PNAS COMMENTARY

Sprawling cities are rapidly encroaching on Earth's biodiversity

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Fig. 1. Locally endemic wildlife imperiled by urban sprawl around Manaus, Brazil, the largest Amazon city with 2.2 million residents. (*A*) Manaus harlequin frog (*Atelopus manauensis*). (*B*) Pied tamarin (*Saguinus bicolor*), a small rainforest primate. (*C*) Landsat satellite image of Manaus and Ducke Forest Reserve (the square forest tract), a 10,000-ha nature reserve being engulfed by urban development. Image credits: frog: Alexander Mônico/National Institute for Amazonian Research; tamarin: © TT News Agency/Alamy Stock Photo; satellite image: NASA Earth Observing System Data and Information System: image Manaus-081101 (2).

One of the most important demographic events of the past half-century is the dramatic growth of urban areas worldwide. Growing cities, like insatiable amoebas, tend to engulf and devour their surrounding lands, often at the expense of biodiversity (Fig. 1). In PNAS, Simkin et al. (1) project the regional and global impacts of urban expansion on more than 30,000 species of native mammals, birds, reptiles, and amphibians from 2015 to 2050. Their findings reveal that burgeoning cities are a far more serious driver of biodiversity decline than many realize, with environmental impacts comparable with those of planet-altering activities, such as agriculture and forestry.

Two broad trends underlay the global proliferation of cities. The first is intrinsic population growth. Earth's populace has risen fivefold since the beginning of the nineteenth century and is now nearly 8 billion people (3). According to the median projection of the United Nations Population Division (3), the global population will continue to grow apace this century, reaching 9.7 billion by 2050 and 11.2 billion by 2100, before roughly stabilizing thereafter. These increases largely result from rising human numbers in developing nations, which are primarily located in tropical and subtropical regions that are the epicenters of global biodiversity.

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The second global trend is a growing proportion of city dwellers, as rural or remote-area residents increasingly move to urban locales in search of work, education, health care, or other needs. As a result, rural populations are shrinking or plateauing across much of the world, whereas urban populations are still growing apace. Currently, more than half (56%) of the global population resides in urban areas, and this figure will surely continue rising, with at least two-thirds of all people expected to be city dwellers by 2050 (3).

By projecting land-cover changes driven by population and urbanization trends across the globe's land surface, Simkin et al. (1) identify the wildlife species that will bear the brunt of the these changes as well as hot spots of urban expansion. Urban footprint growth is modeled under three development scenarios (corresponding to "sustainable," "high-growth," and "fossil-fueled" scenarios that describe an array of possible futures).

A key finding of the present study is just how rapidly urban areas are growing in extent. Urban areas expanded by 1.9 million ha/y from 1990 to 2000, a rate projected to rise to 2.3 to 4.4 million ha/y between 2015 and 2050 (depending on which of the three development scenarios is used in the analysis). Despite the serious and growing scale of urban impacts, global agreements, such as the Convention on Biological Diversity, are still lagging behind the realities of urban expansion as a major driver of environmental change (4, 5).

Simkin et al. (1) predict that, by the year 2050, habitat loss from urban expansion will impact around a third (26 to 39%) of the 30,393 land-dwelling vertebrate species they studied. Among these threatened species, up to 855 will be seriously impacted, with each losing at least a 10th of its remaining habitat. Growing urban clusters that most imperil biodiversity are largely located in sub-Saharan Africa, South America, Mesoamerica, and Southeast Asia. Crucially, these are all tropical regions that harbor much of Earth's biodiversity as well as large tracts of intact habitat essential for the survival of myriad disturbance-sensitive species (6). Urban expansion in these species-rich regions will be a particularly serious threat to nature (7).

Some nations are planning to construct entirely new urban centers in far-flung locales, with the potential for considerable environmental harm. Indonesia, for example, is planning to build a new capital city, Nusantara, in eastern Borneo starting in 2024 (8). This echoes the construction of Brazil's new capital city, Brasília, completed in 1960 in the country's then-remote interior (9), and Abuja, Nigeria's new capital completed in the 1980s (10). Growing demand for natural resources and expansion of new extraction frontiers across the developing world will help to spur migration into rural and remote areas (11, 12), thereby spawning new urban centers in regions with high biodiversity. In addition, massive "development corridors" straddling low- and middle-income nations in Asia, Africa, and the Americas will clearly promote human migration and urbanization (11–13), leading to further disruption of biodiversity-rich lands.

Although Simkin et al. (1) conclude that urban expansion will cause significant habitat loss for only 2 to 3% of all studied species, other anthropogenic impacts associated with human presence—such as habitat fragmentation, illegal mining, air and water pollution, and wildlife poaching—might be just as threatening to species survival. Urban areas and their haloes of supporting infrastructure are potentially impenetrable barriers to dispersal for many species (14, 15). Finally, burgeoning cities tend to consume favorable landscapes, such as flatter or more productive areas, pushing vulnerable species into marginal habitats where they may struggle to survive (16).

According to Simkin et al. (1), urban areas will double or triple in global extent between 2015 and 2050, a striking increase by any measure. The creation of urban landscapes, including buildings, roadworks, and extensive supporting infrastructure, will require vast quantities of raw materials. Extraction of such resources, including limestone, sand, and metals, is already putting serious strains on threatened ecosystems, such as karsts and certain rivers and coastal zones (17, 18). Groundwater supplies based on overharvested natural aquifers can also be seriously depleted by growing urban populations (19).

Using global-scale datasets, Simkin et al. (1) show that urban land expansion will be a potent and continuing driver of habitat and biodiversity decline in the coming decades. They emphasize that urban land expansion has received relatively little attention as a driver of biodiversity decline when compared with other global-scale drivers, such as agriculture and forestry. Cities are proliferating and growing so dramatically that we would be reckless not to heed their warnings.

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