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Cities are hungry for actionable ecological knowledge

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Cities are hungry for actionable ecological knowledge

Urban areas are already home to the majority of the world's population, and an additional 2.5 billion people are expected to become urbanites by 2050. According to the UN, urban areas account for 75% of the freshwater and 76% of wood products used by people. They also generate 75% of humanity's carbon emissions. Meanwhile, they not only are centers of innovation for the arts, technology, and culture, but also contribute more than 75% of the global GDP. However, cities have not been a focal area of work for most ecologists. For example, of the 1195 articles published in ESA's journals in 2018, only 28 articles (2.3%) contained the word "urban" in their abstracts.

Cities, or more specifically urban ecosystems, have been increasingly recognized as one of the last frontiers of the science of ecology. As such, cities are considered to be novel systems and living laboratories in which to test and generate new ecological theories. The fact is, cities need ecological science, and they need it now more than ever for two main reasons. First, cities face serious environmental pollution and ecosystem degradation, which directly affect the quality of life and well-being of the world's growing urban population. Overcoming these environmental problems will take ecological knowledge and ecosystem-based approaches. Second, cities' social and ecological impacts reach far beyond city limits. As such, achieving global sustainability necessitates urban sustainability and therefore the science of ecology as applied to the problems and processes of urban ecosystems.

We believe that there are many opportunities for the science of ecology to help build more ecologically sound and environmentally friendly cities. It is widely recognized that ecological science is needed when building a new city, or when cities are expanding outwards or upwards. For instance, in many Chinese cities, ecological planning has now been explicitly included in urban master planning, and has become an important component, along with preparing for population growth, economic development, and new infrastructure. Chinese cities also have designated "ecological redline" areas, which are based on ecosystem service assessments and are meant to be protected from development.

There are other important but less widely discussed opportunities that arise from the fact that cities are constantly changing internally. Old buildings are replaced; industrial facilities come and go; existing open space is filled while new openings appear elsewhere; and infrastructure is added, upgraded, or abandoned. These internal dynamics offer chances to apply ecological knowledge, which can provide a comprehensive way of thinking as well as the tools for and solutions to social and ecological problems. What's more, these dynamics create opportunities for new urban green spaces to facilitate human connections with nature, to support pollinators, or to increase the capacity of nature-based stormwater management. New York City's Highline Park and Berlin's Natur-Park Südgelände are good illustrations of this.

We argue that incorporating ecological processes at the expanding margins of existing cities and also within their central areas is tantamount to recognizing that each city is a hybrid socioecological system. For example, urban designers and ecologists are working together to increasingly use green and blue infrastructure, as well as gray infrastructure to build "spongier" cities capable of meeting the challenges of inner-city flooding. Copenhagen provides a successful example of making a city more absorbent by implementing green infrastructure in response to a deluge in 2011. Now, several cities in both China and the US have introduced similar ecosystem-based designs.

We believe that ecological knowledge about urban ecosystems is crucially important in understanding the present and future of cities and, therefore, in improving the living conditions for the majority of humankind. And the body of such knowledge is growing. But cities need larger supplies of actionable ecological knowledge, which can be used to directly support urban planning, design, and decision making. Such actionable knowledge must be coproduced by ecologists, policy makers, and practitioners (including urban planners and designers), with public involvement. The social and biophysical complexity and hybridity of urban ecosystems requires urban ecology to use a strong interdisciplinary lens. Discrete research disciplines are inadequate to fully address the complex multi-dimensional nature of urban ecosystems and their ongoing dynamics. Fortunately, urban ecology has been growing to integrate social, biophysical, and engineering sciences, and to link directly with practices such as urban planning and urban design. Making this type of urban ecology the default science of cities remains a grand challenge. But we believe it will generate actionable knowledge for new urban land conversion and improve environmental outcomes as existing cities evolve.
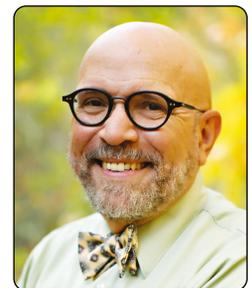
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