

*Letter to the Editor*

## Links Between Land-Sharing, Biodiversity, and Zoonotic Diseases: A Knowledge Gap

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Land-use change is a major driver of biodiversity loss. Despite coverage and their widespread use as a conservation strategy, protected areas will not be able to overcome current trends affecting terrestrial and marine biota (Mora and Sale 2011). Therefore, to reduce pressures upon biodiversity, the 10th Conference of the Parties of the Convention on Biological Diversity (CBD) set a suite of “Aichi Biodiversity Targets.” Among these, Target 7 states that by 2020, agriculture, aquaculture, and forestry ought to be managed to ensure conservation of biodiversity. The goal is to increase wildlife-friendly practices in areas devoted to commodity production, providing both goods and services while contributing to the conservation of biological diversity, a strategy known as “land-sharing” or “wildlife-friendly farming.”

Simultaneously, there is a consensus among intergovernmental organizations regarding the need to address the linkages between biodiversity and human health. The majority of emerging infectious diseases (EIDs) that affect humans are zoonotic with most originating in wildlife, and land-use change is a major driver of EIDs incidence (Loh and others 2015). The CBD has recently highlighted the link between land-use change and infectious diseases in its State of Knowledge Review on biodiversity and human health, and there is now a CBD-WHO Joint Work Programme tasked to

take a closer look at the shared drivers of EIDs and land-use change. In this context, the potential consequences of land-sharing on zoonotic disease risk ought to be addressed as it impinges upon human health, livestock health, health of other wild populations, and the options of productive lands to contribute to biodiversity conservation.

An underlying mechanism of the effects of land-use change on disease dynamics involves changes in abundance and diversity of wild species which might be either hosts or vectors. An increase in species diversity (including host and nonhost species, vectors, predators) might reduce disease transmission risk, a phenomenon called “dilution effect,” where the net effects of biodiversity reduce pathogen prevalence through mechanisms including a decrease in host density, reduced encounters between hosts, or reduced host survival (Keesing and others 2006). The opposite pattern, when increases in species diversity enhance the risk of infection, the “amplification effect,” might occur, for example, through increased encounters between hosts (Keesing and others 2006). Within this framework, given that land-sharing is expected to contribute to conservation of native species in human-dominated areas, this will modify the richness and abundance of wild species, facilitating human–wildlife contacts, and consequently, influence pathogen transmission. For instance, a land-sharing strategy in forestry plantations is the occurrence of a developed understory or multiple vegetation strata within plantations, which increases richness and abundance of

mammals and fosters the occurrence of endangered mammals (Ramírez and Simonetti 2011). Rodents, carnivores, primates, and ungulates are among the most important mammal hosts of zoonotic diseases, and hence, their increase in abundance and richness in response to an increment of structural complexity within plantations may represent an epidemiological risk, which is so far ignored in the well-intended Aichi targets. Whether these outcomes will amplify, dilute, or have no effect on pathogen transmission still remains a question which is relevant for our understanding on zoonotic disease risk and might set a challenge to the willingness of land-owners to engage in wildlife-friendly practices, hampering the chances to protect biodiversity outside protected areas. To the best of our knowledge, no research regarding the effect of any land-sharing practice (such that the above mentioned) on risk of zoonotic transmission has been conducted in wild hosts. Any evidence for other diseases? Very little. A perusal of scientific literature reveals that while land-sharing is receiving increasing attention, only 2 of 151 publications on land-sharing deal with disease risks in animals (Data available from the Web of Knowledge database, using “land sharing” and “wildlife-friendly” as keywords, accessed on July 15, 2016). Clearly, whether conserving wild species in productive lands represents a health risk to humans (not to mention the health risk upon wild species) has yet to be tackled. Therefore, findings of further research should inform policy-makers, health professionals, and practitioners not only about risks of pathogen exposure, but also the design of preventive actions to reduce such risks. These

information place policy-makers in a better position to judge what trade-offs are necessary between the costs and benefits of protecting biodiversity and health in land-sharing settings.

We call on ecologists, conservation biologists, and researchers from public health sciences to investigate the consequences of land-sharing strategies on disease transmission risk. This will be fruitful for both biodiversity management and disease management.

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