EXECUTIVE SUMMARY

MAKING NATURE'S CITY

A SCIENCE-BASED FRAMEWORK FOR BUILDING URBAN BIODIVERSITY

SFEI San Francisco Estuary Institute

Making Nature's City synthesizes global research into a science-based approach for supporting nature in cities. The report identifies seven elements that work together to maximize biodiversity, and illustrates these through a case study in California's Silicon Valley.

Cities not only harbor a significant fraction of the world's biodiversity, but they also can be made more livable and resilient for people, plants, and animals through nature-friendly urban design.

Using the framework developed in this report, local residents and urban designers can work together to link local parks, greenways, green roofs, street trees, stormwater basins, commercial landscaping, and backyards to support biodiversity, while making cities better places to live.

Making Nature's City provides practical guidance for shaping the healthier and more resilient cities of the future.

For the full report, go to www.sfei.org/projects/making-natures-city

THE SEVEN ELEMENTS OF THE URBAN BIODIVERSITY FRAMEWORK

Based on scientific studies of how nature works in cities around the world, we identified seven key elements for urban biodiversity planning and design.

Ohlone Greenway in Berkeley, California (Photo courtesy of Kelguen, CC by 2.0)

01 ELEMENT

Nature needs space

PATCH SIZE

Patch size — the area of each discrete greenspace in a city— is one of the two main drivers of urban biodiversity. Patches can range from smaller neighborhood parks to golf courses, cemeteries, and large city parks, as well as natural spaces such as forests and lakes. Larger patches generally support greater biodiversity because they contain more kinds of habitats and provide more resources than smaller patches. Biodiversity declines rapidly when greenspaces are smaller than 10 acres in size, while large patches (above 130 acres in size) can host species that are area-sensitive and intolerant of urban environments. Networks of habitat patches maintain species richness in urban settings.

02
ELEMENT

Connect the patches

CONNECTIONS

Connections between patches are a critical element in urban biodiversity support. Connections are linear vegetated features, such as greenways and riparian corridors, that facilitate the movement of plants and animals. Contiguous stretches of vegetation linking wider greenspaces, such as green corridors along waterways and right-of-ways form some of the most effective connections in cities. Waterways can also serve as critical connections between urban and rural populations and aquatic and terrestrial habitats. In the absence of continuous corridors, "stepping stones" of matrix habitat, such as closely-spaced pocket parks or green roofs, can increase connectivity between patches.

03
ELEMENT

Small spaces matter

MATRIX QUALITY

The characteristics of the matrix – the areas around and between urban habitat patches and corridors – affect biodiversity. Matrix quality refers to how well these developed areas support biodiversity. Areas with more street trees, bioretention areas, green roofs, and backyard gardens are better able to support native plants and animals. While individual habitat elements in the matrix are often too small to support large wildlife populations themselves, they can support wildlife movement and foraging in cities. Matrix quality improvements can be made around patches to increase the effective patch size, along connections to increase the effective corridor width, between patches to increase connectivity, or clustered to form habitat complexes.

04
ELEMENT

Create ecosystem structure at multiple scales

HABITAT DIVERSITY

Urban areas that restore natural habitat diversity and arrangement can support greater overall biodiversity. Creative planning and design that regenerates the scale, complexity, arrangement, and diversity of habitats supports native species and increases the total resources available. When planning for habitat diversity it is important to both promote coherence and heterogeneity at the city scale and to mimic the spatial complexity, verticular structure, and physical features of individual habitats at the site scale. Protecting and augmenting rare native habitats in cities can be particularly beneficial for habitat specialists, which may be especially vulnerable to habitat loss..

05 ELEMENT

Go local

NATIVE VEGETATION

Native plants support the native wildlife with which they have co-evolved. Over evolutionary history, native species often develop particular relationships with one another and with their physical environment. For example, many insects have developed specialized relationships with native host plants. Native plants can bolster the entire food web by supporting the presence of these specialized local insects, which can, in turn, be a food resource for other wildlife. In addition to providing wildlife habitat, the use of native species in urban landscaping can also reduce water usage and maintenance costs.

06 ELEMENT

Add key features

SPECIAL RESOURCES

Managing for certain physical or biological components of an ecosystem can provide disproportionate benefits to wildlife. These special resources can help animals meet their needs for food, shelter, or water during all or part of the year. For example, large trees and well-designed urban water bodies serve as hubs for local biodiversity. Trees with cavities for nesting birds and woody debris piles for reptiles and insects, which are typically removed in urban environments, can support specialists and increase biodiversity in otherwise resource-limited areas.

07 ELEMENT

Establish wildlife-friendly practices

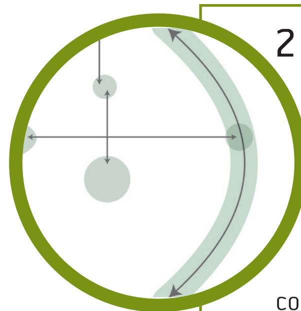
MANAGEMENT

Land or facility managers can often adopt changes that are both beneficial to biodiversity and lower in cost. Biodiversity-friendly management actions include reducing pesticide and herbicide use, minimizing disturbance to sensitive wildlife areas, limiting the impacts of domestic cats and dogs, reducing light and noise pollution, and regulating human activity to reduce conflict with wildlife. Design actions such as fitting buildings with bird-safe windows and creating wildlife underpasses and overpasses are also essential to creating a more wildlife-friendly built environment.

ELEMENTS THAT SUPPORT URBAN BIODIVERSITY

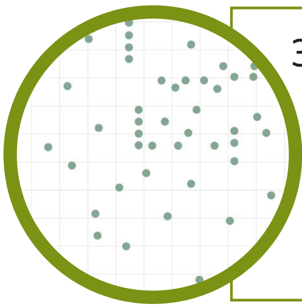
1 • PATCH SIZE

The size of a contiguous patch of greenspace in a city. We define patches as contiguous greenspaces of at least 2 acres in size.



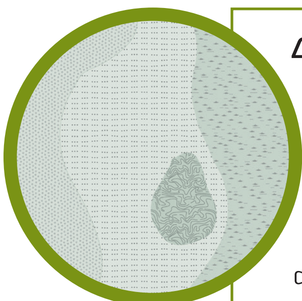
2 • CONNECTIONS

Features in the urban landscape that facilitate the movement of plants and animals. Connections include corridors (thin stretches of greenspace that promote linear movement) and stepping stones (sets of discrete but nearby patches that together promote connectivity across the landscape).



3 • MATRIX QUALITY

Habitat elements that support ecological process and movement in the urban matrix between patches of greenspace and corridors.

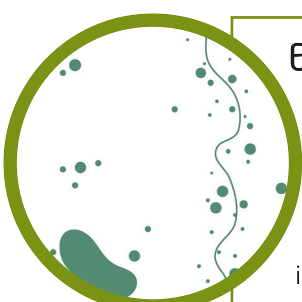


4 • HABITAT DIVERSITY

The type, number, and spatial distribution of habitat types within an urban area. Together, mosaics of habitats create diversity in habitat types at the landscape scale.

5 • NATIVE VEGETATION

Plant species long evolved in a specific geography (including nearby species that may be appropriate in the near future, given anticipated range shifts with climate change).



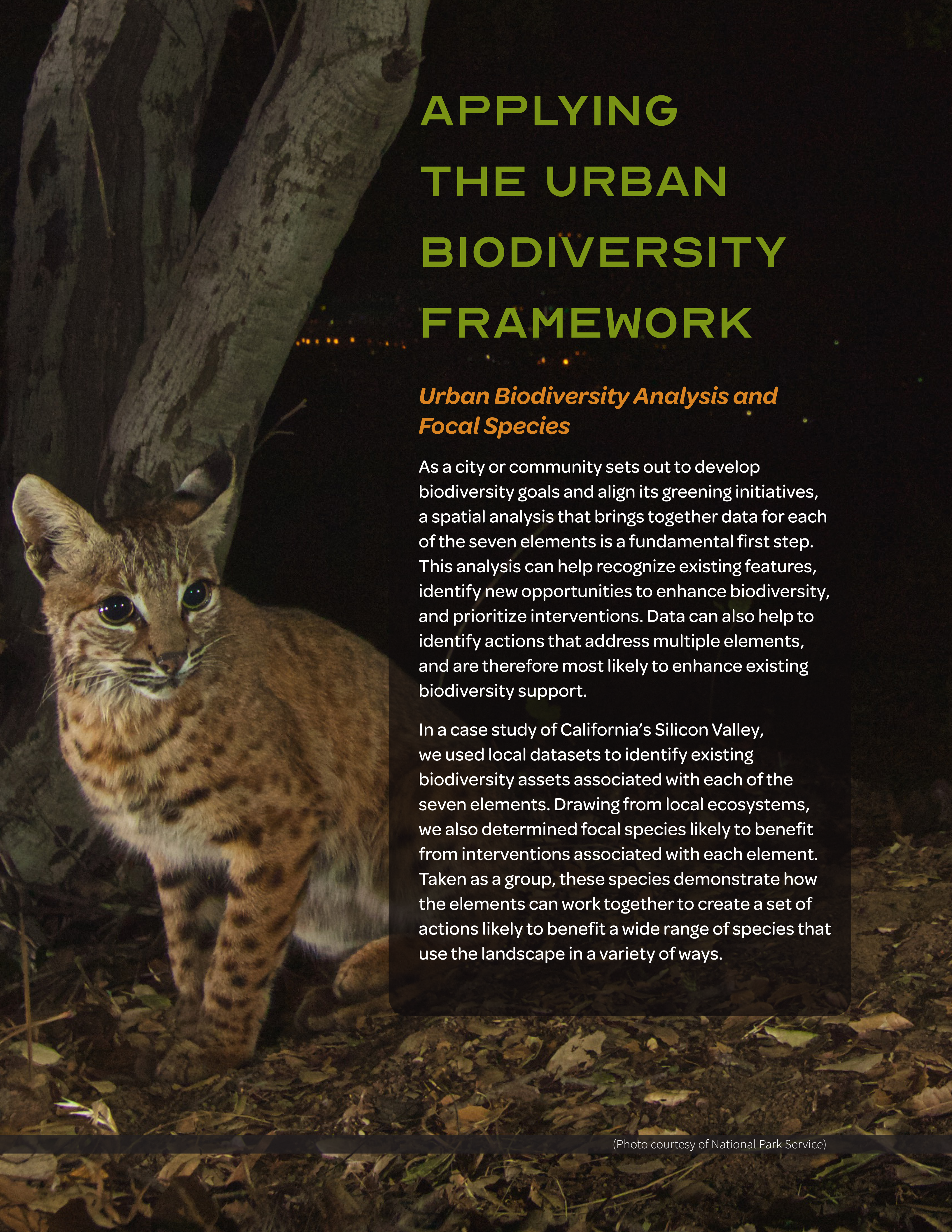
6 • SPECIAL RESOURCES

Unique habitat features necessary to support species' life history requirements, including large trees, wetlands, streams, and rivers.

7 • MANAGEMENT

Human activities and planning that promote positive biodiversity outcomes.

APPLYING THE URBAN BIODIVERSITY FRAMEWORK

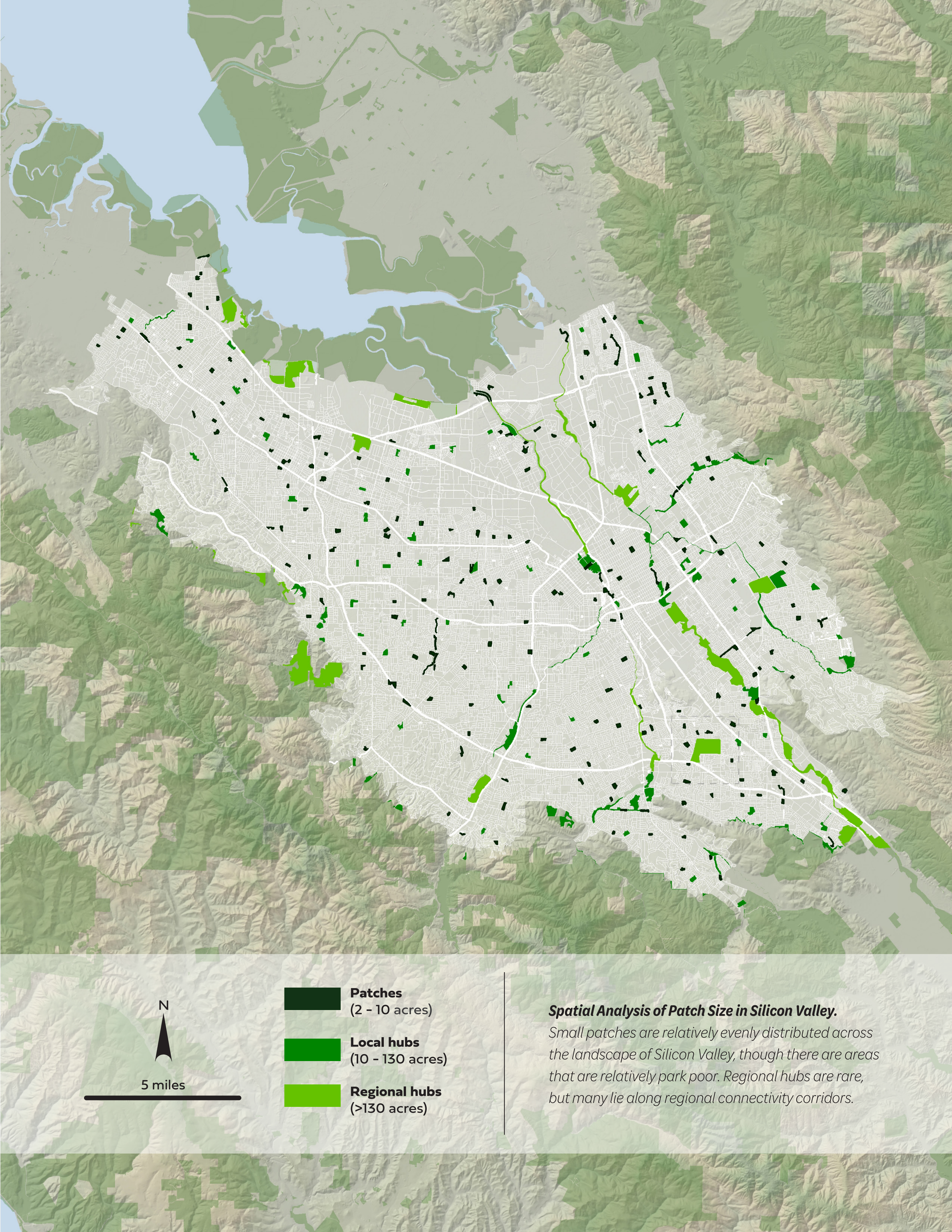


Urban Biodiversity Analysis and Focal Species

As a city or community sets out to develop biodiversity goals and align its greening initiatives, a spatial analysis that brings together data for each of the seven elements is a fundamental first step. This analysis can help recognize existing features, identify new opportunities to enhance biodiversity, and prioritize interventions. Data can also help to identify actions that address multiple elements, and are therefore most likely to enhance existing biodiversity support.

In a case study of California's Silicon Valley, we used local datasets to identify existing biodiversity assets associated with each of the seven elements. Drawing from local ecosystems, we also determined focal species likely to benefit from interventions associated with each element. Taken as a group, these species demonstrate how the elements can work together to create a set of actions likely to benefit a wide range of species that use the landscape in a variety of ways.

(Photo courtesy of National Park Service)



Spatial Analysis of Patch Size in Silicon Valley.
Small patches are relatively evenly distributed across the landscape of Silicon Valley, though there are areas that are relatively park poor. Regional hubs are rare, but many lie along regional connectivity corridors.

FOCAL SPECIES

BLACK-TAILED BUMBLE BEE

The black-tailed bumble bee (*Bombus melanopygus*) is a common pollinator within parks, gardens, grasslands, and chaparral of Silicon Valley. Tolerant of urbanization, the species is abundant in urban areas (Hatfield et al. 2014). Black-tailed bumblebees have been recorded across neighborhoods in Silicon Valley, including East Palo Alto, Palo Alto, Mountain View, Cupertino, Los Altos, Saratoga, and San Jose (iNaturalist 2019). They have also been found in gardens in the suburban areas close to the hills.

Queen bees nest in cavities such as rodent holes and bird nests in urban parks and yards. The queen and worker bees forage for pollen and nectar from clover, sage, manzanita, and other flowering plant species around their nests. Installing potential nesting structures and cultivating bee-friendly gardens in residential landscapes can help support the black-tailed bumblebee.


(Photo courtesy of National Park Service)

DIET: Nectar and pollen from flowering plants, including *Ceanothus, Ericameria, Eriodyction, Eriogonum, Lupinus, Penstemon, Rhododendron, Salix, Ribes, Salvia, Trifolium, Vaccinium,* and *Wyethia*. Bees will visit a mixture of native and exotic flowers.

HABITAT: Bees forage in grassy areas, chaparral, shrubland, urban parks, and gardens. Queens will nest in rodent holes or bird nests.

KEY STRESSORS: Although the species has a stable population throughout its range, it is sensitive to habitat loss, pesticide use, disease spread from domestic bee hives, and competition with non-native bees.

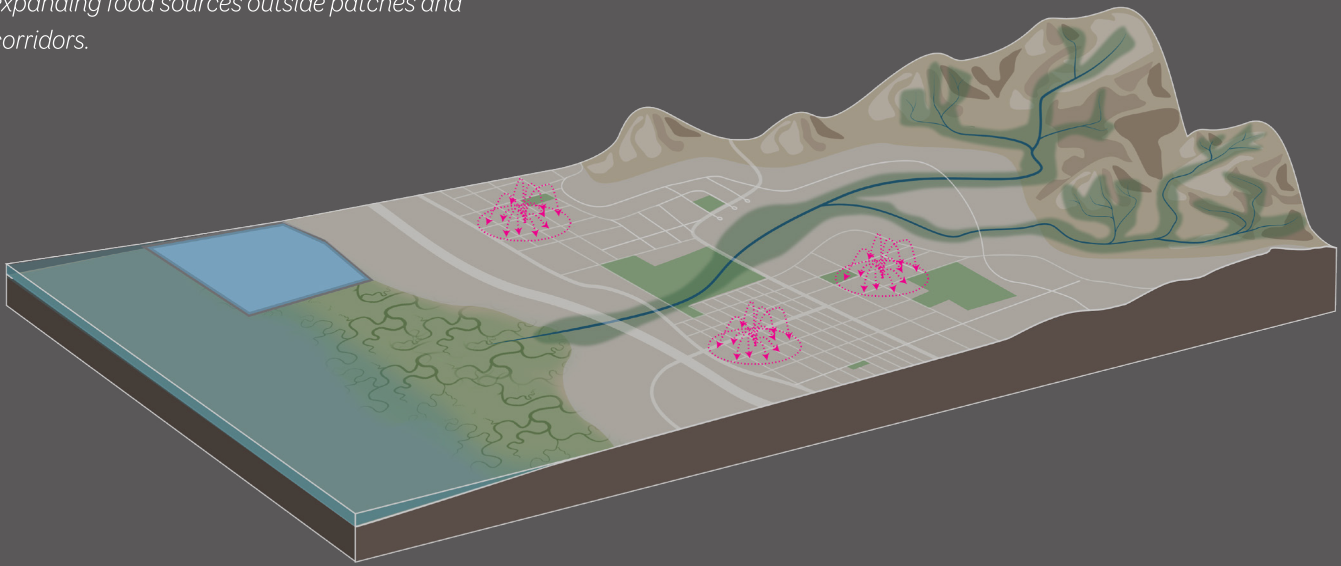

(Photo courtesy of Alejandro Dauguet, CC by 2.0)

A black-tailed bumble bee visiting California rose (*Rosa californica*) in a small area of native landscaping integrated into the De Anza Community College Campus.

(Sources: McFrederick and LeBuhn 2006, Hatfield et al. 2014, Bartomeus et al. 2016)

(Photo courtesy of JKehoe, CC BY 4.0)

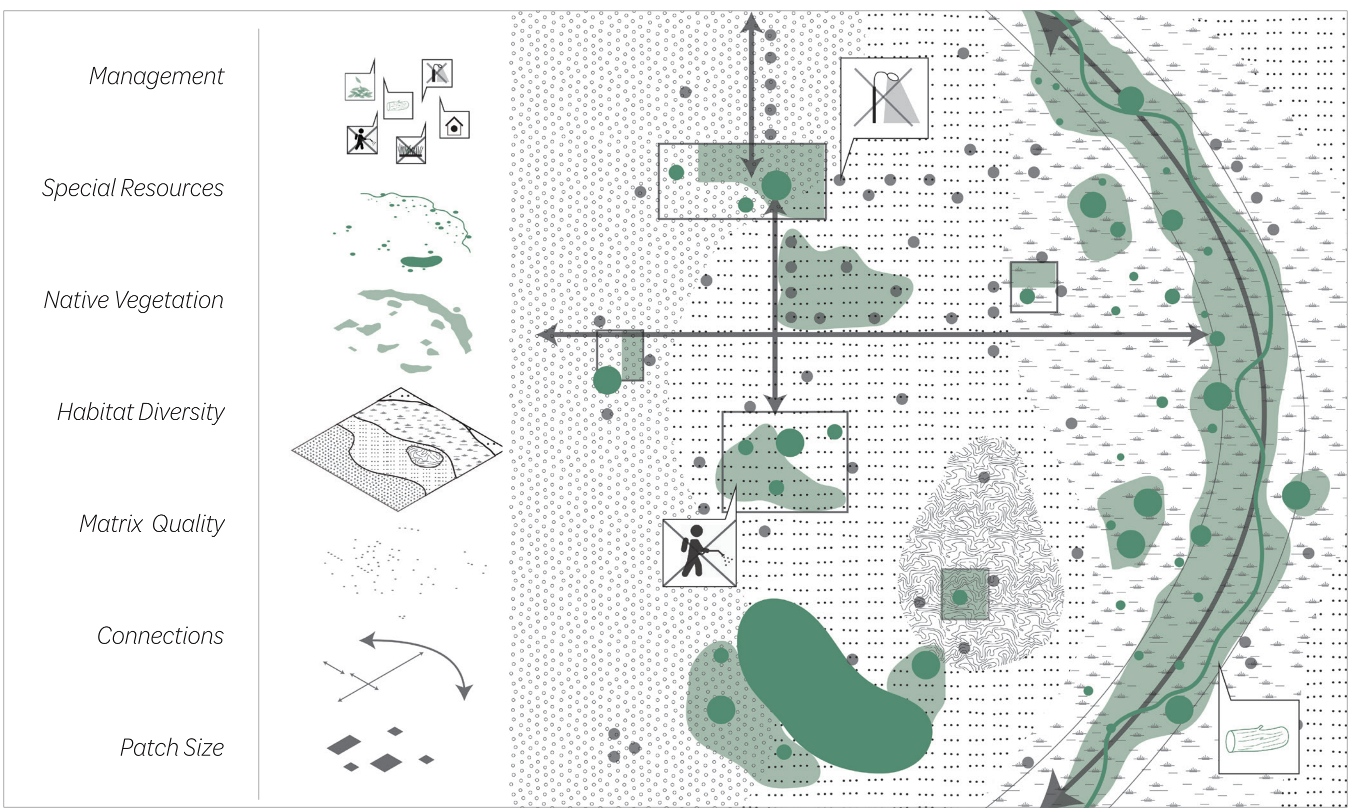
Matrix improvements are particularly beneficial for pollinators. The black-tailed bumble bee will fly through the urban landscape to reach foraging patches. Improvements in the matrix include maintaining potential nesting structures and expanding food sources outside patches and corridors.



CREATING AN URBAN BIODIVERSITY STRATEGY

The Urban Biodiversity Framework can be used by cities, community-based organizations, and other entities at the scale of a site or, more broadly, to develop an urban biodiversity strategy. The process of creating a biodiversity strategy has many benefits, including defining goals for biodiversity, building support for projects, and aligning biodiversity goals with other synergistic priorities. Identifying related efforts and policies can be a first step in building an implementation plan, and can help align biodiversity with other goals, increasing the likelihood of funding and support for projects. Since no one entity can implement the range of actions necessary to create an urban biodiversity network, a landscape-scale strategy can help communities develop a shared vision for where important actions, such as acquiring land, protecting ecosystems, and creating new habitat, are likely to be most impactful. The following pages summarize a few of the possible actions in an urban biodiversity strategy.

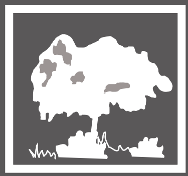
Urban biodiversity planning will be most effective if it advances all seven elements across the landscape.



(Photo courtesy of Robin Grossinger)

Charleston Retention Basin in Mountain View, California (Photo courtesy of Shira Bezalel)

TOOLKIT OF BIODIVERSITY ACTIONS

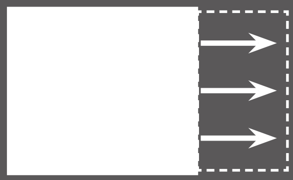


Existing high-quality patches

Approach: ***Preserve and conserve existing open spaces***, in particular remnants of native habitat, that already provide valuable habitat. These spaces can also offer unique recreation and restorative opportunities for people that live in urban areas.

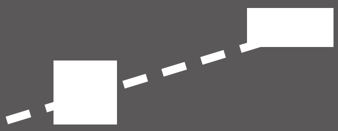
Areas with few or no greenspaces

Approach: ***Acquire or dedicate land to create new patches***. Vacant lots, parking lots, post-industrial sites and other spaces can be repurposed as natural assets. Patch creation in underserved, park-poor neighborhoods should be prioritized.



Greenspaces with room to grow

Approach: ***Acquire land that is adjacent to existing patches*** to increase their effective size. Easements and land use restrictions along patches are another mechanism for expanding patches without changes in ownership.

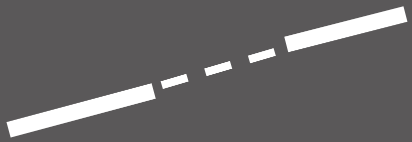


Infrastructure corridors

Approach: ***Create new corridors*** to improve connectivity between patches, or regionally, across the urban landscape. Opportunities can be found along existing infrastructure, under freeways, on easements, and along decommissioned rail tracks and other single-use linear spaces.

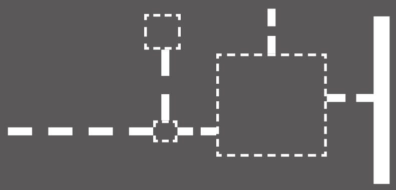
Narrow connections

Approach: ***Expand corridors*** by acquiring land along existing corridors to increase their effective width. Widening corridors can improve connectivity between patches while providing other benefits. For example, increasing setbacks from waterways can reduce flooding in urban areas and improve public access.



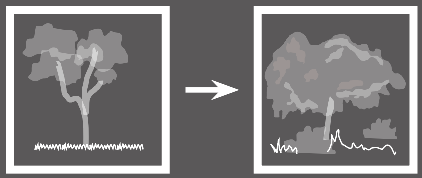
Fragmented connections

Approach: Strategically ***acquire land to fill gaps*** along existing corridors. Daylighting creeks, building wildlife crossings and extending greenways are some examples of gap-filling actions.



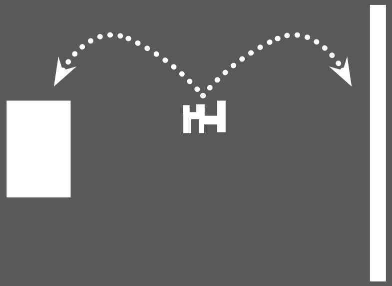
Planning for redevelopment, expansion, or development

Approach: ***Incorporate biodiversity actions early in the design process***. For example, master planning for large areas of land presents an opportunity to both accommodate development and augment urban biodiversity support. Creating biodiversity networks is most effective during early phases of design, when there is most flexibility in the location of buildings and infrastructure.



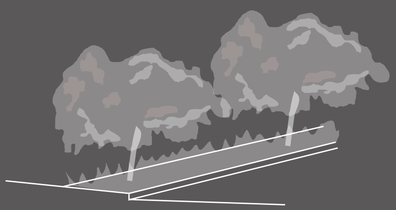
Existing open spaces with large opportunities for improvement

Approach: ***Upgrade existing open spaces*** to better support native flora and fauna, particularly through the inclusion of diverse habitat types, special resources, and native plantings. Spaces that are currently dominated by extensive lawns, impervious areas, or exotic plantings all present opportunities to improve biodiversity support.



Privately-managed residential spaces

Approach: Facilitate and promote programs that support ***residential actions that benefit biodiversity.*** Lawn conversion incentive programs, wildlife-friendly and drought-friendly gardening certification programs, and university cooperative extension programs all provide incentives and opportunities for outreach. Coordinated efforts on private land can create habitat complexes that function as stepping stones and enhance connectivity across the urban landscape.



Treeless streets

Approach: Use opportunities for ***streetscape re-design*** to reduce barriers and improve connectivity between larger features. Adding native street trees, widening planting areas, integrating stormwater features, and reducing travel lanes can help support the movement of species and deliver a wide range of ecosystem benefits for people.

Above, left: Urban interchange in San Jose, CA (Photo courtesy of Dick Lyon, CC by 2.0)
Above, right (and on cover): Collage of flora and fauna images (individual images courtesy of the Biodiversity Heritage Library)

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ABOUT THIS REPORT

EXECUTIVE SUMMARY
MAKING NATURE'S CITY

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