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COMMENTARY

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# Potential impacts of COVID-19 on tropical forest recovery

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## 1 | INTRODUCTION

The coming UN Decade on Ecosystem Restoration is poised for a rocky start. Currently, international sentiment is laser-focused on the COVID-19 pandemic, the rising death toll, and tumbling economies. Come January 2021, when the decade officially begins, we will likely still be facing these same issues, but with an additional lack of international action on habitat restoration. The pandemic has delayed two critical United Nations meetings that were meant to advance the restoration dialogue, among other goals. The Framework Convention on Climate Change (COP 26) has been postponed to 2021, and the Convention on Biological Diversity (COP 15) has been postponed, with no new date set. As a result, national governments will not have a public opportunity to assess current progress, or make or renew restoration commitments for the Paris Climate Agreement, REDD+, or related initiatives such as the Bonn Challenge—ultimately jeopardizing progress toward long-term sustainable development (Fagan, Reid, Holland, Drew, & Zahawi, 2020).

At the same time, one of the more striking ecological consequences of the COVID-19 pandemic that has swept the world was the response of wildlife to the sudden absence of humanity. From a popular media perspective, habitat all around us was seemingly restored overnight (e.g., Wright, 2020). News reports in early 2020 were filled with images of wildlife in unorthodox settings: wild boar foraging in the center of Barcelona, Spain; nesting sea turtles on deserted sunbathing beaches in Brazil; and even a typically nocturnal small Indian civet filmed in broad daylight on a crosswalk in Kerala, India. There have also been dramatic environmental changes—for example, a marked and sustained reduction in global anthropogenic seismic noise (Lecocq et al., 2020), and improved air quality and reduced $NO_2$ levels, with clearer skies above many major cities (NASA, 2020). There has also been a sharp drop in global carbon emissions, with a 4%–7% projected decline for the year (Le Quéré et al., 2020), with coal likely to be one of the hardest hit energy sources (EIA, 2020; Sianato, 2020).

Unfortunately, many of these observations of recovery will be ephemeral, in that they will revert to a *pre*-COVID-19 status once the pandemic has receded (Corlett et al., 2020). For example, air quality in China has worsened rapidly as pandemic restrictions have been loosened (Myllyvirta, 2020) and demand for oil has partially rebounded after a dramatic decline (EIA, 2020). We are then left with a critical question—what will the lasting impacts of the pandemic be on the environment, on the environmental movement, and on environmental restoration and research? In a recent editorial, Corlett et al. (2020) outlined critical impacts of the COVID-19 crisis on scientific research, including reduced scientific capacity through loss of field stations, a decline in scheduled monitoring, and cancellations of field research seasons and international conferences. In this commentary, we focus on some of the direct consequences of this pandemic on the environment that we can anticipate, and in particular, how this pandemic may affect our collective ability as scientists, practitioners, and communities engaged in conservation efforts to restore degraded habitats and facilitate forest recovery in the tropics.

Many international restoration pledges have focused on tropical forests, which have great potential to prevent species extinctions and mitigate global climate change. While there are a number of probable short-term consequences for tropical forest restoration and recovery (Table 1), COVID-19's more lasting impacts likely will be economic, particularly for costly restoration efforts such as tree planting. The COVID-19 recession is straining all major funders of forest restoration, including governments, industry, non-governmental organizations, and private individuals and foundations. Reduced government spending will affect restoration of parks and other public lands, but also privately owned lands if funds are cut for enforcement of environmental regulations or for incentive programs. For example, governments may reduce or suspend payments for ecosystem services, as Ecuador did during its recent economic troubles (Ortiz, 2017; Paz Cordona, 2020). Some governments may also feel empowered to roll back environmental regulations (Phillips, 2020), threatening intact forests and reducing incentives for remediation in response to economic pressure. Collectively, reduced restoration efforts will lower demand for seeds and seedlings, which will harm native plant suppliers. Finally, rippling economic shocks will also affect restoration projects that depend on travel, including sites funded by nature-based tourism or by voluntary carbon offsets, such as those paid for by airline passengers (Galatowitsch, 2009). The downturn in disposable income means that tourism will be slow to recover, and it will be harder to raise funds for restoration from individual donors. Overall, we predict that areas with a high dependence on tree planting and other active restoration interventions will see the greatest declines in resilience and project success.

We can anticipate several additional lasting impacts on restoration from the pandemic (Table 1). First, while economic resources will be strained, and active restoration may decline, there will likely be an increase in interest in passive restoration (i.e., natural regeneration). This is due to the fact that it is widely considered the most cost-effective methodology to implement, especially if done strategically (Crouzeilles et al., 2020). In addition, coming disruptions in market economics and export demand may cause some productive land to be abandoned, further decreasing the cost of natural regeneration. Second, financial constraints will likely push practitioners to carefully weigh the cost and benefits of where, and how, to restore in order to maximize returns. Using prioritization procedures, such as the one developed for the Mata Atlântica biome in Brazil by Strassburg et al. (2019), could increase the impact of restoration activities, for example by improving habitat connectivity through careful site selection (Fagan, DeFries, Sesnie, Arroyo-Mora, & Chazdon, 2016). Third, existing recovering forests and tree plantations will be under significant economic pressure, making additional conservation efforts a priority. Key to these efforts will be engagement with local communities, who are less dependent on external funding and can be quite effective in protecting and restoring forests when their value is recognized (Rasolofoson, Ferraro, Jenkins, & Jones, 2015), particularly if efforts are perceived to enhance food and fuel security.

The fate of both young and older forests is also of concern in the aftermath of the pandemic. Past socioeconomic shocks, like the fall of the Soviet Union (Hostert et al., 2011), the Rwandan Civil War (Ordway, 2015), or drought-driven out-migration from Central America (Redo, Grau, Aide, & Clark, 2012), were associated with short-term natural forest regeneration and wildlife recovery. However, in many cases the return to normalcy led to high rates of forest clearing and hunting, and local population and development pressures determined the degree to which new forests and wildlife persisted over the long term (Bragina et al., 2015; Davis & Lopez-Carr, 2014; Kuemmerle et al., 2009). Accordingly, it is unlikely that COVID-19 will lead to large-scale natural recovery via farm abandonment in rural regions. Demand for agricultural products remains relatively robust even as global supply chains struggle to compensate for shifts in food consumption, with

**TABLE 1** Potential impacts of COVID-19 on tropical forest recovery and restoration

| | Predicted impact |
|---|---|
| Immediate and shorter-term consequences | Ephemeral expansion of species ranges in natural and urban settings |
| | Increased gene flow and colonization events across normally fragmented anthropogenic landscapes |
| | Increased pressure on forest resources, including deforestation |
| | Reduction in source populations of some species due to spike in illegal harvest |
| | Reduction in group and volunteer restoration efforts (e.g., tree planting events) |
| | Reduction in site maintenance and in monitoring of restored sites |
| | Lost opportunities for field research and training, and disseminating results at national and international meetings |
| | Fewer opportunities for international collaborations |
| | UN CBD 2020 postponed |
| | UN COP 26 postponed |
| Longer-term consequences | Loss of restoration funding from ecotourism and funding from non-profits and private donors |
| | Suspended payments for ecosystem services |
| | Reduced reforestation via voluntary carbon offsets (e.g., airlines) |
| | Strain on native plant suppliers due to reduced demand |
| | Variable indirect impacts of economic shock (e.g., loss of remittances, internal migration in developing nations to the countryside, decreased research funding) |
| | Increase in interest in less expensive and more hands-off restoration practices, such as natural regeneration |
| | Increased pressure on regenerating forests and accessible protected areas due to increased poverty |
| | Reduction in wildlife trade due to lower demand and increase in legal restrictions, with implications for species and habitat protection |

commodity prices that are lower but well within recent historical ranges (Indexmundi, 2020). In addition, patterns of urban–rural migration have been upended, with massive displacement of migrant workers in India from cities back to their rural hometowns as one example (Lal, 2020). Furthermore, financial remittances by immigrants to their home countries have collapsed along with the global economy, by a projected 20% (World Bank, 2020). The net long-term impacts of these changes are difficult to predict, but they are likely to be non-linear and have cascading impacts on forests (Diffenbaugh et al., 2020).

Given that poverty is a big pressure on ecosystems, both forest transition theory and empirical studies indicate that increases in rural poverty and population density bode poorly for the conservation of natural ecosystems (Meyfroidt & Lambin, 2011; Rudel, Sloan, Chazdon, & Grau, 2016) and rural wildlife (Knapp, Peace, & Bechtel, 2017). News reports of increased poaching in Botswana as tourism revenues fall, and the rising risk of illegal logging in Malaysia, are likely only the beginning (Newburger, 2020; Taylor, 2020). Similar reports have emerged from Brazil with illegal loggers taking advantage of scaled back law enforcement during COVID-19 to invade indigenous lands in particular, and fuel an increase in deforestation rates (Butler, 2020; SCMP, 2020). The emerging global economic recession will also likely increase the dependency of developing countries on agricultural, timber, and mining export commodities due in part to the devaluation of national currencies. These anticipated impacts may be partly offset by recession-driven declines in expansion into forests by intensive agriculture, which is capital-intensive. Although it is too soon to confirm broad shifts in land-use patterns, early alert systems will be critical to help inform governments and NGOs about spikes in tropical forest clearing and poaching (e.g., Hansen et al., 2016).

In this commentary, we have argued that the long-term ecological consequences of COVID-19 will likely be deleterious in the absence of a concerted conservation effort. In particular, COVID-19 is poised to reduce the extent of tropical forest recovery, both planned and unplanned, over the short term and perhaps longer—with direct implications for conservation. Despite that likelihood, however, it would be a mistake to view the pandemic as having only negative impacts, or only limited and ephemeral positive impacts, on the environment. The need for forest conservation and restoration is greater than ever, and society's reaction to the pandemic may inadvertently provide a path forward.

COVID-19 is unique in that, perhaps for the first time in modern history, we have a global phenomenon that has impacted every country in the world—albeit some more so than others. The resulting global lockdown has spurred a newfound appreciation for nature. Green spaces, parks, and natural areas have been overrun by increased demand. The striking changes in environmental conditions have been detailed in many news outlets, and these changes have not been lost on the general public. Grassroots movements such as Build Back Better, which began in the United Kingdom (https://www.buildbackbetteruk.org/) but has rapidly been adopted elsewhere, are pushing governments to rethink how they rebuild economies in a post-COVID-19 world. In turn, the clear link of COVID-19 to the wildlife trade (Yuan, Lu, Cao, & Cui, 2020) has made some world leaders painfully aware of the risk of overexploiting natural ecosystems. Proposals to ban trade in wildlife and so-called "wet markets" have been initiated and passed in several countries, including those where such trade is highly prevalent (Frutos, Roig, Serra-Cobo, & Devaux, 2020; Nguyen, 2020).

As conservation biologists, we should cultivate this newfound public awareness to pressure governments to strengthen global conservation efforts, which are at a critical juncture (Ceballos, Ehrlich, & Raven, 2020). This can be argued all the more forcefully in a COVID-19 world, as encroachment on tropical forests is a well-documented major source of human–wildlife disease transmission (e.g., Rulli, Santini, Hayman, & D'Odorico, 2017; Wolfe, Daszak, Kilpatrick, & Burke, 2005). Furthermore, while restoration is not a substitute for aggressively conserving intact habitat or curbing greenhouse gas emissions (Holl & Brancalion, 2020), well-planned restoration programs can prevent species extinctions, help mitigate climate change, and potentially alleviate a COVID-19-induced recession.

Such initiatives must be coupled with bold COVID-19 economic recovery programs that support green energy initiatives to combat climate change, such as the EU's massive €750 billion economic stimulus plan (Abnett, 2020; Carrington, 2020) that was passed recently, or the bold $2 trillion climate plan proposed by US presidential candidate Biden to achieve carbon neutrality by 2050, paralleling a similar initiative passed by the US Congress (Chow, 2020; Holden, 2020). Economic stimulus programs could also target payments for ecosystem services to preserve and expand forest cover while supporting cash-strapped people. South Africa's Working for Water program is one example of how a government can restore regional ecosystems while employing impoverished people (Turpie, Marais, & Blignaut, 2008). As countries tighten their economic belts and struggle to escape the dark cloud of COVID-19, building on our increased collective awareness to bolster global conservation and restoration efforts could give us all a much-needed ray of hope.

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## AUTHOR CONTRIBUTION

All authors contributed to conceptualization, wrote the original draft of the manuscript, and reviewed and edited the manuscript.

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