturbance targeting a specific species or genus will spread and kill a larger portion of the population than it otherwise would have. The 10/20/30 rule has been considered for over 30 years as a method of evaluating urban tree canopy diversity. The rule states that no more than 10% of the trees in a canopy should be of the same species, no more than 20% be of the same genus, and no more than 30% be of the same family. This ensures that the canopy's losses can be curbed if a disease or other disturbance is introduced. According to the PlanIT GEO forestry consulting and software group, diverse urban canopies are more resistant to climate change and pests because of each species' unique adaptations (Sabatini, 2024).

The Fort Collins Urban Forest Strategic Plan states that the forestry department is using this 10/20/30 rule as a guide for the management of their own canopy. However, while the entire Fort Collins canopy has been examined in their plan, there are subsections of the canopy that come into more frequent contact with recreators who are looking to interact closely with nature. The public parks of Fort Collins are one of these high traffic areas. This project aims to examine the tree species diversity of Fort Collins' public parks to highlight any parks which might need future management actions to keep them healthy and resistant to disease and disturbance.

Methods

Study area

The study area of this project includes public parks within the city limits of Fort Collins. This is because the tree canopy was thoroughly investigated by the city through their Urban Forest Strategic Plan, however parks on their own have not been examined very closely. These

areas are trafficked quite heavily by individuals seeking to recreate near the trees present in these parks, and so the potential for disease introduction is higher because of this increased traffic and more direct contact. Neighborhood, mini, and community parks will be considered for this project if they have trees, however, areas that are managed differently for a specific use will not be used. These specialty areas include golf courses (unless the golf course is contiguous with public park land, such as in the case of City Park), cemeteries, and archery ranges. This is because the public interacts differently with these areas.

Data sources

ArcGIS Pro would be used to spatially determine which trees resided within which parks, and therefore, which parks were most adherent to the Urban Forest Strategic Plan and it's 10%-20%-30% rule. The first pieces of data collected to begin this analysis were both shapefiles collected from the City of Fort Collins GIS Open Data Portal. The first of these shapefiles was the city limits of Fort Collins, represented through a single polygon, which would be used to clip any data which fell outside city limits, because that data would not be included in the scope of this project. The second shapefile, from the same GIS data portal, was the parks layer, containing sixty-seven polygons representing every park, golf course, cemetery, and planned future park in Fort Collins. This layer would be used to clip away any trees which were not located within park boundaries, as non-park trees were not considered under the scope of this project.

The last source of data, provided as a .csv file by Freddie Haberecht from the Fort Collins Department of Forestry, was a table containing the 64,054 trees inventoried and managed by Fort Collins, which could be found across the city of Fort Collins. The table contained attributes about every tree, with the most important for this project being the species and location of the tree. Any vacant spaces or stumps were also included in this original .csv file.

Data analysis

The first step in performing analysis on this data was to add the data into an ArcGIS Pro project, where it could be visualized and analyzed more effectively. Because these shapefiles came from the same data portal, they were both projected into the 'NAD_1983_StatePlane_Colorado_North_FIPS_0501_Feet' coordinate system, which would be kept the same because of how well it represented northern Colorado.

The ‘parks’ and ‘city limits’ layers from the Fort Collins GIS Open Data Portal were added first to the project. Then, the ArcGIS Pro ‘Clip’ tool was used to clip away the parks which fell outside city limits. Then, polygons from the ‘parks’ layer were manually removed if they represented a planned future development, cemetery, golf course, or archery range, because these specialty spaces are not interacted with in the same way that public parks are. Only the City Park Golf Course polygon was kept because the City Park Golf Course is technically within the park boundaries of City Park and thus the two areas are contiguous and hard to differentiate. These two previous steps brought the number of parks within the scope of this project to fifty-three.

Then, the .csv table from the Fort Collins Department of Forestry was added to the project, however this data was not represented visually because of its format. The ArcGIS Pro ‘XY Table to Point’ tool was used to convert this data from a table into a feature class containing points titled ‘fort_collins_trees’ based on the latitude and longitude coordinates contained as attributes for each tree in the table. Then, once this data was added to the project in the form of points, it was re-projected to match the previously mentioned coordinate system. Once the trees were represented on the map, the ‘Intersect’ tool was used to create a new feature class containing only trees which intersected a polygon in the ‘parks’ layer, called ‘fort_collins_park_trees.’ The ‘fort_collins_trees’ layer was then turned off to make visualization and analysis faster. This left 10487 trees which met the qualifications set out for this project.

A new field was then created in the ‘fort_collins_park_trees’ attribute table called ‘PARKNAME,’ which would house the name of the park polygon each tree was found within. Trees were then selected using the ArcGIS Pro ‘Select by Attributes’ tool. All the trees intersecting with a certain park would be selected, and the ‘PARKNAME’ attribute for those trees would be filled with the corresponding name of the park. This process was repeated for all fifty-three parks. Once each park’s trees were given their attribute, they could be exported as a standalone table using the ‘Export Table’ option. This option worked based on which trees were actively selected. The resulting table, containing only trees found within a particular park, could then be viewed in the ‘Data Engineering’ window, where a bar graph displaying the count of each species present in the park could be found. This bar graph could then be exported as a .csv file using the ‘Export as Table’ option, resulting in a two-column table with species and their corresponding counts.

These steps were repeated for all fifty-three parks, with the resulting tables being copied and pasted into a single Excel workbook, with a sheet for each park individually. A summary sheet was also created, containing every species and its count across all parks in Fort Collins which was exported from the 'fort_collins_park_trees' layer. With the data exported from ArcGIS, it could be graphed and interpreted more easily. In order to clean the data and ensure its integrity, the 'Vacant Space' and 'Stump' species, which were not actual species, but placeholders left over from the original data, were removed from all sheets, leaving behind the final count of 10487 total trees which resided in public parks.

For each park, the species diversity had to be calculated. To do this, the count of each species was divided by the sum of all the trees in the park from every species. This yielded a percentage representing how much of the canopy consisted of that species. These calculations were repeated for every species in every park, allowing for each park to be judged on how well it complied with the 10%-20%-30% rule from the Urban Forest Strategic Plan.

In addition, the size of each park polygon, which was copied from the 'parks' attribute table in ArcGIS Pro, was added to each sheet. Dividing the number of species in a park by the size of that park yielded the species per acre of that park, a crucial metric because the parks vary in size, and species per acre takes this into account. The number of trees per acre was calculated as well, to see how dense the urban canopy was in each park. This process was repeated for all parks. The species per acre of every park, trees per acre, and the percentage of each species present in every park's canopy were then compared against one another to see which parks were most or least diverse.

Results

Below is a table representing the culmination of the summary statistics for each park. For the area column, a darker blue hue indicates the park is relatively large, and a red hue indicates the park is relatively small. For the species per acre and the trees per acre columns, a greener hue indicates a higher value while a redder hue indicates a lower value.

Park Name	Area (acres)	Species Per Acre	Trees Per Acre
ALTA VISTA PARK	0.592732	8.44	13.50
AVERY PARK	5.740623	5.23	20.90
BEATTIE PARK	6.651496	2.71	9.17
BLEVINS PARK	5.837422	3.77	14.73

BUCKINGHAM PARK	4.830742	2.48	5.80
CITY PARK + GOLF COURSE	75.996916	1.97	24.87
CIVIC CENTER PARK	2.146891	11.64	30.28
COTTONWOOD GLEN PARK	12.153272	1.89	9.38
CREEKSIDE PARK	3.494208	9.16	26.04
CRESCENT PARK	7.164488	3.35	16.19
DOVETAIL PARK	6.147372	3.58	27.33
EASTSIDE PARK	2.072902	9.65	24.12
EDORA COMMUNITY PARK	42.232058	1.23	9.05
ENGLISH RANCH PARK	11.973101	2.67	11.78
FOSSIL CREEK COMMUNITY PARK	96.005553	0.43	5.08
FREEDOM SQUARE PARK	0.529681	11.33	22.66
GOLDEN MEADOWS PARK	11.498807	2.44	8.52
GREENBRIAR PARK	21.954756	1.59	13.12
HARMONY PARK	9.999743	2.60	12.90
HOMESTEAD PARK	6.131322	4.40	20.39
INDIAN HILLS PARK	2.162242	19.89	34.22
LANDINGS PARK	8.056084	3.60	13.41
LEE MARTINEZ COMMUNITY PARK	89.600189	0.78	5.17
LEGACY PARK	8.824946	1.25	7.48
LEISURE PARK	0.918868	6.53	23.94
LIBRARY PARK	4.604116	8.04	23.46
LILAC PARK	0.700997	8.56	17.12
MIRAMONT PARK	10.31349	2.52	11.83
OAK ST PLAZA PARK	0.311709	3.21	28.87
OLD FORT COLLINS HERITAGE PARK	14.207931	1.97	12.95
OVERLAND PARK	15.663419	1.92	10.73
POUDRE RIVER WHITEWATER PARK	11.131585	1.89	9.70
RABBIT BRUSH PARK	1.523584	3.28	15.10
RADIANT PARK	9.415862	1.27	7.97
REGISTRY PARK	5.055338	1.98	9.10
RIDGEVIEW PARK	11.002357	2.45	11.54
ROGERS PARK	8.131228	6.64	18.57
ROLLAND MOORE COMMUNITY PARK	70.841074	1.07	9.30
ROMERO PARK	0.155695	6.42	19.27
ROSSBOROUGH PARK	15.798502	2.22	16.58
SOFT GOLD PARK	17.033003	1.88	7.75
SPENCER PARK	0.418525	7.17	19.11
SPRING CANYON COMMUNITY PARK	116.023687	0.49	11.25
SPRING PARK	16.108723	2.67	11.67
STEWART CASE PARK	13.884704	1.58	6.63

SUGAR BEET PARK	5.576309	3.95	17.22
TRAVERSE PARK	5.047974	5.55	26.94
TROUTMAN PARK	15.437481	2.46	14.57
TWIN SILO COMMUNITY PARK	53.655023	0.97	11.22
WARREN PARK	24.692848	2.07	11.70
WASHINGTON PARK	0.694164	10.08	18.73
WATER'S WAY PARK	7.761232	1.55	4.38
WESTFIELD PARK	14.618914	2.53	12.86
WOODWEST PARK	2.817429	4.97	15.26
Averages	**16.95**	**4.15**	**15.21**

Figure 1: This table contains the size in acres, the species per acre, and trees per acre present in each park. The parks are sorted alphabetically. A redder hue indicates a lower value, while a more green/blue hue indicates a higher value.

When viewed as a whole, the public parks of Fort Collins do adhere to the 10%-20%-30% view on a species level. As evidenced in Figure 2, the percentage of the canopy each species represents never exceeds 8% for the ten most common species present across all parks. According to the Urban Forest Strategic Plan of Fort Collins, the top three species present across the whole of Fort Collins' urban canopy were green ash (*Fraxinus Pennsylvanica*) at 11%, honeylocust (*Gleditsia triacanthos*) at 11%, and the bur oak (*Quercus macrocarpa*) at 8%. In contrast, the three most common species across most parks are green ash (*Fraxinus pennsylvanica*) at 7.65%, Colorado blue spruce (*Picea pungens*) at 7.5%, and Austrian pine (*Pinus nigra*) at 6.39%. This would seem to suggest that the parks comply with the 10% rule at least, but this is not necessarily the case.

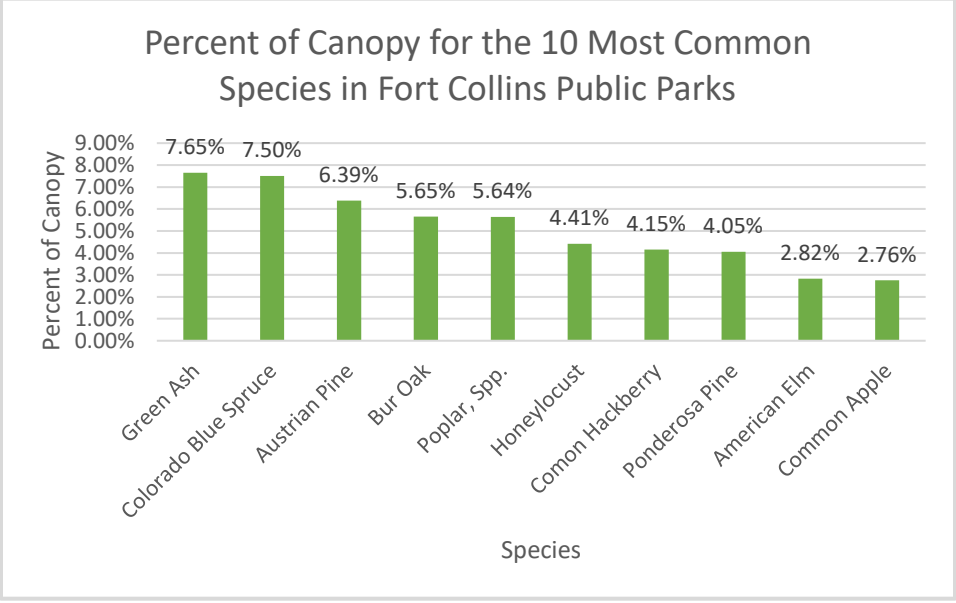

Figure 2: This graph displays the top 10 most populous species present in parks across Fort Collins, as well as the percent of the park canopy that these species each make up.

There are only 5 parks out of the 53 total which adhere to the 10% rule regarding species diversity: Indian Hills Park (which barely qualifies with its most common species making up 10.81% of its canopy), Lee Martinez Community Park, Miramont Park, Rogers Park, and Twin Silo Community Park. These five parks range from 2 acres to 89 acres in size, suggesting that park size was not as strongly correlated with park diversity as initially assumed. Indian Hills is a particular standout, with an area of 2.1 acres, 19.89 species per acre, and 34.22 trees per acre. This kind of diversity represents an outlier in the data, especially relative to the park's size. In fact, the smaller parks trend towards having more trees and, thus, more species per acre than larger parks, likely due to how most of the larger parks' acreage is made up of open grassy areas or other amenities for recreators.

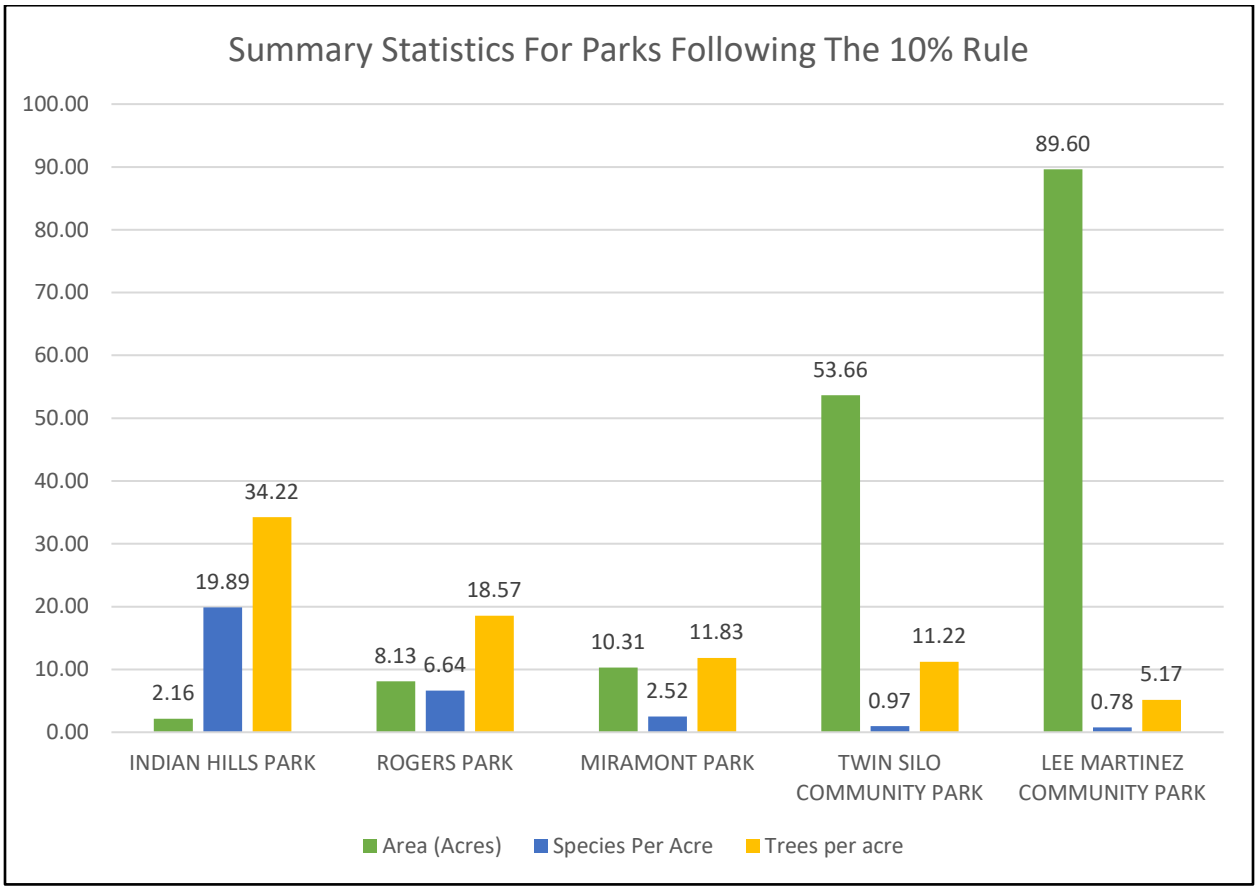

Figure 3: This graph displays the area in acres, species per acre, and trees per acre present in the 5 parks which comply with the 10% portion of the 10/20/30 rule.

The next portion of the rule, where no family should exceed 20% of the canopy, is adhered to by 17 parks out of 53. The data for these parks is represented in figure 5 in the results section. As area increases, the number of species per acre decreases, however this still does not draw any connections between species per acre and whether a park will adhere to the 10/20/30 rule. In fact, only two parks present in this graph met all 3 aspects of the 10/20/30 rule: Indian Hills Park and Rogers Park, both smaller parks with diverse canopies relative to their larger counterparts.

City Park is an outlier in this section, as it has a large area while also sporting 1.97 species per acre and a respectable 24.87 trees per acre. This suggests that City Park, while it does have many trees per acre relative to other parks, is lacking when it comes to species diversity. This is likely because a sizable portion of City Park's canopy is also present across the City Park Golf Course, which was included due to its proximity with the rest of City Park. The golf course has large grassy clearings with no trees, altering how diverse the park appears to be. However, the larger parks do seem to struggle when it comes to species diversity, as represented in figure 5, suggesting correlation between the two factors.

The last portion of the rule, where a canopy should have no more than 30% of the trees be of the same family, is adhered to by 29 out of 53 parks, just over half of all parks, possibly suggesting that family-level diversity might be easier to achieve in an urban canopy when compared to species or genus level diversity requirements. The same inverse relationship identified earlier between the species per acre in a park and its area holds true as well, with the larger parks having exceptionally low species per acre measurements, and the smaller parks having remarkably high species per acre measurements. This can be attributed to how the size of the park skews the data, however the larger parks, by having more trees present, should theoretically be more diverse, a trend that is not supported by the data.

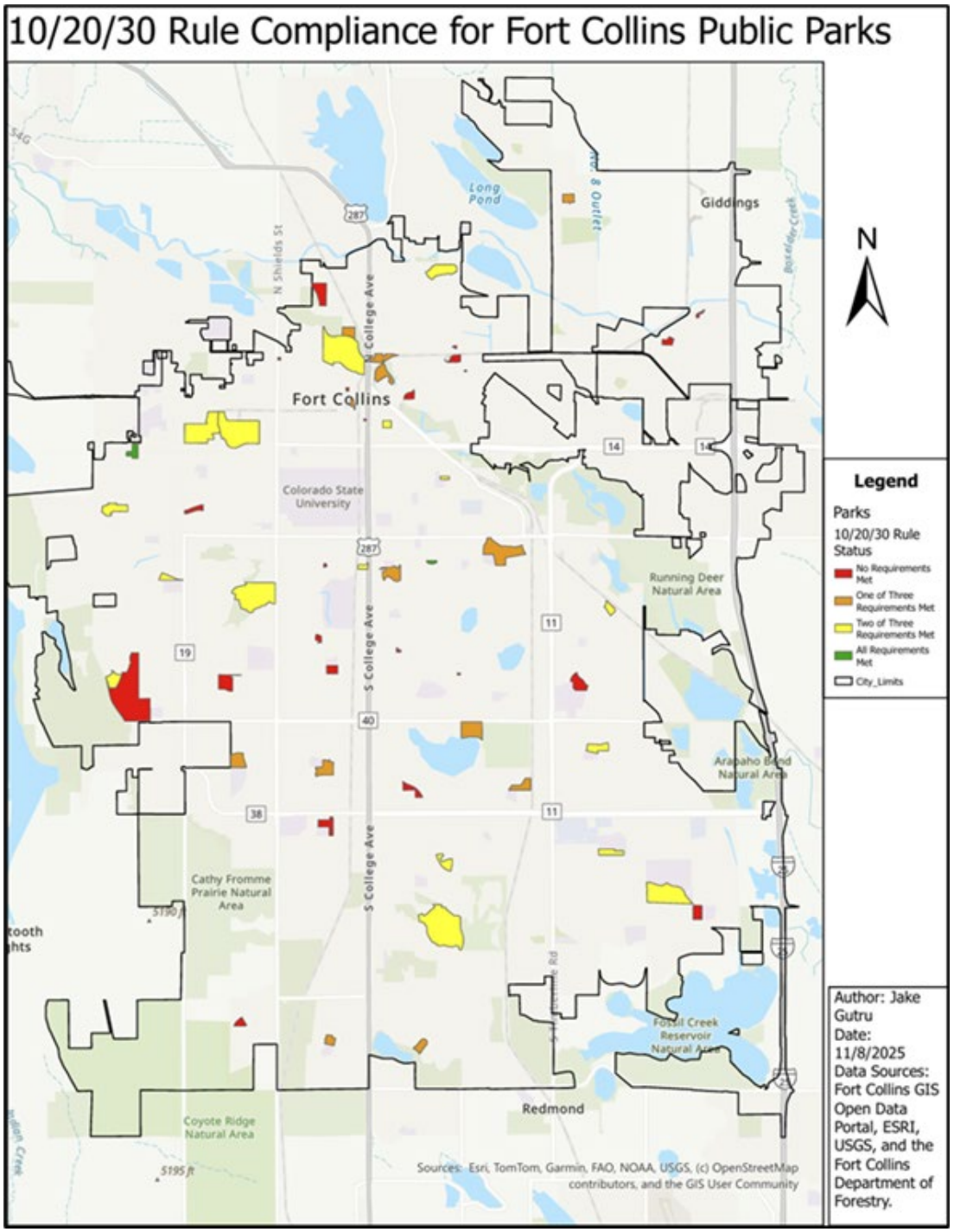

Figure 4: This map displays the acreage of park land which follows between 0 and 3 aspects of the 10/20/30 rule. Green signifies all 3 requirements have been met, yellow signifies 2, orange signifies 1, and red signifies 0. As is evident, most of the park acreage in Fort Collins is not following the 10/20/30 rule wholly.

In total, only 2 of the 53 parks meet all three requirements under the 10/20/30 rule, with those being Indian Hills and Rogers parks. This means that only 3.7% of Fort Collins parks

considered for this project meet the management goals set out in the Urban Forest Strategic Plan, while 23 parks don't meet any requirements under the 10/20/30 rule, or 43.40%. The average size of one of the 53 parks was 16.95 acres, a measure that is being skewed by outliers like Spring Canyon Community Park, Rolland Moore Community Park, and City Park which have relatively large areas between 80 and over 100 acres. The average species per acre among all 53 parks was 4.15, which is above the median species per acre of 2.63.

Discussions

The data suggests that the parks of Fort Collins are not as diverse as would be ideal for disease resistance. As represented in the above map, only a tiny fraction of the total acreage of Fort Collins parks actually follows all of the 10/20/30 rule. With only Indian Hills Park and Rogers Park meeting all requirements under the 10/20/30 rule, there is cause to be wary for the rest of the public parks of Fort Collins.

Specifically, only 9% of the parks followed the 10% rule, 32% followed the 20% rule, and 55% followed the 30% rule. Clearly, species diversity needs to be increased across all parks, with a particular focus on larger parks because these parks failed to meet the requirements of the 10/20/30 rule despite having many trees per acre in some cases. Below is a table containing the name of each park and the aspects of the 10/20/30 rule they were successful in adhering to. This, when considered with the trees and species per acre for each park, can be very telling as to what factors are most important when it comes to assessing the diversity of a park.

Park Name	Park Age	Most Populous Species	% Canopy	Most Populous Genus	% Canopy	Most Populous Family	% Canopy
ALTA VISTA PARK	1978	Ulmus pumila	25.00%	Ulmus	25.00%	Ulmaceae	25.00%
AVERY PARK	1962	Pinus nigra	15.00%	Pinus	36.67%	Pinaceae	39.17%
BEATTIE PARK	1974	Fraxinus pennsylvanica	21.31%	Pinus	34.43%	Pinaceae	37.70%
BLEVINS PARK	1976	Celtis occidentalis	19.77%	Pinus	13.95%	Pinaceae	23.26%
BUCKINGHAM PARK	1976	Fraxinus pennsylvanica	32.14%	Fraxinus	32.14%	Oleaceae	32.14%
CITY PARK + GOLF COURSE	1911	Ulmus americana	14.18%	Picea	15.98%	Pinaceae	24.50%
CIVIC CENTER PARK	2001	Malus spp.	16.92%	Quercus	21.54%	Fagaceae	21.54%
COTTONWOOD GLEN PARK	1999	Populus spp.	20.18%	Quercus	21.05%	Fagaceae	21.05%

CREEKSIDE PARK	1991	Populus angustifolia	15.38%	Populous	15.38%	Fagaceae	18.68%
CRESCENT PARK	2017	Pinus ponderosa	11.21%	Pinus	24.14%	Pinaceae	26.72%
DOVETAIL PARK	2023	Juniperus scopulorum	19.64%	Juniperus	19.64%	Cupressaceae	19.64%
EASTSIDE PARK	1994	Celtis occidentalis	14.00%	Celtis	14.00%	Pinaceae	28.00%
EDORA COMMUNITY PARK	1971	Picea Pungens	14.14%	Picea	18.32%	Pinaceae	37.70%
ENGLISH RANCH PARK	1999	Populus spp.	17.02%	Populus	17.02%	Pinaceae	23.40%
FOSSIL CREEK COMMUNITY PARK	2003	Populus spp.	19.47%	Quercus	20.90%	Fagaceae	20.90%
FREEDOM SQUARE PARK	1975	Tilia cordata	41.67%	Tilia	41.67%	Malvaceae	41.67%
GOLDEN MEADOWS PARK	1985	Pinus nigra	15.31%	Pinus	28.57%	Pinaceae	31.63%
GREENBRIAR PARK	1993	Tilia cordata	11.11%	Pinus	15.97%	Pinaceae	27.78%
HARMONY PARK	2002	Gleditsia triacanthos	15.50%	Quercus	20.16%	Pinaceae	20.93%
HOMESTEAD PARK	2003	Quercus muelenbergii	16.00%	Quercus	23.20%	Pinaceae	44.80%
INDIAN HILLS PARK	1968	Picea pungens	10.81%	Pinus	13.51%	Pinaceae	29.73%
LANDINGS PARK	1984	Fraxinus pennsylvanica	18.52%	Pinus	32.41%	Pinaceae	37.04%
LEE MARTINEZ COMMUNITY PARK	1976	Pinus edulis	9.07%	Pinus	22.89%	Pinaceae	31.32%
LEGACY PARK	1977	Populus sargentii	21.21%	Populus	65.15%	Salicaceae	65.15%
LEISURE PARK	1984	Tilia cordata	27.27%	Tilia	27.27%	Pinaceae	36.36%
LIBRARY PARK	1880	Fraxinus pennsylvanica	15.74%	Pinus	19.44%	Pinaceae	25.00%
LILAC PARK	2004	Picea glauca	33.33%	Pinus	41.67%	Pinaceae	50.00%
MIRAMONT PARK	2001	Pinus nigra	9.84%	Pinus	26.23%	Pinaceae	32.79%
OAK ST PLAZA PARK	2008	Gleditsia triacanthos	100.00%	Gleditsia	100.00%	Fabaceae	100.00%
OLD FORT COLLINS HERITAGE PARK	1962	Fraxinus pennsylvanica	17.93%	Pinus	21.20%	Pinaceae	24.46%
OVERLAND PARK	1987	Fraxinus pennsylvanica	18.45%	Fraxinus	18.45%	Pinaceae	22.02%
POUDRE RIVER WHITEWATER PARK	2019	Populus acuminata	12.04%	Populus	24.07%	Salicaceae	24.07%

RABBIT BRUSH PARK	2006	Gleditsia triacanthos	34.78%	Gleditsia	34.78%	Fabaceae	34.78%
RADIANT PARK	2013	Populus spp.	38.67%	Populus	41.33%	Salicaceae	41.33%
REGISTRY PARK	2012	Crataegus spp.	36.96%	Crataegus	36.96%	Rosaceae	36.96%
RIDGEVIEW PARK	1999	Pinus sylvestris	14.96%	Pinus	41.73%	Pinaceae	56.69%
ROGERS PARK	1991	Pinus ponderosa	9.93%	Quercus/Pinus	19.21%	Pinaceae	27.15%
ROLLAND MOORE COMMUNITY PARK	1983	Picea pungens	17.75%	Picea	19.12%	Pinaceae	29.89%
ROMERO PARK	1982	Picea pungens	100.00%	Picea	100.00%	Pinaceae	100.00%
ROSSBOROUGH PARK	1989	Celtis occidentalis	16.03%	Pinus	30.53%	Pinaceae	36.26%
SOFT GOLD PARK	2004	Pinus strobiformis	16.67%	Pinus	34.85%	Pinaceae	40.15%
SPENCER PARK	1980	Tilia cordata	37.50%	Tilia/Quercus	37.50%	Malvaceae/Rosaceae	37.50%
SPRING CANYON COMMUNITY PARK	2007	Populus spp.	14.02%	Pinus	30.50%	Pinaceae	36.55%
SPRING PARK	1965	Fraxinus pennsylvanica	22.34%	Fraxinus	22.34%	Oleaceae	22.34%
STEWART CASE PARK	2000	Pinus nigra	27.17%	Pinus	34.78%	Pinaceae	53.26%
SUGAR BEET PARK	2019	Quercus macrocarpa	11.46%	Quercus	32.29%	Fagaceae	32.29%
TRAVERSE PARK	2021	Pinus ponderosa	18.38%	Pinus	33.09%	Pinaceae	44.12%
TROUTMAN PARK	1987	Pinus nigra	15.11%	Pinus	25.78%	Pinaceae	27.56%
TWIN SILO COMMUNITY PARK	2017	Gleditsia triacanthos	8.97%	Pinus	21.10%	Pinaceae	21.76%
WARREN PARK	1978	Pinus nigra	15.22%	Pinus	17.99%	Pinaceae	35.29%
WASHINGTON PARK	1906	Fraxinus pennsylvanica	46.15%	Fraxinus	53.85%	Oleaceae	53.85%
WATER'S WAY PARK	2012	Populus sargentii	23.53%	Populus	26.47%	Salicaceae	26.47%
WESTFIELD PARK	1998	Quercus muelenbergii	17.02%	Pinus	19.15%	Pinaceae	29.79%
WOODWEST PARK	1983	Salix spp.	25.58%	Pinus/Salix	25.58%	Pinaceae	27.91%

Figure 5: This table describes the most common species, genus, and family present in each park, as well as the park's age. This demonstrates the correlation between a park's age and how diverse it is. A green hue represents a pass for the 10/20/30 rule, a light red represents a fail.

The species per acre data also raises some questions about the state of the parks of Fort Collins. As represented by the two following graphs, there is a slight correlation between a

higher species per acre measurement and a higher rate of compliance with the 10/20/30 rule, with both parks which follow the rule completely having a higher species per acre measurement.

However, this is not universally true, and there are plenty of parks with high species per acre measurements which do not follow a single aspect of the 10/20/30 rule (Eastside Park, Lilac Park, and others). These are parks with small areas that have high species diversity for their sizes, but because they are limited by their acreage, they simply do not have enough diversity between the few trees present, to meet the requirements of the rule. There are also many parks with low species per acre measurements which still meet 2/3rds of the rule in some combination, mostly the 20% and 30% aspects of the rule.

What this suggests is that increasing the species diversity of parks with large areas like Rolland Moore, City Park, and Spring Canyon Community Park should be a priority. These larger parks experience higher traffic because of how accessible to the public they are and because of how much space they have for residents to recreate within them. On top of this higher traffic, these parks have been shown by this project to have lower species per acre measurements, and none of these larger parks meet all the requirements under the 10/20/30 rule, regardless of size. As represented by the above map, these large parks represent most of the park space in Fort Collins, so addressing their lacking diversity would have a greater impact than focusing on small neighborhood parks with similar issues in diversity.

However, the fact that these parks need management attention is not an immediate concern. Even if these canopies are not diverse enough to meet the requirements as of now, this does not mean that sudden action is necessary to rectify this. Instead, these discrepancies between the goals set out by the Fort Collins Department of Forestry and what the data suggests should be treated as a preliminary warning sign. As climate change continues, and as new disturbances are introduced to the canopy, the parks which lack diversity should be managed with greater intensity as they will be more susceptible to these disturbances.

Looking to other areas across the Front Range of Colorado for inspiration, the city of Boulder has been trying to protect its urban ash tree population since the introduction of the Emerald Ash Borer (EAB) in 2013, which at the time was the furthest west that EAB had been detected in the United States. Following polarized public perception, the Boulder Department of Forestry tried several methods to curb the infestation and reduce its negative effects, from administering

pesticides to removing trees which would be most at risk. In addition, Boulder planted 2,508 trees between the 2013 detection and 2020, with a minimum of 36 unique species being planted annually. This represents an increase in tree diversity and the removal of diseased trees, which might result in short term costs. However, the long-term financial benefits to the town ensure this management strategy is viable, even though tree removal continues to outpace planting (Alexander, 2020).

In addition, as trees die and must be replaced by the town, they should examine the tree data as it stands to choose what to be planted next. For instance, if a tree dies in Rolland Moore Community Park, then the town should be careful not to plant a replacement of the dominant species in the park. This may compromise the aesthetic look of the park, but for the sake of canopy resilience and resistance, it is important to encourage a diverse canopy.

Conclusions

The public parks of Fort Collins are well cared for thanks to the Fort Collins Department of Forestry. Their Urban Forest Strategic Plan is comprehensive, and its goals are specific, and if the city keeps working towards their goals, then the urban canopy of Fort Collins will be diverse, healthy, and resistant to many types of disturbance. However, it is important to keep an eye on specific subsets of the canopy because people interact with each of them in different capacities. For this reason, it is key that the public parks of Fort Collins should be managed with a heightened level of care.

If any disturbances are found within Fort Collins' urban trees, public parks especially should be closely monitored because they are such hot spots of recreational activity and because these trees matter greatly to the residents who frequent them. Preserving these high traffic areas while making them more resistant to disease and disturbance is incredibly important, and not unfeasible because the town of Fort Collins already has the tree inventory data on hand to keep tabs on parks which might be susceptible to disease or disturbance due to the relatively lower diversity of their canopy. Taking these precautionary measures could preserve and sustain the numerous benefits these trees contribute to the city of Fort Collins for years to come.

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