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How future urban sprawl maps out

Projections of urban growth indicate areas where biodiversity is at high risk.

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Forecasts of different regions' likelihood of urban expansion could be used to direct conservation efforts.

FROM REF1

Urbanization shapes the environment, but the way in which it does so depends on where and how cities grow. In an effort to forecast how urbanization over the next couple of decades might affect biodiversity and the carbon cycle around the world, researchers have made detailed predictions about how urban areas are likely to grow.

Urban growth is proceeding apace, with the biggest changes occurring in developing countries. The United Nations (UN) predicts that cities will absorb all of the world's population growth — of around 2.3 billion people — in the next four decades. Yet population projections do not account for variations in how individual cities occupy their land, nor the impact they have on local ecosystems. So geographer Karen Seto of Yale University in New Haven, Connecticut, and her colleagues looked more closely at how individual cities grow¹. "We're not forecasting population, we're



forecasting the expansion of urban space," Seto says.

Seto and her team used NASA satellite images from the year 2000 and population-density estimates from the space agency's Global Rural-Urban Mapping Project to establish a baseline distribution of city-dwellers. They then used UN country-level urbanization projections, as well as economic-growth projections from the Intergovernmental Panel on Climate Change, to predict which regions are likely to grow and by how much. Finally, they assigned to their forecasts population-projection uncertainties derived from the US National Research Council.

Combining these data in a global model yielded a map that assigned a probability of urbanization to 25-square-kilometre blocks all over the world. The team found that wide-ranging urbanization was likely to occur in places such as eastern China and tropical Africa. Mexico, meanwhile, can expect most of its population growth to occur on already-developed land.

The map could be used to guide conservation policies, Seto suggests, by helping policy-makers to prioritize regions to protect from urbanization or to shape the kinds of urbanization allowed. As an initial example, the team overlaid a global map of biodiversity hotspots and another of tropical biomass. This made it easy to identify places where extensive urban expansion is likely to threaten biodiversity. Although some of the cities the authors earmarked for rapid growth — those in eastern China, for example — are far from biodiversity hotspots, projected urbanization in the tropical Guinean forests of West Africa is likely to consume 6.8% of that hotspot.

Preservation priorities

Although predicting the environmental impact of a city's growth is nothing new, this may be the first global-scale attempt, says geographer Peter Marcotullio of the City University of New York.

By examining the global impact of urbanization, Marcotullio says, regional managers can do a better job of conserving biodiversity than individual city managers might manage alone. "We in New York might want to preserve some type of wetlands and in Newark they might want to complement that by preserving more upland ecosystems," he suggests.

The study does a good job of "raising awareness that urban expansion also affects biodiversity and highly valuable natural systems", says Gerhard Heilig, chief of the United Nations' Population Estimates and Projections Section.

But, he adds, urbanization strategies should take account of differences between cities. "The environmental footprint of a particular urban area depends on the spatial arrangement of housing, infrastructure and green space." Such details are difficult

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to capture in the satellite images Seto and colleagues used. This first-generation urban-footprint forecast also leaves out related consequences of urbanization, Heilig says, such as the fact that carbon-capturing forests are now growing in previously agricultural regions that were abandoned when their residents moved into cities.

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Given the team's prediction that the world's urban area will double by 2030, Seto says well-informed decisions made now stand to have a large impact. Seto adds that she hopes conservation groups will begin to consider "urbanization hotspots" and will help to shape the next generation of urban infrastructure to account for biodiversity. "Once roads are in place, sewers are in place, it's really difficult to re-do how a city looks," she says.

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References

1. Seto, K. C., Güneralp, B. & Hutyra, L. R. *Proc. Natl Acad. Sci. USA* <http://dx.doi.org/10.1073/pnas.1211658109> (2012).

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