

# Urban Ecosystem Services: Metro Nature and Human Well-Being

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The concept of ecosystem services (ES) is a fundamental shift in how natural resources are defined and valued by human society. Natural assets, such as forests, agricultural lands, shorelines, and seas, have long been recognized as the sources of essential and economically valuable goods and services. ES specify additional sources of direct or indirect benefits and their economic consequences, such as flood protection, pollinator activity, natural filtering of potable water, and climate stability.

Various ES classifications have been proposed.<sup>i</sup> Each sorts and defines derivations of natural capital, summarizing across extensive scientific evidence. Each also recognizes non-material, experiential benefits that people derive from natural systems, thereby considering the role of environment in human and social capital. The Millennium Ecosystem Assessment classification<sup>ii</sup>, for instance, lists cultural services, including spiritual, educational and recreational components. These cultural services, and the nature-based goods and services that satisfy human biological needs, largely determine levels of human health and well-being.

Today about 80 percent of the U.S. population lives in cities and urbanized areas; the sum is at about 50 percent across the planet.<sup>iii</sup> Urban populations consume concentrated quantities of ES, extracting food, water, energy and the raw materials of goods from ecological systems, near and far. There are observed patterns across the current literature. First, the categories of

intangible experiential benefits now described by ES frameworks don't adequately elaborate the full range of services provided by nature in urban settings, the landscapes where the majority of the world's citizens now live. Despite an extensive evidence base, current classifications seem to imply that non-material services (such as recreation, culture, and education) are primarily generated within large scale, rural, perhaps even pristine landscapes – places beyond the city.

Also, ES classifications purport to address psychosocial benefits, but subsequent descriptions and applications rarely treat the human experience of nature in the same level of detail as biophysical dynamics. Notably, urban residents gain extensive intangible, indirect benefits from the experience of nearby nature, that is, the green spaces found immediately around the places where people live, work, and learn.

This article serves three purposes. First, it suggests that a comprehensive ES outlook should include metro nature services, referring to an expanded set of ES that are profoundly important for billions of urban dwellers around the world. Second, it provides a sampling of the studies and methodologies that affirm metro nature services and demonstrate that there is scientific capacity to understand much more. Finally, a web-based resource that catalogs human health and well-being research results is introduced.

## **Metro Nature Services**

Metro nature is the everyday green within built environments, still regarded by some ecologists as being dysfunctional. It includes naturalistic patches, such as urban forests, greenbelts, conserved open spaces, and riparian corridors. Metro nature also includes constructed nature such as parks, streetscapes, community gardens, pocket parks, and recreation paths. Metro nature is fragmented and diverse in content and character, often imbued with cultural artifact and character.

Natural systems are the fundamental sources of human sustenance and livelihood that provide tangible materials and goods for human society. Yet ecosystem scientists may perceive the processes of productivity to be far removed from urban centers. Metro nature may not measure up to more traditional scientific perceptions of what is “natural.” Certain disciplinary biases sometimes preclude thinking about nature in cities as anything more than a means of beautification, or as a way to mask or screen sensory annoyances. Consequently, many natural resources scientists and managers may overlook the opportunities of metro nature, perhaps even taking it for granted.

## **Environmental services**

Large-scale ecosystems, such as oceans and forests, were the necessary focus of initial and seminal concepts concerning ES. Recent urban ecology research is revealing the particular dynamics of nature in metropolitan areas, and amending ecological assumptions that were once based on extrapolation from the better understood ecology of rural and wildland landscapes. Thus scientists and resource managers can expand how ES are envisioned and defined, based on the specific environmental contexts

of cities and towns. An expanded ES approach should encompass the services provided by smaller scale nature patches, particularly those found in close proximity to high-density human populations

City leaders increasingly employ natural elements and urban ecology to enhance the sustainability and efficiencies of cities. Studies indicate that small remnants of native ecosystems or entirely constructed nature elements provide environmental benefits. Green infrastructure innovations - rain gardens, bioswales, green roofs - are installed to achieve ecology-based management of water, air or energy. Landscapes of large buildings - schools, libraries, city halls - are designed and installed to reduce chemical use, enhance biodiversity, and integrate with regional ecosystems. Roadside plantings are becoming more amenable to wildlife and wetlands. When measured cumulatively across a metropolitan area the positive benefit/cost implications of such biotechnologies are substantial

Due to space limitations and typically high real estate costs in cities natural elements of any scale must be multi-tasking. Metro nature should be planned and managed to generate biophysical benefits, but also configured in ways that satisfy other human needs.

## **Science and social benefit**

Extensive social science research indicates that the presence of greenery in the daily activities and lives of urban dwellers generates profound and important affects. Both passive and active experiences of nearby nature enable extensive psychological, social, and physiological benefits.

Discourse on the humanistic contributions of nature to individuals, communities and society was once prominent in public debate.<sup>iv</sup> Today's decision-makers are often more inclined to pursue observed facts and economic valuations as the basis for public policy. Even though they may privately acknowledge the beneficial experiential aspects of human encounters with nature, they premise their public actions on empirical sources.

Some ecologists regard anecdotal accounts of human health, happiness, functioning and spirit as important, but not quantifiable. However investigators have employed empirical methods to explore the extent and quality of the human services of urban greening for nearly 40 years.

Looking across this body of work, the use of analytic methods has provided two insights. First, the observed benefits of restorative experiences and social renewal due to time spent in gardens and parks have been intuitively noted for centuries, and are now empirically confirmed. While nature in cities may provide beauty and delight, the studies have expanded our understanding of how people and communities benefit from interactions with nature in the built world.

Second, and more important, the systematic, critical approaches of science have revealed greater texture and dimension in the human relationship to nature. Benefits are described in terms of human scale from individual to community, with some degree of variability across place, time and human groups. Research indicates that metro nature is not an expendable amenity, but a profoundly important aspect of urban living.

## Health and well-being benefits

Scientific findings imply associations between even the smallest bits of nearby nature and human health and well-being. A rich research literature about metro nature and human capital spans several decades. Below is a sampler:

a. **Individual Health:** Hospital patients who have a view of nature recover faster from surgery and require less pain relief medication.<sup>v</sup> Views of nature reduce physiological stress response,<sup>vi</sup> including driving stress.<sup>vii</sup> More active lifestyles combat obesity, improve cardiovascular health, increase longevity, and enhance physical and psychological development of children.<sup>viii</sup> Trees and landscapes contribute to more walkable cities and increase recreational benefits. City trees may help reduce escalating personal and public spending for health services.

b. **Individual Mental Functioning:** Nearby nature provides restorative experiences that aids in overcoming the mental fatigue associated with urban lifestyles. Desk workers who have a view of nature report greater job productivity and satisfaction. Experiences of urban nature help children be more disciplined, and can reduce attention deficit disorders. Students show better academic performance on green campuses.

c. **Community Wellness:** Well-managed urban forests can strengthen communities by empowering citizens, improving social ties<sup>ix</sup> reducing crime, and revitalizing neighborhoods. The urban forest contributes to a sense of place. Trees add to our quality of life and make our cities and towns better places to live, work, play, and learn.

d. **Community Economics:** The economic value of a well-managed urban forest

includes increased property values higher rental rates for commercial properties, and positive consumer response in business districts. A city having high environmental quality is an attractive environment for new businesses. These benefits can generate a larger, local tax base, providing revenue to offset urban forest management costs

### **Research Access Tool**

Perhaps such studies are not yet well represented in ES classifications because the research corpus is dispersed across numerous disciplines and their associated journals, e.g., psychology, sociology, urban planning, geography, and landscape architecture. Yet the findings constitute ES that are of interest to many audiences, including resource managers, civic leaders, and health officials.

A science catalog is now available as a web site entitled Green Cities – Good Health, at <http://depts.washington.edu/hhwb/>

In 2009 nearly 1,200 articles and reports were collected, and content analyzed, resulting in 12 themes of key findings. Narrative summaries are being prepared for each theme, to be completed late in 2010. The entire collection serves as a timely compilation of knowledge about metro nature and human health and well-being.

### **Metro Nature Policy & Value**

The scientific evidence justifies an expanded conceptualization of ES concerning urban settings. Assuming that metro nature services should be assimilated into the growing civic discourse about ES, there are important considerations.

### **Planning and management**

Sustained efforts to plan, conserve, and manage metro nature are needed. Many urban parks and green spaces are in local government jurisdictions that aim to satisfy community-based recreation and aesthetic goals. Operations are often site-based, and lacking in comprehensive goals across a metropolitan area or geographic region.

At a larger scale some federal or state initiatives address urban natural areas, but not systematically. The U.S. Forest Service distributes funds to encourage urban forestry programs, and the Environmental Protection Agency has programs that address urban lands or waters that pose public health risks, such as brownfields. Few agencies have addressed the full potential of urban nature, treating it as an integral component of city systems, and worthy of sustained dedicated staff and budget.

The United States and other nations have bestowed special status on bold, dramatic landscapes through national park and reserve designations. The extent of ES provided by urban green spaces indicates that nature systems in cities should also be recognized as special places. They should be comprehensively defined, planned and managed. Some cities have analyzed their metro nature quotient, using indicators such as tree canopy cover or parks area per capita. Additional efforts are needed to determine how to effectively assess and monitor the resources, the urban equivalent of landscape-scale inventory and assessment. Better planning and management practices can then be adaptively applied to enhance metro nature productivity.

## **Economic valuation**

Metro nature poses quandaries for societies that derive economic value based on individualism and private property rights. Urban green is a civic resource that may not respect intentions of possession or exclusion. Private gardens are often precious to their owners, providing joy and beauty to a limited number of people. But metro nature is a valuable civic natural resource, with attendant tensions of who is to receive benefit and who is to steward the resource.

Economic valuation of nonmarket services is both contentious and essential to incorporate metro nature benefits into planning and management efforts. Historically, many ecosystems services have had an implicit value of zero in public and private decision-making. A fair comparison of policy alternatives requires that all the consequences of a proposal be weighed, not just those that are easily measured and valued in monetary terms because they are bought and sold. Numerous market and non-market, direct and indirect techniques are recognized as useful in assessing the economic value of the goods and services provided by ecosystems.

The U.S. Department of Agriculture and the Environmental Protection Agency each have launched national initiatives to define, identify, and propose valuations for comprehensive systems of ES. Such efforts should not limit the range of landscapes under consideration.

Many prior studies and valuation efforts have been applied to rural land or forests, avoiding urban settings. In cities very small nature patches or remnants of native systems, constructed cultural landscapes, or installed biotechnologies can provide quantifiable net positive economic value through ecological functions that supplement or augment engineered systems

(such as stormwater management and reduced heat island effects).

Economic valuation techniques could also be applied to assess psychosocial societal values. For instance, reduced health care costs are associated with moderate physical activity. Studies show that landscaped streetscapes and parks contribute to more walkable communities. Avoided medical costs are a probable economic benefit.

## **Equity and access**

Empirical evidence indicates that metro nature experiences are beneficial to people of all ages, across diverse cultures, and positively affect people in all socioeconomic situations. Social inequity of distribution or access can be a concern.<sup>x</sup> In many cities cultural, political and economic patterns of times past have selectively enabled or limited access to metro nature for certain populations. We now understand why nature in cities is important, and some cities have shown leadership in developing strategies for resource conservation and management. Integral to those efforts should be action to provide metro nature services equitably to all urban inhabitants.

## **Conclusions**

This essay provides several contributions. It demonstrates that an ES outlook that is urban-based may capture an expanded set of functions and benefits that are essential for human populations around the world. A diverse range of studies and methodologies has substantiated metro nature services and affirms that scientific research could add additional insights. Nature in cities, due to intensity of human/environment interactions, is particularly important for human well-being and human habitat. The economic implications of these socio-cultural ES are

diverse and profound, and have not yet been fully assessed. A metro nature services outlook offers many future opportunities in resource science, policy, and management.

## References

- <sup>i</sup>De Groot, RS, M Wilson, and RMJ Boumans. 2002. A typology for the classification, description and valuation of ecosystem functions, goods and services. *Ecological Economics* 41, 3:393-408.
- <sup>ii</sup>Millennium Ecosystem Assessment, 2005. *Ecosystems and Human Well-being: Synthesis*. Washington, D.C.: Island Press.
- <sup>iii</sup>Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat. 2007. *World Urbanization Prospects: The 2007 Revision*. <http://esa.un.org/unup>
- <sup>iv</sup>Chiesura, A. 2004. The role of urban parks for the sustainable city. *Landscape and Urban Planning* 68:129–138
- <sup>v</sup>Nowak, DJ. 2006. Institutionalizing urban forestry as a “biotechnology” to improve environmental quality. *Urban Forestry & Urban Greening* 5, 2:93-100.
- <sup>vi</sup>McPherson, EG, JR Simpson, PJ Peper, SE Maco, and Q Xiao. 2005. Municipal forest benefits and costs in five U.S. cities. *Journal of Forestry* 103, 8:411-416.
- <sup>vii</sup>Rybczynski, W. 1999. *A Clearing in the Distance: Frederick Law Olmsted and North America in the Nineteenth Century*. New York: Scribner.
- <sup>viii</sup>Ulrich, RS. 1984. View through a window may influence recovery from surgery. *Science* 224, 27:420-421.
- <sup>ix</sup>Ulrich, R.S. 1986. Human responses to vegetation and landscapes. *Landscape and Urban Planning* 13:29-44.
- <sup>x</sup>Parsons, R, L Tassinary, RS Ulrich, MR Hebl, and M Grossman-Alexander. 1998. The view from the road: Implications for stress recovery and immunization. *Journal of Environmental Psychology* 18:113-140.
- <sup>xi</sup>TRB-Transportation Research Board. 2005. *Does the Built Environment Influence Physical Activity?: Examining the Evidence, TRB Special Report 282*. Transportation Research Board, Institute of Medicine of the National Academies, 269 pp.
- <sup>xii</sup>Wolf, KL. 2008. City trees, nature and physical activity: A research review. *Arborist News* 17, 1:22-24.
- <sup>xiii</sup>Kaplan, R, and S Kaplan. 1989. *The Experience of Nature: A Psychological Perspective*. Cambridge: Cambridge University Press.
- <sup>xiv</sup>Kaplan, R. 1993. The role of nature in the context of the workplace. *Landscape and Urban Planning* 26, 1-4:193-201.
- <sup>xv</sup>Faber Taylor, A, FE Kuo, and WC Sullivan. 2002. Views of nature and self-discipline: Evidence from inner-city children. *Journal of Environmental Psychology* 22:49-63.
- <sup>xvi</sup>Taylor, AG, FR Kuo, and WV Sullivan. 2001. Coping with ADD: The surprising connection to green play settings. *Environment and Behavior* 33, 1:54-77.
- <sup>xvii</sup>Matsuoka, RH. 2008. High School Landscapes and Student Performance. Unpublished dissertation, University of Michigan.
- <sup>xviii</sup>Westphal, LM. 2003. Urban greening and social benefits: A study of empowerment outcomes. *Journal of Arboriculture* 29, 3:137-147.
- <sup>xix</sup>Coley, RL, FE. Kuo, and WC Sullivan. 1997. Where does community grow? The social context created by nature in urban public housing. *Environment and Behavior* 29:468-492.

- <sup>xx</sup>Kuo, FE, WC Sullivan, RR Coley, and L Brunson. 1998. Fertile ground for community: Inner-city neighborhood common spaces. *American Journal of Community Psychology* 266:823-851.
- <sup>xxi</sup>Kuo, FE, and WC Sullivan. 2001. Environment and crime in the inner city: Does vegetation reduce crime? *Environment and Behavior* 33, 3:343-365.
- <sup>xxii</sup>Kuo, FE, and WC Sullivan. 2001. Aggression and violence in the inner city: Effects of environment via mental fatigue. *Environment and Behavior* 33, 4:543-571.
- <sup>xxiii</sup>Kuo, FE. 2003. The role of arboriculture in a healthy social ecology. *Journal of Arboriculture* 29, 3:148-155.
- <sup>xxiv</sup>Sullivan, WC, FE Kuo, and SF DePooter. 2004. The fruit of urban nature: Vital neighborhood spaces. *Environment and Behavior* 36, 5:678 - 700.
- <sup>xxv</sup>Wolf, KL. 2003. Freeway roadside management: The urban forest beyond the white line. *Journal of Arboriculture* 29, 3:127-136.
- <sup>xxvi</sup>Kaplan, R. 2001. The nature of the view from home-psychological benefits. *Environment and Behavior* 33, 4:507-542.
- <sup>xxvii</sup>Ulrich, RS. 1986. *ibid.*
- <sup>xxviii</sup>Faber Taylor, A, A Wiley, FE Kuo, and WC Sullivan. 1998. Growing up in the inner city: Green spaces as places to grow. *Environment and Behavior* 30:3-27.
- <sup>xxix</sup>Wells, NM. 2000. At home with nature: Effects of "greenness" on children's cognitive functioning. *Environment and Behavior* 32, 6:775-795.
- <sup>xxx</sup>Crompton, JL. 2001. *Parks and Economic Development*. Chicago, IL: American Planning Association.
- <sup>xxxi</sup>Anderson, LM, and HK Cordell. 1988. Residential property values improved by landscaping with trees. *Southern Journal of Applied Forestry* 9:162-166.
- <sup>xxxii</sup>Laverne, RJ, and K Winson-Geideman. 2003. The influence of trees and landscaping on rental rates at office buildings. *Journal of Arboriculture* 29, 5:281-290.
- <sup>xxxiii</sup>Wolf, KL. 2005. Business district streetscapes, trees and consumer response. *Journal of Forestry* 103, 8:396-400.
- <sup>xxxiv</sup>Florida, R. 2005. *Cities and the Creative Class*. New York: Routledge, 198 pp.
- <sup>xxxv</sup>Donovan, GH, and DT Butry. 2010. Trees in the city: Valuing street trees in Portland, Oregon. *Landscape and Urban Planning* 94:77-83.
- <sup>xxxvi</sup>McPherson EG. 2003. Urban forestry: The final frontier? *Journal of Forestry* 101, 3:20-25.