

**DEVELOPING PARTNERSHIPS AND GROWING COMMUNITY ENGAGEMENT
IN THE STUDY OF URBAN NATURE.**

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With the human population exceeding 7.6 billion and with the majority of people now living in urban areas, documenting and mitigating the impacts of urbanization are of global conservation concern. With expertise in education, outreach, and research, natural history museums are ideally suited to be core sites both for invigorating local communities in understanding, appreciating, and helping study urban nature as well as for building collaborative research networks that can help make urban areas more welcoming for wildlife and for people. At the Natural History Museum of Los Angeles County (NHMLA), we are creating a new interdisciplinary model for understanding and connecting to urban nature. These efforts include converting lawn and hardscape into a 1.4-hectare nature and teaching garden, installing a 600-square meter permanent exhibit on urban nature, and producing a field guide to encourage exploration and appreciation of urban nature. The collections housed within natural history museums provide an essential record of where species were found in the past. However, few modern-day records often exist in urban areas because standard methods for biodiversity surveys cannot be applied in areas with such high densities of private properties. Thus, in most urban areas, there is not enough modern data to assess how species are responding to urbanization. Building on community interest in urban nature, we are developing novel citizen science approaches to quickly generate urban biodiversity data. With the help of thousands of citizen scientist volunteers per year, we are generating hundreds of thousands of photo-vouchered species occurrence records on the iNaturalist platform as well as numerous specimens for the Museum's collections. University researchers and local conservation organizations are now partnering with Museum scientists to use these approaches and data to address urban ecology and landscape planning studies.

Here, we outline our education, exhibit, outreach, and research efforts focused on urban nature, and how these efforts have 1) established NHMLA as a core site invigorating the community around urban nature and 2) promoted the development of research networks and collaborative partnerships that apply urban biodiversity data to urban land management and planning issues.

Importantly, throughout the remainder of this review, we use the term "community science" as a synonym for and in preference to the more common term "citizen science." The word "citizen" in "citizen science" highlights that we are all part of a global citizenry that can contribute to biodiversity discovery, research, and conservation. Nevertheless, the word "citizen" can be polarizing and even alienating to some, especially those who may not be naturalized citizens of a given country where a research project is being conducted. Thus, at NHMLA we use the term "community science," in hopes that it is more inclusive when reaching out to and serving a diverse audience. We encourage others who are developing projects that depend upon volunteer efforts to think carefully about their choice of terminology.

Building a Community Passionate about Urban Nature

To create a new interdisciplinary model for understanding and connecting to urban nature, NHMLA developed exhibits and a popular press field guide to get local residents excited about the incredibly diverse biota that can be found all around them, all the time. In the lingo of the Museum, the goal of these efforts was to get people “to put their nature eyes on.” The hope was to make people aware that there is no magic line where nature stops and city begins, and that interesting biodiversity discoveries can be made anywhere, even in the most urban parts of a city. With this awareness, hopefully also comes increased stewardship of urban habitats—and surveys discussed below demonstrate that this is happening.

In 2013, NHMLA celebrated its centennial. Over the prior four years, the Museum opened multiple new exhibits such that by the centennial celebration, 65% of the Museum’s public exhibit space consisted of new exhibits. One of these new exhibits is the “Nature Lab,” which opened in June 2013; the Nature Lab is a 600-square meter permanent exhibit that focuses on urban nature and the stories of species in and around Los Angeles. The exhibit is loosely organized under the traditional urban ecology constructs of urban avoiders, urban adapters, and urban exploiters. The species featured include native and non-native species with stories about animals inside homes, in backyards, in neighborhoods, and in the foothills and mountains surrounding the Los Angeles area.

Themes explored in the Nature Lab can immediately be investigated further when museum visitors step outside into the Museum’s new Nature Garden, a 1.6 hectare teaching and research garden that turned NHMLA into an indoor and outdoor experience. Not only does this space allow people to observe diverse species in the middle of the city, but it also serves as a research site for museum scientists studying urban biodiversity. For example, a Malaise trap and weather station are installed in the Garden to monitor flying insect diversity as part of the Biodiversity Science: City and Nature (BioSCAN) project. A bat detector is also installed near the Garden’s pond, as part of a larger urban survey of the region’s bat diversity.

The most recent major effort to get local residents excited about urban nature is the publication of a new popular press guide, *Wild LA: Explore the Amazing Nature in and around Los Angeles*. This guide is divided into three parts: short, fun chapters introducing readers to the local ecology; 101 species accounts; and then 25 recommended excursions spread across the region where people can see the species and themes presented in the book. The book is intended to be very accessible, with fun facts and call outs on every page and numerous photographs and drawings.

Becoming a Hub for Urban Nature Research

Los Angeles is one of the Earth’s major mega-cities, with over 18 million people living in the Greater Los Angeles Area. Much of the human population growth in the region has taken place over the last 100 years, resulting in a tremendous rate of urbanization. Many of the more than 35 million specimens and historical objects housed in NHMLA’s collections are from the local region and speak to historical conditions. Thus, modern day surveys of biodiversity can be compared to this historical record to assess how species are responding to urbanization. Such efforts are not only relevant to conservation and urban planning, but they activate the collections,

and when paired with strategic outreach demonstrate the value of the collections to a broad audience.

Los Angeles is also home to the busiest port in the United States and one of the busiest airports in the world. With so many people and goods moving through the region, non-native species are also routinely introduced. Minimizing the impact of these potential invasives requires detecting these species quickly.

To assess how species are responding to urbanization and to detect nonnatives, it is necessary to conduct biodiversity surveys. Unfortunately, traditional survey techniques are not appropriate for urban areas because of the patchwork of private property that scientists cannot easily access. NHMLA scientists realized that community science approaches could get around this problem by partnering with members of the community who could help collect species occurrence data from urban neighborhoods. NHMLA scientists have now created multiple community science projects in which members of the public help collect biodiversity data. Many of these projects rely upon smartphone technology in which people can upload photographic vouchers to the iNaturalist platform, with each observation including latitude, longitude, date, and time information. Other projects partner with community scientists who allow Malaise traps for sampling flying insects or bat detectors to be installed in their yards. Recruiting participants has been especially easy in part because of the increased interest in urban nature resulting from the exhibits, media, and museum outreach efforts that focus on this topic.

NHMLA scientists realized that their common interests in urban nature and their common use of community science approaches could be united under a single research center that spanned taxonomic sections that typically work independently in museums. Thus, in 2015, NHMLA launched the Urban Nature Research Center (UNRC). This research focus on urban nature has been very productive with UNRC scientists publishing 29 peer-reviewed manuscripts as well as 6 popular press articles between 2013 and 2019. Eight of the peer-reviewed publications were authored or co-authored with community scientists. These publications focus on diverse topics including discoveries of species new to science and of non-native species never previously documented in the area.

Through community science, UNRC scientists figured out how to generate large amounts of urban biodiversity data. Researchers at other institutions, government agencies, and major conservation-oriented non-profit organizations have now reached out to NHMLA to establish collaborations focused on urban nature research and urban planning. Of particular note is a multi-year collaboration with The Nature Conservancy termed Biodiversity Analysis in Los Angeles (BAILA) that has now resulted in a peer-reviewed publication and a major report. Thus, NHMLA is not only being viewed as hub for urban nature research by the public but also by researchers.

One of the initial motivations for examining urban nature was the hope that increased public awareness of urban nature would result in increased stewardship. A collaborative study between UNRC scientists and education evaluators demonstrated exactly this; participation in community science efforts does have positive conservation outcomes due to increased community awareness.

Conclusions

Natural history museums are usually in urban areas. They also have experts in research, education, exhibits, and outreach. Thus, natural history museums are well positioned to generate interest in urban nature, and this interest can result in high levels of participation in community science projects. By generating large amounts of urban biodiversity data, museum scientists can have novel data that results in peer-reviewed publications and also helps to establish new research collaborations with other organizations that share similar interests in urban biodiversity.