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Viewpoint

Multicity research networks are needed to address global One Health challenges

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Urban areas are Earth's fastest growing land-use type (Gao and O'Neill 2020) and face unique One Health challenges at the intersection of human, animal, and environmental health. With urban development comes noise pollution, light pollution, elevated contaminant exposure risk, heat, habitat loss, and spillover risk from novel species assemblages, all of which affect the health of animals, people, and urban ecosystems (Murray et al. 2022). These processes also differ among neighborhoods on the basis of racial discrimination, income disparities, and gentrification, contributing to health inequity (Schell et al. 2020).

Because of these challenges, cities must be at the forefront of One Health solutions. Most of humanity lives in cities and this proportion is expected to grow, particularly in the Global South (Jiang and O'Neill 2016). Therefore, One Health policies in cities will heavily affect the global population. Urban green spaces (i.e., vegetated areas such as parks and preserves) are increasingly recognized for supporting biodiversity conservation (Lepczyk et al. 2017) and human health (Felappi et al. 2020). Urban green spaces support urban-adapted wildlife, as well as species of conservation concern (Soanes and Lentini 2019), and promote mental restoration in people (Grahn and Stigsdotter 2010). Promoting local healthy urban ecosystems will therefore have global benefits to both people and biodiversity.

Multicity networks and the Urban Wildlife Information Network

To provide these global health benefits, it is crucial to understand whether One Health solutions can be generalized across locations, which requires large-scale systematic data collection efforts. The recent rise in multicity studies, research networks, and community science projects such as UrbBioNet, NEON (the National Ecological Observatory Network), Snapshot USA, iNaturalist, the City Nature Challenge, eBird, and eMammal have provided critical data at the scale needed to address such questions. For example, data from MammalNet were used to identify African swine fever outbreaks in wild boar populations across Europe (Smith et al. 2023), and ticks logged by community scientists via iNaturalist were used to document tick range expansions (Cull 2022).

These examples benefit from large-scale data but can be biased as a result of their collection methods and sampling design. For example, community scientist data often overrepresent wealthier, whiter areas (Ellis-Soto et al. 2023). Some networks document species over large areas by collecting data from diverse sites (Cove et al. 2021). However, these data sets lack repeated and intentional sampling over time, which is critical to understanding ecological variation within and among sites (Strayer et al. 1986). Differences in study design between locations can lead to insufficient comparable data and make data integration statistically challenging or impossible, thereby limiting the robustness of interlocation inferences using theoretical generalizations. To advance urban One Health, multicity studies require systematically collected long-term data that minimize such biases.

The Urban Wildlife Information Network (UWIN) overcomes these challenges by collecting and analyzing long-term data from partners in cities around North America and increasingly across the world (figure 1). UWIN partners follow a systematic study design, ensuring data generated are suitable for continental, macrosystem-scale comparisons across cities that vary in size, biome, and social contexts. This approach means that any among-city differences are more likely to be ecological than methodological. This standardization leads to statistically rigorous data analysis and hypothesis testing with high relevance to ecological theory, as well as on-the-ground application (Magle et al. 2019). UWIN partners are based at a variety of organizations, including academic institutions, nonprofits, and municipal governments. Partners passively monitor a variety of taxa at urban green spaces (e.g., parks, cemeteries, golf courses, preserves) along the urban gradient using motion-triggered camera traps and automated acoustic recorders across seasons. Sites are selected to represent the urban gradient of that particular city on the basis of the distribution of landscape variables including impervious surface, housing density, and canopy cover (Magle et al. 2019). With data from 59 partnering cities in 10 countries and growing (figure 1), UWIN creates opportunities to generalize our understanding of

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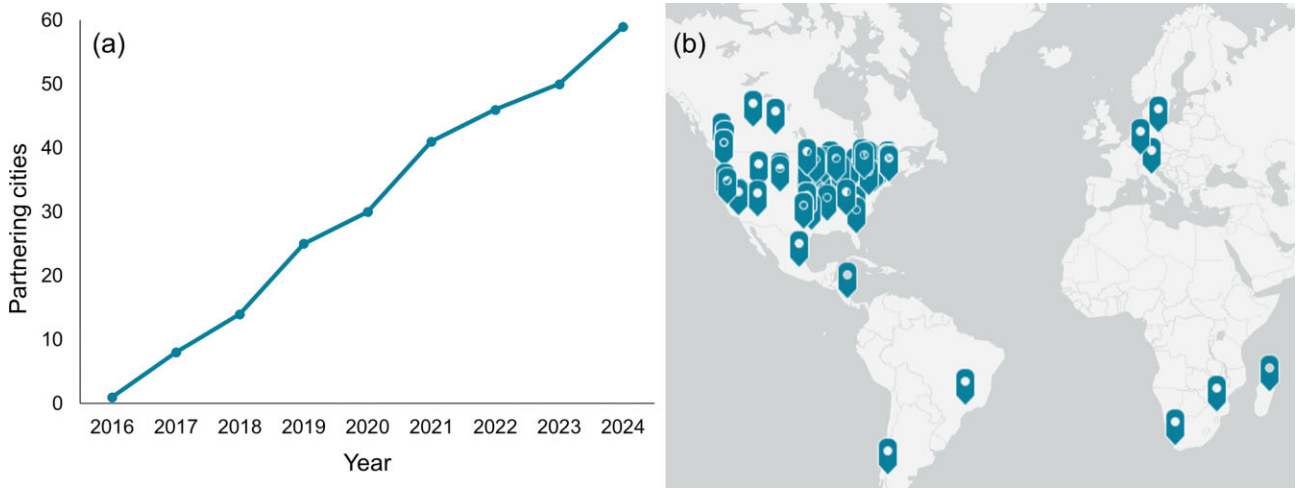

Figure 1. The Urban Wildlife Information Network is a consortium of partnering cities that collect data on urban wildlife using standardized methods to facilitate multicity studies on urban wildlife such as species occupancy, diversity, behavior, and health. The network grew to 59 partnering cities (a) in 10 countries worldwide (b) between 2016 and 2024.

how urbanization affects ecosystems and therefore One Health processes.

Expanding multicity research networks for One Health insights

We highlight a critical opportunity for multicity research networks to center One Health in their projects. Multicity research networks, and UWIN in particular, facilitate standardized surveillance of wildlife hosts, disease vectors, and environmental conditions. Systematic long-term biodiversity data that spans urban biophysical and social environments, although they are currently limited, are necessary to develop One Health solutions that are generalizable beyond single cities. Multicity UWIN studies have demonstrated shifts in mammal communities across income gradients and with gentrification (Magle et al. 2021, Fidino et al. 2024), highlighting key ways that urbanization and social inequality may interact to affect zoonotic host assemblages among urban neighborhoods. In addition to hosts, long-term multicity monitoring of vector assemblages is imperative to identify how global change may alter zoonotic pathogen dynamics. Tick-borne diseases are ideal systems to assess the role of biodiversity, urban structure, and social processes on spillover risk because tick-borne diseases are the most common vector-borne diseases in the United States (Beard et al. 2021). Debates about the role of biodiversity on tick-borne diseases (Rohr et al. 2020) can be tested by leveraging the standardized UWIN sampling across urban gradients representing diverse host assemblages. As such, several UWIN partners sustain coordinated sampling efforts for ticks at UWIN camera sites to understand how urbanization and mammalian host assemblages affect tick densities and pathogen prevalence (figure 2c). UWIN partners have also demonstrated the utility of camera trap data in monitoring visible signs of health conditions such as sarcoptic mange (figure 2d; Murray et al. 2021). Host and vector data can also be integrated with environmental health data such as noise and light pollution, heat, vegetation, and contaminants to understand the relationships among environments and health risks in different contexts. Combining long-term systematic surveillance of hosts, vectors, environmental conditions, and social vulnerability will facilitate One Health studies at unprecedented scales.

Beyond scientific research, long-term biodiversity monitoring sites in cities offer exceptional opportunities for public engagement with One Health issues. Formal (i.e., via community outreach) and informal interactions (i.e., casual conversation) among researchers and community members can help broaden public understanding of and engagement with One Health issues. Community scientists can also annotate camera trap images using public-friendly interfaces such as Zooniverse (Rivera et al. 2024). Monitoring data such as images and recordings are highly engaging and interpretable by the public, helping to foster curiosity about the natural world.

Working together for healthier cities

A core aspect of One Health work is interdisciplinary collaborations across health sectors. UWIN data can help inform interdisciplinary collaborations among ecologists, public health offices, physicians, veterinarians, toxicologists, and environmental scientists by providing spatiotemporal data on wildlife hosts, vectors, and environmental conditions across their city. Beyond data sharing, UWIN partners and advisors represent ecologists as well as social scientists, municipal employees, and urban planners, which provides interdisciplinary as well as theoretical-to-applied perspectives to identify hotspots for health risks. For example, ticks and tick-borne pathogens are emerging in highly urbanized New York City (Gregory et al. 2022, Bajwa et al. 2024). The New York City UWIN team has conducted tick surveillance along their UWIN transect and leveraged key tick host data from the paired camera trap design to identify areas within New York City that may be newly at elevated risk. New York City UWIN has shared the locations of *Ixodes scapularis* tick detections, host data, and tick dragging protocol with municipal parks and health departments, contributing to increased signage about ticks in parks where *I. scapularis* ticks were detected and to targeted municipal health department vector surveillance in parks that were not previously known to contain tick-borne hazards. Furthermore, Chicago UWIN works with public health agencies at the city and state level by sharing tick dragging protocols, site locations to coordinate surveillance efforts, and the locations of pathogen-positive ticks. Operationalizing partnerships between UWIN partners and local health agencies helps to ensure re-

Figure 2. Urban Wildlife Information Network partners collect several types of data relevant to One Health including mammal hosts using camera traps (a), avian hosts using passive acoustic recorders (b), vectors such as ticks using drag cloths (c), and visible signs of wildlife disease such as hair loss associated with sarcoptic mange (d). Panel (b) shows an audiomoth passive acoustic recorder (square with curved stripes) with 3D printed case for attaching to a post or tree and a 6-inch ruler for scale. Photograph: Urban Wildlife Institute, Lincoln Park Zoo.

search results are relevant to policy such as public education and landscape management (Magle 2023). Having a network of multicity partners facilitates the exchange of experiences regarding successful approaches to interdisciplinary work, broadening the impacts for healthy communities from local to regional or global.

To achieve One Health goals, the ecology with cities (i.e., working with diverse groups that can operationalize health efforts) and ecology for cities (i.e., research that empowers communities) approaches can help center monitoring efforts on principles of environmental justice. This means partnering with community leaders and ensuring that sampling sites represent the socioeconomic and racial makeup of the city because marginalized neighborhoods typically have less biodiversity, are significantly noisier, have poorer air quality, have less green space, and experience higher temperatures (Schell et al. 2020), leading to biased results when sampling is not socially representative. Highlighting these disparities helps to identify solutions for communities that need the most help with respect to One Health and environmental justice (Murray et al. 2022).

Many ecological fields now acknowledge the importance of context dependence when interpreting scientific findings from one particular study area (Catford et al. 2022). As such, it is important to balance global trends with local ecological realities, which is facilitated through multicity networks such as UWIN. These collaborations can help us move beyond "it depends" to "it depends on city size, climate, land use, etc.," which enables researchers to operationalize their results beyond the idiosyncrasies of their city. Multicity networks therefore enable us to act locally while thinking globally to support healthier people, animals, and cities in an urbanizing world.

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