Insights from Ecology for Health: Design Guide for Fostering Human Health and Biodiversity in Cities

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As city leaders and communities around the world plan for a healthy environment and address threats to biodiversity, many turn toward integrating nature in urban environments for a variety of ecosystem services and ecological functions. Common examples of such integration include the creation of tree-lined boulevards for urban heat mitigation and urban waterfront restoration for recreation and native habitat. Urban green spaces, which include common features such as trees, herbaceous and shrub cover, bare ground, water features, and green roofs and walls, play a crucial role in supporting biodiversity and human health.[1] However, not all greenspaces support humans and native wildlife equally. For instance, small neighborhood parks are less likely to provide undisturbed native habitat due to their size constraints. One of the key challenges in designing green spaces is navigating tradeoffs, such as the need for active recreational spaces that can coexist with minimally disturbed wildlife habitats, or the desire for simplified landscaping, such as lawns for easy pedestrian access while restoring complex habitats preferred by native wildlife species. There is a tangible need for cities to design green spaces that serve the health of urban residents and native biodiversity.

[1] Abdullah Akpinar, "How Is Quality of Urban Green Spaces Associated with Physical Activity and Health?," *Urban Forestry & Urban Greening* 16 (2016): 76–83.

To address this need, the San Francisco Estuary Institute (SFEI) has created Ecology for Health, a science-based urban design guide to support designers and planners in approaching greenspaces with biodiversity and human health in mind. SFEI is a science research institute with more than seventy staff dedicated to advancing visionary science and interdisciplinary tools for the health and resilience of the San Francisco Bay Area and beyond. A team of scientists and designers within SFEI's Urban Nature team developed the guide to meet the growing demands of planners, designers, policymakers, and the public in gaining the diverse benefits that nature can provide to urban communities. The guide connects the team's biodiversity research with an extensive review of the health benefits of access to biodiverse greenspaces to explore how designing cities for biodiversity improves people's the physical and mental health. This design guidance is also published on SFEI's Making Nature's City Toolkit website, which provides user-friendly navigation through the Ecology for Health principles.

This research spotlight encompasses a selection of planning and site design strategies from the guide, coupled with insights from the Ecology for Health salon—an open-house style engagement event held after the guide's publication to brainstorm its implementation in Bay Area projects. Feedback from the salon, including discussions about the application and future phases of the guide, is incorporated below.

The Guide

The Ecology for Health guide addresses three distinct scales in developing health- and biodiversity- promoting greenspaces: urban planning; site design; and detailed design and management. Within each scale are strategies for designing urban greenspaces that reconcile tradeoffs and maximize the benefits of urban biodiversity and human health support. The guide's proposals are based on scientific literature published over the past thirty years on urban greening, human health, and biodiversity, focusing on understanding the health benefits and tradeoffs associated with access to biodiverse greenspace. When addressing urban biodiversity, the guide focuses on supporting native wildlife. These species have coevolved in specific geographies, resulting in specialized relationships that contribute to the diverse and dynamic ecosystem of a given location.

While the guide synthesizes research on urban biodiversity and human health in cities across the globe, which allows many of the strategies to be applied in cities worldwide, SFEI's work is strongly informed by their experience as scientists and designers in California's San Francisco Bay Area. We acknowledge that this may result in some strategies and case studies being more relevant to the challenges of our

region and those that share its economic, cultural, political, and ecological characteristics.

The selected strategies from the guide highlighted below relate to greenspace connectivity, park design, and waterfront design, addressing both planning and site design scales commonly engaged by planners and landscape architects.

Planning for a connected greenspace network. Filling in gaps between poorly connected greenspaces by creating distributed neighborhood parks, greenways, and other habitat patches helps establish a connected greenspace network. Residents' access to greenspace is associated with improved mental and physical health, and aids wildlife in moving safely between patches (fig. 1).[2] Large habitat patches are associated with higher rates of recreation and health benefits and also offer the most significant wildlife benefits, especially for species sensitive to urban impacts. However, a few large

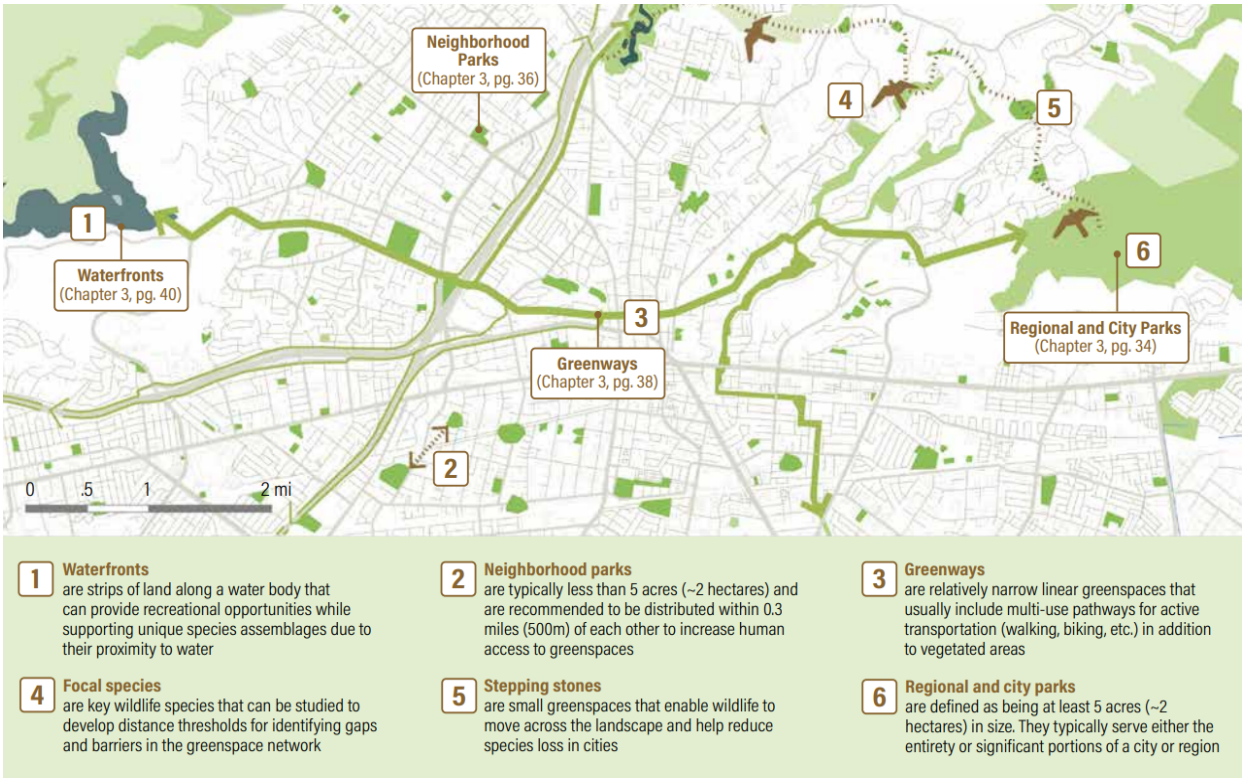

Figure 1: Key elements of a greenspace network may consist of continuous green corridors and distributed neighborhood parks that provide greenspace access to local communities and act as stepping stones for wildlife. Drawing Credit: Vanessa Lee (SFEI).

[2] Akpinar; Deborah A. Cohen et al., "Contribution of Public Parks to Physical Activity," *American Journal of Public Health* 97, no. 3 (2007): 509–14; Amy J. Lynch, "Creating Effective Urban Greenways and Stepping-Stones: Four Critical Gaps in Habitat Connectivity Planning Research," *Journal of Planning Literature* 34, no. 2 (2019): 131–55.

patches, as opposed to small, dispersed patches, limit access to those who can afford to live near them and *may* be more likely to contribute to green gentrification.[3] When resources are limited, planning for greenspaces to be distributed throughout the city can create habitat stepping stones for wildlife and provide recreation access to more residents.

Figure 2: An example of regional and city parks that demonstrate a gradient of use intensity in park areas based on adjacent access, land uses, and existing landscape features. Drawing Credit: Vanessa Lee (SFEI).

[3] Green gentrification is the phenomenon of displacing existing, often lower-income, residents due to an influx of wealthier residents following neighborhood greening, such as the creation of new greenspaces. Catherine Paquet et al., "Are Accessibility and Characteristics of Public Open Spaces Associated with a Better Cardiometabolic Health?," *Landscape and Urban Planning* 118 (October 2013): 70–78; Ross WF Cameron et al., "Where the Wild Things Are! Do Urban Green Spaces with Greater Avian Biodiversity Promote More Positive Emotions in Humans?," *Urban Ecosystems* 23, no. 2 (2020): 301–17; Seung Kyum Kim and Longfeng Wu, "Do the Characteristics of New Green Space Contribute to Gentrification?," *Urban Studies* 59, no. 2 (2022): 360–80; Yu Chen et al., "Can Smaller Parks Limit Green Gentrification? Insights from Hangzhou, China," *Urban Forestry & Urban Greening* 59 (2021): 127009.

Designing parks. Regional and city parks are defined here as larger than five acres (~2 hectares or city blocks) and can include large habitat areas buffered from urban impacts (fig. 2). Buffer zones, which separate high-use park elements from sensitive habitats, limit human disturbance and may incorporate physical barriers such as dense forest plantings or a water body. These zones are essential for maintaining the quality of sensitive habitats by reducing urban disturbances. High-use park elements, such as sports fields and event areas, should be placed near park edges for public access, while sensitive habitats should be placed toward the park's center to reduce urban disturbance. In cases where one of the park edges is connected to an adjacent habitat patch, consider locating sensitive habitats closer to that edge while ensuring an adequate buffer from the road. Additionally, a minimum of approximately 130 acres (~50 hectares or city blocks) dedicated to interior habitat is recommended to support urban-intolerant wildlife.[4]

Neighborhood parks are defined here as being smaller than five acres (~2 hectares or city blocks) and often pose challenges for creating undisturbed habitat due to space limitations. However, small spaces can still contribute to wildlife connectivity and provide habitat for urban tolerant species while providing greenspace access to people (fig. 3). Also, the separation of uses can distinguish human-use areas from habitat zones to minimize disturbance. While this separation may reduce recreational space for residents, certain passive activities like picnicking and seating areas can be incorporated adjacent to habitat areas, and the added biodiversity can support well-being and visitation.[5] To establish high-quality habitat patches in limited space, the guide recommends planting native pollinator gardens and include essential host plants for target wildlife species, such as milkweed for monarch butterflies. Additionally, introducing structural complexity in planting, where feasible, is associated with supporting biodiversity in small greenspaces.[6]

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[4] Joscha Beninde, Michael Veith, and Axel Hochkirch, "Biodiversity in the City: Fundamental Questions for Understanding the Ecology of Urban Green Spaces for Biodiversity Conservation," ed. Nick Haddad, *Ecology Letters* 18, no. 6 (June 2015): 581–92.

[5] Susan L. Prescott et al., "Biodiversity, the Human Microbiome and Mental Health: Moving toward a New Clinical Ecology for the 21st Century?," *International Journal of Biodiversity* 2016 (August 3, 2016): 1–18.

[6] Structural complexity refers to the variety of vegetation types and structural heights at a site. Grant C. Palmer et al., "Determinants of Native Avian Richness in Suburban Remnant Vegetation: Implications for Conservation Planning," *Biological Conservation* 141, no. 9 (September 1, 2008): 2329–41; J. Amy Belaire, Christopher J. Whelan, and Emily S. Minor, "Having Our Yards and Sharing Them Too: The Collective Effects of Yards on Native Bird Species in an Urban Landscape," *Ecological Applications* 24, no. 8 (2014): 2132–43; Esteban Fernández-juricic, "Avian Spatial Segregation at Edges and Interiors of Urban Parks in Madrid, Spain," *Biodiversity and Conservation* 10, no. 8 (August 1, 2001): 1303–16.

Figure 3: A typical site design of small parks, showing separate active human use areas from habitat patches to minimize habitat disturbance. Drawing Credit: Vanessa Lee (SFEI).

Designing waterfronts. Waterfronts are strips of land along a coast, river, or other water body, and can support diverse riparian species due to their proximity to water. Preserving high-quality riparian habitat, which is characterized by dense vegetation, can potentially obstruct scenic views of the water, which are linked to improved well-being.[7] In such cases, raised boardwalks and overlooks are recommended as design interventions at waterfronts to maintain views while limiting disturbance (fig. 4). Furthermore, multi-use trails along existing levees can offer scenic views while minimizing the need for new land disturbance. To mitigate impacts on wildlife and enhance resilience to sea-level rise, the guide recommends positioning trails, pathways, and recreational areas at least 200 feet (~60 meters) from the marine high tide line and 100 feet (~30 meters) from other critical or sensitive habitats.[8]

[7] Daniel Nutsford et al., "Residential Exposure to Visible Blue Space (but Not Green Space) Associated with Lower Psychological Distress in a Capital City," *Health & Place* 39 (2016): 70–78; Joanne K. Garrett et al., "Urban Blue Space and Health and Wellbeing in Hong Kong: Results from a Survey of Older Adults," *Health & Place* 55 (January 2019): 100–110.

[8] G. Bentrup, "Conservation Buffers—Design Guidelines for Buffers, Corridors, and Greenways" (Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station, 2008).

Figure 4: A typical site design of urban waterfronts, showing multi-use trails at habitat edges to preserve sensitive habitat zones with limited human trail access. Drawing Credit: Vanessa Lee (SFEI).

The Salon

To brainstorm how to implement these strategies in the Bay Area and beyond, SFEI convened a salon on September 20th, 2023 at their Richmond, California office. This event brought together planning, design, and engineering firms, federal, state, and local agencies, non-profit and community-based organizations, and academic institutions across the Bay Area, all sharing an interest in urban greenspace planning and design. The purpose was to collectively brainstorm the local and broader application of these strategies. More than fifty attended the salon (figs. 5-7). [9]

The salon featured an overview of the guide, encompassing urban planning, site design, and detailed design strategies, along with support resources previously developed by SFEI. To facilitate the collection of input and feedback from attendees, feedback boards with sticky notes and discussion tables with notepads were provided.

[9] In total, ninety-two RSVPs were received, representing approximately twenty planning, design, and engineering firms, fourteen federal/state/local agencies and regional collaboration, nine non-profit and community-based organizations, and academic institutions.

Figure 5: Salon attendees discussing the regional and city parks strategies presented by the Ecology for Health guide. Photo Credit: Shira Bezalel.

Figure 6: A salon attendee providing thoughts on a feedback board related to how the Ecology for Health team can help support projects in achieving biodiversity and human health goals. Photo Credit: Shira Bezalel.

Figure 7: Salon attendees reading other SFEI publications related to urban ecological and resilience planning and design. Photo Credit: Shira Bezalel.

Salon attendees identified two primary ways in which they intend to use the design guide. First, they plan to incorporate the planning and design strategies into their ongoing and future urban greening projects. This includes addressing design trade-offs between health and biodiversity support, as well as exploring the human health benefits associated with open space and green infrastructure design. Second, they aim to reference the human health and biodiversity benefits identified in the guide when communicating the benefits of urban greening efforts, particularly tree planting and open space design, to their stakeholders and/or clients.

Several key potential next steps for the guide emerged during discussions and in written feedback. Salon attendees expressed a high degree of interest in developing clear, science-based, quantifiable planning and design metrics based on the strategies from the guide. For example, what percentage of tree cover is needed to provide *x* amount of cooling in a park? These metrics would help policymakers, resource managers, and communities set up measurable goals, standards, and targets related to human health, biodiversity support, and other community benefits. These quantified benefits associated with urban greening would also drive policy, funding, planning, and design decisions by providing data to support the implementation of these strategies and tools.

Additionally, there were suggestions to better understand the impacts on and of the unhoused population residing in urban green spaces. In particular, suggestions addressed key challenges associated with managing and maintaining open space and

landscape restoration projects in ways that consider the needs of the unhoused population while improving regional biodiversity support and human health.

Other feedback focused on increasing community collaboration on projects and considering impacts on green equity and climate change mitigation. For instance, discussions centered around prioritizing urban greening efforts in historically underserved communities lacking quality greenspaces. Participants discussed developing strategies to mitigate the impacts of green gentrification through collaboration with affected communities and stakeholders.

Conclusion

The Ecology for Health guide represents an initial step in providing a conceptual framework and technical guidance to balance the needs for biodiversity conservation and human health support within urban greening projects in communities. SFEI is currently evaluating and charting the next steps of the guide to further support biodiversity and human health targets in urban greening initiatives. These suggestions push SFEI to explore future opportunities to work more closely with design partners and communities on projects and to collectively develop design solutions.

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