

In the absence of interventions, heat islands will only grow: **by 2050, urban surface area in the United States is expected to expand by one-third.**

Chicago has become a leader on this issue. It has added cool roofs, green roofs and street plantings — and transformed black-top playgrounds into grass fields. Incentives have helped to trigger the construction of more than 516,000 square metres of green roofs on 509 buildings.

Hannah Hoag  
How Cities Can Beat the Heat  
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# GREEN ROOFS

BRINGING NATIVE PLANT CONSERVATION TO A CITY NEAR YOU

BY  
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Left, Native shortgrass prairie species thrive on a sunny rooftop at Loyola University Chicago. The experimental trays planted with prairie species and non-native sedum mixtures are being used to measure the ability of habitat analog green roofs to hold stormwater and insulate the buildings below.



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**Mountaintops, cliffs, coastal barrens, gravel hill grasslands, sand dunes, dolomite prairies – these can be extremely sunny and dry places with shallow and nutrient-poor soil. Yet plants grow here.**

Top, When blooming on green roofs in a heavily urbanized environment, many native prairie plants like this purple coneflower can provide much-needed nectar to insects that visit. Current research is determining how animals might use green roofs like oases on a highway, providing resting and feeding locations throughout an otherwise inhospitable landscape.

Bottom, On their migration path up from Mexico, monarch butterflies like this one make use of milkweed species on green roofs. The whorled milkweed seen here grows well in the quick-draining soil and full-sun environment found on the green roof of the Peggy Notebaert Nature Museum in Chicago.

AS CITIES AROUND THE WORLD CONTINUE TO EXPAND, habitat for native plants can get pushed farther away, and cities become unlikely places for native plant conservation. Local education and appreciation has prompted more urban residents to use native plants instead of or in combination with horticultural varieties, but available space can still be a barrier to incorporating a large, diverse variety of native species into urban green spaces.

Along with the rapid growth of cities over the past fifty years, one type of livable habitat for plants has been increasing in coverage: green roofs. By incorporating a layer of engineered growing media into the structure of a building, an urban landscape architect can give plants back some living space that was taken away by the construction of a building. Rooftops that were once boring and unsightly become beautiful gardens teeming with life. While green roofs can never replace natural habitat on the ground, they do offer a new potential location for conservation of some native species.

So why don't we plant vast forest and grasslands on green roofs in all of our cities? Unfortunately, green roofs can be harsh places for most plant species to live. Full sun and high wind along with a need to keep the growing medium lightweight (to protect the integrity of the building) and nutrient-poor (to prevent colonization by weeds) means that the top of a roof in New England may feel more like a dry western mountaintop. To combat this problem, succulent, drought-tolerant species are typically used as the main or only type of vegetation on green roofs. These succulents have thick waxy leaves and use a modified type of photosynthesis, which makes them well-adapted to the desert-like conditions on many green roofs. While these tried-and-true species survive harsh environmental conditions, they are rarely native to the region where the green roofs are built.

However, many local native grasses and wildflowers also have traits that should allow them to survive successfully and reproduce on green roofs in many cities. Mountaintops, cliffs, coastal barrens, gravel hill grasslands, sand dunes, dolomite prairies—these can be extremely sunny and dry places with shallow and nutrient-poor soil. Yet plants grow here. For these adapted native species, could green roofs supplement conservation efforts occurring in natural habitats?

New ecology research now suggests using what's called a habitat template approach to incorporate native plant species into green roof design. Such an approach would select native plants from local habitats with environmental constraints similar to green roofs. For example, similar natural habitats in the Chicago region include sand, gravel, and dolomite short-grass prairies. If plant species are chosen from these prairies and planted on green roofs with similar frequency to the analogous habitat, it may be possible to cover the buildings of this large city with prairies. Would designing green roofs with native plant conservation in mind be one way to bring back the prairies that gave "The Prairie State" of Illinois its nickname? Research to address these questions, and to assess how native plant communities on habitat-template green roofs change over time, is currently underway at several institutions in this area, including the Chicago Botanic Garden, Loyola University Chicago, and the Peggy Notebaert Nature Museum.

So far, the results show that some, but not all, native prairie species are able to germinate, grow, survive, and reproduce. Species that make a lot of seeds seem to have an easier time maintaining their populations over several generations. In contrast, species that depend on specific soil-dwelling fungi to help them absorb water and nutrients (these relationships are called mycorrhizal associations) tend to die quickly in the somewhat sterile growing substrate. In the future, as more is learned about the qualities necessary for life on a green roof, it may be possible for thousands of native plant species to find refuge on rooftops all over the country. Habitat analog green roofs could allow many species to increase their presence in locations where they had otherwise disappeared.

If native plant species are successfully supported on green roofs, a vast variety of other organisms could also benefit. Just as you'd expect in a diverse habitat on the ground, strikingly complex arrays of birds, mammals, insects, reptiles, and even bacteria and fungi have been found on green roofs. Mobile animal species with wings successfully make their way to green roofs for obvious reasons. But, just as we saw with the plants, green roofs aren't ideal habitats for all animals because of their isolation and harsh environment. For example, many ground-nesting bird species that make their nests on green roofs have a hard time rearing their young. Once hatched, these baby birds typically leave the nest before

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their wings are developed enough to make the transition from a high rooftop to the ground below. Additionally, some leaf-cutter bees have been found to start building nests on green roofs only to abandon them later when their plant of choice can't grow on the roof and trips between the rooftop and the ground become too stressful.

Despite these exceptions, the many species that do make use of green roofs can find a verdant and diverse variety of plant-based resources in the middle of otherwise concrete jungles. Rare species of birds, spiders, bees, beetles, and other animals have been found on green roofs on several continents. Complex ecological relationships are supported when green roofs are planted with certain species. For example, monarch caterpillars and butterflies feed on milkweeds in the middle of busy cities when their preferred host plants are present and flowering on green roofs.

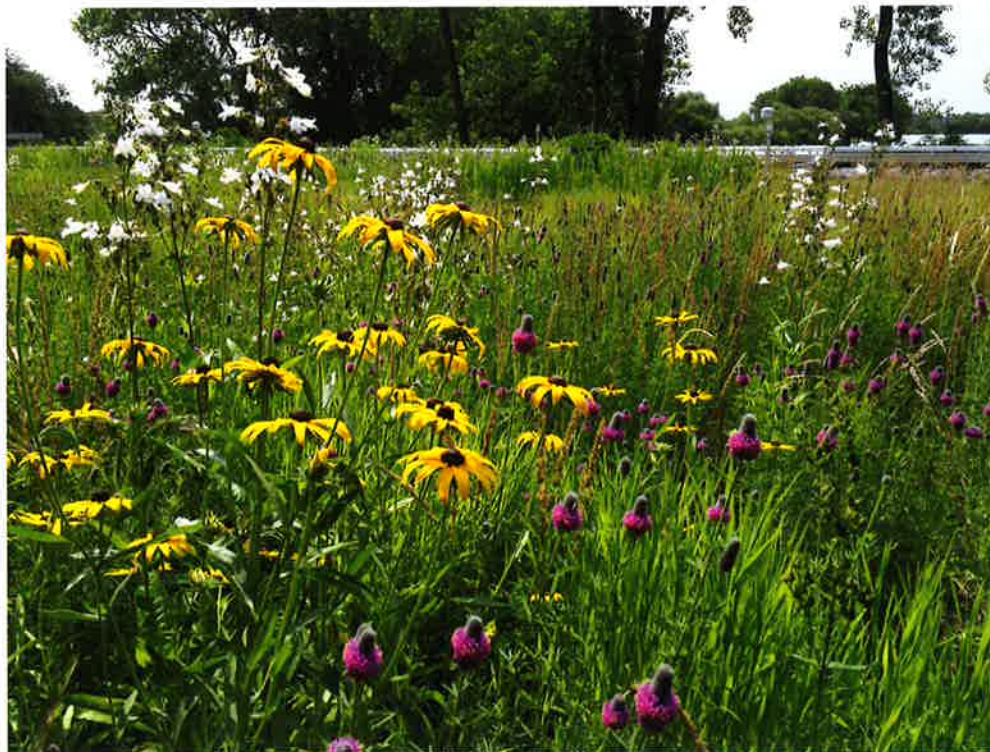
Currently, researchers are beginning to learn about the ecological benefits provided to cities when they include a large number of species-rich green roofs. Because of the novelty of green roofs in most locations,

there is still much to learn about the many ways in which native plants can be supported by this technology. It's possible that one day the living habitats of people and other organisms will be much less distinguishable from each other. Incorporating a wide variety of native plants in green roof design could provide a necessary step in that direction. As more native plant and animal species become adapted to city life, their contributions to broader biodiversity conservation efforts will be realized. ♡

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Native grasses and wildflowers including black-eyed susan, purple prairie clover, and foxglove beardtongue grow on a green roof at the Chicago Botanic Garden. This green roof, designed intentionally to mimic an Illinois prairie, supports over 100 native plant species and provides seeds, nectar, pollen, and nesting material for countless other organisms.