

What has contributed to green space inequities in U.S. cities? A narrative review

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Abstract

Much research has documented green space inequities, but no review has examined their determinants holistically. To address this gap, we conduct a narrative review to synthesize the historical and recent mechanisms contributing to green space inequities in U.S. cities. We identify 77 publications covering this topic and find that two complementary macro-mechanisms shape green space inequities: residential segregation and unequal green space investments. Historical mechanisms include racial residential segregation, redlining, and postwar suburbanization. More recent mechanisms include nonprofits' involvement in green space provision, green gentrification, and contemporary plans. Moving toward green space equity requires addressing both historical and current mechanisms.

Keywords: Green space, environmental justice, segregation, parks, inequality

Introduction

Green space—describing vegetated areas often accessible to the public—is an essential element in cities, providing numerous benefits for human health, well-being, and climate change adaptation (Chawla 2015; Liu, Kwan, and Kan 2021; Mushangwe et al. 2021; Wheeler et al. 2019). However, many Global North and Global South cities experience green space inequities, which describe low-income people and racial/ethnic minority groups having a lower provision of green space (Rigolon 2016; Schüle et al. 2019; Wolch, Byrne, and Newell 2014). Additionally, these demographic groups tend to have lower life expectancy and higher prevalence of chronic diseases (Rigolon et al. 2021), thus, green space inequities might be linked to health disparities (Burbidge et al. 2022; R. Connolly et al. 2023). Due to the associations between green space inequities and health disparities (R. Connolly et al. 2023), scholars and activists have framed unequal provisions of green space as environmental injustices (Kabisch and Haase 2014; Rigolon, Browning and Jennings 2018; Wolch, Byrne, and Newell 2014).

Although several literature reviews have documented the existence of green space inequities worldwide (Allegretto, Kendal, and Flies 2022; Rigolon 2016; Rigolon, Browning, Lee, et al. 2018; Schüle et al. 2019; Wolch, Byrne, and Newell 2014), few reviews have shed light on their determinants (Kephart 2022; Kotsila et al. 2022; Swope, Hernández, and Cushing et al. 2022). For example, Kephart (2022) reviews how historical and present-day laws, policies, plans, and practices determining racial residential segregation shape the distribution of greenness in the U.S., finding that redlining continues to shape today's greenness distribution. Similarly, Swope, Hernández, and Cushing et al. (2022) show significant associations between historically redlined areas and present-day environmental and health outcomes in the U.S., focusing on a broad set of environmental amenities (e.g., healthy food, clean air). Also, Kotsila et al. (2022) propose ten drivers of injustices in urban

sustainability initiatives, including structural inequalities, urbanization processes excluding people of color, environmental privilege, power imbalances, growth-oriented policies fostering gentrification, and others.

Although the three aforementioned reviews provide some insights about what has contributed to green inequities, to our knowledge no review has synthesized and connected all the mechanisms that uphold the issue. Specifically, Kephart (2022) only covers residential segregation, whereas the two other reviews (Swope, Hernández, and Cushing 2022; Kotsila et al. 2022) focus on a broad set of environmental amenities rather than just green space. To address this knowledge gap, we conduct a narrative review to synthesize and connect the mechanisms that contributed to green space inequities in U.S. cities. We advance previous research by presenting a comprehensive overview of such mechanisms including historical and current policies, plans, and practices, as well as their connections. We also identify two distinct but complementary macro-mechanisms that contribute to inequities: residential segregation and unequal green space investment. By providing a critical and holistic analysis of such mechanisms, this review can help planners, policymakers, and advocates undertake actions to advance green space equity.

Defining green space and green space inequities

In the planning literature, green space often refers to spaces dominated by vegetation that are either publicly or privately owned (Jennings, Browning, and Rigolon 2019; Sandström 2002; Taylor and Hochuli 2017). Examples include urban parks, trees, forests, greenways, community gardens, green schoolyards, and private yards (Jennings, Browning, and Rigolon 2019; Kabisch and Haase 2014).

Green space provides essential benefits for human health, well-being, climate change adaptation, and biodiversity (Chawla 2015; Liu, Kwan, and Kan 2021; Mushangwe et al.

2021; Wheeler et al. 2019). These benefits are part of the ecosystem services offered by green space, which can be classified into four categories: provisioning (e.g., food, medicinal plants), regulating (e.g., climate change adaptation, air quality regulation), cultural (e.g., recreation, social cohesion), and habitat and supporting services (e.g., soil protection) (Jennings, Browning, and Rigolon 2019). The unequal distribution of green space restricts low-income people and racial/ethnic minority people from enjoying such benefits, which is associated with health disparities (Schüle et al. 2019; Connolly et al. 2023).

Green space inequity describes a situation wherein green spaces are not fairly distributed among different demographic groups, limiting their benefits to some people (Rigolon 2016; Rigolon et al. 2022). People with low socioeconomic status and those who are part of a racial or ethnic minority group generally have a lower green space provision than less disadvantaged groups (Allegretto, Kendal, and Flies 2022; Rigolon 2016; Rigolon, Browning, and Jennings 2018; Schüle et al. 2019; Wolch, Byrne, and Newell 2014). Most reviews on green space inequities have focused on parks, finding that low-income and racial/ethnic minority neighborhoods tend to have fewer acres of parks per person and parks with lower quality than less disadvantaged groups (Rigolon 2016; Rigolon et al. 2018; Schüle et al. 2019; Wolch, Byrne, and Newell 2014). These reviews have included studies in the Global North, including the U.S. (Rigolon 2016; Schüle et al. 2019; Wolch, Byrne, and Newell 2014), and Global South (Rigolon et al. 2018). Also, Allegretto, Kendal, and Flies (2022) found that low-income racially/ethnically minority neighborhoods had lower-quality urban forests than less disadvantaged communities.

As noted, these documented green space inequities raise concern for environmental justice (Kabisch and Haase 2014; Rigolon, Browning, and Jennings 2018; Wolch, Byrne, and Newell 2014) due to their implications for health inequities (R. Connolly et al. 2023). Environmental justice includes three dimensions (Kabisch and Haase 2014; Low 2013).

When focusing on green space, distributional justice describes the fair provision of green space among all demographic groups. Procedural justice focuses on the fair integration of all groups in the planning and decision-making process about green space. Interactional justice describes a situation in which people experiencing marginalization (e.g., people of color, immigrants) feel safe, recognized, and welcome in public green spaces. In this review, we focus on how procedural injustices related to policies, plans, and practices have resulted in distributional injustices in the provision of green space. In other words, we examine how certain unfair *processes*, including policies, plans, and practices (procedural injustices), contributed to an *outcome*, i.e., the inequitable distribution of green space (distributional injustice).

Methods

We conducted a narrative literature review to identify and synthesize publications that focused on mechanisms such as historical and current policies, plans, and practices contributing to distributional injustices in green space provision. The inclusion criteria were as follows. First, we only included studies from the U.S. because the country has a centuries-long history of structural racism, which might have contributed to green space inequities (Rigolon et al. 2022; Schell et al. 2020). Second, we cast a comprehensive net in terms of publication types, as we included peer-reviewed journal articles, books, and book chapters. Third, publications had to document the mechanisms (e.g., policies, plans, practices) that contributed to distributional green space inequities. To be included, studies did not have to find quantitative evidence about *causal* links between certain policies and green space inequities, but we use the term *mechanism* throughout the paper to describe policies, plans, and practices (procedural injustices) that have some associations with distributional inequities.

To identify relevant publications, we conducted a systematic literature search on Scopus, looking for combinations of keywords in the title, keywords, and abstract fields. Specifically, we ran a more general search where words like “cause”, “mechanism”, and “determinants” were paired with “green space” and “inequities” (alongside synonyms; see Table 1). We also ran more targeted searches after identifying highly-cited empirical papers in this field, which described key mechanisms contributing to inequities (e.g., Boone et al. 2009). These targeted searches included keywords such as “redlining”, “nonprofit”, “gentrification”, “white flight”, and “disinvestment” alongside “green space” and “inequities”. We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al. 2021) for our literature search (see Figure 1). With our initial search, we found 2,045 unique publications.

[Insert Table 1 here]

We reviewed the title, abstract, and full text of the publications to exclude those publications that did not meet our inclusion criteria. At the title stage, we excluded publications that clearly did not cover the broad topic of the review (e.g., focused on green space-health associations) or that did not focus on U.S. cities. At the abstract stage, we mostly excluded publications that focused on spatial analyses of green space distribution without examining any mechanism. At the full-text stage, we primarily excluded publications that focused on broader environmental amenities and not specifically green space.

[Insert Figure 1 here]

After a full-text screening, we found 49 publications that met our inclusion criteria. Based on a backward reference search on the included publications, we found 20 additional publications that also met our inclusion criteria. We also found 8 additional publications in our libraries meeting our inclusion criteria. In total, we identified 77 publications meeting our

inclusion criteria (70 journal articles, 2 book chapters, and 5 books). During the screening process, the two authors checked titles, abstracts, and titles independently. At the title and abstract review phases, a publication advanced to the next round if either author marked the publication as included. At the full-text review stage, the two authors resolved the few diverging opinions about inclusion by discussing specific publications. Agreement rates were high at each stage (98.3% for titles, 97.1% for abstracts, and 87.5% for full texts).

We then extracted information from the 77 publications describing the study characteristics – such as the green space type, city, and method – and the key findings related to the goal of this review. We calculated descriptive statistics for the study characteristics to provide a general picture of this literature. We then conducted a content analysis of the main findings of the 77 publications and identified 10 distinct mechanisms that contribute to green space inequities (see Results section). This content analysis process involved each author carefully reading the study findings; extracting the most relevant findings and organizing them in a spreadsheet; engaging in an iterative process of creating mechanisms (including brainstorming activities); and consolidating certain mechanisms that were initially separate. We further categorized these mechanisms under two macro-mechanisms – residential segregation and unequal green space investment. This also helped us establish connections between some mechanisms contributing to green space inequities in U.S. cities.

Results

Characteristics of included publications

As indicated earlier, we identified 77 publications that met our inclusion criteria (see Table 2). Twelve (15.6%) of the studies focused on the U.S. nationally, and 65 (84.4%) were about specific U.S. cities. Based on green space type, 33 (42.8%) of the studies focused on parks, 14 (18.2%) on trees, 4 (5.2%) on greenness (measured through the Normalized

Difference Vegetation Index), 3 (3.9%) on urban forest, 1 on (1.3%) green resort space, 12 (15.6%) focused on a combination of either parks, trees, gardens, urban forest and recreational areas, and 10 (13.0%) did not specify the green space type but rather used the terms green space, green infrastructure, and open space. Additionally, 40 publications (51.9%) used quantitative methods, 13 (16.9%) used qualitative methods, 17 (22.1%) used mixed methods, and 7 (9.1%) were literature reviews.

This research has been published in journals and books spanning several disciplines (based on aims and scope), including 19 (24.7%) publications in urban planning, 11 (14.3%) in urban geography, 2 (2.6%) in leisure and recreation, 2 (2.6%) in sociology, 2 (2.6%) in public administration, 1 (1.3%) in public health, 1 (1.3%) in political science, and 39 (50.6%) in interdisciplinary outlets. The journals with the most articles identified through our search are *Landscape and Urban Planning* (7 articles), *Cities* (5 articles), and *Environmental Justice* (4 articles).

[Insert Table 2 here]

Major mechanisms contributing to green space inequities

We first identified 10 distinct mechanisms that contributed to green space inequities, which are part of two macro-mechanisms: residential segregation and unequal green space investment (see Figure 2 and Table 2). Mechanisms creating residential segregation include the historical and current policies, plans, and practices that contribute to separating populations by race/ethnicity and socioeconomic status. We classified two of the 10 mechanisms as contributing solely to residential segregation: racially restrictive covenants and exclusionary zoning/subdivision regulations (Boone et al. 2009; Kephart 2022; Rigolon and Németh 2021). Figure 2 shows when each of the 10 mechanisms started to occur; for

example, exclusionary zoning started in the early 1900s but is still occurring today, and suburbanization began around the 1950s and has continued since then.

[Insert Figure 2 here]

Mechanisms describing uneven green space investments contributed to directing more funding to neighborhoods mainly inhabited by non-Hispanic white people and by middle- and upper-class people. We classified several mechanisms as primarily contributing to uneven green space investment, such as City Beautiful and New Deal disproportionate investment, public disinvestment in green space, nonprofit involvement, green gentrification, recent city plans and funding policies, and barriers to greening private land in disadvantaged areas (Nowak, Ellis, and Greenfield 2022; Perkins 2010; Rigolon and Németh 2021; Grabowski, McPhearson, and Pickett 2023; Dong et al. 2023). Finally, mechanisms such as redlining, suburbanization and white flight, and green gentrification pertain to both macro-mechanisms, as they involve where different demographic groups can afford to live and which areas receive green space investment – see more below for a discussion (Boone et al. 2009; Anguelovski 2016).

We argue that each macro-mechanism is necessary but not sufficient to create green space inequities, so the two macro-mechanisms play complementary roles. Without residential segregation (i.e., with demographic groups integrated geographically), uneven green space investments would be unlikely to result in systematic differences in green space provision by income and race/ethnicity (see Kephart 2022, for a review on segregation). If green space investments were distributed equally across a city, low-income communities of color would not experience unequal distributions of green space even if they were residentially segregated from affluent white people (see Denver’s case discussed in Rigolon

and Németh 2021). In the sections below, we provide more details about the 10 mechanisms and the complementary roles of the two macro-mechanisms.

Several organization types created the 10 mechanisms contributing to green space inequities, including cities, the federal government, developers, and nonprofits. Specifically, cities are responsible for green space investment levels and distribution (City Beautiful and New Deal disproportionate investment, public disinvestment in green space, and recent city plans and funding policies) as well as land use decisions contributing to where different demographic groups live (exclusionary zoning and subdivision regulations as well as green gentrification, which might be fostered by limited affordable housing). The U.S. federal government has implemented initiatives and policies such as the Home Owners' Loan Corporation's "redlining" maps (see below) and subsidies to suburbanization. Also, developers implemented racially restrictive covenants in new subdivisions starting around the 1910s, and much later nonprofit organizations got involved in green space creation and maintenance. The involvement of these different organizations shows that many actors might have contributed to green space inequities in the U.S.

Racially restrictive covenants

Developers of residential subdivisions in many U.S. cities started using racially restrictive covenants in the 1910s to prevent Black people and other people of color from living in affluent white areas and to preserve property values in these areas (Boone et al. 2009; Walker, Keeler, and Derickson 2024). Racially restrictive covenants were contracts attached to property deeds that prohibited non-white people from owning or renting properties in certain subdivisions (García, Gee, and Jones 2016; Boone et al. 2009). Neighborhood associations and the real estate industry enforced these covenants, which were enforceable until 1948 (García, Gee, and Jones 2016; Boone et al. 2009; Rigolon and Németh

2021). Racially restrictive covenants resulted in significant residential segregation between white and Black communities in many U.S. cities (García, Gee, and Jones 2016; Boone et al. 2009; Rigolon and Németh 2021; Walker, Keeler, and Derickson 2024).

Several papers in our review showed evidence of the connections between racially restrictive covenants and green space inequities (see Table 2), with one finding that neighborhoods that had such covenants still have more tree canopy than neighborhoods without covenants today (Walker, Keeler, and Derickson 2024). Segregation created by covenants resulted in green space inequities because covenants contributed to creating crowded Black-majority neighborhoods that were often the only residential option for Black people, leaving little space for amenities like green spaces in such neighborhoods (Rigolon and Németh 2021; Kephart 2022; Boone et al. 2009; Walker et al. 2023; Grove et al. 2018). Also, racially restrictive covenants led to lower provision of green space for people of color by prohibiting them from living in affluent white neighborhoods (Kephart 2022; Rigolon and Németh 2021; Boone et al. 2009; Walker et al. 2023; Walker, Keeler, and Derickson 2024). In the early 1900s, such affluent neighborhoods received good public investments in green space due to their higher property tax revenue generation, parks provided by developers to make subdivisions more desirable, and advocacy by real estate developers to create public parks in covenanted neighborhoods (Kephart 2022; Rigolon and Németh 2021; Boone et al. 2009; Walker et al. 2023). We provide more details about these mechanisms that contribute to disparate investments in some of the subsequent sections.

Exclusionary zoning and subdivision regulations

Historically, exclusionary zoning and subdivision regulations were used to restrict low-income people of color from living in desirable neighborhoods that were inhabited by white residents, and which also happened to have good green space provision (Boone et al.

2009; Rigolon and Németh 2021; Kephart 2022; Grove et al. 2018; Trounstein 2016).

Exclusionary zoning generally describes the use of zoning standards that make housing unaffordable – such as single-family units only on large lots – to prevent low-income people from living in certain neighborhoods (Rigolon and Németh 2021). Similar to exclusionary zoning, exclusionary subdivision regulations in the early 1900s were developer-driven regulations requiring certain standards in new subdivisions to attract only wealthy residents (Rigolon and Németh 2021).

A few papers showed that exclusionary zoning and subdivision regulations established in the 1900s-1930s contributed to green space inequities (see Table 2). Specifically, Denver's first zoning ordinance in 1925 established exclusionary zoning areas in affluent neighborhoods that also had large provisions of green space (Rigolon and Németh 2021). Using a form of racially exclusionary zoning, Baltimore's 1910 ordinance enforced the segregation of white people from people of color, and the latter were restricted to live in a few highly-crowded park-poor neighborhoods (Boone et al. 2009). Other research suggests that zoning was used as a way to exclude low-income people of color from areas with good provisions of public good (Trounstein 2018). These land use provisions were established during the formative years of many American cities, at a time of rapid park building when entire subdivisions were developed (Boone et al. 2009; Rigolon and Németh 2021).

Exclusionary zoning requiring single-family homes only on large lots is still in place around many large parks in American cities today; thus, these land use provisions established early in the 20th century continue to affect contemporary green space inequities (Boone et al. 2009; Rigolon and Németh 2021; Grove et al. 2018).

City Beautiful and New Deal disproportionate investment

During the City Beautiful and New Deal eras (1900s-1930s), many U.S. cities made large investments in parks and other green spaces to boost their prestige and stimulate economic development (Boone et al. 2009; Rigolon and Németh 2021; Grove et al. 2018). Most investments in the largest and most expensive parks were directed to affluent white neighborhoods, from which people of color were excluded via racially restrictive covenants and exclusionary land use provisions (Boone et al. 2009; Grove et al. 2018; Rigolon and Németh 2021; Kephart 2022; Walker et al. 2023). In Baltimore and Denver, for example, a few small-sized parks and playgrounds were allocated to immigrant-dominated and majority-Black neighborhoods, and most large parks and parkways were sited in white areas that paid higher property taxes (Boone et al. 2009; Rigolon and Németh 2021). In this period, Denver's park funding system involved four separate districts; within each district, park investment was proportional to the property tax revenue collected (Rigolon and Németh 2021). Thus, wealthier districts (which were almost exclusively white) where higher property taxes were collected also received more park investment (Rigolon and Németh 2021). Linking park funding to property taxes also allowed wealthier communities to directly get back some of their taxes in terms of public green space and higher property values (Trounstine 2018).

Additionally, uneven green space investments during this period were often due to advocacy from wealthy neighborhood associations and real estate developers, who held significantly more political power than low-income communities of color (Boone et al. 2009; Rigolon and Németh 2021; Walker et al. 2023). These disproportionate investments need to be seen in the context of segregated parks and beaches, wherein Black and other racial/ethnic minority people could not use open spaces dedicated to white people only (Boone et al. 2009; Eisenhauer 2021; Rigolon and Németh 2021).

Redlining

In the U.S., redlining refers to a set of policies that contributed to disinvestment in low-income communities of color, including disinvestment in green space (Nardone et al. 2021; Nowak, Ellis, and Greenfield 2022; Schinasi et al. 2022) and to reinforcing residential segregation by race (Aaronson, Hartley, and Mazumder 2021; Faber 2020). In 1933, the federal government established the Home Owners' Loan Corporation (HOLC), which was mainly intended to relieve homeowners defaulting on their mortgages in the U.S. (Michney 2022; Schinasi et al. 2022). The HOLC developed “security” maps to designate investment risk levels for various neighborhoods based on factors such as previous home values, proximity to noxious land uses such as industrial areas, and racial demographics (Nardone et al. 2021; Schinasi et al. 2022).

The main element of the HOLC maps was the definition of four mortgage security risk classes – “Class A, the highest grade (Best), was colored green and was deemed as a minimal risk for lenders. Class B (Still desirable) was colored blue, Class C (Declining) was colored yellow, and the lowest grade, Class D, was colored red and considered hazardous” (Nowak, Ellis, and Greenfield 2022, p.2). When the maps were drawn, more people of color than white residents lived the red graded areas, or were “redlined” (Nardone et al. 2021; Namin et al. 2020; Nowak, Ellis, and Greenfield 2022). Thus, lending decisions made by HOLC, which were later reflected in security maps, made it difficult for people residing in redlined neighborhoods to secure mortgage financing and own a home (Michney 2022; Nowak, Ellis, and Greenfield 2022). Also, redlining contributed to reinforcing racial segregation by potentially encouraging white households to move away from redlined neighborhoods or from cities for which HOLC maps were created due to the racial stigma associated with the maps (Aaronson, Hartley, and Mazumder 2021; Faber 2020).

The legacy of redlining on green space distribution is still experienced today. Areas categorized as a higher risk in the HOLC maps (i.e., red or yellow), which are still mostly inhabited by low-income people of color, currently have lower tree canopy cover (Grove et al. 2018; Hoffman, Shandas, and Pendleton 2020; Locke et al. 2021; Nowak, Ellis, and Greenfield 2022; Schell et al. 2020; Walker, Keeler, and Derickson 2024), lower greenness measured via NDVI (Napieralski et al. 2022; Nardone et al. 2021), less street greenery (Yang et al. 2023), and lower park acreage (Rigolon and Németh 2021) than areas considered at lower risk. Although redlining is no longer public policy, contemporary green space inequities are one of its legacies (Locke et al. 2021; Namin et al. 2020; Nowak, Ellis, and Greenfield 2022; Schell et al. 2020). Further, a Minneapolis study found that within each HOLC grade, areas with racially restrictive covenants have more tree canopy than non-covenanted areas (Walker, Keeler, and Derickson 2024). Some studies have shown that redlining, by contributing to less green space provision in disadvantaged communities, also led to increased climate vulnerabilities related to increased heat in such communities (Hoffman, Shandas, and Pendleton 2020; Napieralski et al. 2022; Walker, Keeler, and Derickson 2024).

Studies on redlining and green space inequities have provided some explanations of the mechanisms through which redlining contributed to lower green space provision in disadvantaged areas. First, lower greenness and tree canopy in redlined areas might be due to the lower availability of private resources to plant and take care of vegetation, as it was harder for people in those areas to own homes due to limited access to lending and to accumulate wealth (Nowak, Ellis, and Greenfield 2022; Walker, Keeler, and Derickson 2024). Second, reduced private investment due to limited mortgage availability in redlined areas (Nowak, Ellis, and Greenfield 2022) might have contributed to reduced public investment, as some cities defined park funding systems wherein property taxes collected in a

given area were spent to fund parks in the same area (Rigolon and Németh 2021). Third, redlined neighborhoods have included more industrial and commercial land in the past and recent years, and thus have less residential land than neighborhoods ranked as more “desirable” (Napieralski et al. 2022). Because property owners plant fewer trees and cities build fewer parks in industrial and commercial areas than in residential areas, redlined communities might have less greenery than other neighborhoods (Napieralski et al. 2022). Fourth, neighborhoods ranked as more desirable in HOLC maps might have had more political power than redlined areas when advocating for park investments (Hoffman, Shandas, and Pendleton 2020; Locke et al. 2021; Walker, Keeler, and Derickson 2024).

Suburbanization and white flight

After World War II, suburbanization and white flight led to disinvestment in cities where many low-income people of color kept living (Boone et al. 2009; Bustad and Andrews 2020; Kruse 2005; Low, Taplin, and Scheld 2005; Rigolon and Németh 2021). White flight is part of broader suburbanization trends and involves white people leaving central cities to move to still-segregated suburban cities (Bustad and Andrews 2020; Kephart 2022; Kruse 2005; Low, Taplin, and Scheld 2005; Rigolon and Németh 2021). White residents also left cities to avoid the effects of desegregation laws that enabled people of color to live in every neighborhood and to use central city parks that were previously dedicated to white people (Kruse 2005). As many affluent white residents relocated to suburbs, several central cities lost population, some properties became vacant, and property and sale tax revenues declined (Boone et al. 2009; Bustad and Andrews 2020; Kruse 2005). Suburban areas, where many white people relocated to thanks to federal subsidies, experienced a construction boom and built new larger parks thanks to a growing tax base (Boone et al. 2009; Rigolon and Németh 2021).

These processes – central cities shrinking and suburbs growing – likely contributed to green space inequities between white suburbs and more diverse central cities (Boone et al. 2009; Rigolon and Németh 2021). These widening green space inequities were in large part due to stark differences in fiscal capacity between central cities and suburbs, wherein the first lost wealthy residents and consequently sales and property taxes, and the latter gained such residents and their capacity to generate tax dollars (Boone et al. 2009; Rigolon and Németh 2021; Trounstin 2018). Because suburban cities (mostly white and affluent) saw an increased tax base thanks to new residents, they were able to invest significant funding in green space, and they also obtained green space via subdivision ordinances requiring developers to dedicate land for parks (Boone et al. 2009; Rigolon and Németh 2021). Central cities were left with limited resources to care for parks and build new ones compared to growing suburbs, which also implemented exclusionary zoning ordinances to maintain their affluent white demographic composition (Boone et al. 2009; J. J. T. Connolly and Anguelovski 2021; Kruse 2005; Rigolon and Németh 2021; Trounstin 2018).

Public disinvestment in green space

As political attitudes shifted toward fiscal conservatism and a smaller government in the second half of the 20th century, public funding for green space and recreation was gradually lowered, particularly harming central cities that had already experienced disinvestment due to white flight (Bustad and Andrews 2020; Low, Taplin, and Scheld 2005; Perkins 2010; 2013). For example, the passage of California’s Proposition 13 in 1978, a measure to significantly curb property tax increases, resulted in a substantial loss of funding for city and county parks departments (Pincetl 2003). Public disinvestment in green space has been linked to the rise of neoliberalism in public governance, involving reduced taxation to boost economic development driven by private enterprise (Bustad and Andrews 2020;

Perkins 2010; 2013). Although neoliberalism has been presented as a race-neutral economic development approach, these cuts in public funding for green space have systematically harmed low-income people of color (Bustad and Andrews 2020).

As park funding was cut, many parks in central cities (where low-income people of color continued to be concentrated) fell into disrepair and often became the object of vandalism (Low, Taplin, and Scheld 2005; Perkins 2010; 2013), and many recreation centers serving low-income communities of color were closed (Bustad and Andrews 2020). Such funding cuts occurred during periods (1970s to early 2000s) when cities became more diverse due to continued white flight and increased immigration (Low, Taplin, and Scheld 2005; Perkins 2010). Thus, dramatically reduced public funding for parks due to lower tax revenues reduced cities' capacity to maintain, improve, and create green space, limiting potential efforts to address existing inequities.

Nonprofits involvement

The aforementioned reduction in public funding for green space stimulated the creation of nonprofit organizations working on parks and other open spaces, which is another effect of the rise of neoliberalism (Bustad and Andrews 2020; Holtzman 2021; Joassart-Marcelli 2010; Perkins 2010; Willse 2023). To fill gaps left by public agencies, nonprofits created new parks, maintained them adequately, ran recreation programs, and developed tree planting programs (Joassart-Marcelli, Wolch, and Salim 2011; Rigolon 2019; Heynen, Perkins, and Roy 2006). Central Park in New York City, for example, was significantly transformed from an undermaintained place to a highly-visited well-maintained amenity by the first private park conservancy in the U.S.: The Central Park Conservancy (Holtzman 2021; Krinsky and Simonet 2011).

Several studies show that nonprofits creating and maintaining green space led to green space inequities (Brecher and Wise 2008; Cheng, Yang, and Deng 2022; Holifield and Williams 2014; Holtzman 2021; Joassart-Marcelli 2010; Joassart-Marcelli, Wolch, and Salim 2011; Kropp 2024; Loughran 2014; Nisbet and Schaller 2020; Pitas, Powers, and Mowen 2021; 2022; Rigolon and Németh 2018; Willse 2023). This is mainly because nonprofits, mostly funded by philanthropies and corporations, are more likely to flourish and support green spaces in well-off areas than in disadvantaged communities (Joassart-Marcelli, Wolch, and Salim 2011; Perkins, 2010; Willse 2023). Specifically, in cities with active park conservancies working in large flagship parks (e.g., Central Park in New York City), parks supported by conservancies (generally located in affluent areas) have better maintenance than parks that do not receive private funding (often located in low-income communities of color) (Holtzman 2021). Additionally, green space-supporting nonprofits, more likely to be active in well-educated communities, help pass ballot initiatives to fund green space and conservation through their advocacy (Pincetl 2003; Willse 2023).

Although most studies – including two national-level analyses (Cheng, Yang, and Deng 2022; Willse 2023) – find that nonprofits can worsen green space inequities, at least one study showed that equity-oriented nonprofits have improved the provision of parks in low-income communities of color in Los Angeles (Rigolon 2019). A series of park equity policies passed in California and Los Angeles in the late 2000s helped this equity-oriented work by nonprofits (Rigolon 2019). Thus, the discrepancy between the findings of Rigolon’s (2019) study and those of other research on nonprofits contributing to green space inequities (e.g., Cheng, Yang, and Deng 2022; Perkins 2010) might be attributed to the absence of policies in other states and at the federal level that support the work of equity-oriented nonprofits.

Green gentrification

Some of the efforts to add much-needed green space to disadvantaged areas, including those by nonprofits, have backfired (Rigolon and Németh 2018). Specifically, in some cases, urban greening initiatives such as parks and green stormwater infrastructure have contributed to gentrification in disadvantaged areas (Mullenbach 2022; Anguelovski 2016; Anguelovski, Connolly, et al. 2022; Anguelovski, Ranganathan, and Hyra 2021; Cole and Immergluck 2021; Gould and Lewis 2017; Anguelovski, Brand, et al. 2022; Raia-Hawrylak 2014; Riedman et al. 2022; Rigolon and Németh 2020; Shokry, Connolly, and Anguelovski 2020; Walker 2021). Such “green gentrification” occurs when new or improved green spaces become a trigger for neighborhood change, resulting in changes in demographics, real estate, and consumption patterns (Gould and Lewis 2017).

Green gentrification can lead to the displacement of low-income people, especially renters, from areas near new green spaces (Gould and Lewis 2017; Shokry, Connolly, and Anguelovski 2020; Walker 2021). Hence, green gentrification likely contributes to green space inequities, as many low-income people of color might not be able to afford to live near new green spaces, including highly-prized parks such as New York City’s High Line and Atlanta’s Beltline (Anguelovski, Connolly, et al. 2022; Rigolon and Németh 2020; Shokry, Connolly, and Anguelovski 2020). Also, these processes might contribute to low-income communities of color living in areas with less green space and thus higher vulnerabilities to climate threats, such as flooding and extreme heat (Shokry, Connolly, and Anguelovski 2020; Walker 2021).

Recent city plans and funding policies

Several studies focused on how green space plans, and funding policies, and overall investments in the last 25-30 years contributed to maintaining or reinforcing green space

inequities (see Table 2). Research showed that such recent investments within cities failed to prioritize equity when creating new parks (J. J. T. Connolly and Anguelovski 2021; Rigolon and Németh 2021; Wolch, Wilson, and Fehrenbach 2005), installing green stormwater infrastructure (Gerlak et al. 2021; Park 2023; Walker 2021; Zoll 2021; Zuniga-Teran et al. 2021), and planting trees (Anderson et al. 2023; Foster, Dunham, and Bukowska 2024; Garrison 2019; Ock et al. 2024; Varuzzo and Harvey 2017). Yet at least one study found mixed findings across three cities regarding the equitable distribution of green stormwater infrastructure, with such investment following flooding risk more than neighborhood demographics (Pallathadka et al. 2022). Further, several city-level analyses found that municipal park investments per capita are higher in cities with higher household income, lower shares of people of color, lower racial segregation and heterogeneity (thus predominantly white cities), and lower income inequality (thus homogeneously affluent cities) (Joassart-Marcelli 2010; Leon-Moreta, Totaro, and Dixon 2020; Rigolon, Browning, and Jennings 2018; Trounstein 2016; 2018).

A few papers reviewed city plans for green infrastructure (Grabowski, McPhearson, and Pickett 2023) and urban forestry (Grant et al. 2022; Kolosna and Spurlock 2019) and found that the plans had a limited focus on equity and often failed to recognize existing inequities. For example, one found that only 13% of green infrastructure plans in a sample of U.S. cities included equity considerations (Grabowski, McPhearson, and Pickett 2023). Yet one study in California found that most general plans of the sampled cities included equity-oriented green space policies (Brinkley and Wagner 2024), suggesting that, as for nonprofit involvement, recent green space initiatives in the state might not follow more inequitable national patterns.

Some studies suggest reasons why recent green space investments did not go disproportionately to disadvantaged communities. First, some funding policies do not include measurable criteria to direct monies to disadvantaged communities, and thus power differentials in local politics result in funding being allocated without equity considerations (Anderson et al. 2023; Rigolon, Giamarino, and Christensen 2024; Wolch, Wilson, and Fehrenbach 2005). Second, other funding policies require neighborhoods and community organizations to apply for competitive grants, and affluent white neighborhoods tend to have more capacity to apply for these funding opportunities than disadvantaged neighborhoods (Gerlak et al. 2021; Wolch, Wilson, and Fehrenbach 2005; Zuniga-Teran et al. 2021). Third, many city policies require or incentivize the inclusion of green stormwater infrastructure in residential developments, and such developments might be more frequently built in affluent or gentrifying neighborhoods than in disinvested communities (Park 2023; Walker 2021). Fourth, city-level studies attributed disparities between cities to fiscal and institutional capacity differences between wealthier and less affluent cities (richer cities have more money to invest in parks) and to the fact that more diverse and segregated cities are more politically divided, and thus less likely to invest in public goods (Joassart-Marcelli 2010; Leon-Moreta, Totaro, and Dixon 2020; Rigolon, Browning, and Jennings 2018; Trounstone 2016; 2018).

Barriers to greening private land in disadvantaged areas

Some studies reported that low-income communities of color face barriers to planting and maintaining trees on private land due to water availability and cost, general cost and time needed to care for trees, and limited control of landscaping among renters (see Table 2). Specifically, a Los Angeles study found that low-income communities of color include vegetation that is more drought-sensitive, and this might be due to disparities in water use linked to water costs (Dong et al., 2023). Similarly, a Phoenix study found that low-income

neighborhoods are less green than higher-income neighborhoods because of either their limited water availability or their lower ability to pay for water (Jenerette et al., 2011). Several other studies showed that inequities in residential tree canopy might be attributed to the resources needed to plant and take care of trees (including watering) and to renters having less control over their homes and yards than homeowners, as disadvantaged neighborhoods tend to have higher shares of renters (Donovan and Mills 2014; Heynen, Perkins, and Roy 2006; Locke and Grove 2016; Perkins, Heynen, and Wilson 2004). Some authors have linked green space inequities resulting from these barriers to climate inequities because, due to low green space provision, disadvantaged communities are more exposed to climate threats such as extreme heat (Dong et al. 2023; Jenerette et al. 2011).

Discussion

Two complementary macro-mechanisms contributing to green space inequities

In this review, we synthesized and connected mechanisms that have contributed to green space inequities, including historical and current policies, plans, and practices. To our knowledge, no review has examined such mechanisms holistically across more than one hundred years of urban history in the U.S. Specifically, we analyzed how procedural injustices in policies, plans, and practices resulted in distributional injustices in the provision of green space. We found 77 publications that focused on the topic, which used a wide variety of methods and covered several geographies across the U.S.

Based on our analysis, we identified 10 distinct mechanisms contributing to green space inequities in the U.S., which we further categorized into two main macro-mechanisms: residential segregation and unequal green space investment. We classified two out of the 10 mechanisms (racially restrictive covenants and exclusionary zoning and subdivision regulations) as contributing solely to residential segregation, describing processes leading to

the separation of populations by race/ethnicity and socioeconomic status. Mechanisms describing unequal green space investment tend to distribute more green space funding to affluent white neighborhoods than neighborhoods inhabited by low-income people of color. The mechanisms we classified in this group include City Beautiful and New Deal disproportionate investment, public disinvestment in green space, nonprofit involvement, green gentrification, recent city plans and funding policies, and barriers to greening private land in disadvantaged areas. Further, we considered redlining, suburbanization and white flight, and green gentrification as part of both macro-mechanisms, since they are associated with where different demographic groups can afford to live and how green space investment is distributed.

Based on our analysis of the findings of the included publications, we argue that each macro-mechanism, on its own, is necessary but not sufficient to generate distributional inequities in green space provision. Indeed, policies, plans, and practices to create segregated neighborhoods were motivated by racism and the desire to preserve property values (Boone et al. 2009; Kephart 2022; Rigolon and Németh 2021; Walker et al. 2023; Walker, Keeler, and Derickson 2024). Without residential segregation by race and class, it is unlikely that the disparate green space investments would have resulted in systemic green space inequities (see Kephart 2022). Also, equal distributions of green space investments would not have led to today's inequities even if neighborhoods were racially segregated (Rigolon and Németh 2021). Uneven distributions of green space investments have occurred over time because affluent white neighborhoods hold significant power, which in part comes from their homogeneous racial demographics values (Boone et al. 2009; Rigolon and Németh 2021; Trounstein 2016; 2018; Walker et al. 2023). Thus, the two macro-mechanisms are distinct but complementary in creating distributional inequities in green space provision (see Boone et al. 2009; Walker et al. 2023). Studies in Baltimore and Minneapolis showed that, in the first half

of the 20th Century, neighborhood associations and real estate developers implemented exclusionary initiatives such as racially restrictive covenants while at the same time advocating for green space investments in such exclusionary areas (Boone et al. 2009; Walker et al. 2023).

Our two macro-mechanisms relate to the analytical framework proposed by Grove et al. (2018), which sheds light on historical and current patterns of environmental injustice by focusing on the interplay among distributional and procedural injustice over time. Specifically, both our macro-mechanisms and Grove et al.'s (2018) framework consider the interactions among past and present actions (procedural injustices) that contribute to distributional injustices in environmental amenities and suggest a holistic view of the challenges to tackle to achieve equity. Additionally, the mechanisms we identified partially align with Kotsila et al.'s (2022) drivers of injustices in urban sustainability initiatives. In particular, “racialized or ethnically exclusionary urbanization” resonates with the mechanisms contributing to residential segregation in our review (e.g., racially restrictive covenants); “exclusive access to the benefits of urban sustainability infrastructure” is similar to the mechanisms that lead to unequal green space investment (e.g., redlining); and “the growth imperative and neoliberal urbanism” include the green gentrification processes we also identified (pp. v-vi). Thus, the mechanisms contributing to green space inequities might be part of broader processes that shape inequitable sustainability initiatives.

Mechanisms and their connections

In this section, we summarize the ten mechanisms we identified, put some of them into context via additional literature, and highlight connections between various mechanisms, as shown in Figure 2. The earliest accounts of mechanisms contributing to green space inequities are racially restrictive covenants and exclusionary zoning and subdivision

regulations (Boone et al. 2009; Kephart 2022; Rigolon and Németh 2021; Walker et al. 2023; Walker, Keeler, and Derickson 2024). Neighborhoods with such exclusionary policies were able to obtain significant green space investment in the first half of the 20th Century (City Beautiful and New Deal eras) thanks to parks built by developers, effective advocacy by their wealthy residents, and park funding systems that directed more investments to areas with higher property tax revenues (Boone et al. 2009; Rigolon and Németh 2021; Walker et al. 2023). The linkage between racial segregation and green space distribution was also highlighted in South Africa, where the Apartheid system has been connected to green space inequities (Venter et al. 2020).

Moreover, redlining contributed to green space inequities by limiting homeownership opportunities (which might lead to more tree planting), concentrating non-residential land uses in redlined areas, and consolidating political power in areas listed as more desirable (Hoffman, Shandas, and Pendleton 2020; Locke et al. 2021; Napieralski et al. 2022; Walker, Keeler, and Derickson 2024). Besides having a lower green space provision (Nardone et al. 2021; Nowak, Ellis, and Greenfield 2022; Schinasi et al. 2022), areas that were redlined also currently experience more environmental injustices related to air pollution, heat, and healthy food stores than those that were deemed as more desirable (Shaker et al. 2023; Lane et al. 2022; Wilson 2020).

Suburbanization and white flight starting in the 1950s also fueled green space inequities by contributing to differentials in fiscal capacity between central cities, where people of color continued to live, and suburban cities, where many middle and upper-class white people relocated (Boone et al. 2009; Rigolon and Németh 2021; Trounstein 2018). The limited fiscal capacity of central cities due to a decreased tax base was worsened starting in the 1970s with the advent of fiscal conservatism and neoliberal governance, which contributed to widespread disinvestment in public parks, particularly in central cities (Bustad

and Andrews 2020; Low, Taplin, and Scheld 2005; Perkins 2010). Public disinvestment in green space then indirectly contributed to the creation of nonprofit organizations working on green space provision, maintenance, and activation (Joassart-Marcelli, Wolch, and Salim 2011; Perkins 2010; Pincetl 2003). Over time, the increased involvement of nonprofits led to green space inequities by raising private dollars for parks in affluent communities and contributing to the creation of more green space funding sources in more well-educated areas (Cheng, Yang, and Deng 2022; Perkins 2010; Pincetl 2003; Willse 2023).

Recently, green gentrification might have contributed to maintaining green space inequities, as many low-income people in areas receiving new green space might eventually be displaced from those areas due to rising housing prices (Gould and Lewis 2017; Rigolon and Németh 2020; Shokry, Connolly, and Anguelovski 2020). Green gentrification and related displacement are global phenomena, with studies ranging between Barcelona, Spain (Isabelle Anguelovski et al. 2018), Melbourne, Australia (Sharifi et al. 2021), and Beijing, China (Wu and Rowe 2022).

Further, green space investments in the last 25-30 years might not have prioritized disadvantaged communities because funding policies do not include measurable equity criteria; such policies require community organizations to apply for competitive grants (with disparate capacity to do so between low-income and well-off communities); and disparities in fiscal and institutional capacity between wealthier and less affluent cities (Gerlak et al. 2021; Joassart-Marcelli 2010; Rigolon, Giamarino, and Christensen 2024). Also, some funding policies do not recognize the barriers that low-income communities face to planting trees on private land, including the limited availability and high cost of water, the time needed for tree care, and limited control of residential landscaping among renters (Dong et al. 2023; Donovan and Mills 2014; Heynen, Perkins, and Roy 2006; Jenerette et al. 2011).

Studies covering racially restrictive covenants, redlining, green gentrification, and barriers to greening private land in disadvantaged areas have suggested that green space inequities might contribute to higher climate vulnerabilities such as increased heat and flood risk in disadvantaged communities (Hoffman, Shandas, and Pendleton 2020; Napieralski et al. 2022; Walker, Keeler, and Derickson 2024; Shokry, Connolly, and Anguelovski 2020; Walker 2021; Dong et al. 2023; Jenerette et al. 2011). Thus, such mechanisms might have also contributed to climate inequities.

Limitations and future research

This review has some limitations that future empirical studies and reviews could help address. First, our review only focused on studies in the U.S., and it is unclear how much our findings might extend beyond the U.S. Thus, we call for more research on the determinants of green space inequities in a variety of countries, including those with a history of racial segregation and colonization (e.g., African and Latin American countries) and those without such history (e.g., many European countries). For example, studies could examine whether redlining in the Netherlands (Aalbers 2005) contributed to green space inequities in that country. Second, we identify significantly more studies covering certain mechanisms (e.g., redlining) than others (e.g., suburbanization and white flight). This might be because of the keywords we used or because few studies on the latter mechanisms actually exist. Further investigations into less-studied mechanisms are a needed addition to this body of literature.

Third, most studies we identified found evidence of associations between certain policies, plans, and practices and green space inequities, and many did not discuss how a given policy might affect green space distribution. Thus, more research is needed to establish causal linkages between specific policies and inequities and to elucidate the mechanisms underlying such linkages. Fourth, our review did not focus on whether policies, plans, and

practices that constituted procedural injustice contributed to interactional injustices. Future research could examine the connections between past and current procedural injustices and interactional injustices, building on work about the exclusion of Black residents from beaches and parks that were labeled as “white only” in the early to mid-1900s (Eisenhauer 2021) and studies about people of color’s experiences of green spaces in neighborhoods undergoing green gentrification (Harris, Rigolon, and Fernandez 2020). Additionally, we call for more research into the current projects and policies that are successfully addressing green space inequities while not contributing to gentrification and displacement.

Planning implications

The findings of this review offer insights to planners and policymakers who are interested in reversing green space inequities. First, it is important for planners to be aware of mechanisms contributing to inequities to plan for more equitable futures. In this sense, future plans and policies need to take into account the continuing effects of mechanisms that created inequities; without addressing underlying mechanisms (especially the most recent ones), it is very difficult to advance green space equity (Yañez et al. 2021).

Second, the two macro-mechanisms we identified (residential segregation and unequal green space investment) pose interesting questions for planners and policymakers. In theory, addressing one of the two macro-mechanisms might be sufficient to advance green space equity. Yet, if plans and policies only focused on disproportionately directing green space funding to disadvantaged communities, as some U.S. cities have done recently (Yañez et al. 2021), these investments might result in green gentrification and displacement, and thus inequities might be recreated. Thus, to move toward equity, such plans and policies would have to include provisions to limit the displacement of low-income renters (Oscilowicz et al. 2021). Alternatively, advancing green space equity by reducing residential segregation can

involve creating policies that allow low-income people of color to live in park-rich high-opportunities areas or building subsidized housing in such communities (Oscilowicz et al. 2021). Overall, recent research shows that most efforts to address green space inequities in the U.S. aim to provide more green space investment in low-income communities of color rather than desegregate cities by building affordable housing in high-opportunity areas, suggesting that the first might be the most viable option as the second might face Not-In-My-Backyard opposition (Hughey, Stewart, and Zeidler 2023; Rigolon et al. 2024; Yañez et al. 2021).

Third, we found that different public agencies (cities and federal governments) and different sectors of planning (green space, land use, housing) have contributed to creating green space inequities. Thus, plans and policies to ameliorate such inequities need to integrate different planning sectors and could involve different levels of government (Rigolon and Németh 2018). Also, community-based organizations have started to play a key role in advocating for green space equity, often pushing the public agencies that created inequities (e.g., cities) to take action to reverse them (Rigolon et al. 2024; Yañez et al. 2021). Specifically, cities that are committed to addressing these inequities might not be able to do so on their own, as they might rely on state or federal funding to build parks in disadvantaged communities, or state laws might preempt them from implementing anti-displacement policies such as rent control and inclusionary zoning (Goodman and Hatch 2023; Eldridge, Burrowes, and Spauster 2019). Despite these challenges, our findings suggest ways forward for planners and policymakers who are motivated to advance green space equity.

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Table 1: Literature search keywords

Search strategy	Keywords
1	("green space*" OR "greenspace*" OR "parks" OR "green infrastructure" OR "greenway*" OR "open space*" OR "trees") AND ("inequit*" OR "disparit*" OR "inequalit*") AND ("cause*" OR "mechanism*" OR "determinant*" OR "contribut*" OR "policy" OR "policies" OR "creat* green space inequit*" OR "creat* green space disparit*" OR "lead* to green space inequit*" OR "further* inequit*" OR "discrimination" OR "discriminate*")
2	("redlining" OR "racism" OR "segregation" OR "nonprofits") AND ("green space*" OR "parks" OR "greenspace*" OR "greenway*" OR "open space*") AND ("inequities" OR inequ* OR disparit* OR "equity")
3	("nonprofit*" OR "NGO" OR "nongovernmental organization" OR "nongovernmental organization" OR "community based organization*") AND ("green space*" OR "parks" OR "greenspace*" OR "greenway*" OR "open space*") AND ("inequities" OR inequ* OR disparit* OR "equity")
4	("gentrification" OR "green gentrification*") AND ("green space*" OR "parks" OR "greenspace*" OR "greenway*" OR "open space*") AND ("inequities" OR inequ* OR disparit* OR "equity")
5	("white flight") AND ("green space*" OR "parks" OR "greenspace*" OR "greenway*" OR "open space*") AND ("inequities" OR inequ* OR disparit* OR "equity")
6	("disinvestment*") AND ("green space*" OR "parks" OR "greenspace*" OR "greenway*" OR "open space*") AND ("inequities" OR inequ* OR disparit* OR "equity")

Table 2: Included publications based on the 10 distinct mechanisms

Mechanisms	Publications
Racially restrictive covenants ^a	Boone et al. 2009; García, Gee, and Jones 2016; Kephart 2022; Grove et al. 2018; Rigolon and Németh 2021; Walker et al. 2023; Walker, Keeler, and Derickson 2024
Exclusionary zoning and subdivision regulations ^a	Boone et al. 2009; Grove et al. 2018; Kephart 2022; Rigolon and Németh 2021; Trounstine 2016; 2018
City Beautiful and New Deal disproportionate investment ^b	Boone et al. 2009; Eisenhauer 2021; Rigolon and Németh 2021; Grove et al. 2018; Kephart 2022; Trounstine 2018; Walker et al. 2023
Redlining ^{a, b}	Nardone et al. 2021; Nowak, Ellis, and Greenfield 2022; Schinasi et al. 2022; Namin et al. 2020; Rigolon and Németh 2021; Locke et al. 2021; Hoffman, Shandas, and Pendleton 2020; Napieralski et al. 2022; Walker, Keeler, and Derickson 2024; Schell et al. 2020; Yang et al. 2023
Suburbanization and white flight ^{a, b}	Boone et al. 2009; Bustad and Andrews 2020; J. J. T. Connolly and Anguelovski 2021; Rigolon and Németh 2021; Low, Taplin, and Scheld 2005; Kephart 2022; Kruse 2005; Trounstine 2018
Public disinvestment in green space ^b	Bustad and Andrews 2020; Perkins 2010; 2013; Low, Taplin, and Scheld 2005; Pincetl 2003
Nonprofits involvement ^b	Perkins 2010; Holifield and Williams 2014; Joassart-Marcelli 2010; Joassart-Marcelli, Wolch, and Salim 2011; Rigolon 2019; Heynen, Perkins, and Roy 2006; Holtzman 2021; Krinsky and Simonet 2011; Kropp 2024; Brecher and Wise 2008; Cheng, Yang, and Deng 2022; Loughran 2014; Nisbet and Schaller 2020; Pitas, Powers, and Mowen 2021; 2022; Rigolon and Németh 2018; Willse 2023
Green gentrification ^{a, b}	Rigolon and Németh 2018; Anguelovski 2016; Anguelovski et al. 2022; Anguelovski, Connolly, et al. 2022; Anguelovski, Ranganathan, and Hyra 2021; Cole and Immergluck 2021; Gould and Lewis 2017; Mullenbach 2022; Raia-Hawrylak

	2014; Riedman et al. 2022; Rigolon and Németh 2020; Shokry, Connolly, and Anguelovski 2020; Walker 2021
Recent city plans and funding policies ^b	Anderson et al. 2023; Brinkley and Wagner 2024; J. J. T. Connolly and Anguelovski 2021; Foster, Dunham, and Bukowska 2024; Garrison 2019; Gerlak et al. 2021; Grabowski, McPhearson, and Pickett 2023; Grant et al. 2022; Joassart-Marcelli 2010; Kolosna and Spurlock 2019; Leon-Moreta, Totaro, and Dixon 2020; Ock et al. 2024; Pallathadka et al. 2022; Park 2023; Rigolon, Browning, and Jennings 2018; Rigolon, Giamarino, and Christensen 2024; Rigolon and Németh 2021; Trounstine 2016; 2018; Varuzzo and Harvey 2017; Walker 2021; Wolch, Wilson, and Fehrenbach 2005; Zoll 2021; Zuniga-Teran et al. 2021
Barriers to greening private land in disadvantaged areas ^b	Dong et al. 2023; Donovan and Mills 2014; Heynen, Perkins, and Roy 2006; Jenerette et al. 2011; Locke and Grove 2016; Perkins, Heynen, and Wilson 2004

Notes: ^a part of the “Residential segregation” macro-mechanism. ^b part of the “Disparate green space investment” macro-mechanism.

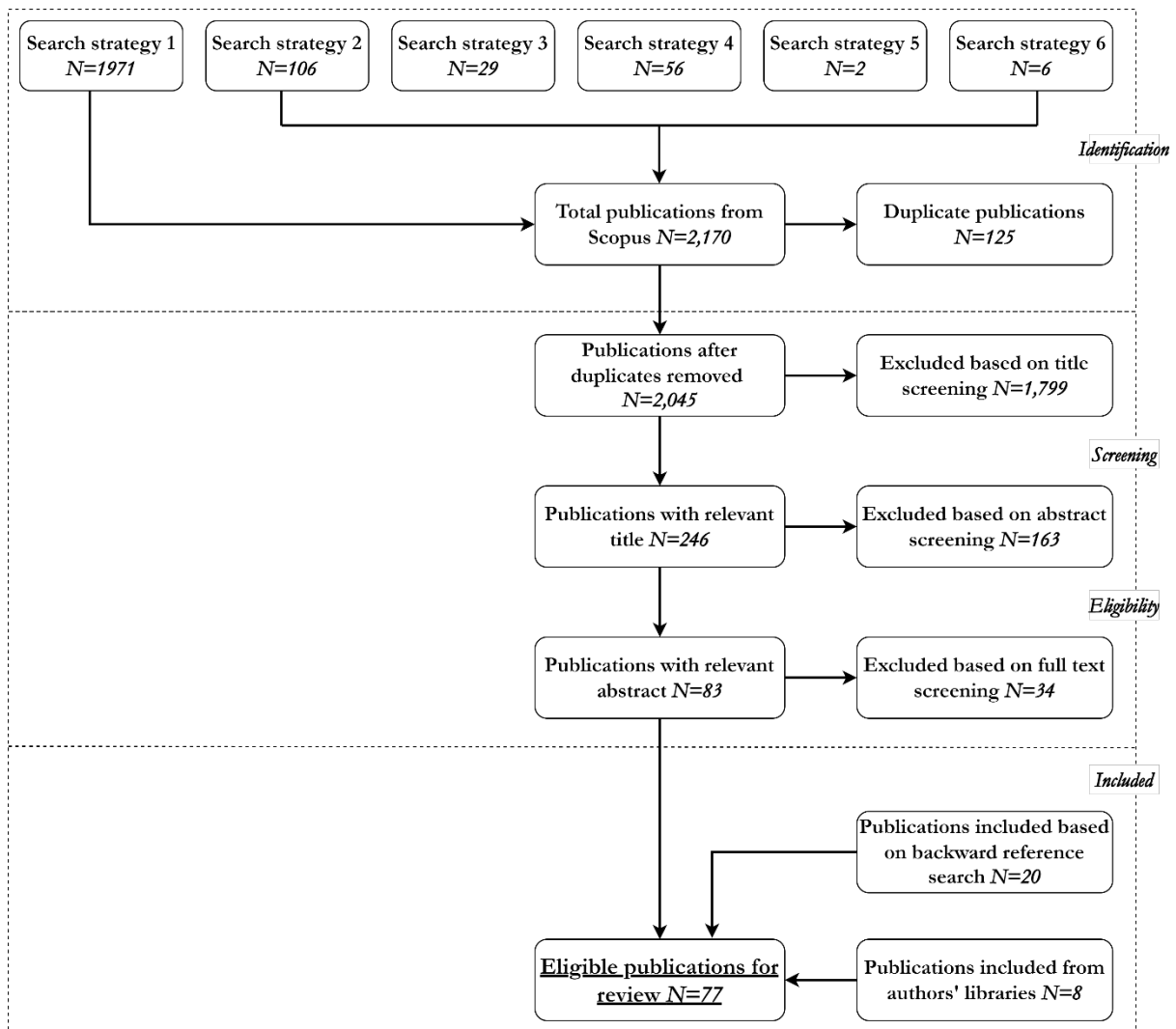


Figure 1: Literature search process based on the PRISMA flow diagram

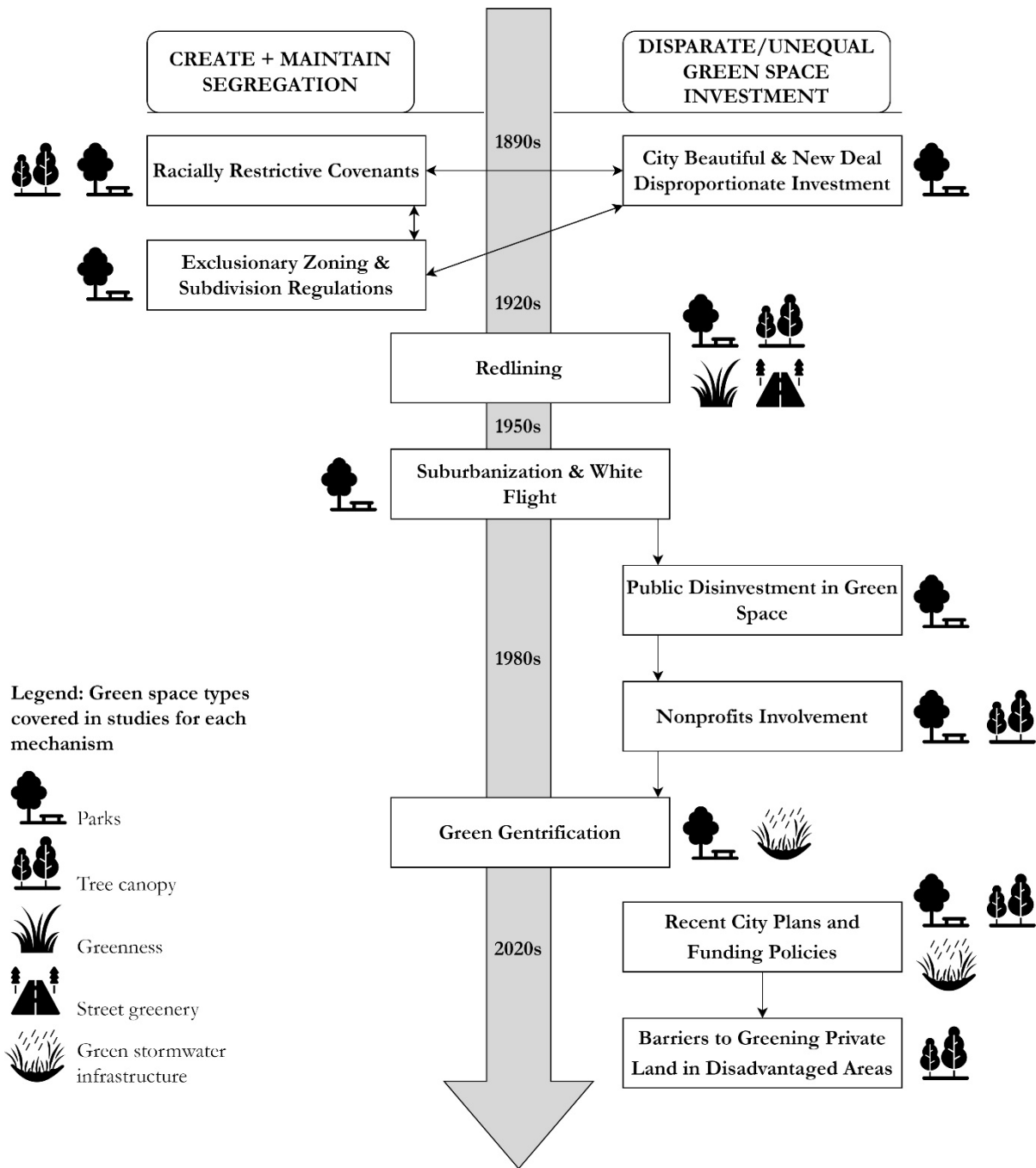


Figure 2: Historical and current policies, plans, and practices contributing to green space inequities in U.S. cities.