Potholes in the global-road map ? Response to Laurance et al

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Potholes in the global-road map – Response to Laurance et al.

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Laurance et al.^1^ have developed a composite global map to identify areas where new roads will lead to the greatest environmental damage, and areas that would benefit from road expansion. Prioritization for environmental impact avoidance is important, but must be robust enough for context specific application. Multiple problems in the current analysis however, invalidate this strategy for road planning. These include a mismatch of scale between global patterns of biodiversity and the requirements for informed planning, poor quality of global datasets, lack of complementarity analyses, and side-lining of regional conservation priorities. Furthermore, by overemphasizing the importance of agriculture relative to other commercial activities, the authors ignore regional economic drivers of road building^2^. All these shortcomings hamper any potential down-scaling to a national or regional level – the scale at which roads are planned – and could have serious ramifications for biodiversity conservation and development planning if inappropriately applied.

Laurance et al. readily acknowledge that road planning occurs at smaller scales and that the drivers and environmental impacts will vary across contexts. However, in their analysis, environmental layers include coarse-scale global datasets that are notoriously incomplete and inaccurate [e.g. World Database on Protected Areas (PAs)^3^], or are broad estimations of species distributions across large areas (e.g. IUCN range maps, plant species estimations). Their downscaling to a finer resolution is not supported by the underlying data^4^, and will almost certainly result in serious commission and omission errors. Without sensitivity analyses to determine model robustness to changes in the underlying inputs^4^, we have no estimate of how downscaling exacerbates these biases. Laurance et al. also weight all biodiversity layers equally, but roads have different effects on various components of biodiversity: exacerbating poaching threats for some species, fragmenting ranges for others, and so on^5,6^. Furthermore, by failing to incorporate complementarity analyses, the authors invariably overemphasize species-rich areas regardless of local and regional conservation priorities, a well-known issue in conservation planning^7^.

Laurance et al. are correct in prioritizing PAs as relatively road free, but in areas of fragmented land-use, PAs are often too small to hold viable populations of globally endangered species, such as tigers and elephants^8,9^. The authors also preclude alternate conservation and production approaches, such as a biodiversity-friendly multiple-use landscape matrix^10^. These areas provide habitat as well as corridors for connectivity for protected and natural areas, especially considering species range shifts to changing climate^11^.

Laurance et al. also seemingly ignore the circularity in their principal economic argument of road-mediated agricultural intensification: i.e. areas that have lost most of their natural vegetation to intensive agriculture are also those that already have the highest density of roads, highest rates of application of fertilizer and irrigation, and are already producing amongst the highest output of agricultural products in the world^12^. By weighting these areas, they invariably bias the resulting map towards further road intensification. Indeed, for several of the road “hotspot” countries (e.g. India), projected agricultural increases are close to zero (See Suppl. Fig. 15 in Laurance et al.) and thus further road intensification is moot. Some of the greatest emerging threats to biodiversity in many countries are from the growth of industry, mines and infrastructure, and incorporating these would have resulted in a more realistic prioritization for road expansion.

Although Laurence et al. claim to provide “an important first-step towards strategic road planning”^1^, visual down-scaling reveals inconsistencies between their prioritizations and on-ground realities. For example, they over-predict the biodiversity value of large tracts of oil palm plantations in Malaysia and Indonesia, thus classifying them as areas of conflict with high road benefits ("Fig. 1":http://www.atree.org/sites/default/files/articles/VanaketalResponseToLauranceetalFigure1.pdf). Strangely, Singapore, amongst the most densely populated countries in the world, is prescribed as biodiverse where road expansion should be avoided ("Fig. 1":http://www.atree.org/sites/default/files/articles/VanaketalResponseToLauranceetalFigure1.pdf). On the other hand, large parts of India are shown as hotspots for road development, deprioritizing habitats such as semi-arid savannas^13^, and ignoring areas of customary conservation practice^14^ that can potentially result in isolating many PAs and severing connectivity ^15^.

Ideally, such an analysis of road planning should be an aggregation of local and regional studies that combine the best available data on road-networks, local biodiversity values, and detailed land-cover/land-use maps that capture the potential of the landscape to support both biodiversity as well as movement of wide-ranging species. In the hands of politicians and policy makers who have little regard for biodiversity, Laurence et al.'s global-scale analysis can result in harmful policy recommendations and could irreversibly compromise sustainable biodiversity conservation that incorporates local-scale development planning.

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References

1 Laurance, W. F. et al. A global strategy for road building. Nature 513, 229-232 (2014).
2 Caro, T., Dobson, A., Marshall, A. J. & Peres, C. A. Compromise solutions between conservation and road building in the tropics. Curr. Biol. 24, R722-R725 (2014).
3 Visconti, P. et al. Effects of errors and gaps in spatial data sets on assessment of conservation progress. Conserv. Biol. 27, 1000-1010 (2013).
4 Hurlbert, A. H. & Jetz, W. Species richness, hotspots, and the scale dependence of range maps in ecology and conservation. Proc. Nat. Acad. Sci. 104, 13384-13389 (2007).
5 Forman, R. T. & Alexander, L. E. Roads and their major ecological effects. Annu. Rev. Ecol. Syst., 207-C202 (1998).
6 Trombulak, S. C. & Frissell, C. A. Review of ecological effects of roads on terrestrial and aquatic communities. Conserv. Biol. 14, 18-30 (2000).
7 Margules, C. R. & Pressey, R. L. Systematic conservation planning. Nature 405, 243-253 (2000).
8 Watson, J. E. M., Dudley, N., Segan, D. B. & Hockings, M. The performance and potential of protected areas. Nature (In press).
9 Leimgruber, P. et al. Fragmentation of Asia's remaining wildlands: implications for Asian elephant conservation. Anim. Conserv. 6, 347-359 (2003).
10 UNCTAD. Trade and Environment Review 2013: Wake Up Before It’s Too Late. (United Nations, 2013).
11 Watson, J. E., Iwamura, T. & Butt, N. Mapping vulnerability and conservation adaptation strategies under climate change. Nature Climate Change (2013).
12 Foley, J. A. et al. Solutions for a cultivated planet. Nature 478, 337-342 (2011).
13 Dutta, S. & Jhala, Y. Planning agriculture based on landuse responses of threatened semiarid grassland species in India. Biol. Conserv. 175, 129-139 (2014).
14 Kothari, A., Corrigan, C., Jonas, H., Neumann, A. & Shrumm, H., (eds) Recognising and Supporting Territories and Areas Conserved By Indigenous Peoples And Local Communities: Global Overview and National Case Studies. Vol. Technical Series no. 64 160 (Secretariat of the Convention on Biological Diversity, ICCA Consortium, Kalpavriksh, and Natural Justice, Montreal, Canada. , 2012).

15 Joshi, A., Vaidyanathan, S., Mondol, S., Edgaonkar, A. & Ramakrishnan, U. Connectivity of tiger (Panthera tigris) populations in the human-influenced forest mosaic of central India. PloS one 8, e77980 (2013).