

Changes in Our Global Footprint



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Our impacts on the Earth are slowing down relative to population and economic growth.

The environmental footprint of humanity is truly massive. Indeed, over our planet's 4.5 billion-year history – at least two-thirds of which has sustained life – no other species has ever come close to us in terms of consuming so much of the world's energy, resources and land area.

That's a scary thought, especially as we contemplate the environmental consequences of having up to 12 billion people on Earth by the end of this century. Thankfully there is some good news as the pace of expansion of the human footprint appears to be slowing down, at least relative to our burgeoning population and global economic growth. But this comes at a cost, as the places that humans are expanding into are last large expanses of wilderness areas left on the planet.

These are key conclusions of two related studies recently published in *Nature Communications* and *Current Biology* that were undertaken by a diverse research team of Australian, North American and European scientists. In this research, we attempted to estimate how much the global human footprint had expanded during the past two decades and what the implications are for the environment. Our results are clearly alarming, but with glimpses of a silver lining behind the darkening clouds.

Our Growing Global Footprint

For starters we estimated that, by the mid-1990s, humans had significantly altered 77% of the planet's ice-free land area. This was based on composite maps of human activities, such as roads and other infrastructure, cities, crops and pastures, electrical night-lights, and other measures of human presence.

By two decades later we found that the human footprint had grown to 86% of the planet's land area. Perhaps unsurprisingly, the areas that had been newly exploited over this period were those most suitable for agriculture or livestock grazing. The last places that still remain largely free of human impacts are chilly boreal regions, such as northern areas of Eurasia and North America, and sprawling deserts, including the vast Sahara and expanses of inland Australia.

If you're a fan of biological diversity, the news is especially grim. The biggest losses of wilderness over the past two decades were in the species-rich Amazon and Congo Basins, which lost nearly one-third and one-sixth of their total area, respectively.

Perhaps even more alarming is the fate of the planet's biodiversity hotspots – 35 places on the Earth that sustain exceptionally high concentrations of species. Biodiversity hotspots are defined by two features: they have lots of locally endemic species that occur nowhere else on Earth, and at least 70% of their original habitat has been destroyed by humans. Well-known examples of hotspots include Madagascar, the Brazilian Atlantic forests, and the degraded rainforests of West Africa and eastern Australia.

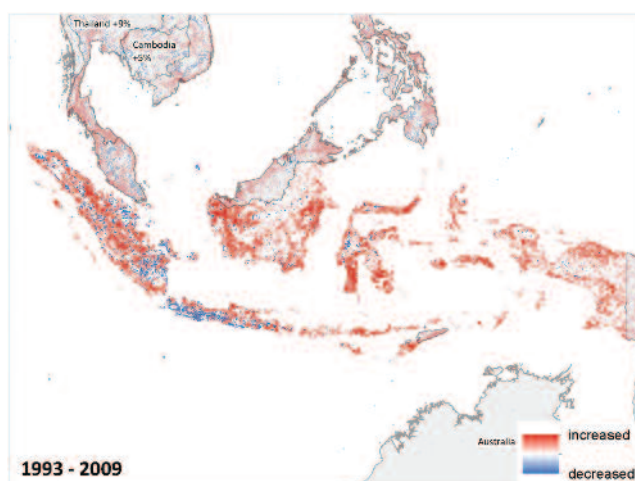
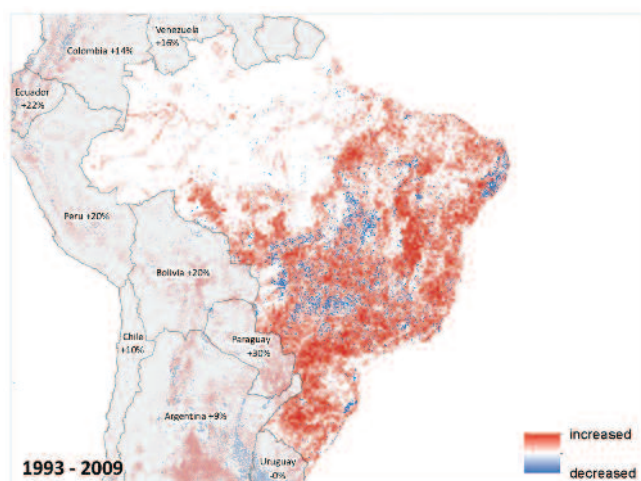
When we examined the current human footprint across all of the biodiversity hotspots, we found that 97% of their total area had been heavily impacted by people. That is definitely not good news, and it suggests that we better get serious about saving the last vestiges of these biological wonderlands if we hope to stave off massive species extinctions.

A Silver Lining

So that's the bad news, but there's a more optimistic way to look at our findings. From 1993 to 2009 the global human footprint grew by just 9%. That's a lot less than the increase of the human population, which rose by 23%, and the expansion of the global economy, which exploded by more than 150% over the same period.

Hence, while the human footprint is still expanding and often becoming more locally intense, at least it's not growing at the same breakneck pace as the human population and especially the global economy. If it was, there would barely be a square centimetre of pristine wilderness left on the planet. Yet wilderness is still declining, and during our study more than 3 million km² was lost. That's half the size of the Australian continent.

An important caveat of our study is that we looked only at human land uses, ignoring the effects of human-induced climate



Source: Nature Communications (dx.doi.org/10.1038/ncomms12558)

Changes in the human footprint in Latin America (left) and South-East Asia (right) from 1993–2009.

change, invasive species and non-natural fire regimes. Many leading scientists would argue that if things like climate and atmospheric change are included, the entire planet will already have been altered to some degree and that our maps underestimate humanity's impact.

For instance, across the entire Earth, carbon dioxide levels have risen from about 280 to 400 parts per million since the dawn of the industrial age. There is still much we don't know about the future of climate change, but it appears virtually certain that the rapidly rising concentrations of greenhouse gases are elevating global temperatures and changing the physiology and dynamics of plant and animal communities. It may well be having more far-reaching consequences than that.

Increase Our Efficiency – Or Else

The broad conclusion from our analyses is that it appears people are becoming more efficient in their exploitation of the planet, at least in terms of our overall land-use footprint. That surely is good news.

Truth be said, however, we haven't had that much of a choice. The Earth, and especially areas suitable for farming and livestock, are finite. We literally don't have that many new frontiers to conquer. This underscores the vital importance of using the lands we're already exploiting more efficiently and leaving the last remnants of untouched nature intact.

For example, across large expanses of the planet, farming is still relatively inefficient, producing just a fraction of the food per hectare that is possible with more modern farming methods, fertilisers and high-yielding plant varieties. Sub-Saharan Africa is a poster-child for underperforming agriculture, but there are many other regions – especially in parts of Asia, Latin America and eastern Europe – where farming could be greatly improved.

We direly need to improve our farming given that global food demand is expected to double by mid-century. This is in

response to rapid population growth and changing food preferences – notably rising demands for meat and dairy products – particularly in developing nations.

One of the biggest changes we'll see on Earth in the coming decades is a rapidly growing number of mega-cities exceeding 10 million people in Asia, Africa and Latin America. Those cities will have lots of hungry people who need to be fed.

To face such challenges we really have just two choices. Either we gobble up the last remaining wild parts of the planet, and face the dire environmental and biological consequences that will result. Or we learn to use the land we're already exploiting more capably.

Our findings suggest we're beginning to use our dwindling planet more efficiently, but we still have a long way to go.

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Slash-and-burn farmers in Gabon, central Africa. Farming must become more efficient if we're to feed a rapidly growing world without destroying the last vestiges of Earth's wilderness.

Credit: William Laurance