Biodiversity conservation during a global crisis: Consequences and the way forward

Alok Bang[a,1] and Suvarna Khadakkar[b]

The coronavirus disease 2019 (COVID-19) pandemic is the latest episode in a string of environment-borne human tragedies, catastrophic in its magnitude, reach, and repercussions. Understandably, the scientific literature has focused on the causes and consequences of the pandemic from an anthropocentric viewpoint. As immense as the human tragedy surrounding the pandemic is, the glaring blind spot is the ecological impact of the pandemic and the pandemic-induced lockdown. Scientific reports on the impacts of the pandemic on issues of conservation concern are minuscule in comparison with reports on social, economic, political, and health-related consequences. The sudden rapid outbreak of the disease, short time frame since the commencement of the lockdown, and inaccessibility to field sites to start new empirical studies and monitor ongoing studies have resulted in the absence of scientific evidence of direct impacts of the lockdown on species and ecosystems of concern. As a result, much of the direct ecological impact of the

The current pandemic, the subsequent lockdown, and the postlockdown flurry to return to normalcy will have vital positive and negative consequences for biodiversity conservation in places such as the dense forests in the northeast Indian state of Sikkim, pictured here. A world biodiversity hotspot, the Eastern Himalayan region in northeast India has recently been the focus of some debate regarding the compliance of environmental regulations in development projects such as construction of roads and hydroelectric power stations.

[a]Department of Biology, Indian Institute of Science Education and Research, Pune 411008, India; and [b]Centre for Sericulture and Biological Pest Management Research, Rashtrasant Tukdoji Maharaj Nagpur University, Nagpur 440022, India

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[1]To whom correspondence may be addressed. Email: alokbang@gmail.com.

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lockdown is still anecdotal. We believe that the current pandemic, the subsequent lockdown, and the post-lockdown flurry to return to normalcy will have vital positive and negative consequences for biodiversity conservation. Furthermore, we believe that these repercussions present an opportunity to learn important lessons for how to deal with future crises. Here, we present an account of the possible consequences of the pandemic on biodiversity conservation and the way forward for a more stringent and comprehensive planetary conservation strategy.

Immediate Impacts

Conservation development projects requiring a mandatory human presence, such as surveillance of protected areas, treatments of diseases of wild plants and animals, and eradication of invasive alien species, may take a backseat. Without protection and with added anthropogenic pressures owing to the mass migration and unemployment in the biodiversity-rich developing world, the species and habitats of concern may be in danger of hunting, poaching, mining, logging, and diseases.

The negative perception of wildlife as disease carriers may result in retaliatory killings of possible carries species such as bats and pangolins, resulting in severe repercussions for these threatened species.

For example, during the lockdown, the Amazonian rainforest destruction rose by 55% in the first four months of 2020 compared with the same period last year (See also "We've been in lockdown, but deforestation has not" https://www.pnas.org/content/117/40/24609?cct=1971); centuries-old coral reefs in the Caribbean are irreversibly damaged as a result of the lack of treatment against fungal diseases, and invasive species such as rats are destroying native species and habitats on island nations such as New Zealand in the absence of eradication efforts (1–3). In contrast, a reduction in ecotourism and human presence may help species sensitive to anthropogenic pressure to thrive. Anecdotal evidence suggests that the lockdown has resulted in increased pregnancies in zoo animals, reintroduction programs of vulnerable species, and increased sightings of wildlife close to human inhabitation from around the world (4).

The diversion of funds to more urgent causes, as well as travel restrictions, are likely to have a direct impact on research activities such as the long-term monitoring programs, species and ecosystems of conservation priority, socioecological research involving human subjects, and expeditions to understudied locations. Personnel in research institutes, voluntary organizations, and environmental education initiatives across the world are either being furloughed or facing a hiring-freeze resulting from a lack of monetary support (5), which will further impact conservation research, development, and outreach. On the other hand, the lockdown has seen an upsurge in virtual citizen science projects (6). Such collaborations between the researchers and the general public, in digitization, preliminary data gathering, and volunteering, are likely to underscore the role of citizens in conservation projects. These efforts to involve civil society may become more effective tools of conservation and biodiversity-related awareness.

Several impactful changes in national and international conservation policies and practices have taken place since the pandemic started. The positive news includes a temporary ban by China on wildlife markets, the resultant standstill in the wildlife trade industry in South-East Asia, and the possibility of further bans by other countries on wildlife trade. However, a blanket ban will harm millions of poor people dependent on wildlife for their livelihood and nutrition, eventually resulting in possible overexploitation (7). The EU's Green New Deal, which is central to the road to post-COVID recovery to greener economies, has received worldwide support (8) and may pave the way for greener economies.

On the negative side, many nations such as the United States, Indonesia, and India are relaxing environmental regulation laws, resulting in unprecedented rates of logging, higher rates of development project clearances, and monetary impetus to revive fossil fuel industry (9–11). Additionally, several intergovernmental meetings such as the World Conservation Congress, UN Ocean Conference, UN Nature Summit, 15th meeting of the conference of the parties to the UN Convention on Biological Diversity, and 26th session of the conference of the parties to the UN Framework Convention on Climate Change—part of what some thought would be a "super year for conservation"—have been canceled or postponed. These meetings had intended, in part, to review the last decade's biodiversity conservation and emission targets and to plan targets for the coming decade. All these developments will have a negative impact on biodiversity conservation.

Long-Term Impacts

The negative perception of wildlife as disease carriers may result in retaliatory killings of possible carries species such as bats and pangolins, resulting in severe repercussions for these threatened species (12). For example, all Asian pangolins are endangered or critically endangered, and any future retaliatory killings may push the species toward extinction. Unemployment and mass migration as a result of the pandemic may result in added pressure on wildlife and habitats for food and livelihood by increased poaching, hunting, and logging, leading to closer contact between humans and wildlife, resulting in future outbreaks of zoonotic diseases (13, 14).

Alternatively, anthroponotic transmissions of coronavirus strains from humans to wild animals have been reported, including transmissions to some species of conservation concern such as the Great Apes. Such transmissions in the past have led to moderate-to-severe outcomes such as 90% to 100% morbidity and about

20% mortality in Chimpanzee populations (15, 16). The transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) from humans to species of concern such as tigers and lions has already occurred (17). As a result, there has been an urgent call to suspend ecotourism and reduce field research to stop the spread of COVID-19 in wild animals (18). Conservation funding is projected to shrink because of the lack of tourists and also because of the movement of funds toward issues of more immediate societal and economic concerns, which is likely to affect conservation practices. Decreased conservation funding is known to impede the efficacy of conservation projects, resulting in higher biodiversity and habitat losses (19).

On the positive side, a drop in consumer demand and goods production has led to decreased energy consumption by industries, leading to a decline in shipping and trade that's also had an impact on oil usage (20). Travel restrictions have brought down the mobility by 75% to 95% in many developed nations, resulting in reduced oil and fossil fuel usage. Consequently, many air pollutants such as $PM_{2.5}$, PM_{10}, NO_2, SO_2, CO, and CO_2 reduced up to 30% within 2–4 weeks of the lockdown (21, 22). This reduction is good news for biodiversity as past studies show that elevated CO_x, NO_x, SO_2, and other air pollutants are known to negatively affect plant, insect, bird, and mammal biodiversity (23–25).

There has also been a significant decrease in noise pollution since the lockdown. Noise pollution is known to affect anatomical and morphological development, physiology, and behavior in a range of invertebrate and vertebrate species in terrestrial and aquatic ecosystems (26, 27). Noise pollution is also known to reduce diversity, changing the community structure and interspecific interactions (28). Studies before the lockdown have shown that noise pollution is not just an urban problem but also pervades more remote locations, including protected areas, where anthropogenic sound levels are often double the natural background noise levels (29). The problem can be more acute in aquatic environments because noise travels faster and farther in water. Calmer waters and calmer terrestrial environment may thus result in lower levels of stress hormones, higher survival rates, and higher sightings of acoustically communicating organisms closer to human inhabitation and regaining original ecosystem structure and function.

Finally, a review of the past five global economic and political crises demonstrates that despite a temporary improvement in the indicators of environmental health immediately after the crisis, the desire to return to economic normalcy often resulted in even less regard for environmental health in comparison with the precrisis period, resulting in a more rapid rate of decline of environmental health (30). Additionally, indicators of environment health take longer to revive than economic indicators (31), suggesting the fragility of conservation indicators and a need to stabilize them during and after global crises.

A Path to Progress

Although catastrophic, the ongoing global crisis is not unique in its magnitude, reach, and resultant costs to humanity. For decades now, ecologists have warned about climate change, the unprecedented rate of extinction of species, and subsequent social and economic disenfranchisement of millions of poor people in developing biodiversity-rich countries. For example, weather-related disasters displaced more than 16 million people in 2018 in the developing world, and by 2050 disrupted weather will affect 200 million people (32). Hopefully, this pandemic has brought realizations regarding the connections among the human and the nonhuman components of the planet, the grave consequences of causing an imbalance in natural processes shaped over millennia, and the unpreparedness of the humanity surrounding such catastrophes. The way forward for biodiversity conservation should be four-pronged, with the involvement of policy, industry, conservationists, and the general public.

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The concerted and urgent global response to COVID-19 should pave the way for similar responses to global ecological crises. Strengthening of international conservation taskforces, support for alternative technologies in economic proposals such as the Green New Deal, stringency in national environmental regulation policies, the inclusion of indigenous and poor people in conservation agenda linking conservation with livelihood generation, higher monetary support to tropical developing nations floundering under conventional economic development models, innovative solutions such as the "tropical Carbon tax" in developing nations to generate revenue, and a philosophical and practical infusion of ecological capital in economic and developmental policies are some of the solutions to be fostered.

Corporations and conservationists can come together on "business for nature" models of development rather than the conventional "nature for business" models. For example, increased investments by companies dependent on natural resources such as seafood, agro-produce, and forest products in the well being of these ecosystems will result in higher returns. Programs such as the Science-Based Targets Initiative (SBTI) by companies to align industrial interests with scientific evidence-based national policies and ecological conservation could create a new developmental paradigm. Once the pandemic-induced restrictions are lifted, the world may undertake the path of least resistance, reverting to earlier energy and economic demands, as has happened in the follow-up periods of past global crises, such as the surge in carbon emissions following the 2008–2009 global financial crisis (30), which needs to be proactively sidelined.

Many of the environmental variables have changed in a matter of a few weeks and have reached record new levels in decades. The lockdown thus provides a unique opportunity to frame new research questions about changes in environmental variables and their impact on species and ecosystems, especially of conservation concern, before, during, and after the lockdown. Newer solutions of automation in conservation, research, teaching, networking, and outreach need to be tested and implemented to be prepared for future crises resulting in unavailability of human resources. Journal publishers should fast-track publishing of ecological research on critical global issues without compromising the quality of research and make that work freely accessible as is any published material regarding COVID-19. Such rapid and free availability will help in recognition of global ecological issues of concern and will result in the broader dissemination of knowledge. Finally, there will be newer allies for biodiversity conservation, which should be fostered. Healthcare professionals, medical researchers, epidemiologists, corporations, and the general public demanding cleaner environment and a more sustainable lifestyle may realize the interconnectedness of different problems facing humanity.

The rapid and visible changes in environmental variables within a few weeks of the lockdown were surprising even for experts, which should create an optimistic attitude toward biodiversity conservation. That modern human consumption practices create a large environmental footprint, resulting in carbon emissions, habitat degradation, biotic homogenization, eventually causing a decline in biodiversity, needs to be realized, curtailed, and levied. Our failure to arrive at standard, agreeable solutions in the face of impending disasters is less a reflection of our abilities to devise and implement stringent solutions and more a reflection of our priorities. The pandemic has shown us that seemingly extreme solutions and their implementation, such as a mandatory lockdown of human activities for a specific duration every year, may restore the planetary environment, even if temporarily. If nothing else, such temporary solutions will delay the tipping points of future environmental crises. The scientific community will need to lead from the front, in creating solutions and in steering the sociopolitical will required to implement these solutions for a more long-lasting process of environmental conservation. In the absence of such realization, the environment and biodiversity conservation may take an even further backseat in national and international agenda in the post–COVID-19 world.

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