Project Title:
Understanding Urban and Community Forests Contributions to Physical Activity and Health

Category:
Innovation Grant

Amount Requested:
$148,752

Funding Match:
$148,753

Contact Information:

Myron Floyd
NC State University
College of Natural Resources
Box 8004
Raleigh, NC 27695
919-513-8026 (phone)
919-515-3687 (fax)
myron_floyd@ncsu.edu

Abstract:

The National Urban and Community Forestry Advisory Council identified public health impacts of urban forests as a research priority. Two of the ten leading public health challenges in the U.S. are physical inactivity and obesity. Studies of the built environment show that community design and urban form shape opportunities for physical activity. Few studies have examined the specific contributions that urban and community forests make to public health through physical activity. This study proposes to examine the potential for urban forests to promote physical activity and health. A multidisciplinary team of researchers will compile and integrate national epidemiologic and health surveillance data with data from urban forest inventory databases to examine relationships among urban forest characteristics and physical activity and health. One level of analyses will examine these relationships between cities, exploring national trends. A second level of analysis will employ higher resolution data to focus on three metropolitan areas to determine the relative influence of urban forest characteristics, community design, and population characteristics on physical activity and obesity. Results of the study will be of great interest to policy makers and professionals working in the natural resources and public health arenas.

1. Scope and Applicability/Justification

Increasing understanding of the public health benefits of urban and community forests is a high priority of the National Urban and Community Forestry Advisory Council (NUCFAC). Physical activity and obesity are two of the 10 leading health indicators representing major health concerns confronting the United States in the 21st century.[1] Despite widespread promotion of the benefits of physical activity, most adults and children do not accumulate recommended levels of activity. Adverse consequences of physical inactivity impact nearly all aspects of human health, from obesity and overweight to type 2 diabetes, loss of muscle strength and joint function, depression and anxiety, colon cancer, and cardiovascular diseases.[2] Certain groups bear a disproportionate share of these health effects: deaths from heart disease are 40% higher among African Americans than whites, Latino Americans are twice as likely to die from diabetes as non-Hispanic whites, and obesity in children has tripled in the last 30 years.[1] Estimates of premature deaths due to physical inactivity range between 200,000 to 300,000 while the combined costs of inactivity and obesity in the U.S. are estimated to be approximately $76 billion in 2000 dollars.[3, 4 5, 6]

Urban and community forests could play a critical role in addressing the national health burden associated with inactivity and obesity prevalence. Even though the number of studies on environment and physical activity is increasing,[7] few investigations have given explicit attention to how urban and community forests contribute to human health through physical activity. Consequently, the capacity of urban and community forests to promote opportunities for physical activity and to contribute to improved health among the Nation's citizens is unknown. To begin to understand the role that urban and community forest landscapes can play in reducing the health burden associated with physical inactivity, obesity and related diseases, baseline knowledge about linkages among forests characteristics, characteristics of urban populations, and physical activity is needed.

The primary purpose of the project is to provide a national assessment of the potential role of urban and community forests in influencing the prevalence of physical activity in the U.S. The specific objectives of the project are to:

(1) Characterize the distribution of urban and community forests in the U.S. for selected metropolitan statistical areas (MSA).
(2) Develop methodology and tools to integrate national epidemiologic and health surveillance data with data from urban forest inventory databases.
(3) Characterize the nature and strength of associations between urban and community forests characteristics and physical activity and obesity for the selected MSA, controlling for community design and population characteristics.
(4) Identify forest-public health linkages that can drive policies and support advocacy to preserve and manage urban and community forests for public health benefits.
(5) Develop communication strategies to position urban and community forestry as a partner in addressing the leading public health challenges in the U.S.

To carry out the objectives, a multidisciplinary and inter-institutional team of investigators with strong interest, relevant expertise and extensive experience in their respective fields will be coordinated. Team members from the following institutions and organization have been

prearranged: (1) College of Natural Resources, NC State University; (2) Centers for Disease Control and Prevention (CDC); (3) USDA Forest Service, Northern Research Station, People and Their Environments Program; (4) USDA Forest Service, Urban Tree Cover Assessment Program; (5) Baltimore Ecosystem Study Long Term Ecological Research (BES LTER); (6) Central Arizona-Phoenix Long Term Ecological Research (CAP LTER); (7) Center for Health Promotion and Disease Prevention, University of North Carolina-Chapel Hill.

Results from this project would interest and potentially benefit several national organizations including both governmental agencies and nongovernmental organizations. As the leading public health agency for the Nation, the CDC would be a primary target audience for products from the study. Other federal natural resource management agencies such as the National Park Service that manage urban resources also stand to benefit from the study. Nongovernmental organizations that would be targeted include American Forests, the National Recreation and Park Association (NRPA), the International City and County Management Association (ICCMA), and the Robert Wood Johnson Foundation (RWJF). American Forests is a leader in advocating for preservation, enhancement and restoration of urban forests. The NRPA focuses on ensuring access to parks, open space, and recreational opportunities for all members of society. The NRPA and the CDC partnered to establish "Hearts N Parks" field study that resulted in "Step Up to Health" which focuses on developing and enhancing efforts at the local level to prevent chronic diseases through parks and recreation. The ICCMA is important in terms of its influence in cities; in their 2005 study, 89% of their members indicated that the primary government organizations responsible for addressing the obesity situation are park and recreation agencies.[8] Finally, the RWJF has several programs targeting childhood obesity, including Active Living Research, Active Living by Design, and Leadership for Healthier Communities. Moreover, the results could be leveraged to obtain additional funding from federal research programs (e.g., NIH) focused on environmental influences on physical activity and obesity.

The results from this study are immensely valuable and timely. Overall we need a broad and comprehensive analysis that addresses how urban forest structure is related to inactivity and obesity before more specific studies can be developed to identify mechanisms through which urban forests affect human health. If current obesity trends persist, some analysts predict 2 in every 5 adults and 1 in every 4 children in the U.S. will be obese within the next 7 years. [9] Inactivity and obesity could shorten life expectancy by 2 to 5 years in coming decades as the complications from sedentary lifestyles and excessive weight gain take hold in the population[10] while increasing prevalence of inactivity, obesity, and relation illnesses will also challenge the system of health care. Although urban and community forests are not the single environment for providing solutions to the obesity epidemic, the stakes are high and urgent action by policymakers, researchers, and practitioners from a variety of sectors and disciplines working at multiple scales is needed to develop solutions that encourage activity and prevent obesity.[11] To become a more effective partner in this effort, it is important that the NUCFAC and the broader urban and community forest community have evidence of the impact that use of urban forests can make to increased physical activity in the population.

Other opportune aspects of this study are associated with our knowledge on the ecology of cities and the effects of urbanization change over time. Grimm et al.[12] argue that in order to advance our understanding of urbanization we need to implement a continental research program across

multiple gradients and cities of all sizes. This study can serve as an example for how to implement an analysis of that scale and caliber. Furthermore, over time we need to gather how changes in urban design may affect human health[13]; research implementing the use of remote sensing technology can be used in the future to document how the relationships between urban forest structure and physical activity change over time.

2. Literature Review

NUCFAC has funded a study that examines physical activity in relation to urban trees. Seeger[14] proposed to track the routes of three population groups that regularly walk or run to determine whether trees influenced choice of routes. We are not aware of any NUCFAC-funded studies that attempt to integrate urban forest structure and surveillance data on physical activity and obesity, like we have outlined in this proposal. One other health-related study supported by NUCFAC has shown that children with attention-deficit/hyperactivity disorder, or ADHD, have been shown to benefit from exposure to natural settings. Kuo and Taylor[15] observed that activities in natural settings were significantly more effective in reducing ADHD symptoms than indoor environments. This "green advantage" was independent of child age, gender, socioeconomic status, type of community, and severity of the diagnosis. Research over time has shown that exposure to natural environments offers mental restoration,[16] reduces stress,[17] reduced mental fatigue[18], promotes effective functioning (a measure of psychological well being)[19] and contributes to shorter postoperative hospital stays.[20]

A growing body of evidence suggests that low levels of physical activity and obesity in the U.S. population are associated with the physical environment, community design, and land-use patterns (e.g., urban sprawl). For example, a national study found that residents of high sprawl communities (i.e., areas with larger block sizes) were more likely to walk less during leisure time, weighed more, and were more likely to report hypertension than residence in low sprawl communities.[21] Another study showed that residents of highly walkable neighborhoods (indicated by single and multiple family housing units) accumulated significantly more minutes of walking per week and were less likely to be overweight than residents in low walkable neighborhoods (single-family residences).[22] Diversity of land uses may also influence physical activity and obesity among urban residents. Frank and associates[23] found that a quartile increase in land use diversity resulted in a 12% reduction in obesity (measured as body mass index or BMI). Research consistently shows that availability of parks, trails, and recreational facilities is associated with higher levels of physical activity among adults.[24] Natural features such as trees, water,[25] green space in neighborhoods,[26] vegetation in neighborhood outdoor spaces[27] and greenness along greenway trails[28] are associated with greater use or enhanced enjoyment of such resources. Although, presence of dense vegetation has been shown to be associated with less use of urban trails.[29]

An Indiana analysis compared baseline and 2-year follow-up measures of BMI among children and youth.[30] The authors reported an inverse association between neighborhood greenness (measured by normalized difference vegetation index, or NDVI) and BMI at Time 2, controlling for BMI at Time 1, residential density, gender, age, and race/ethnicity. Studies from Europe and Australia report similar findings for adults. Access to a garden and green areas was associated with lower BMI and less perceived stress among in a Denmark study.[31] Researchers in England found a positive association between proportion of green space and self-reported health.[32] An

Australian study found that residents who perceived their neighborhood as "highly green" reported better physical and mental health than residents who perceived their neighborhoods as less green, controlling for sociodemographic variables. [33]

Existing evidence shows that residents and populations benefit from access to parks, open space, and urban trees. What is unknown is the role of urban and community forest characteristics in influencing physical activity relative to community design and population characteristics. Our proposed study is unique in that it will address the gap in linking urban forests, community design, and socioeconomic variables, and physical activity at multiple scales. In a national assessment, if there are characteristics associated with urban forest structure and function that are associated with physical activity and obesity we expect that these parameters will consistently explain the variation among cities. We can also determine if any regional trends exist. For instance, certain aspects of urban forests may be more important in different climate zones. Through analysis of selected MSAs we can analyze variables at a higher spatial resolution. Some variables may be apparent at one scale of analysis and not another. Plus, the city analyses will allow us to delve into other potentially influential socio-ecological characteristics that vary across a city spatially.

3. Organization/Methodology

The project will be executed in two stages. First we will identify data and variables related to urban forests and physical activity, on a national scale, to examine variations among cities. In the second stage we will conduct more in-depth analyses on three metropolitan areas (Baltimore, MD, Raleigh-Durham, NC, and Phoenix AZ) to examine potential citywide trends associated with urban forest characteristics, socio-economic variables, physical activity, and obesity. These are locations for which team members have access to data and measures to undertake regional comparisons.

Stage 1
Physical Activity/Obesity Measures and Data

The primary data source for physical activity and obesity will be the Behavioral Risk Factor Surveillance System (BRFSS). The BRFSS is the nation's largest ongoing random-digit dialed telephone health survey of the U.S. non-institutionalized population 18 and older that tracks health conditions on an annual basis. Data are collected at state levels and in selected metropolitan areas. The data are publically available from the CDC. Dr. Judy Krueger of the CDC has extensive experience with the BRFSS and will take the lead in preparing these data for analysis.

BRFSS physical activity questions were updated in 2001 to include domains of leisure time, household, and transportation-related activity of moderate- and vigorous intensity, and walking questions (also referred to as "lifestyle physical activity). Prior to 2001, the BRFSS detailed information about participation in sports, recreation, and exercise to measure physical activity and did not include routine moderate intensity activities such as housework and yard work. [34] Based on these questions, three measures of physical activity will be used: (1) *prevalence of all physical activity*, (2) *leisure-time physical activity*, and (3) *inactivity*. *Obesity* will be indicated by body mass index, or BMI, (weight [kg] / height [m]^2) which is based on self-reported weight and height.

To examine variation among metropolitan statistical areas, metropolitan area physical activity and weight statistics will be computed. These data are available from the Selected Metropolitan/Micropolitan Area Risk Trends (SMART) project. As described by the BRFSS page on the CDC website, the SMART project provides BRFSS data at the metropolitan scale to track health indicators in metropolitan and micropolitan statistical areas (MMSAs) with 500 or more respondents. Metropolitan areas refer to a group of counties with at least one urbanized area of 50,000 or more in population. Micropolitan area is a group of locations with at least one urban cluster with at least 10,000 in population but less than 50,000. It should be noted that some states collected leisure-time physical activity data in some years and other states collected "lifestyle" physical activity data (i.e., all physical activity) in other years. For example, leisure-time activity data were collected in 134 metropolitan areas in 2004, 153 areas in 2005, and 145 areas in 2006. The use of lifestyle physical activity vs. leisure-time physical activity will be determined by ability to match the SMART with forest characteristics data on units of analysis and year.

Urban Forest Structure and Socio-Economic Indicators

In an analysis of national trends, we will first compile remote sensing data, like National Land Cover Data and data from the National Agriculture Imagery Program that will allow us to assess characteristics of urban forest structure. National Land Cover Data are readily accessible across the United States, but the methods used to analyze those data may prohibit comparisons of cover among regions (i.e. Northeast vs. Southeast) (Nowak, personal communication). Therefore, we will further assess other remote sensing data sources, and develop appropriate methodology for a nationwide analysis of urban forest structure. Some important variables we will need to analyze include percent tree cover in both urban and exurban areas, greenness, total area dedicated to open space and trails, total impervious surface cover, relative percent cover of buildings and transportation zones, etc. Other important descriptors of metropolitan regions we will mine from national datasets, such as the US Census are: total population, population density, total land area, land area dedicated to specific land uses, city age, average census block area, road network density and other metrics associated with indicators of sprawl, population diversity, city age, growth statistics, and climate zone.

To examine for associations between urban forest characteristics and physical activity and obesity measures, population density and community design will be used as control variables. Community design will be indicated by two measures: (1) average block size, available from US Census block data and (2) residential density, defined as the number of residential units per land area devoted to residential uses.

Stage 2
Physical Activity/Obesity Measures and Data

For regional or citywide analyses, county-level data are available as a supplement the 2006 BRFSS. These data allow for identification of current county-level variables that are likely to be correlated with BRFSS core health outcomes. The data are available for all U.S. counties. Variables that are potential mediators or moderators for physical activity and obesity will be identified. They are likely to include environmental measures, crime statistics, and poverty/income indicators.

Urban Forest Structure and Socio-Economic Indicators
Citywide analyses of Baltimore, Phoenix, and Raleigh-Durham metropolitan regions will require high-resolution land cover classifications that allow us to assess the fine scale heterogeneity found in urban areas. We will follow a similar study design and methodology to that implemented by Grove et al.[35, 36] in order to evaluate vegetation structure, population dynamics, lifestyle behavior, social stratification, and housing age.

We will also have to control for confounding variables within cities. In addition to population density and community design variables included at the national level, data that could be useful include (1) intersection density, (2)percentage of the 7 main land use categories (residential, commercial, office, institutional, parks and recreation, industrial, and vacant); (3) percentage of retail use, defined as total area in retail use divided by total land area in parcels; and (4) Socio-demographic characteristics (i.e. race/ethnicity percentage, percent owner occupied housing units and percent high-school and above graduates).

4. Products
The products of this project will include reports tailored for members of the respective key target audiences. Peer-reviewed journal articles will be submitted for the academic and research community. Web-based project briefs will be developed to highlight the benefits of the project for the different target audiences. A comprehensive technical report will be produced that will include technical notes on any new tools developed to undertake the analysis. Finally, nationwide and regional data sets developed for the study are valuable to other researchers and we will develop a database that will be accessible via one of the LTERs or Urban Long Term Research groups.

5. Collaboration
As described, the project will be delivered in collaboration with five external partner organizations. Two of the partners are units within the USDA Forest Service. Another federal partner is the Division of Nutrition, Physical Activity, and Obesity within the CDC. The Central Arizona-Phoenix Long Term Ecological Research (CAP LTER) at Arizona State University is an academic partner. The Center for Health Promotion and Disease Prevention at the University of North Carolina-Chapel Hill will play an advisory role in statistical analysis.

6. National Distribution/Technology Transfer of Findings
Findings from this project will be disseminated through national and international peer reviewed journals. The following journals represent likely sources for publication in traditional research outlets: *American Journal of Health Promotion, American Journal of Preventive Medicine, Annals of Behavioral Medicine, Environment and Behavior, Leisure Sciences, City and Community, Society and Natural Resources, Health & Place,* and, *Landscape and Urban Planning*. These journals reflect the disciplinary perspectives of the research team – parks and recreation management, public health, forest management and urban ecology. Unique opportunities for workshops, panels at symposia, and continuing education will feature reports on (a) applications of findings on associations between urban forests and physical activity (b) developing strategies for integrating project findings with land use decision making; (c) developing strategies to increase the public's knowledge and understanding of how urban and community forests support physical activity and better health. Venues will include research

conferences such as the International Symposium on Society and Resource Management, Society of American Foresters national convention, the American Public Health Association annual meeting, the Active Living Research conference, Environmental Design Research Association annual meeting, and the National Recreation and Parks Association Congress.
Keywords: green spaces, obesity, physical activity, recreation, urbanization

7. Project Evaluation

To determine how the project increases public knowledge of the importance of urban and community forestry, we will conduct a series of interviews with participants of the workshops and educational sessions. The interview process will be designed to ascertain what type and form of information is most helpful in making a case to policy-makers for urban and community forests and how community partners might collaborate to address health concerns through natural resource planning. Key outcomes for determining effectiveness of product dissemination would relate to the extent members of stakeholder groups have advocated for policy change, used results from the study, sought additional information about health benefits of urban forests, or developed a new partnerships or programs to promote use of urban and community forests for physical activity. These outcomes can be adapted to meet "SMART" criteria.

8. Experience/Personnel/Adequacy of Resources

N.C. State University will be represented by Drs. Anderson, Baran, Devine, Floyd, Henderson, and Leung, faculty researchers in the Department of Parks, Recreation, and Tourism Management (PRTM) and spatial analysis program (Baran, Devine, and Leung). Dr. Myron Floyd will coordinate project activities and will serve as Principal Investigator. Dr. Floyd has been PI or Co-PI on several large multidisciplinary projects. His research focuses on the role of parks and other recreation settings in promoting physical activity. Dr. Henderson will work closely with Dr. Floyd to ensure overall quality control and will lead development and implementation of project evaluation. Dr. Henderson is professor in PRTM with research interest in gender and women's leisure and physical activity and health. Dr. Henderson is widely regarded as a leading expert on research methods and evaluation. She is a member of the National Advisory Committee for Active Living Research, a program of the Robert Wood Johnson Foundation since 2004. Dr. Anderson will work with Dr. Henderson on project evaluation. Dr. Anderson is professor and head in PRTM with research interest in personal and community benefits attributed to natural areas. She is recognized as a developer of and leader in applying the benefits based management framework to identify and manage for benefits individuals and communities perceive they derive from being in natural areas.

The subgroup of Drs. Baran, Devine, and Leung will be responsible for overseeing the development of a GIS database, development of urban form neighborhood characteristics measures, and assisting with development of forest characteristics measures and integration of physical activity, forest, and urban form characteristics data sets. Dr. Baran is a research associate professor with a shared appointment in PRTM, Center for Earth Observation and the PhD in Design Program at NC State University. She teaches research methods courses in the PhD in Design Program and has extensive teaching and research experience in using GIS. Dr. Devine is Professor and Chair of the Graduate GIS Faculty at NC State University. Dr. Leung is Associate Professor in PRTM. His research focuses on monitoring visitor use in parks and forest settings, recreation ecology, and applications of spatial technologies.

The respective roles for each partner are as follows: Dr. Judy Krueger, Division of Nutrition, Physical Activity and Obesity, Centers for Disease Control and Prevention works extensively with national health and epidemiologic surveillance data sets, including the Behavioral Risk Factors Surveillance Survey (BFRSS) and Youth Risk Behavior Surveillance System. Dr. Krueger will assist with study design and will compile data sources needed to measure physical activity and obesity, contribute to dissemination of findings, and will contribute to development of products for dissemination to target audiences in the health promotion fields. The CDC Division of Nutrition, Physical Activity, and Obesity represents an essential partner for investigating health benefits of urban and community forests and disseminating findings and products that will have national impact.

Dr. Paul Gobster, research social scientist with the Forest Service Northern Research Station, is a member of a program of research on how to manage park and forest environments in urban settings. He has specific interest in how people perceive and experience parks and forests, including issues of aesthetics, psychological restoration, and physical activity. Dr. Gobster will be responsible for leading product development and coordinating transfer of findings to key stakeholders within the urban and community forestry sector. He will also contribute to dissemination of research findings.

A subgroup led by Dr. Melissa McHale will locate, prepare, and analyze data associated with urban forest structure and health, as well as spatially integrate those data with other socio-ecological variables on both national and regional scales. Dr. McHale participated in and led numerous collaborative studies on ecosystem services, landscape preferences, and carbon dynamics in urban systems at the CAP LTER where she worked as a post-doctoral researcher. Now she is an assistant professor of urban ecology in the Department of Forestry and Environmental Resources, facilitating the establishment of a graduate degree program in urban ecology at NCSU's College of Natural Resources. Integral to this sub-group are Dr. Morgan Grove, Mr. Jarlath O'Neil-Dunne and Dr. Chris Boone who will provide expertise on urban forest canopy cover assessments and the methodology for spatially assessing complex urban socio-ecological relationships. Dr. Grove, a Research Scientist (Social Ecology) with the USDA Forest Service (Northern Research Station), has an extensive experience developing research projects focusing on long-term relationships among environmental quality, neighborhood life and satisfaction, social capital, and community stability in metropolitan regions. He has also developed techniques and applications for integrating remotely sensed data, field surveys, and administrative data using advanced spatial and time-series analyses. Mr. O'Neil-Dunne, a geospatial analyst with University of Vermont's Spatial Analyst Laboratory and leader in the UTC Assessment (USDA Forest Service), is well known for his expertise in object-based image analyses. His urban tree canopy assessments have been used by several major cities to establish tree canopy goals. Dr. Chris Boone, a research professor in both the School of Human Evolution and Social Change and the School of Sustainability at ASU, has spent much of his career working on collaborative research projects with BES LTER and CAP LTER. His research expertise encompasses environmental justice and vulnerability, urban socio-ecological systems, GIS, public health and urban sustainability.

Dr. Ziya Gizlice, PhD, is with UNC Center for Health Promotion and Disease Prevention (HPDP). He is the director of the HPDP Biostatistical Support Unit. Dr. Gizlice will advise on BFRSS data analysis and interpretation of results. Dr. Gizlice has extensive experience in developing and administering BRFSS in North Carolina.

References

1. U.S. Department of Human Services. Healthy People 2010: Understanding and Improving Health, 2nd ed.: U.S. Government Printing Office, 2000.
2. U.S. Department of Human Service. Healthy People 2010: Physical activity and fitness Washington, DC: US. Government Printing Office, 2000.
3. McGinnis JM, Foege WH. Actual causes of death in the United States. JAMA : the Journal of the American Medical Association 1993;270:2207-12.
4. Powell KE, Blair SN. The public health burdens of sedentary living habits: theoretical but realistic estimates. Medicine & Science in Sports & Exercise 1994;26:851-6.
5. Pratt M, Macera CA, Wang G. Higher direct medical costs associated with physical inactivity. Physician Sportsmedicine 2000;28:63-70.
6. Finkelstein EA, Fiebelkorn IC, Wang G. National medical spending attributable to overweight and obesity: How much, and who's paying? Health Affairs 2003;22:219-26.
7. Kraft MK, Sallis JF, Moudon AV, Linton LS. The second Active Living Research Conference: signs of maturity. Journal of Physical Activity and Health 2006;3:S1-S5.
8. International City/County Management Association Active living approaches by local governments 2005. Available online at: http://www2.icma.org/main/ld.asp?from=search&ldid=18012&hsid=1
9. Wang Y, Beydoun MA. The obesity epidemic in the United States -- gender, age, socioeconomic, racial/ethnic, and geographic characteristics: a systematic review and meta-regression analysis. Epidemiology Reviews 2007;29:6-28.
10. Olshansky SJ, Passaro DJ, Hershow RC, et al. A potential decline in life expectancy in the United States in the 21st century. The New England Journal of Medicine 2005;352:1138-45.
11. Brownson RC, Kelly CM, Eyler AA, et al. Environmental and policy approaches for promoting physical activity in the United States: A research agenda. Journal of Physical Activity and Health 2008;5.
12. Grimm NB, Foster D, Groffman P, et al. The changing landscape: Ecosystem responses to urbanization and pollution across climatic and societal gradients. Frontiers in Ecology and the Environment 2008;6:264-72.
13. Jackson LE. The relationship of urban design to human health and condition. Landscape and Urban Planning 2003;64:191-200.
14. Seeger CJ. The urban forest: A contributor to physical activity levels in the built environment?: National Urban and Community Forestry Advisory Council, U.S.D.A. Forest Service, 2005.
15. Kuo FE, Taylor AF. A potential natural treatment for attention-deficit/hyperactivity disorder: Evidence from a natural study. American journal of public health 2004;94:1580-6.
16. Kaplan R. The role of nature in the urban context. In: Altman I, Wohlwill J. Behavior and the natural environment (Volume 6) ed. New York, NY: Plenum Press, 1983:127-62.
17. Parsons R, Tassinary LG, Ulrich RS, et al. The view from the road: Implications for stress recovery and immunization. Journal of Environmental Psychology 1998;18:113-40.

18. Kuo FE. Coping with poverty: Impacts of environment and attention in the inner city. Environment and Behavior 2001;33:5-34.

19. Herzog TR, Strevey SJ. Contact with nature, sense of humor, and psychological well-being. Environment and Behavior 2008;40:747-76.

20. Ulrich RS. View through a window may influence recovery from surgery. Science 1984;224:420-1.

21. Ewing R, Schmid TL, Killingsworth RE, Zlot A, Raudenbush S. Relationship between urban sprawl and physical activity, obesity, and morbidity. American Journal of Health Promotion 2003;18:47-57.

22. Saelens BE, Sallis JF, Black JB, Chen D. Neighborhood-based differences in physical activity: An environmental scale evaluation. American journal of public health 2003;93:1552-8.

23. Frank LD, Andresen MA, Schmid TL. Obesity relationships with community design, physical activity, and time spent in cars. American journal of preventive medicine 2004;27:87-96.

24. Kaczynski AT, Henderson KA. Environmental correlates of physical activity: A review of evidence about parks and recreation. Leisure Sciences 2007;29:315-54.

25. Tinsley HEA, Tinsley DJ, Croskeys CE. Park usage, social milieu, and psychosocial benefits of park use reported by older urban park users from four ethnic groups. Leisure Sciences 2002;24:199-218.

26. Fisher KJ, Li FZ, Michael Y, Cleveland M. Neigborhood-level influences on physical activity among older adults: A multi-level analysis. Journal of Aging and Physical Activity 2004;12:45-63.

27. Taylor AF, Wiley A, Kuo FE, Sullivan WC. Growing up in the inner city: Green spaces as places to grow. Environment and Behavior 1998;30:3-27.

28. Lindsey G, Wilson J, Yang JA, Alexa C. Urban greenways, trail characteristics and trail use: Implications for design. Journal of Urban Design 2008;13:53-79.

29. Reynolds KD, Wolch J, Byrne J, et al. Trail characteristics as correlates of urban trail use. American Journal of Health promotion 2007;21:335-45.

30. Bell JF, Wilson JS, Liu GC. Neighborhood greenness and 2-year changes in body mass index of children and youth. American journal of preventive medicine 2008;35:547-53.

31. Nielsen TS, Hansen KB. Do green areas affect health? Results from a Danish survey on the use of green areas and health indicators. Health & place 2007;13:839-50.

32. Mitchell R, Popham F. Greenspace, urbanity and health: Relationships in England. Journal of Epidemiology & Community Health 2007;61:681-3.

33. Sugiyama T, Leslie E, Giles-Corti B, Owen N. Associations of neighbourhood greenness with physical and mental health: do walking, social coherence and local social interaction explain the relationships? Journal of Epidemiology & Community Health 2008;62:e9.

34. Fridinger F, Macera C, Cordell HK. The use of surveillance data and market research to promote physical activity. American journal of preventive medicine 2002;23:56-63.

35. Grove JM, Troy AR, O'Neil-Dunne JPM, Burch WR, Cadenasso ML, Pickett TA. Characterization of households and its implications for the vegetation of urban ecosystems. Ecosystems 2006;9:578-97.

36. Grove JM, Cadenasso ML, Burch WR, Pickett TA, O'Neil-Dunne JPM, Schwarz K, Wilson M, Troy AR, Boone C. Data and method comparing social structure and vegetation structure of urban neighborhoods in Baltimore, Maryland. Society & Natural Resources 2006 19:117-36.

Budget Narrative

Salary and Fringes: ($53,908) We request support for one Ph.D. Student Research Assistant for all three years. Graduate students fringes are figured at 14%. Salaries are inflated 5% for years 2 & 3.

Current Services ($3,000) Based on past experience, this amount is needed to develop a project web site to make products and data bases accessible to collaborators and target audiences.

Subcontract with Arizona State ($15,000) is requested to subcontract to Arizona State to complete data collection and analysis for the Phoenix study site.

Travel ($9,660) is requested for all three years to present research at professional meetings: 1 Trip per year for PI and graduate student to @ $1610 Airfare, hotel and per diem.

Other Direct Costs:

Tuition ($27,216) is requested for tuition and fees for the graduate student.

Facilities and Administrative Costs – ($32,618) The University approved facilities and administrative costs is attached. This is figured at the approved rate of 49% of MTDC which excludes tuition and includes the first 25,000 of subcontracts.

NCSU Cost Share

Cost Shared Salary and Fringes ($131,497) PI, Floyd and all Co-PIs will cost share 5% of their effort to complete the objectives of this project for all three years. Their fringe benefits are figured at the University approved rate of 25%.

Facilities and Administrative Costs – ($51,740) The University approved facilities and administrative costs is attached. This is figured at the approved rate of 49% of MTDC

Total Request: $148,752
Total NC State Cost Share : $148,753
Total Project Costs: $297,505

United States
Department of
Agriculture

Forest
Service

Northern Research Station
1033 University Pl. #360, Evanston, IL 60201
phone (847) 866-9311 *fax* (847) 866-9506

Reply To: 4000

February 11, 2009

Myron F. Floyd, Ph.D.
Professor
Department of Parks, Recreation and Tourism Management
College of Natural Resources
North Carolina State University
Raleigh, NC 27695-8004

Dear Dr. Floyd:

I enthusiastically support your pre-proposal to the National Urban and Community Forestry
Advisory Council (NUCFAC) to study the public health impact of urban forests. As you know, I
have a longstanding interest in how people perceive and experience parks and forests, including
issues of aesthetics, psychological restoration, and physical activity. Our unit has initiated several
cooperative agreements related to benefits of urban forests, and this proposed research would fit
well within our current mission.

I understand that my primary role in this project will be to lead the development of products from
the study to disseminate to key stakeholders in the urban and community forestry community.
Given the emphasis on technology transfer within the Forest Service and experience in the agency,
I am confident that I can contribute significantly in this role. Our Evanston office is co-located
with a unit of the Northeastern Area State and Private Forestry and Tom Dilley of that unit has
also expressed interest in assisting in this phase of the project.

Thank you again for the opportunity to work with you on this project. I have enjoyed our previous
collaborations and I look forward to continued work with you in the future. Please feel free to call
(847-866-9311 ext. 16) or email (pgobster@fs.fed.us) me if I can be of further assistance. Best
wishes on the pre-proposal submission.

Sincerely,

PAUL H. GOBSTER, Ph.D.
Research Social Scientist

Centers for Disease Control
and Prevention (CDC)
Atlanta GA 30341-3724

Judy Kruger, PhD
Epidemiologist, Physical Activity and Health Branch,
Division of Nutrition, Physical Activity, and Obesity
National Center for Chronic Disease Prevention and Health
    Promotion
Centers for Disease Control and Prevention
4770 Buford Hwy, NE MS K-46
Atlanta, Georgia 30341

February 11, 2008

Myron F. Floyd, PhD
Professor
Dept. of Parks, Recreation and Tourism Management
North Carolina State University
Box 8004
Raleigh, NC 27695-8004
E-mail: myron_floyd@ncsu.edu
Phone: 919-513-8026
FAX: 919-515-3687

Dear Dr. Floyd,

It is with great pleasure that I submit this letter on behalf of the Physical Activity and Health Branch, Division of Nutrition, Physical Activity, and Obesity, CDC in strong support for your proposal to integrate the Behavioral Risk Factor Surveillance System (BRFSS) data with urban forest data in cities and MSAs to examine possible associations with physical activity and obesity. This event is important venture to bring together public health, parks, recreation, and tourism professionals with an interest in assessing the role of urban and community forests in influencing the prevalence of physical activity. To our knowledge this proposal is the first of it's kind to integrate professionals and resources from several agencies and organizations for the purpose of understanding the role that urban and community forest landscapes can play in reducing the health burden associated with inactivity and obesity.

The mission of the Physical Activity and Health Branch (PABH) is to understand and promote physical activity to enhance health and quality of life. Our work is related to the theme of this proposal as we believe that the promotion of physical activity at the national level requires a combination of approaches -- from the individual level, but also from a broader social ecological perspective. Therefore, it is important to develop a greater understanding of the characteristics of the urban and community landscape environment, and to examine the individual's relationship to his or her community, in order to support functioning environmental systems.

We are willing to assist by offering technical expertise by providing input into the study design, access to data sources needed to measure physical activity and obesity, data analysis, the development of the final product, and dissemination of findings to targeted audiences in the

public health field. We look forward to collaborating with you on this proposal. Please let us know if there is additional information that you need.

Sincerely,

Judy Kruger

Judy Kruger, PhD
Epidemiologist, Physical Activity and Health Branch,
Division of Nutrition, Physical Activity, and Obesity
National Center for Chronic Disease Prevention and Health
    Promotion
Centers for Disease Control and Prevention
4770 Buford Hwy, NE MS K-46
Atlanta, Georgia 30341

February 12, 2009

Myron F. Floyd, PhD
Professor
Department of Parks, Recreation and Tourism Management
College of Natural Resources
NC State University
Raleigh, NC 27695-8004

Dr. Floyd:

Thank you for inviting me to collaborate on your project. I am pleased to provide this letter of support. In their National Research Plan for Urban Forestry, the National Urban and Community Forestry Advisory Council has documented its interest in better understanding how urban forests influence human health and physical activity. I believe this project has potential to increase our knowledge in this area.

I understand that my role is to work closely with Dr. Melissa McHale of the Department of Forestry and Environmental Resources at NC State. Dr. McHale and I have been working together to establish a collaborative long-term research agenda that can guide the development of an urban research area in Raleigh-Durham-Chapel Hill. As a partner on your project, I will continue to assist Dr. McHale and provide expertise on urban forest canopy cover assessments and the methodology for integrating socio-ecological variables and remotely sensed data.

I'm look forward to working with you and the group that has been assembled for this project.

Sincerely,

/s/ J. Morgan Grove

J. Morgan Grove, Ph.D.
Research Scientist

February 11, 2009

Myron F. Floyd, PhD
Professor
Department of Parks, Recreation and Tourism Management
College of Natural Resources
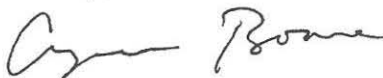NC State University
Raleigh, NC 27695-8004

Dr. Floyd:

It is my pleasure to write this letter of support for your grant application to the National Urban and Community Forestry Advisory Council. I have extensive experience and expertise in research that addresses environmental justice, vulnerability, and public health concerns in Phoenix and Baltimore. My experience and past involvement in research programs, such as this one, which aim to address the associations between urban infrastructure and public health in a socio-ecological context, will be beneficial to this project.

As a partner on your project, I will work closely with Dr. Melissa McHale at N.C. State University to provide expertise on methods for evaluating and relating socio-ecological variables and public heath indicators. I knew Dr. McHale while she was a post-doctoral researcher at CAP LTER and look forward to collaborating on this project.

The proposed research will contribute to a better understanding of the potential influences of urban forests on physical activity and human health and I thank you for the invitation to partner on this project.

Sincerely,

Dr. Christopher Boone
Associate Professor and Graduate Chair, School of Sustainability
School of Human Evolution and Social Change
Arizona State University
PO Box 875502
Tempe, AZ 85287

THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

1700 MARTIN LUTHER KING JR. BLVD.   T 919.966.6080
CAMPUS BOX 7426   F 919.966.6264
CHAPEL HILL, NC 27599-7426   www.hpdp.unc.edu

February 13, 2009

Myron F. Floyd, PhD
Professor,
Department of Parks, Recreation and Tourism Management
College of Natural Resources
NC State University
Raleigh, NC 27695-8004

Dear Dr. Floyd:

On behalf of the the UNC Center for Health Promotion and Disease Prevention's Biostatistical Support Unit (HPDP-BSU), I am pleased to offer my support for your proposal to the National Urban and Community Forestry Advisory Council on urban forests and physical activity. The mission of the HPDP-BSU is to provide biostatistical support for the planning, conducting, evaluating, and reporting of research on health promotion and disease prevention.

I understand that your project will involve integration of Behavioral Risk Factor Surveillance System (BRFSS) data with environmental data from selected metropolitan areas to examine for possible associations with physical activity and obesity. The BRFSS is an ongoing data collection program designed to measure behavioral risk factors/conditions including physical activity and obesity in the adult population (18 years of age or older) living in households. In 2007, the BRFSS conducted 430,912 interviews nationwide (all 50 states and the District of Columbia, Guam, the U.S. Virgin Islands, and the Commonwealth of Puerto Rico). Metropolitan Statistical Area (MSA) specific data were available for 184 MSAs including Baltimore-Towson, Phoenix-Mesa-Scottsdale, and Raleigh-Cary MSAs in 2007.

I have extensive experience with the BRFSS and served as the Project Director and Coordinator for North Carolina BRFSS and served on the CDC's BRFSS Working Group representing the states between 2001 and 2005. I still use the BRFSS data in many projects and have published a number of manuscripts using the nationwide BRFSS data. I will be happy to share my knowledge about the BRFSS data and provide assistance related to the statistical analysis of the BRFSS and environmental data.

Thank you for extending this opportunity to assist with your project. Please contact me if you have further questions about our center. I look forward to working with you on this project.

Sincerely,

Ziya Gizlice, PhD
Director of Biostatistical Support Unit
Center for Health Promotion and Disease Prevention, CB#7426
University of North Carolina at Chapel Hill
Chapel Hill, NC 27599

Phone: (919) 966-6040
FAX: (919) 966-3374
email:ziya_gizlice@unc.edu