COVID-Clarity Demands Unification of Health and Environmental Policy

Running Title: Policy Unification for a Sustainable Future

Thomas R. Gillespie[1,2*], Kate E. Jones[3,4], Andrew P. Dobson[5], Julie A. Clennon[1], and Mercedes Pascual[6]

[1]Department of Environmental Sciences, Emory University, Atlanta, USA

[2] Program in Population Biology, Ecology, and Evolutionary Biology, and Department of Environmental Health, Rollins School of Public Health, Emory University, Atlanta, USA

[3]Department of Genetics, Evolution and Environment, University College London, London, UK

[4]Institute of Zoology, Zoological Society of London, London, UK

[5]Department of Ecology and Evolution, Princeton University, Princeton, USA

[6]Department of Ecology and Evolution, University of Chicago, USA

[*]Correspondence to: thomas.gillespie@emory.edu; +1.404.727.7926; https://orcid.org/0000-0002-7901-7248

Keywords: Anthropocene, Climate Change, COVID-19, Deforestation, Ecology, Global Health, Nature-Based Solutions, One Health, Pandemics, Sustainability

What does Covid-19's emergence tell us about becoming better prepared for climate change and other environmental shocks? Can preventing and preparing for future pandemics also slow rates of climate change, reduce extinction rates, and create economic policies that sufficiently acknowledge the value of natural capital?

Over the past 50 years, the human population has doubled and in this same time period, we have shifted from predominantly rural to predominantly urban living. Despite this concentration of human populations into cities, our activities now impact 75% of the planet's terrestrial land surface (Venter et al., 2016). Agriculture dominates this impact, with crop and livestock production now covering over one-third of the globe, with projections of beyond half the Earth being used for agriculture if current trends continue unabated (Mehrabi et al., 2018). In light of this, what urban dwellers choose to eat and how their needs are supplied will largely shape food and land-use systems. We must ensure that these choices will not further degrade natural systems in ways that promote natural and economic disasters by accelerating climate change and zoonotic disease spillover. Protecting and promoting tropical forests is one of the most immediate steps we can take to simultaneously mitigate climate change while reducing the risk of future pandemics.

Pathogen spillover is increasing and this trend is most strongly associated with agricultural drivers (Rohr et al., 2019). Agricultural expansion leads to shrinking and fragmentation of wildlife habitat, facilitating pathogen spillover by 1) altering community composition in ways that may amplify pathogen hosts and vectors, 2) increasing the interface between wildlife habitat and human habitation, and 3) promoting novel wildlife behaviors often related to seeking new food sources as their longstanding natural sources disappear or become less dependable (Gillespie & Chapman, 2006; Faust et al., 2018; Gibb et al., 2020).

Destruction of tropical forests hits both columns of the climate change ledger: burning forests adds CO_2 to the atmosphere, while concomitantly reducing the planet's potential to remove the excess of CO_2 currently circulating in the atmosphere (Bonnie et al. 2000; Kremen et al., 2000). As the most biodiverse of ecosystems, these forests are also the place where anthropogenic disturbance has the greatest potential to unleash novel pathogens (Jones et al., 2008; Figure 1). Further, mitigating climate variability has precautionary value, as anomalous climate events can act synergistically with, and facilitate, pathogen emergence (Shaman & Lipsitch, 2013).

A recent cost-benefit analysis of pandemic prevention found that reducing deforestation by half would be a cost-effective way to substantially reduce spillover risks, with an ancillary benefit of close to $4 billion per year in reduced greenhouse gas emissions (Dobson et al., 2020). Unfortunately, current policies and agricultural industry norms often provide incentives for encroachment of forested areas. Consequently, society must address demand and incentive structures for the production and trade of forest-risk commodities (i.e., products such as palm oil, soya, and beef that result in the loss, conversion and degradation of native forest). Solutions may be found by incorporating sustainability commitments into upfront financing for such activities. This could then be combined with reforms to risk assessments that incorporate the valuation of spillover and loss of forest-associated health co-benefits for forest conversion agricultural proposals (IPBES, 2020). Success in this undertaking will require truly transformative change with unification of health and environmental policy and greater connectivity of policy initiatives from local to global.

The COVID-19 pandemic has forced us to recognize the linkages between our health, the environment, and financial and agricultural systems. Catastrophe can be the mother of invention! The global disaster of the COVID pandemic must facilitate the re-organization of agriculture and wealth distribution in ways that maximize environmental protection and reduce and reverse climate change. We must capitalize on this moment of global clarity; our collective future depends on it.

References

Bonnie, R., Schwartzman, S., Oppenheimer, M., Bloomfield, J. (2000). Counting the cost of deforestation. *Science*, **288**, 1763-1764. https://doi.org/10.1126/science.288.5472.1763

Dobson, A.P., Pimm, S.L., Hannah, L., Kaufman, J.A., Ando, A., Bernstein A., …M.M. Vale (2020). Ecology and economics for pandemic prevention. *Science*, **369**, 379-381. https://doi.org/10.1126/science.abc3189

Faust, C. L., McCallum, H. I., Bloomfield, L.S., Gottdenker, N.L., Gillespie, T.R., Torney, C.J., Dobson, A.P. & Plowright, R.K. (2018). Pathogen spillover during land conversion. *Ecology Letters*, **21**(4), 471-483. https://doi.org/10.1111/ele.12904

Gibb, R., Redding, D.W., Qing Chin, K., Donnelly, C.A., Blackburn, T.M., Newbold, T. & Jones, K.E. (2020). Zoonotic host diversity increases in human-dominated ecosystems. *Nature*, **584**, 398–402. https://doi.org/10.1038/s41586-020-2562-8

Gillespie, T.R. & Chapman, C.A. (2006). Prediction of Parasite Infection Dynamics in Primate Metapopulations Based on Attributes of Forest Fragmentation. *Conservation Biology,* **20**, 441–448. https://doi.org/10.1111/j.1523-1739.2006.00290.x

IPBES. (2020). IPBES Workshop on Biodiversity and Pandemics Report. Secretariat of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, Bonn (Germany). p. 95. https://doi.org/10.5281/zenodo.4147317

Jones, K.E., Patel, N.G., Levy, M.A., Storeygard, A., Balk, D., Gittleman, J.L., … P. Daszak (2008). Global trends in emerging infectious diseases. *Nature*, **451**, 990–993. https://doi.org/10.1038/nature06536

Kremen, C., Niles, J.O., Dalton, M.G., Daily, G.C., Ehrlich, P.R., Fay, P.J., Grewal, D. & Guillery, R.P. (2000). Economic incentives for rain forest conservation across scales. *Science*, **288**, 1828-1832. http://dx.doi.org/10.1126/science.288.5472.1828

Mehrabi, Z., Ellis, E.C., & Ramankutty, N. (2018). The challenge of feeding the world while conserving half the planet. *Nature Sustainability*, **1**(8), 409-412. https://doi.org/10.1038/s41893-018-0119-8

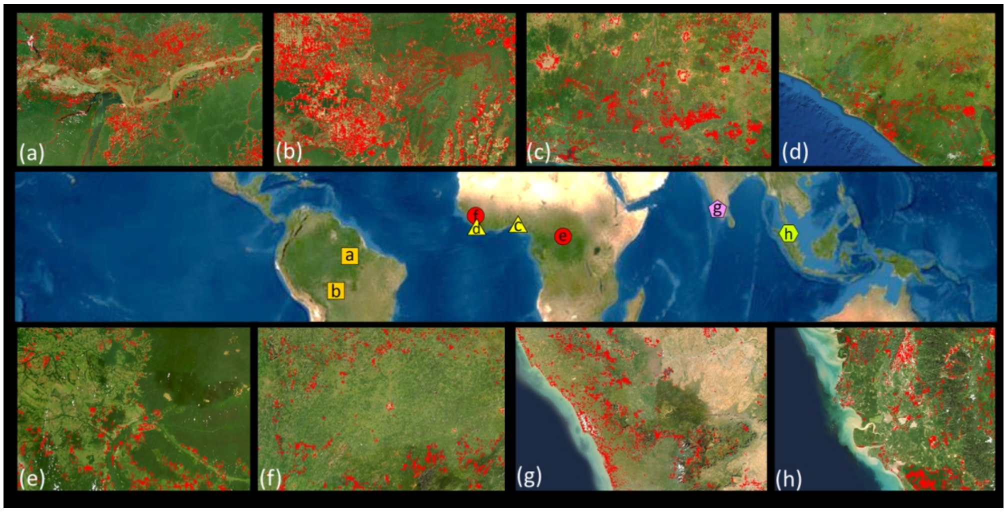
Rohr, J.R., Barrett, C.B., Civitello, D.J., Craft, M.E., Delius, B., DeLeo, G.A, … Tilman, D. (2019). Emerging human infectious diseases and the links to global food production. *Nature Sustainability,* **2**, 445–456. https://doi.org/10.1038/s41893-019-0293-3

Shaman, J. & Lipsitch, M. (2013). The El Niño–Southern Oscillation (ENSO)–pandemic influenza connection: coincident or causal? *Proceedings of the National Academy of Sciences*, **110**, 3689-3691. https://doi.org/10.1073/pnas.1107485109

Venter, O., Sanderson, E.W., Magrach, A., Allan, J.R., Beher, J., Jones, K.R … Watson, J.E.M. (2016). Sixteen years of change in the global terrestrial human footprint and implications for biodiversity conservation. *Nature Communications*, **7**(1), 12558. https://doi.org/10.1038/ncomms12558

Figure Legend:

Figure 1. Select zoonotic disease emergence events resulting from anthropogenic disturbance of tropical forests with landcover change (red): a) and b) Hanta Virus Pulmonary Syndrome, c) and d) Lassa Fever, e) and f) Ebola, g) Kyasanur Forest Disease, and h) Nipah. Data Source: ESA Climate Change Initiative © - Land Cover led by UCLouvain (2017); ESRI, Maxar, Geosys, Earthstar Geographics, CNES/Airbus DS. USDA, USGS, AeroRID, IGN, and the GIS User Community



Select zoonotic disease emergence events resulting from anthropogenic disturbance of tropical forests with landcover change (red): a) and b) Hanta Virus Pulmonary Syndrome, c) and d) Lassa Fever, e) and f) Ebola, g) Kyasanur Forest Disease, and h) Nipah. Data Source: ESA Climate Change Initiative © - Land Cover led by UCLouvain (2017); ESRI, Maxar, Geosys, Earthstar Geographics, CNES/Airbus DS. USDA, USGS, AeroRID, IGN, and the GIS User Community

264x133mm (149 x 149 DPI)