THE GREEN VISIONS PLAN

for 21st century southern california

AUGUST 2008

17. Access to Parks and Park Facilities in the Green Visions Plan Region

Chona Sister
John Wilson
Jennifer Wolch

Acknowledgements: Financial support for this work was provided by the San Gabriel and Lower Los Angeles Rivers and Mountains Conservancy, as part of the "Green Visions Plan for 21st Century Southern California" project.

Prepared for: San Gabriel and Lower Los Angeles Rivers and Mountains Conservancy
900 South Fremont Avenue, Alhambra, California 91802-1460

Cover Photo: Thanks to the Los Angeles County Parks and Recreation website for cover photos.

Preferred Citation: Sister C., Wilson, J., and Wolch, J. 2008. The Green Visions Plan for 21st Century Southern California. 17. Access to Parks and Park Facilities in the Green Visions Plan Region, University of Southern California GIS Research Laboratory and Center for Sustainable Cities, Los Angeles, California.

This report was printed on recycled paper.

USC Center for Sustainable Cities

GIS research laboratory
Department of Geography
College of Letters, Arts, and Sciences
University of Southern California
Los Angeles, CA 90089-0255
www.usc.edu/dept/geography/gislab

USC Viterbi School of Engineering

USC College of Letters, Arts & Sciences

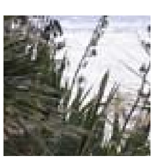
THE GREEN VISIONS PLAN

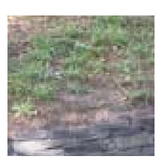
for 21st century southern california

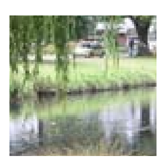
The mission of the Green Visions Plan for 21st Century Southern California is to offer a guide to habitat conservation, watershed health and recreational open space for the Los Angeles metropolitan region. The Plan will also provide decision support tools to nurture a living green matrix for southern California. Our goals are to protect and restore natural areas, restore natural hydrological function, promote equitable access to open space, and maximize support via multiple-use facilities. The Plan is a joint venture between the University of Southern California and the San Gabriel and lower Los Angeles Rivers and Mountains Conservancy, Santa Monica Mountains Conservancy, Coastal Conservancy, and Baldwin Hills Conservancy.

www.greenvisionsplan.net

TABLE OF CONTENTS







EXECUTIVE SUMMARY

The present technical report examines access to and equity in the distribution of park and open space resources across the Green Visions Plan (GVP) study area, with a particular focus on access to various types of park infrastructure and facilities.

Employing the radius technique for the assessment of access, various distance thresholds were delineated around each of the parks across the GVP area. Geographic Information System (GIS) tools were utilized to refine the distance measure, incorporating a street network as opposed to using as-the-crow-flies distance. Populations within the designated radii were deemed as having access, and their demographic characteristics were compared with those of populations outside the distance thresholds. This approach facilitates the characterization of populations with easy access to a park, highlighting the important role of distance in access measurement. Results from extending the radius technique to account for the effect of population densities, using the measure of available park acres per capita, is also reported for populations who have pedestrian access to parks (i.e., within a quarter-mile radius to a park, or equivalent to half a mile round trip).

Findings from the present report demonstrate that only 14.6% of the region's population has pedestrian access to greenspaces (where pedestrian access is defined as living ¼ mile—or ½ mile round trip—to the nearest park), leaving 85.4% of the population without easy access to such resources. A straightforward comparison of proportions of race/ethnic groups inside and outside the quarter-mile radius suggests that Latinos and African-Americans are well represented within this critical distance, compared to Whites; that is, there are higher proportions of Latinos and African-Americans within a quarter mile to a park compared to the latter. This result points to an inherent weakness of the radius technique—simply comparing proportions inside the critical distance with those outside tends to obscure the benefits enjoyed by populations living in low-density communities. Since more Whites live in areas with low residential densities, relative to other groups, there are proportionally fewer of them located inside the critical distance, compared to Latinos and African-Americans who tend to be located in high-density areas. Yet such in low-density communities, backyard space is relatively plentiful and hence access to open space, especially space for daily play for children, is understated.

Defining access as park acres per capita (and thus accounting for the effect of densities) for populations within the quarter mile buffer, provides a different picture. Whites now have disproportionately greater access to parks and open space, compared to Latinos and African-Americans. The latter two race/ethnic groups are likely to have 12 to 15 times less park acreage per capita compared to Whites.

A somewhat different picture emerges when park facilities are included in the equity assessment. Parks and open spaces were field-audited, to inventory the types of facilities available in difference areas of the GVP region. This audit illustrates that parks and recreational open space in White neighborhoods tend to have fewer facilities. A number of parks and open spaces in predominantly White neighborhoods are expansive wilderness-type parks more common in the urban-wildlife fringes of the region; these spaces are typically equipped with trails and pathways, but are largely lacking facilities such as swimming pools and play fields typical of a neighborhood or community park. Conversely, field audited parks in Latino neighborhoods with typically higher residential densities have a dearth of facilities requiring larger spaces such as trails and pathways for walking/jogging. This suggests that access in terms of park acreage or in terms of distance is not always equivalent to access to specific facilities and amenities. In order to provide a more comprehensive picture of park resources in a given area, it is important to account for facilities and amenities in addition to park acreage.

1 INTRODUCTION

The case of Hawkins vs. the Town of Shaw (461. F.2d 1171 [1972]) established the legal precedent that if a community elects to provide a public service, this service must be made equally accessible to all (Symons, 1971; Marcuse, 1978; Merget, 1979; McLafferty, 1982). Differential access to public facilities that privileges one group and disadvantages another thus constitutes an environmental injustice.

Borne out of the struggles of the environmental justice movement, environmental justice research has traditionally focused on locally undesirable land uses (LULUs) and their disproportionate siting in minority communities (e.g., United Church of Christ, 1987; Mohai and Bryant, 1992; Pulido et al., 1996; Boone and Modarres, 1999; Pastor et al., 2001; Mohai and Saha, 2006). On the other hand, it can be argued that proximity to environmental amenities, such as recreational parks, can be as important to an individual's health and well-being, as is keeping a safe distance from environmental hazards such as toxic dumps and air pollution hot spots (Barnett, 2001).

Of late, the quest for a healthier environment has expanded from a limited focus on the chemical environment to one that includes the effect of the built environment (e.g., Frank and Engelke, 2001; Frumkin, 2005; Lake and Townshend, 2006). A number of chronic diseases, most notably obesity, diabetes and cardio-vascular diseases have been linked to sedentary lifestyles (Center for Disease Control and Prevention, 1990; King et al., 1995; Frank and Engelke, 2001; Mokdad et al., 2001; Ewing et al., 2003; Frank et al., 2004; Sallis and Glanz, 2006; Steffen, et al. 2006). In turn, attention has been given to the important role played by land use and urban design in influencing inactive lifestyles, or conversely, in promoting physical activity (e.g., King et al., 1995; Sallis et al., 1998; Frank and Engelke, 2001;Giles-Corti and Donovan, 2002; Handy et al., 2002; Ewing, et al., 2003; Saelens et al., 2003; Lake and Townshend 2006; Aytur et al., 2007; Frank et al., 2007; Rundle et al., 2007).

By offering opportunities for both passive and active recreation, well-designed parks and open spaces promote a more active lifestyle that is key to a person's health and well-being (Sherer, 2003; Bedimo-Rung et al., 2005; Giles-Corti et al., 2005; Cohen, et al. 2006; Garcia and White, 2006). In a national study examining physical activity and inactivity patterns of youth from 11 to 21 years old, Gordon-Larsen et al. (2000) reported that the use of a community recreation center were associated with an increased likelihood of engaging in high level moderate to vigorous physical activity. In turn, the propensity to use recreational resources increases with higher percentage of park area in a given neighborhood (Rosenberger et al., 2006; Roemmich et al., 2007), or greater proximity to such resources (Cohen et al., 2006).

While the health benefits of active lifestyles engendered by park use are well recognized, park resources are not always equally accessible across populations. Examining parks and park funding in the City of Los Angeles, Wolch et al. (2005) showed that while the City of L.A. has 7.3 park acres per 1,000 residents, its communities that are predominantly Latino only have 1.6 park acres per 1,000 residents. The City's tracts that are heavily populated by African Americans have 1.7 park acres per 1,000 residents and tracts dominated by Asian-Pacific Islanders have 0.3 park acres per 1,000 residents. In contrast, L.A. City's predominantly White neighborhoods enjoy 31.8 park acres per 1,000 residents (Wolch et al., 2005). Given that most ethnic neighborhoods have more children per family, the gap between the haves and have-nots becomes even wider when the numbers are normalized to park acres per capita children.

The dearth of recreational facilities, well-maintained parks, or other safe places to exercise in low-income minority neighborhoods has been attributed as a causal factor in the low levels of physical activity in minority children and youth, which in turn have been purpoted to lead to higher incidence of obesity and related diseases such as diabetes and hypertension in these groups (Gordon-Larsen et al., 1999; Sallis et al., 2001; Gordon-Larsen et al., 2000; Kumanyika and Grier, 2006)

Empirical investigations examining equity in the distribution of public facilities are based on the hypothesis that public service provision is biased against certain socio-economically disadvantaged populations, such that these receive less or poorer quality resources compared to others (Lineberry, 1976). The present report tests this hypothesis and specifically asks, do minorities and low-income groups have disproportionate access to park resources across the GVP region?

Most studies that examine access to park resources across larger spatial extents (e.g., regional scale) are limited to an accounting of park acreage, without considering the facilities and amenities contained therein. However, as shown in Sister et al. (2007), park acreage alone does not provide a complete picture of the recreational opportunities available to residents. For example, smaller neighborhood parks in dense areas typically have play equipment, but lack amenities that require space, such as pathways for walking/running and soccer fields. And conversely, areas with greater park acreage may be replete with expansive wilderness-type open spaces, but may lack typical neighborhood-type amenities such as play equipment.

The presence of specific facilities and amenities (or lack thereof) directly influences the types of activities that can be performed in a given park, and is an important factor in park visitation. For example, in an in-depth interview of Chinese park users in Barnes Park in Monterey Park, California, Loukaito-Sideris (1995) learned that most Chinese place great importance on the aesthetic value of parks (i.e., gardens with colorful flowers, ponds, pavilions, tea houses are highly appreciated), perceiving the typical American park as too structured and poorly landscaped, and as such, they have less desire to visit these parks (the few that were seen at the park and interviewed were there mostly for companionship and to escape their small apartments).

Indeed, leisure activity preferences exist across different race, age, and gender groups (Carr and Williams, 1993; Loukaito-Sideris, 1995; Shinew et al.,1996; Bialeschki and Walbert, 1998; Stodolska and Yi, 2003; Ho et al., 2005). For example, Latinos tend to value parks for their social qualities (e.g., parks as sites for large family picnics), African Americans tend to capitalize on the physiological aspect (e.g., teams sports) of these spaces, while White park users tend to engage mostly in individualistic activities (e.g., walking, jogging, dog walking) (Loukaito-Sideris, 1995). Moreover, Latinos tend to prefer soccer (Garcia et al., 2002) over traditional American games of football, basketball, baseball, golf, and tennis; while African Americans tend to favor team sports such as basketball (Loukaito-Sideris, 1995; Shinew et al., 1996). Men tend to use facilities for competitive team sports more than women (Cohen et al., 2007); and park users belonging to the younger age group use play equipment and sports facilities more frequently than older individuals who are more inclined towards passive and leisurely activities and may tend to use pathways more (Cohen et al., 2007). All these imply that the average American park designed for the needs of the average user may not necessarily address the needs of a specific neighborhood with distinct characteristics (Loukaito-Sideris, 1995). This makes the case for the importance of considering not just park acreage, but also the facilities and amenities contained therein, when accounting for recreational resources available in a given area.

The present report seeks to provide a multi-dimensional characterization of park resources available to residents in the GVP region, by systematically accounting for park acreage, the facilities and amenities present therein, as well as the condition of parks—an effort that has heretofore not been undertaken on a region-wide scale. It takes on the investigation conducted earlier by Wolch et al. (2005) in the City of Los Angeles, but extends this across a broader expanse that encompasses most of Los Angeles County, and portions of Ventura and Orange Counties. In addition, we harnessed the capabilities of a Geographic Information Systems (GIS) by adopting a more refined measure of distance utilizing street networks.

In the next two subsections, we preface the present study with a discussion of the different conceptualizations of equity (Section 1.1), followed by a description of factors behind existing disparities in park access across the region (Section 1.2), and then an overview of the traditional approaches used in measuring accessibility to recreational parks and open spaces (Section 1.3). Section 2 describes the methodological approach and the details of our implementation of such an approach. We then present the results and discussion in Section 3, describing the distribution of park resources and facilities across different race/ethnic groups. Section 4 concludes with a summary of the main findings of the study, the limitations, and opportunities for future work.

1.1 Notions of equity as applied to park service provision

There are various conceptions of equity, a number of them competing—for example, merit, worth, entitlement, need, contribution to the common good, and rights (as enumerated in Boyne et al., 2001). Hay (1995) provides a review and sums these notions into eight key concepts-- procedural fairness, fulfillment of legitimate expectations, formal equality, substantive equality, equal choice, desert, rights, and need. In public service provision, Talen (1998) distinguishes four conceptions of equity: (1) as equality, (2) equity predicated on need, (3) equity according to demand, and (4) equity as defined by market criteria. As applied to park service provision, the first notion of equity translates to equal amounts of or equal opportunities for everyone to use a specific service or facility, regardless of socio-economic status, willingness or ability to pay, or any other criteria. With equity as equality, people living in the suburbs should have the same level of access to parks as people in older, denser inner city neighborhoods that are typically lacking private backyards or gardens, or access to wildlands. In the second conception of equity where provision is predicated on need, disadvantaged neighborhoods should have disproportionately more opportunities and access to recreational services and facilities. This notion of equity is also termed "compensatory" equity (Crompton and Wicks, 1988) and referred to as "unequal treatment of unequals" (Lucy, 1981). The third notion of equity distributes public services according to demand, be it economic (demonstrated use) or political (advocacy). Communities with more park users or those that clamor for more parks are provided more access to facilities and services.

Distribution according to demand does not always produce the same outcome as distribution according to need (Talen, 1998). For example, low patronage at parks does not necessarily mean lack of users (and as such, low demand); it may be that existing park facilities do not match the specific needs of a neighborhood. Furthermore, low-income communities may not be well organized to actively advocate for more parks in their area (Wolch et al., 2005), and as such, these communities in need may not necessarily receive park funding under the third conception of equity. The fourth notion, equity defined by market criteria, distributes amenities and services according to users' willingness to pay, with the main goal of maximizing efficiency. "Buy back" strategies, that is, imposing user-fees to fund maintenance and expansion of park facilities demonstrates this market-based conception of equity (Foley and Pirk, 1991). While the operationalization of this strategy has been effective in creating self-sustaining parks, it can also create a "recreation apartheid", separating communities that can afford to "buy back" from those that cannot (Foley and Pirk, 1991).

Highlighting the redistributive aspect of public service provision and the welfare criterion in the distribution of public facilities, this report adopts the second conception of equity—that is, equity based on need. A variety of definitions of need are possible; for example, need might be defined on the basis of membership in a population subgroup that has been historically disadvantaged due to discrimination, or on the basis of economic marginality, or linked to physical fitness and/or obesity, e.g., the share of children who fail public school fitness tests, or who are overweight. In the present analysis, the demographic characteristics of a population, specifically race/ethnicity, and population (especially youth) density, and socioeconomic characteristics such as poverty level and income, are used as the criteria for "need" in examining the distribution of parks in the GVP region. That is, the distribution of parks in the region is deemed equitable if populations that are predominantly of color and poor, low-income, with high population and youth densities are provided better access to parks.

1.2 Existing disparities in park resources across the region

Subdividing the region into 10 distinctive subregions, Sister et al. (2007) showed that across the GVP area, there exist disparities between the locations of park resources and the locations of populations that are disadvantaged and in most need. Areas located close to large expanses of open spaces (e.g., those in West L.A., East Ventura, and areas of the San Fernando Valley that are in close proximity to the Santa Monica Mountains National Recreation Area) and relatively less dense neighborhoods enjoyed park acreage ranging from 32 to 126 park acres per 1,000 residents; a figure considerably higher than the oft-used National Recreation and Parks Association (NRPA) standard of six to 10 acres per 1,000 residents. These areas are typically affluent White neighborhoods. On the other hand, older communities that frequently have higher residential densities and smaller parks, such as the South, West, and Metro L.A. subregions, have park resources ranging from 1.2 to 4.8 acres per 1,000 residents—ratios considerably lower than the NRPA standard. Neighborhoods that have lower park acreage are typically inner-city, low-income communities of color.

This distribution of park resources in the region can be attributed to several factors. For example, Los Angeles was developed with the conscious effort towards low-density housing, with residents owning private gardens (Davis, 1996; Fulton, 1997). This, coupled with the passing of Proposition 13, which favored sales-tax-generating land uses, resulted in the decline of public spending for public parks (Cranz, 1982; Pincetl, 2003, Wolch et al., 2005). The creation of recreational open spaces was then relegated to private developers who proceeded to build clubhouses, swimming pools, and playfields inside gated suburban communities, away from the older inner city communities.

The phenomenon of concentrated poverty in inner cities and its fiscal consequences have also served to exacerbate the existing disparities. The devolution of federal responsibilities that came with the "New Federalism" in the late 1970s saw local municipalities increasingly responsible for providing public services to its residents (Joassart-Marcelli et al., 2002). Cities with particularly high levels of poverty experienced greater fiscal pressure, as they were faced with higher welfare costs to provide for a greater proportion of low-income residents (Wolch, 1996). On the other hand, Proposition 13 restricted the amount of revenue municipalities can collect from property tax, further limiting fiscal resources of local governments (Fulton, 1997). Faced with these constraints, poorer cities with lower tax base often resorted to cutbacks in service provision (Joassart-Marcelli et al., 2002; Wolch et al., 2005), including lower local budgets for park and recreation provision (Garvin and Berens, 1997). This, in turn, translates to poorly-maintained parks, inadequate facilities, and less opportunities for park acquisition. Later efforts to link residential development with the provision of open space, such as the Mello-Roos legislation of the early 1980s, further reinforced disparities because most new developments that triggered Mello-Roos requirements were suburban. And while a number of park funding bonds which specifically targeted low-income communities were designed to alleviate local fiscal constraints, the competitive grant process used to allocate funds has posed a challenge to communities with limited resources. As a result, poor communities in need often still miss out on grant opportunities; in some cases, park bond funding served to exacerbate existing inequities in park access (Wolch et al., 2005).

1.3 Measuring spatial accessibility

While the notion of equity is paramount in examining factors that account for and/or are correlated with public service delivery, accessibility is a tool to investigate whether or not equity has been achieved (Talen and Anselin, 1998; Talen, 2001). Spatial accessibility to amenities generally refers to the ease with which amenities can be reached (Hewko et al., 2002), as well as the quality, quantity and the type of activities offered by the amenities (Handy and Niemeier, 1997; Smoyer-Tomic et al., 2004: 288). The various accessibility measures used in examining the distributional equity of parks (see Talen and Anselin, 1998 for a review) can be classified into two general approaches: (1) the container approach; and (2) the minimum distance approach (Table 1).

The container approach specifies a unit inside which the total number or amount of the amenity of interest is summed (Talen and Anselin, 1998; Nicholls, 2001; Lindsey et al., 2001; Smoyer-Tomic et al., 2004). It is typically expressed as:

$$C_i = \frac{\sum S_j}{P_i} \quad (1)$$

whereby the container measure C_i is the ratio of the total sum of opportunities S (e.g., number of facilities or total sum of park area) to population size P within the boundaries of neighborhood i; the more opportunities available within the "container" the greater the accessibility (Smoyer-Tomic et al., 2004). Using this approach, equity is achieved if locations of "containers" having more opportunities (i.e., >Ci) coincide with locations of populations in need (e.g., low-income, minority).

Table 1. A list of empirical investigations examining access and equity to recreational open spaces utilizing the: (a) container approach; (b) minimum-distance approach; (c) coverage/covering model; and (d) radius technique.

Author(s)	Public Amenity, Study Site	Some details on the methods	Unit of Analysis/ Buffer Size	Results*
(a) CONTAINER APPROACH**				
Mladenka and Hill, 1977	Parks in Houston, TX	Implemented correlation analysis examining relationship between income and race with park acreage and recreational facilities (Also examined libraries) (Also implemented minimum-distance approach; see later entry)	Census tracts	=I, =W
Mladenka 1980	Parks and recreation in Chicago, IL	Examined relationship between income and race with park acreage, number and type of recreational facilities, programs and activities (Also examined fire protection, refuse collection and education along with parks and recreation)	Wards	= W (African Americans) +I, +W (African Americans) when facilities are considered (as opposed to park acreage) "Unpatterned inequality"
McLafferty and Ghosh, 1982	Swimming pools and ice rinks in Cedar Rapids, IA	Implemented a relative regression index to examine public service locations and income groups (Also examined libraries, fire stations, headstart opportunities, and nutrition centers)	Enumeration districts	+I when using relative r-measure =I when using simple r-measure
Koehler and Wrightson 1987	Parks and recreation in Chicago, IL	Patterned after Mladenka (1980) Additional statistics from 1983 Differentiated homogeneous (i.e., >80% race) from heterogeneous wards	Wards	+I in racially homogeneous wards =I, =W in racially heterogeneous wards

Table 1 (continued)

Talen and Anselin, 1998	Playgrounds in Tulsa, OK	Utilized Moran's I statistic to the square root transformed container index (Also implemented minimum-distance approach, see entry in [b])	Census tracts	=I, =W* Only portion of distributive characteristics of any of access measure correlate with spatial distribution of Socio Economic Status (SES) Not unpatterned inequality, but situational inequality
Wolch et al., 2005	Parks in the City of Los Angeles	Examined park acres per 1K (Also implemented radius technique, see later entry)	Census tracts	+I, +W*
Gilliland et al., 2006	Public recreation facilities in London, Ontario, Canada	Used two outcome measures: (1) recreation opportunity (RO) *density* defined as opportunities per m^2, and (2) RO *prevalence* defined as opportunities per 1K children and youth	Municipal planning districts	=-I using RO density =I using RO prevalence
Timperio et al., 2007	Public open space in Melbourne, Australia	Quintiles of SES compared with (1) mean number of public open space (POS), (2) mean number of POS per 1K capita, (3) mean area of POS per person, (4) mean POS per person, (5) mean area POS as proportion of total land available	Postal districts	-I =I once population density was considered
(b) COVERING/COVERAGE MODEL**				
Talen, 1997	Parks in Pueblo Colorado and Macon, Georgia	Buffers drawn from Census block centroid along street network Further examined spatial clustering of access scores with spatial clustering of SES	1 mile and 2 mile	-I, -W in Macon +I, +W in Pueblo
Smoyer-Tomic et al., 2004	Playgrounds in Edmonton, Canada	Buffers drawn from postal (Also implemented minimum distance, see earlier entry)	0.8 kilometers(= ½ mile)	-I, +C with slightly greater =I when good playgrounds are considered

Table 1 (continued)

(c) MINIMUM DISTANCE**				
Mladenka and Hill, 1977	Parks in Houston, TX	Linear distance to nearest park facility measured from five random points in each tract (Also examined libraries) (Also implemented container approach; see earlier entry)	Census tracts	=I, =W Evidence suggests slight
Talen and Anselin, 1998	Playgrounds in Tulsa, OK	Compared three distance measures: (1) gravity potential, (2) average travel cost, (3) minimum Euclidean distance (Also implemented container approach, see earlier entry)	Census tract centroids	=I, =W Only a portion of the distributive characteristics of any of the access measures correlates with the spatial distribution of SES Not unpatterned inequality, but situational inequality
Hewko et al., 2002	Playgrounds, community halls, leisure centers in Edmonton, Alberta, Canada	Compared results from three aggregation methods: the (1) traditional unweighted geometric-centroid, (2) population-weighted mean center, (3) weighted average postal code distance methods	Postal code centroids	Different aggregation methods showed different cluster patterns of accessibility Did not examine access in relation to SES
Smoyer-Tomic et al., 2004	Playgrounds in Edmonton, Canada	Derived a child population-weighted average of the postal code distances to playgrounds for each neighborhood (Also implemented covering/coverage method, see later entry)	Postal code centroids	-I, +C =I when condition of playgrounds are considered
Mitchelson and Lazaro, 2004	Golf courses in North Carolina	Used accessibility index that accounted for number of golf holes and travel time	Census tract centroids	+W, +I Low access in CTs with high % African American
Omer, 2006	Public parks in Tel Aviv, Israel	Minimum distance (Also implemented radius technique)	House level	+I Greater access for Jews (majority), lower access for Arabs (minority)

Table 1 (continued)

(d) RADIUS TECHNIQUE**				
Tarrant and Cordell, 1999	Recreation sites in Chattahoo-chee National Forest, GA	Buffers drawn around boundaries of wilderness areas, good fisheries habitats and campgrounds (all three treated as LDLU)	1500 meters (=0.93 mile)	-I =W
Lindsey et al., 2001	Greenway trails in Indianapolis, IN	Census tracts at least partially within half mile of each greenway assumed to have access	½ mile Census tracts	-I, -W
Nicholls, 2001	Public parks in Bryan, Texas	Buffers created from: (1) straight-line radius from geographic center of each park; (2) service areas along a street network Census blocks within buffers assumed to have access	½ mile	-I, -W =population density, =age
Wolch et al., 2005	Parks in the City of Los Angeles	Radius technique, but reclassified the buffers into corresponding CTs and reported: (1) % CT population inside buffer; (2) park acres per 1K capita in CTs within buffer (Also implemented coverage method, see earlier entry)	¼ mile Census tracts	+W, +I, +C in terms of park acres per 1K capita -W, -I when comparing percentage population within a quarter mile radius versus outside buffer
Omer, 2006	Public parks in Tel Aviv, Israel	Buffers drawn using Euclidean distance from park's perimeter (Also implemented minimum-distance model, see earlier entry)	250 meters (0.16 mile) House-level	+I Greater access for Jews (majority), lower access for Arabs (minority)

* Notations used in the "Results" column

+ I   Means high access**, high income; signifies non-equitable distribution relative to income

-I   Means high access, low income; signifies equitable distribution relative to income

+W   Means high access, high % White; signifies non-equitable distribution relative to minority group

- W   Means high access, low % White; signifies equitable distribution relative to minority group

+C   Means high access, high %Children; signifies equitable distribution relative to children and youth density

=   Means little, or no correlation between access and variables (I or W); amenities distributed equally

**In the container approach and in the coverage/covering model, high access means more opportunities inside container; in the minimum distance approach, high access means shorter distance from population to amenity of interest; in the radius technique, population inside some critical distance threshold are deemed to have higher access while those outside the threshold have lower access.

The container approach is computationally straightforward, and as such, it is widely used (Table 1a); on the other hand, subtle variations in the implementation of the approach as well as inherent limitations can lead to contradictory results, biasing them towards unpatterned inequality. For example, examining the distribution of Chicago parks in 1967 and 1977, Mladenka (1980) did not find any systematic bias against income or race, prompting him to characterize the distribution of resources across the City as that of "unpatterned inequality" (Table 1a). Distinguishing "homogeneous" (>80% White or Black) from heterogeneous wards (<80% White or Black), Koehler and Wrightson (1987) revisited the study by Mladenka (1980) and showed that in homogeneous wards, race and home ownership were independent influential factors in the distribution of parks in Chicago (median income had little independent effect). Wards that were predominantly African-American and those with lower levels of home ownership had significantly fewer parks (Table 1a).

Comparing different access measures, Talen and Anselin (1998) mapped out a surrogate container index (because C_i is an integer value, they used Moran's I statistic applied to the square root transformed C_i), and demonstrated that only a portion of the distributive characteristics of the access measure correlate with the spatial distribution of socio-economic status (SES). The Moran's I statistic indicated spatial randomness in the container index, which in turn, results in a bias towards unpatterned inequality when running bivariate and multivariate analyses between access and SES values (Talen and Anselin, 1998). They attributed the resulting non-systematic bias from their analyses (using the container and the minimum distance approaches) to situational inequity rather than unpatterned inequality (Table 1a).

The definition of the outcome measure also affects results. For example, Gilliland et al. (2006) utilized two outcome measures—"recreation opportunity (RO) density" defined as opportunities per square meter, and "RO prevalence" defined as opportunities per 1,000 children and youth—and found that there were more opportunities in locations with low income populations when RO density was used, but the relationship was not as significant using RO prevalence (Table 1a).

Since the approach quantifies the amount of amenities within a boundary, an inherent weakness of the container approach is the fact that it does not account for the spatial distribution of opportunities within a "container" (Nicholls, 2001). For example, populations along the boundary of a census tract may be closer to parks in an adjacent tract; as such, levels of access for this group may be erroneously represented. This problem stems from using pre-defined boundaries (e.g., wards, census tracts, or cities) as "containers", when these do not always match the service areas of the amenity of interest. The resulting service-area-mismatch also increases the likelihood of unpatterned inequality regardless of the underlying relationship between the distribution of amenities and the socio-economic explanatory variables (Talen and Anselin, 1998).

A number of studies address this problem by using "purposive containers", that is, boundaries that can address specific research goals at hand. For example, Gilliland et al. (2006) utilized municipal planning districts as the areal unit of measurement, justifying that these were designed by city planners and analysts with careful consideration and using extensive local knowledge to represent natural neighborhoods (Ross et al., 2004 in Gilliland et al., 2006). Another example is the report by Sister et al. (2007) whereby subregions having distinctive locational and demographic characteristics were adopted as "containers".

One variation of the container approach (Table 1b) represents populations of interest as a centroid and delineates a critical distance around it, typifying "accessible" distance (e.g., 1 mile and 2 miles in Talen, 1997; 0.8 kilometer or half a mile in Smoyer-Tomic et al., 2004); instead of accounting for all opportunities within a "container", the amount of opportunities within this "accessible" distance is quantified. Referred to as the "covering" (Talen, 1997) or "coverage" model (Smoyer-Tomic et al., 2004), it accounts for the spatial distribution of the amenities relative to populations heretofore unaccounted for by the traditional container approach. The main drawback of the covering model derives from the representation of the populations of interest as a single one-dimensional point (e.g., centroid of a census tract). Populations are typically distributed across space; when these spatially distributed individuals are aggregated into an areal unit (e.g., census tracts), aggregation errors relating to the ecological fallacy and the modifiable areal unit problems (MAUP) arise; these errors are even more pronounced when the aggregate unit is, in turn, represented by a single point (Hodgson et al., 1997), such as in the coverage model. Hewko et al., (2002) examined aggregation errors with respect to spatial accessibility research and recommended an approach integrating less aggregated units with finer resolution data to minimize these errors.

Adopting the approach above, Smoyer-Tomic et al. (2004) incorporated postal code centroids, which are finer aggregates, to examine playgrounds at the neighborhood level in Edmonton, Canada (Table 1b). They identified the following steps in implementing the approach: (1) creating a 0.8 kilometer (approximately half a mile) buffer around each postal code centroid representing the maximum distance residents would travel to reach a neighborhood park; (2) summing the number of playgrounds within each postal code's buffer zone; and then (3) calculating the child population-weighted average of (2) for each neighborhood (Smoyer-Tomic et al., 2004:292). Although the additional steps in integrating postal codes were time consuming and computationally intensive, the results were deemed more accurate than the traditional centroid methods. Talen (1997) avoided some of these problems in examining parks in Tulsa, Oklahoma, by utilizing census block centroids in place of the traditionally used census tracts (Table 1b). Although the study sacrificed detailed data available at a coarser tract level, the use of the smaller census blocks (finer resolution) minimized the effects of aggregation errors.

The second approach to accessibility measurement is the minimum distance approach (Table 1c), which conceptualizes access as the distance D from an origin i (i.e., neighborhoods) to a destination j (i.e., amenity), and is denoted as:

$$D_i = \min_j \mathrm{d}_{ij} \quad (2)$$

Direct or surrogate measures of the ability of a population to reach a facility may be used; in many cases, this measure is a simple distance metric, e.g., as-the-crow-flies distance or driving distance, and in other cases, this may be some measure or estimate of travel time, or the direct or opportunity costs of travel and interaction (White, 1979). Using this approach, shorter distances are indicative of higher accessibility; equity is achieved if populations in need (e.g., low-income, minority) are located in closer proximity to the amenity of interest.

Unlike the traditional container approach, the minimum distance approach explicitly accounts for the spatial configuration of opportunities. On the other hand, there are a number of drawbacks to this approach. For example, in some applications of the approach, populations are assigned to the single closest facility, and the cumulative access to multiple facilities that are within reasonably accessible distances is ignored (Smoyer-Tomic et al., 2004); such a constraint may underestimate the actual level of access available in an area. Another inherent drawback to this approach relates to the ecological fallacy and MAUP arising from aggregation errors. Since the minimum distance approach utilizes points to represent distributed populations, it is subject to the "self-distance" problem (or "source B" error, Hillsman and Rhoda, 1978). This happens when a facility location coincides exactly with the neighborhood centroid, resulting in a distance measurement of zero (Hewko et al., 2002). Another type of aggregation error arises when all residents, represented by the centroid, are allocated to the facility closest to the centroid, even if some residents are actually closer to other facility locations (Hewko et al., 2002). Just like errors when using the container approach, the limitations from the minimum distance approach can lead to erroneous conclusions regarding underlying relationships between the spatial distribution of amenities relative to the socio-economic characteristics of a population.

One variation in the implementation of the minimum-distance approach is the "radius technique" (Table 1d), which identifies a critical distance around the amenity of interest, and deems the populations within the radius as having access in contrast to those outside. This technique therefore allows for a straightforward identification of populations who live closer to amenities and those without easy access. Obviously, not everyone lives along a park boundary, so that there is bound to be a smaller proportion of the population within the critical radius compared to the numbers outside (unless the radius defined is extremely large, which would not be useful). An inequitable situation arises when disadvantaged groups (i.e., low income, minority) are particularly underrepresented in the park buffers defined by the radii. For example, inequity would be the clear conclusion if, for a specific city or metropolitan area, only 10% of people of color were to live within the buffer defined by the critical distance or radius (such as ¼ mile from a park), compared to the White population were it to have 40% of its population inside the critical distance.

The examination of equity using the radius technique typically proceeds by comparing the demographics of populations with access—usually as proportions (e.g., percent race/ethnic groups)—to those outside the critical distance or the entire population (Lindsey et al., 2001, Nicholls et al., 2001). Again, inequity exists if a significantly smaller proportion of disadvantaged groups have access (i.e., live inside the radius) compared to the proportions outside the critical distance or the population in the area as a whole.

The radius technique can be viewed as a "hybrid" approach that incorporates the importance of distance in accessibility measurement, just as the traditional minimum-distance approach does. However, it differs from the latter as it does not use distance as the access measure, but proceeds by describing areas contained within some critical boundary. The radius technique therefore has a discrete notion of accessibility just as the container approach does, but foregrounds the role of distance, which the latter does not explicitly account for. It differs from the coverage or covering model (Table 1b) because the latter delineates the radius around the population of interest and quantifies the amount of amenities within a critical distance (and as such, can be viewed as an implementation of a container approach), whereas the radius technique draws the radius around the amenity of interest and describes population characteristics inside this critical distance (and as such, can be viewed as an implementation of the minimum distance approach). The hybridity of the radius technique is reflected in different authors classifying it under different approaches. Lindsey et al. (2001: 338) consider it as the implementation of the container approach, while Nicholls (2001: 205) classifies it as a covering model, and Omer (2006: 258) implements the technique, but calls his implementation a coverage model.

Most results from straightforward comparisons of populations inside and outside a critical distance buffer do not always uncover inequities (Table 1d). Examining spatial equity in the distribution of outdoor recreation sites in Chattahoochee National Forest in North Georgia, Tarrant and Cordell (1999) delineated a radius of 1,500 meters (approximately 1 mile) around campgrounds, wilderness areas, fisheries habitats, as well as overcrowded sites; the first three represented locally desirable land uses (LDLUs) and the latter represented a LULU. Patterning their approach after environmental justice studies (Glickman, 1994; Hamilton, 1995; U.S. General Accounting Office, 1995; Kriesel et al., 1996; all cited in Tarrant and Cordell, 1999), they used logit regression to compare populations in census block groups (CBG) which were contained in or were located within 1,500 meters (approximately 1 mile) of recreation sites, with that of CBGs outside the radius. Their results showed the following: lower income households were significantly more likely to be situated closer to the more desirable recreation sites, race was not a significant factor, and that there was no significant relationship between the LULUs examined (poor benthic fisheries and overcrowded sites) and the demographic variables.

Lindsey et al. (2001) examined access to greenway trails in Indianapolis, Indiana by comparing demographic characteristics of people living within pedestrian access (defined in their study as 0.5 mile) of the greenway corridors with those outside the half-mile buffer. Based on the implementation of their approach, low-income and minority groups were also shown to have more access to the greenways: 35% of the population in census tracts within half a mile of the greenways were African-Americans compared to only 21% of the city-county population, and 16% of the trail population fell below the Federal poverty threshold level, compared to only 12% of the city-county population. Populations along the greenway trails had lower median income, lower median housing values, and a smaller proportion of adults with high school diplomas, and 15% of populations along the trails did not own vehicles, compared to 4% in the city-county population. The density of the trail population adjacent was nearly twice as high as the city overall.

Examining park equity in Bryan, Texas, Nicholls (2001) implemented the approach, and utilized a more refined distance measure using the street network function in ArcView (Environmental Systems Research Institute, Redlands, California). Results from the study's comparisons also suggested an equitable distribution of parks—non-Whites, as well as those with lower housing values or rents were more likely encountered within half a mile from parks, and those living in more densely populated areas appeared particularly well served by park facilities.

When the analysis of the results from the radius technique is extended—from straightforward comparisons of population demographics inside and outside the buffer—to incorporate the measurements of park area per capita within the buffer defined by the critical threshold distance, inequities were evident (e.g., Wolch et al., 2005 and Omer, 2006, Table 1d). Wolch et al. (2005) delineated a quarter mile buffer around parks in the City of Los Angeles and found that there was a higher proportion of residents of color inside the buffer (just as Lindsey et al., 2001 and Nicholls, 2001 found) compared to the proportion of White populations (only one-fifth of the White population were inside the quarter-mile buffer). The lower proportions of Whites within the critical distance are apt to be a consequence of lower residential densities in White-dominated areas, thus effectively making distances to parks greater in these areas compared to more dense neighborhoods. Re-aggregating the buffers back into census tract boundaries, Wolch et al. (2005) were able to report that estimates of park acreage per 1,000 capita (population and children under 18) showed that Whites still had disproportionately higher access in terms of park area per capita compared to people of color (Table 1d).

The present study expands on the study carried out by Wolch et al. (2005), and others using the radius approach. The analysis examines a metropolitan expanse that includes most of L.A. county, and portions of Ventura and Orange counties using the approach documented in the next section.

2 METHODS

2.1 Methodological approach

The present study adopted the radius approach to examine equity in the distribution of recreational parks and open spaces across the GVP area. Here we assume that populations in closer proximity to a park have better access compared to populations that are more distant.

Different studies have identified different values as the critical distance for park access, delineating buffers ranging from ¼ to 2 mi (Tables 1b and c). However, except for Talen (1997) who used two distance buffers (1 and 2 mi) to test for the sensitivity of the analysis with respect to network distances, no analysis have been performed, to date, to examine the sensitivity of different distance thresholds used in literature. In lieu of this, the present empirical analysis starts with an examination of demographic characteristics across six different distance thresholds— ¼, ½, ¾, 1.0, and 2.0 mi—testing for the sensitivity of the results to the choice of buffer distance.

While the buffer size can be used to differentiate the smaller catchment areas of local parks designed to serve local residents from that of larger regional parks designed to attract users from a more extensive geographic area, existing studies have not used such a rationale when adopting a buffer size. For example, as mentioned above, Talen (1997) utilized two buffer distances—1 and 2 miles—justifying the former as the criteria for park access given in De Chiara and Koppelman (1982), and adopting the second to test for sensitivity. She examined access to parks in Macon, Georgia and in Pueblo, Colorado and showed that in the latter, the distribution of parks favored higher income areas when access is assessed on the basis of park acreage contained within a particular distance—and this relationship was more pronounced when the distance range was set to 2 miles. On the other hand, in Macon, Georgia where parks were fewer and more clustered, the accessibility pattern favored low-income areas with higher percentages of traditionally disadvantaged residents using both the 1- and 2 mile buffer distances. Tarrant and Cordell (1999) examined the characteristics of populations around Chattahoochee National Forest (North Georgia)—which can be viewed as a regional destination—and utilized a 1,500 meter buffer (approximately 1 mile), patterning this choice after environmental justice research which adopts between 1 to 1.5 miles as the threshold value within which the cost or benefits of a particular land use is greatest. Most other studies adopt either ¼ or ½ mile buffers, justifying the choice as the reasonable walking distance to a park or playground (e.g., Lindsey et al., 2001; Nicholls, 2001; Smoyer-Tomic et al., 2004; Wolch et al., 2005).

Differentiating parks as local neighborhood parks or as regional destinations can be problematic, especially when examining a large area such as the greater Los Angeles metropolitan region. This is in part because the jurisdictions within the region do not have a uniform approach to categorizing their parks and the related facilities therein; thus there is no consistent park typology used to classify parks as either local or regional (Wolch, 2005). One can argue that "small" parks are local parks and "large" parks are typically regional destinations. While this size-based classification scheme seems to be intuitively reasonable, operationalizing such a notion is not as simple. For example, what should the cut-off size be for a park to qualify as "small" and another as "large"? There are neighborhood parks maintained by local municipalities that are large, such as those that have golf courses, for example. These recreational spaces are expansive, but are not designed as regional destinations. One can also argue that the facilities present should be taken into consideration when distinguishing between "local" and "regional". On the other hand, however, a number of regional parks have facilities such as swings, slides, and picnic tables, typical of local neighborhood parks.

With the present goal in mind—that is, to quantify equity in access to park resources—and considering the complexities mentioned above, the present study does not differentiate between local parks and those designed as regional attractions when delineating a distance threshold. We argue that proximity to a park remains an important determinant in park visitation regardless of whether the destination is a local or a regional park (Giles-Corti and Donovan, 2002; Harnik and Simms, 2004; Cohen et al., 2007; Frank et al., 2007). People generally tend to make more short visits and fewer long ones—the fundamental concept behind the "distance decay effect" (Gould, 1985). As such, we argue that it is valid to say that residents who can easily walk to their neighborhood park in less than 30 minutes have better access than those who will take two hours to get to the same park, or than those who have to get in a car to reach it within a reasonable amount of time. By the same token, people who live next door to a large regional park have better access to it than those who have to commute to reach it—notwithstanding that such recreational areas may have been designed to attract people from far and wide.

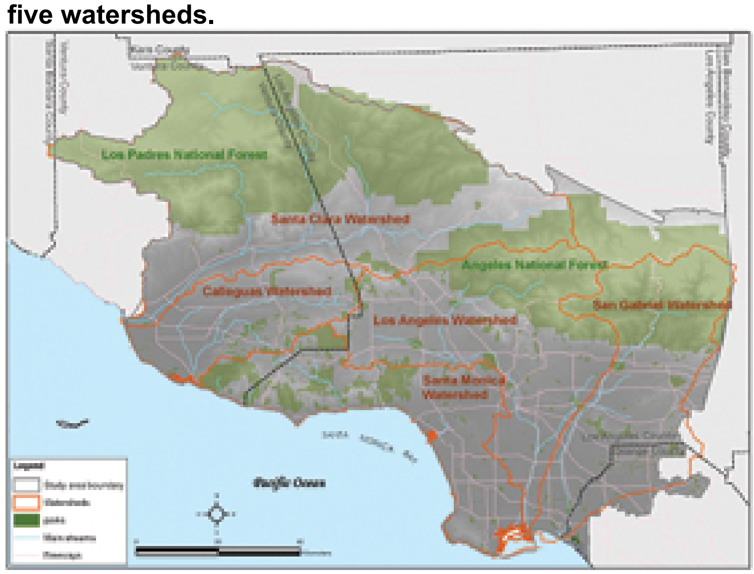
Equity in the distribution of park resources was examined in two ways. First, the demographics of populations with access (defined here as populations located inside some critical distance threshold) were compared to the demographics of populations without access (populations outside the critical distance threshold). This allowed for the identification of populations that do not have easy access to a park. Second, for areas with pedestrian access to a park (i.e., within a ¼ mile), park area per 1,000 capita was reported, comparing the amount of park space across different race/ethnic and income groups characterizing the area within the park buffers. This corrected for the impact of population densities on available park acreage, as well as facilitated the comparison of accessible park acreage across race/ethnic groups. This strategy accounted for the fact that neighborhoods of color are typically more dense than White neighborhoods in the GVP area (Sister et al., 2007).

In addition to calibrating the location of parks relative to populations and park acreage, the current study also compared the facilities present, as well as the condition of the parks, in a representative sample of field-audited parks. These comparisons were carried out in areas of the study region in which park buffers had predominantly White populations and in those that are predominantly Latino. Only a handful of field-audited parks had buffers that were predominantly African-American (n = 7) or Asian-American (n = 14); since these small sample sizes may not be representative, discussion on facilities and condition were limited to predominantly White and Latino race/ethnic groups. The latter two make up the largest groups (in terms of numbers) in Southern California, and as such, facility and condition comparisons between these two can be insightful in terms of the equity of recreational facility provision between a socioeconomically dominant race/ethnic group (i.e., White) and a subordinate one (i.e., Latino).

2.2 The study site

The present report examines park access and equity across the GVP study area. This area is delineated by the boundaries formed by the Los Angeles River, Calleguas Creek, Santa Clara River, San Gabriel River, and Santa Monica Bay watersheds (Figure 1). Covering an area of 11,215 km2, this area includes most of Los Angeles County, a large part of Ventura County, and the northwest portion of Orange County (Figure 1; Sister et al., 2007). In the present report, this area is referred to hereafter as the "GVP region", or simply the "region".

Figure 1: The GVP area showing the boundaries of the five watersheds.



2.3 Parks layer

The park layer utilized in this study was created by pooling together data from the following sources: ESRI's Business Analyst, land use/land cover data from the Southern California Association of Governments (SCAG), coastal access information from the California Coastal Commission, and Thomas Brothers Maps, with the latter used mainly for cross-referencing and verification. From these sources, a total of over 1,800 park polygons were identified (park count is higher than the service area count (i.e., buffers) since adjacent parks were treated as a single unit in the present analysis).

This parks layer was further augmented with audit information on facilities present at each park. Using the SAGE (Systematic Audit of Greenspace Environments, see Byrne et al., 2005) audit instrument, we collected information from websites and data from on-site field surveys. The web audits were exhaustive, collecting information on all parks, primarily from city and county web sites; where information was missing in such sites, we utilized search engines. Field audits were performed in order to collect additional data, verify information found in web sites, and get information on parks without website information. While web audits were exhaustive, field audits were representative, with site visits carried out in 10-15% of the parks and open spaces across the study area. Data collected by the field audit teams were tested for reliability and validity through comparisons with a “gold standard”, as well as with ground truth data. Results of these reliability and validity tests are detailed in Sister et al. (2007). For the present purpose, the results of the audits from different teams were consistent and accurate enough to provide a moderately detailed picture of the parks and open space resources across the region.

It should be noted that the absence of a particular facility in a park web site does not necessarily mean that such a facility is not present in the park. This is because lack of facility information on a website could either mean that: (1) the facility is absent; or (2) the facility is present, but the website failed to mention the presence of such a facility. Thus, absence of a facility on a park website does not necessarily confirm a facility’s absence or presence in a park. As such, analyses involving park facilities and amenities in the present report are limited to field survey data.

2.4 Delineating the distance thresholds

Considering the range of critical distance values reported in literature (Tables 1b and d), we delineated six distances—¼, ½, ¾,1.0, 1.5, and 2.0 miles—and tested the sensitivity of the results (i.e., how population characteristics vary) as the choice of threshold value changes.

Buffers for each of the threshold values were generated using ESRI’s Network Analyst extension in ArcMap and the street network file from Geodetic Data Technology (GDT). Network Analyst requires a point layer as an input to represent facilities; for this, we utilized surrogate access points, which are intersection points of streets with park boundaries. These intersection points were converted into a point coverage in ArcInfo, which was then used as the input coverage representing facilities from which buffers were generated (<new service area> function in Network Analyst); these are akin to buffers along a street network, except that portions along boundaries without street access are deemed inaccessible (i.e., not contained inside the critical distance). Since one park usually have more than one surrogate access point, the resulting buffers generated from the latter were aggregated (<dissolve> in ArcToolbox) so that each park has only one park buffer that corresponded to it. While utilizing the surrogate access points (as opposed to using park centroids) entailed additional steps and longer computational processing time, this strategy allowed for a more realistic estimate of distance to a park, and avoided buffers being drawn inside a park boundary (i.e., the self-distance problem) as would be the case if park centroids were to be used.

2.5 Assigning population characteristics

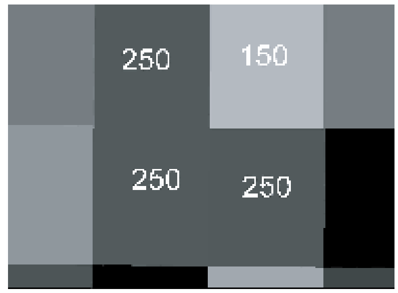
The following socio-economic characteristics were examined: proportion of Latinos, Whites, African-Americans, and Asian-Americans (these four represent the major race/ethnic groups in the region), proportion of population up to 17 years old, proportion of households below the Federal poverty threshold level, and median household income. Census 2000 tract data were used as the source for demographic information, but the population counts and the resulting proportions were refined using LandScan population distribution data.

LandScan applies a “likelihood” coefficient to the census count for each of its 30-arc second (approximately 90 meter x 90 meter) grid cells based on key indicators of population, namely, land cover, roads, slope, and nighttime lights (Bhaduri et al., 2002). As such, LandScan is a more spatially refined population grid compared to the original Census 2000 data. In order to assign the socio-economic data from the Census tracts into the re-distributed counts from LandScan, Census tract data were overlaid onto the LandScan layer. To accomplish this, LandScan, which comes in a grid format, was first converted into a vector layer.

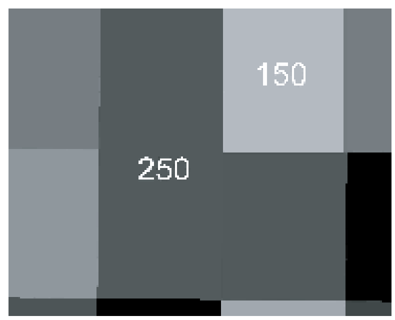
The grid-to-polygon conversion in ArcToolbox or the <gridpoly> function in ArcInfo allows grid to polygon conversions, however, these two functions aggregate adjacent grid cells having similar values, effectively underestimating the LandScan population cell counts. For example, given three adjacent LandScan grid cells with a population count of 250 each (Figure 2a), and a fourth cell with a value of 150 (that is, a total of 900 people in all four cells together), using either of the grid-to-polygon or <gridpoly> functions will convert the three adjacent "250" cells to one polygon, assigning the latter a non-additive value of 250 (Figure 2b). This new area, together with the "150" polygon would add up to only 400, underestimating the original LandScan counts in three of the four cells.

Considering the shortcomings of these two conversion functions, we carried out the LandScan grid-to-polygon conversion applying a series of steps that employed the concept of Thiessen (Voronoi) polygons (Figure 2c) to preserve the original grid population data. First, the LandScan grid was converted into a point coverage (<gridpoint> in

Figure 2. A comparison of the effect of converting a LandScan population grid (a) using (b) ArcToolbox's grid-to-polygon function or the <grid-to-poly> function in ArcInfo, and (c) the implementation of Voronoi polygons using grid center points as the input coverage.



(a) The original LandScan layer with four cells, three of which have a value of 250 and one with a value of 150. Total population count for all four cells is 900.



(b) The result of a grid-to-polygon conversion in Arctoolbox or the <gridpoly> function in ArcMap. Both aggregate adjacent cells of the same value, and assign the aggregated result a non-additive value. As a result, total counts are underestimated. In this example, the original population total of 900 is underestimated by 500 because the three "250" cells are aggregated as one cell with a value of 250.

(c) By generating Voronoi polygons as the input point layer, square polygons are drawn and the counts preserved. This approach was implemented in the present study and effectively converted population grids into vector polygons, while at the same time preserving the counts. The total population for the four squares after implementing this approach remains 900.

ArcInfo), utilizing the grid cell centroids. Using this point coverage, Voronoi polygons were generated; since the points were equidistant, the resulting tessellation mainly consisted of rectangles (except along the boundaries of the study area and the coastline), approximating a vector version of the LandScan grid (for the present purpose, the term “cell” loosely to refers to polygons in the LandScan vector layer, even if the resulting polygons are not technically grid cells). The census tract layer was then overlaid (using <intersect> in ArcToolbox) on this LandScan “vector” layer.

Population and household estimates of the output layer resulting from the intersection of the Census tract with the (“vectorized”) LandScan layer were calculated using a simple area-weighted average. That is, the population (or household) P of any given polygon in the output layer 1 is equivalent to the proportion of the population count P_0 in the input layer to the size of the area A0 in the input layer, multiplied by the size of the new area A_1 in the output layer:

$$P_1 = \frac{P_0}{A_0} A_1 \qquad (3)$$

For example, if a LandScan cell originally with a population count of 200 is bisected by a Census boundary into two polygons—one a quarter of the original LandScan cell size and the other three-quarters of the original size, these two polygons will be reassigned population counts of 50 and 150, respectively, the former being one-quarter and the latter, three-quarters of 200.

Since census tract data on race/ethnicity, children, and poverty level are reported as percentages, these proportions were simply multiplied with the new population estimates (or household counts for poverty level). For example, if a polygon having a population count of 200 intersects a Census tract with the following demographics: 40% Latino, 30% White, 25% African-American, 4% Asian-American, 15% age up to 17, and 10% below the Federal poverty level, the new layer will be assigned the following counts: 200 x 40% = 80 Latinos, 200 x 30% = 60 Whites, 200 x 25 = 50 African-Americans, 200 x 4% = 8 Asian-Americans, 200 x 15% = 30 children up to 17 years old, and 200 x 10% = 20 households under the Federal poverty threshold level. For median household income, a “total median household income” value was first calculated by multiplying the median household income from the Census tract by the number of households estimated in a polygon. After the overlay, the number of households contained in the resulting polygons was calculated (as described above), and the weighted total household income was calculated using the new household counts. In the final layer, the median household income was recalculated by dividing the total median household income by the number of households per polygon.

The LandScan-Census layer (i.e., the map layer generated from the intersection of the LandScan and Census layers, which contains both LandScan population estimates and Census demographic data, as explained above) was then overlaid onto the network buffers (Section 2.4). The new demographic data resulting from the intersection were recalculated in the same manner described above; that is, utilizing areal weighting. After re-assigning the values, buffers belonging to the same park were re-aggregated (using the <dissolve> function in ArcToolbox), such that once again, there is one buffer corresponding to each park; during this aggregation, the counts were simply summed. The “predominant” race/ethnic group in a given park buffer corresponds to the race group that has the highest proportion over the other race groups.

3 RESULTS AND DISCUSSION

3.1 Demographics across different distance thresholds

Figure 3 shows the six distance thresholds delineated around recreational parks and open spaces in the GVP region. Again, park buffers generated in the present study using (surrogate) access points do not always completely surround a park like a typical straight-line buffer would; the park buffers do not extend along portions of a park without street-level access (i.e., the portions of the boundary of parks that do not intersect a street). A number of these anomalies can be observed, for example, along portions of the boundary of the Los Padres National Forest.

The characteristics of populations encompassed by each of the distance threshold are shown in Table 2. In the region, a total of 500 km2, or 4.4% of the study area, is within a quarter mile of a park (Table 2a)—the latter is deemed a reasonable walking distance to and from a park (or half a mile round trip; Wolch et al., 2005), and as such, areas within this critical distance have easy pedestrian access to park resources. Of the 11 million people who reside in the region, only 1.61 million people—0.45 million of which are children—live within this pedestrian-accessible distance to a recreational park space (Table 2a). In other words, there are a total of 9.4 million people in the region—2.62 million of which are children—who do not have easy access to these spaces (Table 2b).

The proportion of race/ethnic groups within the ¼ mile threshold varied little, ranging from 14.0% to 15.6%, with Latinos and African-Americans exceeding their region averages (Table 2a). This trend is exhibited across the other five distance thresholds, and is slightly more pronounced for African Americans. The proportion of Asian Americans living within the ¼ mile park buffer was slightly lower than the proportion of the White population; but across all the other distance thresholds, Asian American representation was closer to their region average (Table 2a). These two sets of trends suggest higher than expected numbers of Latinos and African Americans living close to parks (relative to a completely random distribution of race/ethnic groups across the metropolitan region). However, the major discovery is that only 14.6% of the population in the region has easy access to a park.

Examining the proportion of race groups within a quarter-mile buffer to parks in the City of Los Angeles, Wolch et al. (2005:20; Table 1) also found that Whites have the least proportion of its population—only about one-fifth—within the quarter-mile buffer. This pattern is a consequence of the lower residential densities in White neighborhoods, effectively lowering the proportion of the race group represented within a given park buffer.

Figure 3. The six distance thresholds delineated in the present study. Also shown are the recreational parks and open spaces across the greater Los Angeles metropolitan region.

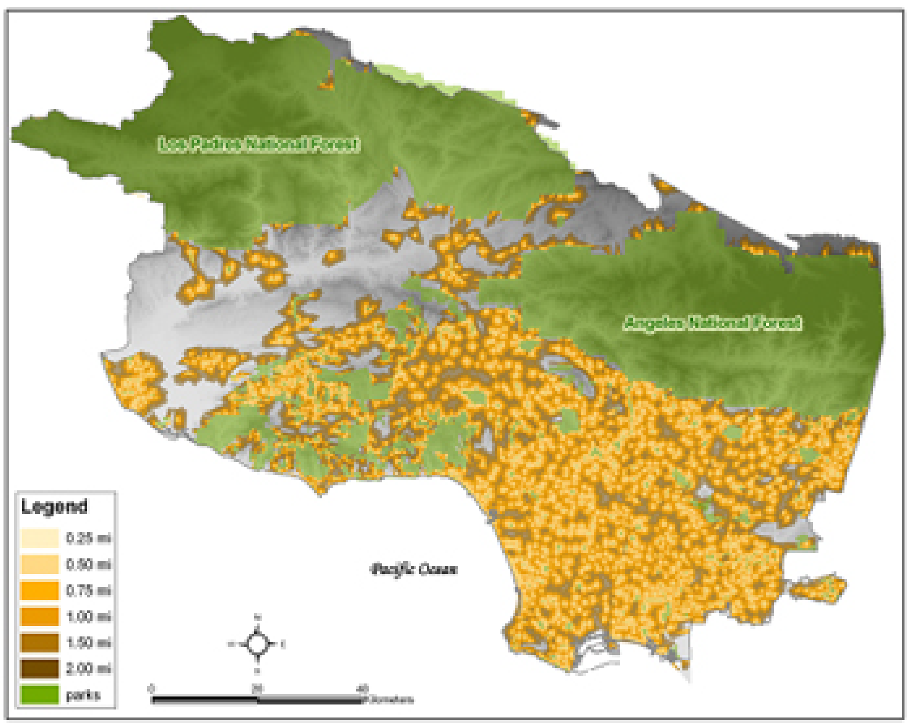


Table 2. Demographics of populations (a) inside (with access) and (b) outside (without access) the different distance thresholds.

(a) Inside buffer	**Distance Threshold (mi)**					
	0.25	**0.50**	**0.75**	**1.00**	**1.50**	**2.00**
Land area (km^2)	500	1,536	2,524	3,248	4,068	4,533
% of study area	4.4	13.7	22.5	29.0	36.3	40.4
Population (x 10^6)	1.61	5.0	7.92	9.52	10.40	10.6
% of total population	14.6	45.3	72.1	86.6	94.6	96.4
Density (per km^2)	3,211	3,247	3,139	2,931	2,558	2,322
Race groups inside buffer						
# Latino ($x10^6$)	0.50	2.22	3.54	4.23	4.59	4.64
# White ($x10^6$)	0.54	1.62	2.55	3.09	3.44	3.52
# African American ($x10^6$)	0.15	0.47	0.74	0.88	0.93	0.93
# Asian ($x10^6$)	0.19	0.60	0.97	1.18	1.29	1.31
% Race inside buffer (proportion of race group inside buffer to each race group total for region)						
% Latino	14.6	46.4	74.0	88.5	96.0	97.1
% White	14.4	43.4	68.2	82.7	92.1	94.2
% African American ($x10^6$)	15.6	49.1	77.2	91.8	97.1	97.1
% Asian American	14.0	44.1	71.3	86.8	94.8	96.3
Children and poverty						
# ≤ 17 years old ($x10^6$)	0.45	1.41	2.23	2.67	2.91	2.96
% ≤ 17 years old	27.9	28.2	28.1	28.1	28.0	28.0
# Households in poverty	0.27	0.86	1.36	1.61	1.72	1.74
% Poverty (proportion of households inside buffer)	17.2	17.5	17.4	17.1	17.1	16.9
Income	49,083	47,964	47,707	48,106	49,035	49,306

(b) Outside buffer	**Distance Threshold (mi)**					
	0.25	**0.50**	**0.75**	**1.00**	**1.50**	**2.00**
Land area (km^2)	10,715	9,680	8,694	7,970	7,147	6,682
% of study area	95.5	86.3	77.5	71.0	63.7	59.7
Population (x 10^6)	9.4	6.01	3.08	1.49	0.62	0.457
% of total population	85.5	54.6	28.0	13.5	5.6	4.3
Density (per km^2)	877	621	354	186	86	70
Race groups not covered						
# Latino ($x10^6$)	4.08	2.56	1.23	0.54	0.20	0.15
# White ($x10^6$)	3.19	2.12	1.19	0.66	0.31	0.24
# African American ($x10^6$)	0.81	0.49	0.22	0.08	0.03	0.03
# Asian American ($x10^6$)	1.17	0.76	0.39	0.18	0.07	0.05
% Race not covered						
% Latino	85.5	53.5	25.7	11.3	4.2	3.1
% White	85.4	56.8	31.8	17.7	8.3	6.4
% African American	84.6	51.1	23.0	8.4	3.1	3.1
% Asian American	86.0	55.9	28.7	13.2	5.1	3.7
Children and poverty						
# ≤ 17 years old ($x10^6$)	2.62	1.67	0.84	0.40	0.16	0.13
% ≤ 17 years old	27.9	27.7	27.4	26.8	24.4	27.0
# Households in poverty	1.52	0.93	0.43	0.18	0.07	0.05
% Poverty	16.3	15.6	14.1	12.3	11.1	11.6
Income	49,878	51,249	54,985	60,122	61,874	60,424

In terms of absolute population counts, Latinos have the highest number (700,000) residing inside the ¼ mile buffer, followed by Whites (540,000; Table 2a). There are 190,000 Asian Americans with ¼ mile access to a park, and 150,000 African Americans. The ratio of these race/ethnic group counts relative to each other (Table 2) approximate the race/ethnic composition in the study area—the study area has a total of 4.78 million Latinos, 3.74 million Whites, 0.96 million African Americans, and 1.36 million Asian Americans.

The above points to one shortcoming of the radius technique: applying distance thresholds and simply comparing populations inside the critical distance with those outside may be akin to taking representative samples of the entire population. One is bound to find ratios inside the buffer (with access) similar to the ratios outside of the critical distance, unless the distribution of both race/ethnic groups and parks are spatially concentrated in specific neighborhoods across the metropolitan area. Based on the results of the present study, the proportions of race/ethnic groups inside and outside the critical distance do not vary much when using different distance thresholds because the largest park areas occur on the periphery of the region, far away from the major residential areas (Figure 3). The results reported in Table 2 were not unexpected given that other studies implementing the radius technique to compare proportions of populations inside and outside a distance threshold (Tarrant and Cordell, 1999; Lindsey et al., 2001; Nicholls, 2001) mostly reported no systematic bias against minority or low income groups (Table 1d).

Median household incomes encompassed by the six different distance thresholds varied little, ranging from $47,707 at the lower end (at ¾ mile) to $49,306 at the higher end (at 2.0 miles) of the range (Table 2a). Percent poverty levels across all six distance buffers were also comparable, ranging from 16.8% to 17.5%. Median household incomes inside each critical distance were consistently lower compared to those of households outside the distance thresholds. Additionally, the median household incomes that were outside the critical distance consistently increased as the buffer size increased, while the percentage poverty level was inversely proportional to the buffer size in all but the 2.0 mile buffer (Table 2b). This implies that as one moves further from the parks, the more likely one encounters higher-income households—a trend counter-intuitive to the notion that public service provision is biased against minority groups and the poor.

In the present study, utilizing the radius technique to compare incomes of households close to parks with those outside some critical distance suggests that there are greater proportions of high-income households located further from parks. Residential densities in most high income neighborhoods are typically low, and the properties more expansive, thus imposing constraints on the number of households that can locate within a certain distance to a park. Low income neighborhoods, on the other hand, typically have higher densities, such that when examining a sample area surrounding a park, these higher densities translate to a higher representation of the high-density low-income group, as compared to a low-density high-income group. In any case, even if high income neighborhoods may have lower pedestrian access, they typically have better options in terms of mobility and transportation compared to low-income groups, and better access to expansive private recreational spaces, such as backyards or private clubs. All these considerations suggest the need to consider relative access to recreational resources and opportunities within the buffers, as is reported in the next subsection.

3.2 Park acres per capita for populations with one quarter mile access

It is evident in the discussion above that a straightforward comparison of population demographics inside and outside a critical threshold will typically bias high density groups who end up with a higher representation inside the critical distance. As such, the present study extends the implementation of the radius technique by reporting the park area per capita available for each major race group having pedestrian access to a park. "Pedestrian access" is defined here as a quarter mile distance or half a mile round trip (Wolch et al., 2005).

Examining the characteristics of populations having pedestrian access more closely, we assigned each of the 1,657 quarter-mile buffers to the predominant race/ethnic group (Table 3). For example, if in a particular

Table 3. Available park area per capita among populations with quarter-mile access to a park; parks are assigned to the largest race/ethnic group to facilitate comparisons across the four major race/ethnic groups in the region.

	Latino	White	African American	Asian American	Total
N	595	905	50	107	1,657
Total park acres	16,038	144,598	1,056	3,041	149,290
Population	822,341	621,854	69,102	89,475	1,602,772
# ≤17 yrs old	269,081	136,814	20,489	21,317	447,701
% ≤17 yrs old	32.7	22.0	29.6	25.8	27.9
Park acres					
per 1K capita	19.5	232	15.3	34	
per 1K children	59.6	1,056	51.5	142.6	

park buffer there are 50% Hispanics, 30% Whites, 10% African-Americans, and 5% Asian-Americans (the other 5% could be other race groups), this buffer is classified as "predominantly Hispanic". The characteristics of the park buffers as organized according to the predominant race group with pedestrian access to it are presented in Table 3.

Out of the 1,657 quarter-mile buffers, 55% (or 905) served predominantly White populations (Table 3). These areas enjoyed 232 park acres per 1,000 residents and 1,056 park acres per 1,000 children—the highest access across all four race/ethnic groups. It should be noted that the per capita estimates given here are typically higher than estimates using census tracts as the unit of measurement. Estimates reported in the present study are based on the quarter-mile buffers (representing pedestrian access) which have smaller areal extents, and hence fewer residents, relative to the areal extents of the parks. These smaller population-to-park-area ratios potentially overestimate the park area per capita ratios (compared to other studies using Census tracts, for example, as the unit of analysis); however, for the purpose of comparing available acreage within walking distance across race/ethnic groups, these relative amounts of the estimates are useful.

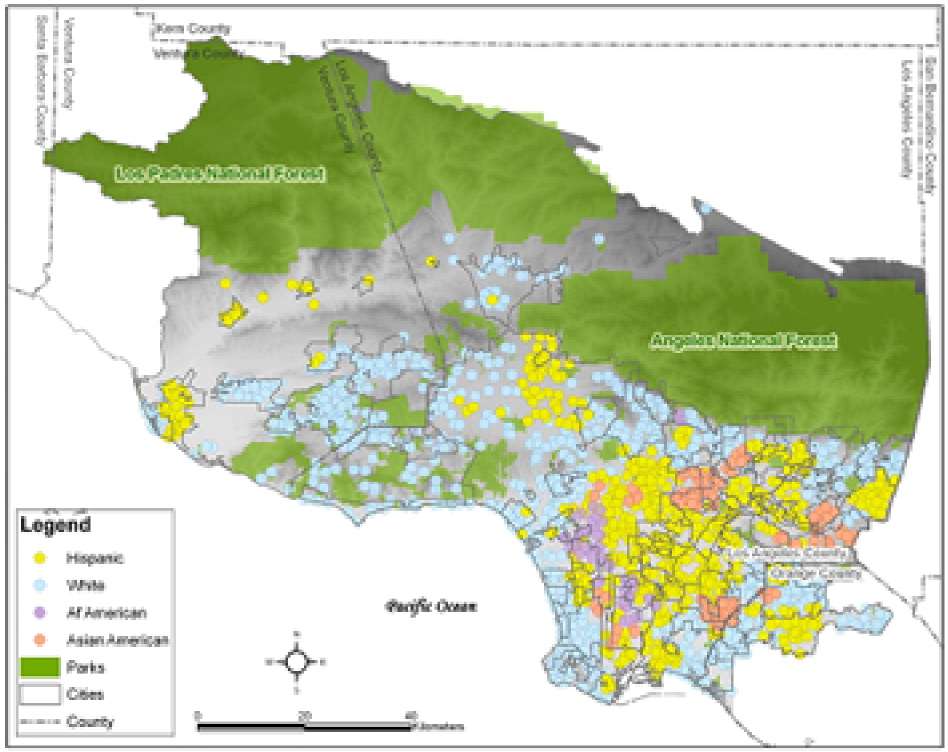
Buffers with predominantly Latino and African American populations have comparable park acreage, with values 12 to 15 times lower than that enjoyed by residents living in buffers dominated by Whites. Buffers with predominantly Latino populations have 19.5 park acres per capita and those with predominantly African American populations have 15.3 park acres per 1,000 capita. Compared to White neighborhoods typically located in the suburban fringes (Figure 4), these predominantly Latino and African-American areas are located in the central and east portion of Los Angeles County with relatively higher residential densities. Additionally, there are clusters of predominantly Latino population in the northeast quadrant of the San Fernando Valley, as well as in the City of Oxnard and several smaller agricultural communities in Ventura County and in the City of Anaheim in Orange County.

Most of these neighborhoods of color typically have more children, and as such, park acres per capita children are expected to be lower in these areas relative to White neighborhoods. Latino and African American dominated park buffer zones have 51 to 60 park acres per 1,000 capita children—approximately 17 to 20 times less than that of buffers with predominantly White populations across the GVP region (Table 3).

Buffers in which Asian-Americans predominate have 34 park acres per 1,000 capita and 143 acres per 1000 children capita, tailing far behind predominantly White buffer areas, but ahead of buffers where Latinos and African-Americans are most dominant. Asian-American dominated buffers are mostly concentrated in the San Gabriel Valley, in the eastern portion of L.A. County (e.g., West Covina, Hacienda Heights, Rowland Heights, and

Diamond Bar), in the cities of Cerritos and Artesia close to the Orange County border, and in the City of Carson in South Bay (Figure 4).

Figure 4. Locations of buffers with the dominant race groups in each identified by a specific color; yellow for predominantly Hispanic areas, blue for Whites, purple for African Americans, and peach for Asian Americans.



Again, although the absolute values presented here are higher (as explained above) compared to census tract-based estimates, the trends in park area per capita corroborates the patterns reported by Wolch et al. (2005) for the City of Los Angeles. Both Wolch et al. (2005) and the present study showed that buffers in predominantly White neighborhoods enjoy a disproportionately higher access to park acres compared to the three other race/ethnic groups.

3.3 Differential access to park facilities

The distribution of park facilities across the four major race/ethnic groups were examined in 292 field audited parks. It should be noted that for this analysis, adjacent parks were aggregated so that there was a smaller sample size analyzed than there were actual parks that were field audited (as reported in Sister et al., 2007). In particular, we examined quarter-mile access (i.e., buffers that are defined by ¼ mile distance to a park boundary) to seven (7) specific park facilities or infrastructure:

1. Play equipment
2. Basketball courts
3. Baseball diamonds
4. Soccer fields
5. Pathways for walking/jogging
6. Benches
7. Barbecue facilities

Results are presented in Table 4, with the percentage race/ethnic groups organized into quintiles; the latter allows for a closer examination of how buffers and facilities are distributed across all 292 parks. For each race/ethnic quintile, the number of parks with a specific facility is reported, as well as the number of persons served per park acre.

Table 4. Parks and park facilities as they are distributed across the four major race/ethnic groups; each group is divided into quintiles.

			# parks with facility for every 10 parks						
% race	# parks	Persons/ pk acre	Play equip	Basket-ball	Base-ball	Soccer	Walk/ jog	Benchs	BBQ
(a) Latino									
0-20%	154	98	6	4	2	1	**4**	9	5
21-40%	70	176	7	4	3	1	2	**9**	5
41-60%	54	204	8	5	3	1	2	9	4
61-80%	37	215	8	4	3	1	2	**10**	6
>80%	34	378	8	7	4	**1**	2	**10**	6
(b) White									
0-20%	87	268	8	5	3	1	2	**10**	6
21-40%	67	180	8	5	3	1	2	**10**	5
41-60%	67	149	7	4	2	1	**3**	**10**	5
61-80%	88	134	6	4	3	1	**3**	9	5
>80%	40	52	5	4	1	1	**4**	8	4
(c) African-American									
0-20%	332	168	7	4	3	1	3	**9**	5
21-40%	10	295	8	5	4	0	3	9	1
41-60%	3	54	**10**	**3**	**7**	**3**	0	**10**	**7**
61-80%	3	80	10	10	3	0	0	10	7
>80%	1	195	0	0	0	0	0	10	0
(d) Asian-American									
0-20%	274	171	7	4	3	1	3	**9**	5
21-40%	45	180	6	5	2	1	**3**	9	4
41-60%	25	148	9	4	4	1	3	**10**	6
61-80%	5	102	8	4	2	0	0	**10**	**8**
>80%	0	0	0	0	0	0	0	0	0

Since there was an unequal number of field-audited parks for each race/ethnic group (see the row labeled "N" in Table 3), we normalized the number of parks with facility as the probability of encountering a facility given ten parks. For example, if, for a particular race group, there were 60 parks with a particular facility out of 600 field audited parks, this race group would have one out of 10 parks having such a facility. If another race group had 400 parks field audited, with 40 of these parks having the facility, this group would also be reported as having one out of 10 parks having the facility.

Latino quintiles and park facilities. Latinos make up 44% of the population in the study area, although results in Table 4 reveal that most of the parks (i.e., 224 of 349) contained ≤40% Latino population within the quarter mile buffer. This result indicates that there are more parks in areas with smaller Latino populations and that areas with greater proportions of Latinos have relatively fewer parks. To illustrate, of the 349 parks field audited, a total of 154 parks were located in areas with only 0-20% Latinos (i.e, the first quintile range, Table 4), whereas only 34 parks were located in buffers with >80% Latinos (i.e., the last quintile range, Table 4).

The above trend, which was masked in the earlier comparisons of populations inside and outside a critical distance (Section 3.1), is evident in the increase in the number of people served per park acre as one increases the percentage of Latinos living within one quarter mile of a park (Table 4a). Estimated from field audits, this trend corroborates with findings described earlier in Section 3.2; that is, predominantly Latino areas have lower access in terms of park area per capita compared to Whites. The more Latino-dominated the areas, the less park access the residents enjoy, due to higher population-to-park area ratios (i.e., potentially more congested parks). Again, this is largely because of the higher population densities exhibited by the minority group, and the limited space, hence, smaller parks in Latino neighborhoods.

In terms of facilities present, the field audited parks indicated that parks with ≥41% Latino populations were well-equipped with facilities, with seven to eight out of ten parks equipped with play equipment, four to seven out of ten barbecue equipment and/or basketball courts (Table 4a). The 29 park buffers with >80% Latinos were the best equipped of all, although when one takes into account the high number of people served in high density Latino neighborhoods, the facilities in these parks may not actually be "more" when compared to areas catering to fewer people.

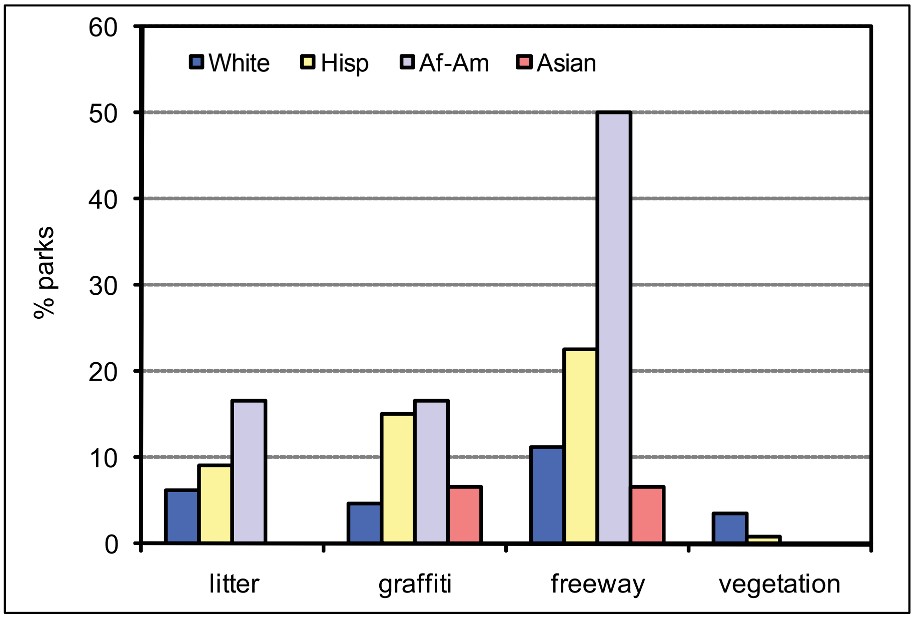
The results in Table 4 also show what is missing from predominantly Latino areas. Most parks in these neighborhoods with high residential densities do not have enough space for soccer fields or trails and pathways for walking/jogging presumably because of the dense settlement patterns and limited space.

White quintiles and park facilities. Among the four race/ethnic groups, Whites have the most evenly distributed number of buffers across the quintile range compared to other groups (Table 4b). Whites make up 34% of the population in the study area and they are more likely to live in lower density neighborhoods. This is indicated in the decreasing number of people served per park acre as the percentage White population in the park buffers increases (Table 4b)—a pattern opposite that of the Latino quintiles described earlier (Table 4a). Again, this corroborates results presented in Section 3.2—that quarter-mile buffers that are predominantly White have disproportionately higher access in terms of park acreage per capita compared to other race groups, a trend that is more pronounced as the proportion of Whites in the buffer area increases.

In terms of facilities, predominantly White areas (>60% White) appear to be near parks with fewer facilities relative to the other groups—this is shown by the decreasing number of parks with facilities of various types as the percent White population increases (Table 4b). This is true for all facilities except pathways for walking/jogging—four out of 10 parks (the highest number in all the sampled parks) in predominantly White areas have these facilities. Many of the field audited parks in predominantly White areas were large recreational and open space areas in/near the San Gabriel and Santa Monica Mountains or beaches that are well-equipped with opportunities for activities such as walking/jogging, but lacking facilities typically encountered in neighborhood parks. This dearth of specific facilities in areas with predominantly White populations may be less of a problem than it would otherwise be, since the residents in these neighborhoods are more affluent and many of their active (e.g., play equipment, exercise, etc) and passive (e.g., barbecue) recreational needs might be served by private gyms, club houses, and/or in their own backyards. However, the dearth of public park facilities for physical activity in these areas remains striking.

African-American and Asian-American quintiles. African-Americans and Asian-Americans make up 9% and 12%, respectively of the study area's population. Park buffers of the 349 field-audited parks reflect these low proportions, with most buffers falling under the 0-20% quintile range for both race/ethnic groups (Tables 4.4c and d). It is interesting to note that in the 41-80% African-American quintile range, park buffers had the highest number of play equipment, basketball courts, baseball diamonds and barbeque equipment (Table 4c). On the other hand, these results are inferred from only six (three at 41-60% and another three at 61-80%) audited parks—a sample size that may be too small to be representative of the entire region. There seems to be no apparent consistent trend across proportions of Asian-American quintiles; again, this may be due to the smaller sample sizes in the higher end of the quintile range for this group. The field audited parks in the higher quintiles for both distributions are either too few or not represented at all (as is the case with >80% quintiles for both race groups); as such, patterns across the quintiles are difficult to discern, and may not be adequate to draw conclusions and make inferences about the entire region.

Figure 5. Percent field-audited parks where litter, graffiti, freeway noise, and overgrown vegetation were encountered, organized according to the major race group living within 0.25 mi of the parks.



3.4 Park condition

Of the 349 field audited parks, three parks were not rated in terms of condition; as such, the results below are based on a sample size of 346 parks provided with condition ratings.

During the field survey, there were more parks in predominantly Latino and African-American neighborhoods where litter, graffiti, and freeway noise were encountered compared to the other groups (Figure 5). The presence of litter and graffiti decreases the aesthetic qualities of a park and may affect users' perceptions of safety; these in turn may impact the desirability and utilization rates of particular parks. As such, access to parks perceived as derelict may actually be lower than what is suggested by quantitative estimates of park acreage or the presence/absence of facilities. The higher proportion of parks with audible freeway noise indicates that there are more parks in predominantly Latino neighborhoods that are close to freeways. As such, users who frequent these places may be disproportionately exposed to the noise and air pollution hazards associated with freeways. Parks in White neighborhoods were the opposite. Here, nuisances were seldom encountered, with the exception of overgrown vegetation (Figure 5).

Table 5 presents the race/ethnic group quintiles with the corresponding percentage of parks rated "very poor", "poor", "good", "very good", and "excellent" in terms of overall maintenance quality. Again, African- and Asian-Americans had relatively few parks above the 41-60% quintile range (Tables 4.5c and d, respectively); as such the discussion below largely focuses on Latino and White populations (Table 5a and b, respectively).

In buffers with predominantly Latino and White populations, none of the parks were rated "very poor" and very few were rated "poor". Of the few parks rated "poor", most are located in predominantly Latino areas, as indicated by the relatively higher percentage of parks in the Latino quintile range of greater than 80% (Table 5a). The opposite trend is observed in the White quintiles, with "poor" parks falling under the lower quintile range (i.e., 20-40% and lower; Table 5b). This means that one is more likely to encounter parks in poor condition in neighborhoods with higher proportions of Latino and lower proportions of White populations. Complementary to this is the trend exhibited by parks rated "excellent". In the Latino quintile range, these parks were more likely encountered where the proportion of Latinos is lower (20-40% and lower; Table 5a) and the proportion of Whites is higher (Table 5b).

The condition of parks may be an important factor determining park user preference since people may be more likely to visit parks that are well maintained and in better condition. Additionally, as noted above, park condition affects perceptions of safety. Places that are poorly maintained, such as derelict parks, are often perceived as unsafe, and as such, are less likely to be patronized (McKenzie et al., 2006). Given that there are more parks in relatively poorer condition in predominantly Latino neighborhoods, it is likely that levels of accessibility to parks and recreational resources in Latino neighborhoods are lower than suggested by measures based solely on distances or park acreage.

Table 5. Overall maintenance of parks; organized into quintiles for the proportion of (a) Latino, (b) White, (c) African-American, and (d) Asian-American race/ethnic groups

% race		% parks (# in parenthesis)				
	# parks	very poor	poor	good	very good	excellent
(a) Latino						
0-20%	152	0	3 (4)	20 (31)	45 (69)	31 (47)
21-40%	70	0	2 (3)	31 (22)	46 (32)	20 (14)
41-60%	53	0	19 (7)	30 (16)	42 (22)	15 (8)
61-80%	37	0	5 (2)	28 (11)	59 (22)	5 (2)
>80%	34	0	24 (8)	35 (12)	26 (9)	15 (5)
(b) White						
0-20%	87	0	13 (11)	32 (28)	40 (35)	15 (13)
21-40%	66	0	8 (5)	27 (18)	51 (34)	14 (9)
41-60%	67	0	4 (3)	30 (20)	45 (30)	21 (14)
61-80%	87	0	1 (1)	23 (20)	44 (38)	32 (28)
>80%	39	0	8 (3)	15 (6)	44 (17)	31 (12)
(c) Af-Am						
0-20%	329	0	7 (22)	26 (86)	45 (148)	22 (72)
21-40%	10	0	0	40 (4)	40 (4)	20 (2)
41-60%	3	0	33 (1)	0	67 (2)	0
61-80%	3	0	0	67 (2)	0	33 (1)
>80%	1	0	0	0	0	100 (1)
(d) Asian-Am						
0-20%	271	0	7 (21)	24 (66)	45 (122)	22 (61)
21-40%	45	0	2 (1)	44 (20)	33 (15)	20 (9)
41-60%	25	0	0	24 (5)	56 (14)	20 (5)
61-80%	5	0	20 (1)	0	60 (3)	20 (1)
>80%	0	0	0	0	0	0

The level of safety in a given park is difficult to assess, with different indices used depending on how safety is interpreted. For example, the level of traffic volume may be an important measure if pedestrian safety is a concern (Wolch et al., 2005). Features such as emergency call boxes, park rangers, lifeguards, and security personnel can also be quantified as indicators of safety. In addition, crime rates can also be taken into account. It should also be noted that some features or indices may capture some aspects of safety in a given recreation setting, but may not be appropriate measures for other types of settings. For example, the presence of lights may be used as an indicator of safety for neighborhood parks, but their absence in wilderness parks does not necessarily mean a lack of safety in the latter (Wolch et al., 2005).

For the present study, the presence of emergency phones, on-site staff, and security were noted as indices of safety during the field survey. Results show that the presence of these facilities in predominantly White and Latino areas did not vary greatly, ranging from three to four parks for every 10 parks for telephones and five to six for every 10 parks for on-site staff. Only one out of 10 parks had on-site security in either predominantly White and Latino areas. The results indicating the presence of these three safety features did not reveal any pattern pertaining to differences in levels of safety in predominantly White compared to predominantly Latino areas.

4 CONCLUSIONS

In the GVP region, only 14.6% of the population has pedestrian access to park space (i.e., ¼ mile or ½ mile round trip), leaving 86% of the population without easy access to such resources. Because people of color typically live in areas with higher residential densities, Latinos, African-Americans, and to some extent, Asian-Americans have higher representation in terms of proportions living inside a quarter mile distance to a park (compared to the proportions of these race groups outside this critical threshold).

Accounting for the effect of densities, however, leads to a very different picture. Predominantly White areas clearly have disproportionately greater access to park space when access is defined as the amount of park area per capita. On the other hand, parks in these predominantly White buffer neighborhoods have fewer facilities, which is not surprising since a number of parks in these areas are expansive nature parks equipped with trails and pathways and/or beaches that mark the urban-wildland fringes or land-ocean interfaces of the region.

Latinos, African-Americans, and Asian-Americans have disproportionately lower access to park space in terms of area per capita relative to Whites. Buffer areas dominated by Latino and African-American populations are worse off and have six times less park acreage per capita on average compared to those buffers dominated by Whites. Considering that there are more children in the former neighborhoods, these disparities are even more pronounced when per capita children are taken into account. This means communities of color, which are typically high density with minimal private open space and often close to undesirable land uses, have limited opportunities for play, exercise, and recreation.

Insufficient physical activity has been implicated as one factor influencing the rise of obesity rates (and related disease such as diabetes and hypertension) in Latinos and in African-American populations (Gordon-Larsen et al., 1999; Gordon-Larsen et al., 2000; Sallis et al., 2001; Kumanyika and Grier, 2006). If disparities in health—specifically those relating to the growing obesity problem in minority groups—are to be addressed, intervention strategies should include increasing access to well-maintained parks and facilities for those who are disproportionately disadvantaged and in most need.

In examining equity in park access in the GVP region, the present study accounted for the presence of facilities, as well as the condition of parks, in addition to reporting park acreage. While there are other studies that account for park facilities and/or the condition of parks, most of these are limited to smaller study areas (e.g., a neighborhood, or city), or to a small number of parks (typically less than 10). Equity studies across larger spatial extents containing over 1,000 parks (the present study identifies over 1,800 parks in the L.A. region) are typically limited to an accounting of park acreage per capita (e.g., Garcia and White, 2006; Trust for Public Land, 2006). As the present study has shown, park acreage per capita does not describe the full story in terms of accessibility to park resources. For example, in a given Latino neighborhood, a park with a basketball hoop may be present, but such a park would not address the preference of Latinos for other types of sports equipment or facilities. Also, there may be a number of parks in a given locality, but if such parks are not well-maintained or perceived as safe, effective accessibility to these resources may actually be lower than access as estimated by park acreage alone.

The present analysis of park facilities, however, was largely constrained by the number of parks that were field audited. Field audit data for areas that were predominantly African- or Asian-American were largely inadequate in number to draw relevant conclusions from. While web audits covered a larger sample size (they were exhaustive for those parks with website data), such data are inherently constrained by the variability between cities in terms of reporting the facilities in their parks. In some cases, cities would list facilities present in their parks, but would not match these to specific parks; in these cases, it was difficult to ascertain which parks contained which facilities. Additionally, as mentioned earlier, the absence of a facility on a website is not necessarily a confirmation that a specific facility is absent. The lack of facilities listed on websites may simply mean that a particular jurisdiction does not report that information and/or has not updated their website information. Also, it is largely impossible to report the condition of parks based on web audits.

Future work examining large regions should find creative ways to address the near impossibility (given time and budget constraints) of accounting for every facility/amenity and the condition of every park across such large spatial extents. One strategy that could be adopted is the concept of a “wiki”, a web application that facilitates collaborative authoring by allowing multiple authors to add, remove, and edit content (http://en.wikipedia.org/wiki/wiki). For the purpose of assembling a comprehensive park information database, such a concept can be implemented with a web site containing a GIS park layer, wherein cities (or residents or community groups) can easily click on a specific park within their jurisdiction and add detailed information such as facilities, amenities, or recreational programs present. Such collaborative efforts spread out the costs (time and budget) such that it becomes possible to acquire more detailed information for specific parks across a large region. This idea could be incorporated into web-based decision-support tools such as those developed under the auspices of the Green Visions Plan for 21st Century Southern California (http://www.greenvisionsplan.net/).

5 LITERATURE CITED

Aytur, S. A., Rodriguez, D. A., Evenson, K. R., Catellier, D. J., and Rosamond, W. D. 2007. Promoting active community environments through land use and transportation planning. American Journal of Health Promotion 21(4S): 397-407.

Barnett, H. 2001. The Chinatown cornfields: Including environmental benefits in environmental justice struggles. Critical Planning 8: 50-61.

Bedimo-Rung, A. L., Mowen, A. J. and Cohen, D. A. 2005. The significance of parks to physical activity and public health, a conceptual model. American Journal of Preventive Medicine 28(2S2): 159-166.

Bhaduri, B., Bright, E., Coleman, P. and Dobson, J. 2002. LandScan: Locating people is what matters. GeoInformatics 5(2): 34-37.

Bialeschki, M. D. and Walbert, K. L. 1998. You have to have some fun to go along with your work: The interplay of race, class, gender, and leisure in the industrial South. Journal of Leisure Research 30(1): 79-100.

Boone, C. G. 1998. Real estate promotion and the shaping of Los Angeles. Cities. 15(3): 155-163.

Boone, C. G. and Modarres, A. 1999. Creating a toxic neighborhood in Los Angeles County, A historical examination of environmental equity. Urban Affairs Review 35(2): 163-187.

Boyne, G., Powell, M. and Ashworth, R. 2001. Spatial equity and public services, An empirical analysis of local government finance in England. Public Management Review 3(1): 19-34.

Byrne, J., Wolch, J., Swift, J. and Ryan, C. 2005. SAGE (Systematic Audit of Green-space Environments): Audit Form and Instructions. University of Southern California Center for Sustainable Cities and GIS Research Laboratory, Los Angeles, CA.

Carr, D. S. and Williams, D. R. 1993. Understanding the role of ethnicity in outdoor recreation experiences. Journal of Leisure Research 25(1) 22-38.

Center for Disease Control and Prevention. 1990. Coronary heart disease attributable to sedentary lifestyle—Selected states, 1988. Morbidity and Mortality Weekly Report 39: 541-544.

Cohen, D., Sehgal, A., Williamson, S., Sturm, R., McKenzie, T.L., Lara, R., and Lurie, N. 2006. Park Use and physical Activity in a Sample of Public Parks in the City of Los Angeles. RAND Corporation Technical Report. Rand Corporation, Santa Monica, CA.

Cohen, D. A., McKenzie, T. L., Sehgal, A., Williamson, S., Golinelli, D. and Lurie, N. 2007. Contribution of public parks to physical activity. American Journal of Public Health 97(3): 509-514.

Cranz, G. 1982. The Politics of Park Design, A history of urban parks in America. The MIT Press, Cambridge, MA.

Crompton, J. L. and Wicks, B. E. 1988. Implementing a preferred equity model for the delivery of leisure services in the U.S. Context. Leisure Studies 7: 287-483.

Davis, M. 1996. How Eden lost its garden: A political history of the Los Angeles landscape. In: Scott, A.J. and Soja, E. W. (Editors), The City, University of California Press, Berkeley, pp. 160-185.

De Chiara, J. and Koppelman, L. 1982. Urban Planning and Design Criteria. Van Nostrand Reinhold, New York, NY.

Ewing R., Schmid, T., Killingsworth, R., Zlot, A. and Raudenbush, S. 2003. Relationship between urban sprawl and physical activity, obesity and morbidity. American Journal of Health Promotion 18(1): 47-57.

Foley, J. and Pirk, H. 1991. Taking back the parks, Part 1. Parks and Recreation 26:54-58, 143.

Frank, L. D. and Engelke, P. O. 2001. The built environment and human activity patterns: Exploring the impacts of urban form on public health. Journal of Planning Literature 16(2): 202-218.

Frank, L., Andresen, M. A. and Schmid, T.L. 2004. Obesity relationships with community design, physical activity and time spent in cars. American Journal of Preventive Medicine 27: 87-96.

Frank, L, Kerr, J., Chapman, J., and Sallis, J. 2007. Urban form relationships with walk trip frequency and distance among youth. American Journal of Health Promotion 21(4S): 305-311.

Frumkin, H. 2005. Health, equity and the built environment. Environmental Health Perspectives 113(5):A290-A291.

Fulton, W. 1997. The Reluctant Metropolis. The Johns Hopkins University Press, Baltimore, Maryland.

Garcia, R. and White, A. 2006. Healthy parks, schools, and communities: Mapping green access and equity for the Los Angeles region. The City Project Policy Report. Accessed online in May 29, 2007 at http://www.cityprojectca.org/ publications/index.html.

Garcia, R., Flores, E. S. and Pine, E. 2002. Dreams of fields: Soccer, community, and equal justice. Report on Sports in Urban Parks to the California Department of Parks and Recreation, Center for Law in the Public Interest, Los Angeles.

Garvin, A. and Berens, G. 1997. Urban Parks and Open Space. Urban Land Institute, Washington DC.

Giles-Corti, B. and Donovan, R. J. 2002. The relative influence of individual, social and physical environment determinants of physical activity. Social Science and Medicine 54: 1793-1812

Giles-Corti, B., Broomhall, M. H., Knuiman, M., Collins, C., Douglas, K., Ng, K., Lange, A. and Donovan, R. J. 2005. How important is distance to, attractiveness, and size of public open space? American Journal of Preventive Medicine 28(2S2): 169-177.

Gilliland, J., Holmes, M., Irwin, J. D. and Tucker, P. 2006. Environmental equity is child's play: mapping public provision of recreation opportunities in urban neighborhoods. Vulnerable Children and Youth Studies 1(3): 256-263.

Glickman, T. S. 1994. Measuring environmental equity with Geographic Information Systems. Resources 116: 2-6.

Gordon-Larsen, Adair, L. A. and Popkin, B. M. 1999. The relationship of ethnicity, socioeconomic factors, and overweight in U.S. adolescents. Obesity Research 11(1): 121-129.

Gordon-Larsen, P, mcMurray, R. G. and Popkin, B. M. 2000. Determinants of adolescent physical activity and inactivity patterns. Pediatrics 105(6): e83-e90.

Gould, P. 1985. The Geographer at Work. Routledge, London.

Hamilton, J. T. 1995. Testing environmental racism: Prejudice, profits, political power? Journal of Policy Analysis and Management 14:107-132.

Handy, S. L. and Niemeier, D. A. 1997. Measuring accessibility: and exploration of issues and alternatives. Environment and Planning A 29: 1175-1194.

Handy, S. L., Boarnet, M. G., Ewing, R. and Killingsworth, R. E. 2002. How the built environment affects physical activity, views from urban planning. American Journal of Preventive Medicine 23(2S2): 64-158

Harnik, P. and Simms, J. 2004. Parks: How far is too far? American Planning Association. Accessed online in March 20, 2006 at http://www.tpl.org/ content_documents/cityparks_Planning_mag_article12 2004.pdf.

Hay, A. M. 1995. Concepts of equity, fairness and justice in geographical studies. Transactions of the Institute of British Geographers 20: 500-508.

Hewko, J., Smoyer-Tomic, K. E. and Hodgson, M. J. 2002. Measuring neighbourhood spatial accessibility to urban amenities: does aggregation error mater? Environment and Planning A 34: 1185-1206.

Hillsman E. L. and Rhoda, R. 1978. Errors in measuring distances from populations to service centers. Annals of Regional Science, 12: 74-88.

Ho, C., Sasidharan, V., Elmendor, W., Willits, F. K., Graefe, A. and Godbey, G. 2005. Gender and ethnic variations in urban park preferences, visitation and perceived benefits. Journal of Leisure Research 37(3): 281-306.

Hodgson, M. J., Shmulevitz, F. and Korkel, M. 1997. Aggregation error effects on the discrete-space p-median model: the case of Edmonton, Canada. The Canadian Geographer 41: 415-428.

Joassart-Marcelli, P. M., Musso, J. A. and Wolch, J. R. 2002. Fiscal consequences of concetrated poverty in a metroplitan region. Annals of the Association of American Geographers 95(2): 336-356.

King, A. C., Jeffery, R. W., Fridinger, F., Dusenbury, L., Provence, S., Hedlund, S. A. and Spangler, K. 1995. Environmental and policy approaches to cardiovascular diseases prevention through physical activity: issues and opportunities. Health Education Quarterly 22(4): 499-551.

Koehler, D. H. and Wrightson, M. T. 1987. Inequality in the delivery of urban services: A reconsideration of the Chicago parks. The Journal of Politics 49(1): 80-99.

Kriesel, W., Centner, T. J. and Keeler, A.G. 1996. Neighborhood exposure to toxic releases: Are there racial inequities? Growth and Change 27: 479-499.

Kumanyika, S. and Grier, S. 2006. Targeting interventions for ethnic minority and low-income populations. The Future of Children 16(1): 187-207.

Lake, A. and Townshend, T. 2006. Obesogenic environments: exploring the built and food environments. The Journal of the Royal society for the Promotion of Health 126(6): 262-267.

Lindsey, G., Maraj, M. and Kuan, S.C. 2001. Access, equity, and urban greenways: An exploratory investigation. The Professional Geographer 55(3): 332-346.

Lineberry, R. 1976. Equality, public policy and public services: The underclass hypothesis and the limits to equality. Policy and Politics 4: 67-84.

Loukaitou-Sideris, A. 1995. Urban form and social context: Cultural differentiation in the uses of urban parks. Journal of Planning Education and Research 14:89-102.

Lucy, W. 1981. Equity and planning for local services. Journal of the American Planning Association 47: 447-457.

Marcuse, P. 1978. Equal access to public services. Proceedings of the General Education Seminar, Columbia University 7: 23-31.

McKenzie T. L., Cohen D. A., Sehgal, A., Williamson S., and Colinelli, D. 2006. System for Observing Play and Leisure Activity in Communities (SOPARC): reliability and feasibility measures. Journal of Physical Activity and Health. 3(S): S208-S222.

McLafferty, S. 1982. Urban Structure and Geographical Access to Public Services. Annals of the Association of American Geographers 72(3): 347-354.

McLafferty, S. L. and Ghosh, A. 1982. Issues in measuring differential access to public services. Urban Studies 19: 383-389.

Merget, A. 1979. Equity in the distribution of municipal services. In: Bryce, H. J. (Editor) Revitalizing Cities, Lexington Books, Lexington, MA, pp. 161-191.

Mitchelson, R. L. and Lazaro, M. T. 2004. The face of the game, African Americans' spatial accessibility to golf. Southeastern Geographer 44(1): 48-73.

Mladenka, K. R. 1980. The urban bureaucracy and the Chicago political machine: Who gets what and the limits of political control. American Political Science Review 74: 991-998.

Mladenka, K. R. and Hill, K. Q. 1977. The distribution of benefits in an urban environment, parks and libraries in Houston. Urban Affairs Quarterly 13(1): 73-94

Mohai, P. and Bryant, B. 1992. Environmental racism: Reviewing the evidence. In Bryant, B. and Mohai, P (Editors) Race and the Incidence of Environmental Hazards: A Time for Discourse. Westview Press, Boulder, CO, pp. 163-176.

Mohai, P. and Saha, R. 2006. Reassessing racial and socioeconomic disparities in environmental justice research. Demography 43(2): 383-399.

Mokdad, A. H., Ford, E. S., Bowman, B. A., Dietz, W. H., Vinicor, F., Bales, V. S. and Marks, J. S. 2001. Prevalence of obesity, diabetes, and obesity-related health risk factors. Journal of the American Medical Association 289(1): 76-79.

Nicholls, S. 2001. Measuring the accessibility and equity of public parks: A case study using GIS. Managing Leisure 6: 201-219.

Omer, I. 2006. Evaluating accessibility using house-level data: A spatial equity perspective. Computers, Environment and Urban Systems 30: 254-274.

Pastor, M., Sadd, J. and Hipp, J. 2001. Which came first? Toxic facilities, minority move-in, and environmental justice. Journal of Urban Affairs 23:1-21.

Pincetl, S. 2003. Nonprofits and park provision in Los Angeles: An exploration of the rise of governance approaches to the provision of local services. Social Science Quarterly 84(4): 979-1001. Rise of governance approaches to the provision of local services. Social Science Quarterly 84(4): 979-1001.

Pulido, L., Sidawi, S. and Vos, R. O. 1996. An archaeology of environmental racism in Los Angeles. Urban Geography 17(5): 419-439

Roemmich, J. N., Epstein, L. H. and Raja, S. 2007. The neighborhood and home environments: Disparate relationships with physical activity and sedentary behaviors in youth. Annals of Behavioral Medicine 33(1): 29-38.

Rosenberger, R. S., Sneh, Y. and Gurvitch, R. 2006. A spatial analysis of linkages between health care expenditures, physical inactivity, obesity and recreation supply. Journal of Leisure Research 37(2): 216-235.

Ross, N.A., Tremblay, S.S. and Graham, K. 2004. Neighborhood influences on health in Montreal, Canada. Social Science and Medicine 59: 1485-1494.

Rundle, A., Roux, A. V. D., Freeman, L. M., Miller, D., Neckerman, K. M. and Weiss, C. 2007. The urban built environment and obesity in New York City: A Multilevel Analysis. American Journal of Health Promotion 21(4S): 326-334.

Saelens, B. E., Sallis, J. F. and Frank, L. D. 2003. Environmental correlates of walking and cycling: findings from the transportation, urban design, and planning literatures. Annals of Behavioral Medicine 25(2): 80-91.

Sallis, F. and Glanz, K. 2006. The role of built environments in physical activity, eating, and obesity in childhood. The Future of Children 16(1): 89-108

Sallis, J. F, Bauman, A. and Pratt, M. 1998. Environmental and policy interventions to promote physical activity. American Journal of Preventive Medicine 15(4): 379-397.

Sallis, J. F., Conway, T. L., Prochaska, J. J., McKenzie, T. L., Marshall, S. J. and Brown, M. 2001. The association of school environments with youth physical activity. American Journal of Public Health. 91: 618-620

Sherer, P. M. 2003. The Benefits of Parks: Why America Needs More City Parks and Open Space. Accessed online in March 2005 at http://www.tpl.org/.

Shinew, K. J, Floyd, M. F., McGuire, F. A. and Noe, F. P. 1996. Class polarization and leisure activity preferences of African Americans: Intragroup comparisons. Journal of Leisure Research 28(4): 219-232.

Sister, C., Wolch, J., Wilson, J., Seymour, M., Linder, A., Byrne, J. and Swift, J. 2007. Parks and Open Space Resources in the Green Visions Plan Area. University of Southern California Center for Sustainable Cities and GIS Research Laboratory, Los Angeles, CA.

Smoyer-Tomic, K. E., Hewko, J. N. and Hodgson, M. J. 2004. Spatial accessibility and equity of playgrounds in Edmonton, Canada. The Canadian Geographer 48 (3):287-302.

Steffen, L. M., Arnett, D. K., Blackburn, H., Shah, G., Armstrong, C., Luepker, R. and Jacobs, D. 2006. Population trends in leisure-time physical activity: Minnesota heart survey, 1980-2000. Medicine and Science in Sports and Exercise 38(10): 1716-1723.

Stodolska, M. and Yi, J. 2003. Impacts of immigration on ethnic identity and leisure behavior of adolescent immigrants from Korea, Mexico, and Poland. Journal of Leisure Research 35(1): 49-79.

Symons, J. G. 1971. Some comments on equity and efficiency in public facility location models. Antipode 3(1): 54-67.

Talen, E. 1997. The social equity of urban service distribution: An exploration of park access in Pueblo, Colorado and Macon, Georgia. Urban Geography 18(6): 521-541.

Talen, E. 1998. Visualizing fairness: Equity maps for planners. Journal of the American Planning Association 64: 22-39.

Talen, E. 2001. School, community, and spatial equity: An empirical investigation of access to elementary schools in West Virginia. Annals of the Association of American Geographers 91(3): 465-486.

Talen, E. and Anselin, L. 1998. Assessing spatial equity: An evaluation of measures of accessibility to public playgrounds. Environment and Planning A 30: 595-613.

Tarrant, M.A. and Cordell, H.K. 1999. Environmental justice and the spatial distribution of outdoor recreation sites: An application of Geographic Information Systems. Journal of Leisure Research 31(1): 18-34.

Timperio, A., Ball, K., Salmon, J., Roberts, R. and Crawford, D. 2007. Is availability of public open space equitable across areas?. Health and Place 13: 335-340.

Trust for Public Land. 2006. Jacksonville, Albuquerque have Largest City Park Systems: New Facts on City Parks Released. Accessed online in September 2006 at http://www.tpl.org.

U.S. General Accounting Office. 1995. Hazardous and non-hazardous waste: Demographics of people living near waste facilities. U.S. Government Printing Office, Washington, DC.

United Church of Christ Commission on Racial Justice (UCCCRJ). 1987. Toxic Wastes and Race in the United States. A National Study of the Racial and Socioeconomic Characteristics of Communities with Hazardous Waste Sites. United Church of Christ, New York, NY.

White, A. 1979. Accessibility and public facility location. Economic Geography 55 (1):18-35.

Wolch, J. R. 1996. The rise of homelessness in Los Angeles during the 1980s. In Scott, A. J., and Soja, E. W. (Editors), The City, Los Angeles and Urban Theory at the End of the Twentieth Century, University of California Press, Berkeley, CA, pp. 390-425.

Wolch, J., Wilson, J. P. and Fehrenbach, J. 2005. Parks and park funding in Los Angeles: An equity-mapping analysis. Urban Geography 26(1): 4-35.