Tropical forests and child health

See Articles page e180

The world lost about 2·3 million km² of forest during the first 12 years of the 21st century, with loss of tropical forest outpacing that of other forest types.[1] Agricultural expansion and wood extraction are among the leading causes of tropical deforestation, and some human populations clearly benefit from increased food, fuel, wood, and fibre production.[2] But what is the cost? In recognition of the profound, long-term effect of deforestation on emissions of greenhouse gases and the global climate, in 2008 the UN established the Programme on Reducing Emissions from Deforestation and Forest Degradation. The effects of deforestation on climate, however, seem quite distant, reducing the urgency to take action. But what if forest destruction directly and immediately affected child health? What if setting aside forests in protected areas near human communities prevented childhood illnesses? Would that change local, regional, or large-scale forest-management policies for human wellbeing?

In an important new study published in this issue of *The Lancet Planetary Health*, Thomas Pienkowski and colleagues address the effects of protected areas and forest destruction on human health in 35 547 households in Cambodia over 10 years.[3] The authors recognise that substantial attention has been paid to the human health consequences of ecosystem changes.[2,4] However, they point out that, by and large, previous scientific studies were focused on individual health consequences (eg, a specific infectious disease). Although this specificity is in some ways a virtue, it also limits the ability to draw broad conclusions about the net effects of habitat-destroying development projects on the overall health of local communities. Pienkowski and colleagues cast a much broader net: they analyse changes in diarrhoea, acute respiratory infections, and fever in children, which are associated with the amount of local land set aside in protected areas, and with the destruction of local forests. Diarrhoeal diseases and acute respiratory infections decreased with increasing size of local protected areas, and all three childhood disease categories increased with the extent of local loss of dense forest.

Pienkowski and colleagues reported that protected area coverage and deforestation had largely independent effects on the incidence of these childhood diseases. Thus, some of the protective effects of protected area coverage are not simply due to inhibition of deforestation, although these effects remain unexplained. The authors suggest that protected areas might stabilise land access, promote the provision of ecosystem services, increase local access to natural resources, or restrict exposure to zoonotic diseases by reducing human–wildlife contact. Postulated mechanisms underlying the association between forest destruction and childhood diseases include compromised ability of degraded forests to regulate microbial contamination of surface and ground waters, leading to increases in diarrhoeal diseases, and smoke from biomass burning (which accompanies deforestation) exacerbating respiratory illnesses. As the authors recognise, a key limitation of their study is the absence of data directly related to the mechanisms underlying the statistical associations they identified.

More broadly, Pienkowski and colleagues use observational and correlational approaches to draw inferences about cause–effect relations between anthropogenic environmental changes and human health outcomes. With such approaches, which are commonplace in epidemiology and ecology, researchers need to provide safeguards to identify correlations between variables that could be spurious rather than causal. Two safeguards in this study particularly reduce the likelihood that the associations calculated are spurious. First, the authors incorporated what they considered to be an internal, negative control. Because they had no directional expectation about effects of deforestation or protected area coverage on the totality of non-specific illnesses and injury in the adult population, they included this response variable in the analyses. A finding that chronic illness and injury were correlated with deforestation or protected area coverage, without plausible causal linkages, would suggest spurious relations and cast doubt on the entire analysis. However, no such association was detected.

The other safeguard was not emphasised by the authors, but could be quite important. The data for this study were collected between 2005 and 2014, a period during which deforestation in Cambodia increased substantially.[5] During this period, Pienkowski and colleagues point out that "national health outcomes improved with time". At a national scale, therefore, one would expect a positive correlation between deforestation and overall human health, which would lead to the conclusion that deforestation improves—and protected area coverage compromises—human health. But the local-scale analyses paint an utterly different picture, which is made far more compelling by matching the scale of analysis to the scale of likely causal relations between environmental and human health variables. In a sense, then, the national correlations between environment and health act as a control for the local analyses.

Protected areas are typically established to achieve conservation goals and are therefore ecocentric. Resistance to the establishment of protected areas can increase if the ecocentric goals are thought to conflict with anthropocentric goals. Pienkowski and colleagues' research is exciting because it shows that the benefits of protected areas might not be only ecocentric. If local human communities accrue important health gains from protection of natural habitats, perhaps the calculus of costs and benefits could change to accommodate mutual benefits for people and the environment.

Richard S Ostfeld
Cary Institute of Ecosystem Studies, Millbrook, NY 12545, USA
ostfeldr@caryinstitute.org

I declare no competing interests.

1 Hansen MC, Potapov PV, Moore R, et al. High-resolution global maps of 21st-century forest cover change. *Science* 2013; **342:** 850–33.
2 Myers SS, Gaffikin L, Golden CD, et al. Human health impacts of ecosystem alteration. *Proc Natl Acad Sci USA* 2013; **110:** 18753–60.
3 Pienkowski T, Dickens BL, Sun H, Carrasco LR. Empirical evidence of the public health benefits of tropical forest conservation in Cambodia: a generalised linear mixed-effects model analysis. *Lancet Planet Health* 2017; **1:** e180–87.
4 Whitmee S, Haines A, Beyrer C, et al. Safeguarding human health in the Anthropocene epoch: report of The Rockefeller Foundation—*Lancet* Commission on planetary Health. *Lancet* 2015; **385:** 1973–2028.
5 Forest Trends. Conversion timber, forest monitoring, and land-use governance in Cambodia. http://forest-trends.org/releases/uploads/Cambodia%20Concessions%20Report%20small%20size.pdf (accessed July 20, 2017).