MANGROVES AND COVID-19:
GLOBAL ENVIRONMENTAL PROBLEMS ARE PART OF THE SAME STORY

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INTRODUCTION

In late 2019 the COVID-19 virus attacked a world made vulnerable to the pandemic by globalization of trade and travel, effects of climate change, resource over-exploitation, and biodiversity loss. Mangrove ecosystems suffered from this convergence of environmental problems but also presented innovative opportunities to address them.

While the human health and economic impacts of the pandemic appropriately are receiving the most urgent attention, environmental issues of biodiversity loss and climate change are at the very heart of the pandemic and affect responses to it. Emerging infectious diseases (EID) such as Covid-19 are driven by dense human populations increasingly disrupting natural ecosystems, globalization is sending this EID around the world even before its symptoms became apparent, and changing climates are affecting drivers such as increasing demand for animal protein, unsustainable expansion of shrimp ponds, and excessive harvest of natural resources that include those provided by mangrove ecosystems.

Emerging infectious diseases always have environmental dimensions

COVID-19 was no surprise because new EIDs had been increasing regularly since 1941 and have invariably been linked to environmental factors. Zoonoses, diseases originating in animals that can be passed to humans, were found to be the source of over 60% of EIDs. Notable examples include the remarkably fatal Ebola hemorrhagic fever that emerged in West Africa in 1976 and had a devastating impact on chimpanzees and gorillas, though the primary reservoir may have been fruit bats.

Though not nearly as contagious as COVID-19, the 1997-8 outbreak of the Nipah virus in Malaysia taught some valuable lessons. A major contributor was the clearing of species-rich tropical rain forests to make room for commercial farming of vast expanses of oil palm that as of 2016 covered over 6 million hectares. With much of their tropical forest habitat disappearing, Malaysia's 17 species of fruit bats turned to drinking, and contaminating, the juice ("toddy") being collected from the oil palms. Fruit bats, most of which had populations that inhabited mangroves, also visited the domestic fruit orchards planted near factory farms where domestic pigs fed on fallen fruit contaminated with excreta from the bats and became infected with Nipah virus which they then passed on to pig farmers who became ill. Malaysia suffered 265 cases of Nipah virus, with 105 deaths (40%). The virus subsequently spread to Bangladesh, India, Indonesia, and Myanmar, with several thousand cases and mortality rates of 40 to 75%.

The conclusion is clear: humans become exposed to EIDs by encroaching on natural habitats that are rich in species (such as mangrove forests that provide habitats to many species of fruit bats) and harvesting wildlife either as live specimens for the animal trade or as meat for consumption. Some EIDs have much higher mortality rates than that of COVID-19 (currently averaging 3-4%, with much variation among countries), another good reason to treat future EID threats seriously, seek to stop their spread as soon as they emerge, and be prepared to respond effectively if they start to spread.

The COVID-19 pandemic was facilitated by biodiversity loss

Biological diversity (biodiversity for short) is the variability among living organisms and the ecological complexes of which they are part, including genetic diversity within species, between species and of ecosystems. Biodiversity generates substantial economic benefits, especially through supporting ecosystem services such as adaptation to climate change, producing edible species, supporting tourism, and controlling harmful insects. More generally, biodiversity in natural ecosystems has helped to keep contagious pathogens from becoming pandemics through nature's systems of checks and balances.

In short, growing numbers of humans living in dense urban populations are consuming more of nature's resources, becoming exposed to new health hazards, , taking advantage of the globalized spread of resource consumption, and posing threats to a healthy, productive, and sustainable environment.

Ecosystem degradation is driving COVID-19 and other pandemics

In terms of scale, ecosystems are the largest components of biodiversity, and pandemics can emerge from any of them. Forest ecosystems, including mangroves, are especially relevant to COVID-19 because they support most biodiversity and are home to the wild species that carry the most zoonoses.

Tropical forests alone contain about 60 percent of the planet's plant species. The conversion of forest ecosystems from natural to human-dominated is often driven by fragmentation through transportation and other linear infrastructure, especially railroads, highways, canals, and fences that cut natural ecosystems into smaller parcels at a time when connectivity of natural landscapes is widely recognized as an important conservation objective. Fragmentation reduces species richness in the remaining patches, alters nutrient cycles, and brings people into closer contact with hosts of potentially zoonotic pathogens like COVID-19.

Global and local wildlife trade enabled the spread of COVID-19

Covid-19 arrived when the global economy was already based on international and domestic trade that accelerated habitat degradation in developing countries to provide food, timber, energy, wildlife, and minerals to consumers in distant lands who are far removed from the damage their consumption was causing.

Plants and animals that are part of global trade carry with them a wide range of viruses, bacteria, fungi, ectoparasites, and other pathogens. Almost 5600 vertebrate species are traded, along with thousands of plant species. At the domestic level, wild animal markets, especially in tropical and sub-tropical settings, bring together species that would not be interacting in their natural habitats, thereby exposing both the captive wild species as well as merchants and shoppers to pathogens that they likely would not have encountered in nature.

Climate change haunted the spread of COVID-19 and responses to it

The World Health Organization describes climate change as the greatest threat to human health in the 21st century, especially because of the health impacts from the ecological changes associated with increasing temperatures. The Intergovernmental Panel on Climate Change projects a global temperature increase by 1.5° C by 2040, which is expected to lead to significant sea level rise, population movements, and extreme climatic events (storms, droughts, floods, and forest fires). Such changes would bring significant risks to health, livelihoods, food security, water supply, human security, and economies.

One of the lessons of COVID-19 is that acting too late carries serious costs to both people and the economy. Climate change is not just a concern for the future, but very much a current problem that requires urgent action along with addressing biodiversity loss and the hazards of emerging infectious diseases such as COVID-19.

FROM COVID-19 TO A NEW FLOWERING OF HUMAN SOCIETY

The social energy generated by the COVID-19 pandemic provides an opportunity to improve the relationship between people and the rest of nature. Here are four linked policies to consider as part of mangrove-based biodefense and support to human well-being:

1. Use mangroves to demonstrate how a One Health approach could be applied more widely. "One Health" has become a mainstream approach to recognize the intimate connections among humans, animals, ecosystems, and economies. One Health builds collaboration among a wide range of expertise on all aspects of human, animal, and plant health, calling for actions, policies, legislation, and research that incorporate environmental sustainability into economic planning. This minimizes the threats of global pandemics while also seeking to conserve the critical biodiversity infrastructure that supports life on Earth.

A One Health approach would build on an international network of experts from all relevant disciplines in a collaborative effort to support research and communication about how to support a healthy environment. One Health can connect all layers of society, from rural villagers in mangroves to modern researchers in urban hospitals.

As a practical contribution, it would be useful to establish a global One Health system of wildlife monitoring and surveillance that includes population status, interactions with humans, and potential for identifying infectious diseases as they emerge and before they become costly global pandemics. Such a system could use local people who have long lived in and around mangrove ecosystems to monitor the health of the wildlife living in their area and be alert to any signs of emerging infectious diseases and any other human-wildlife issues.

2. Improve human relations with animals. Humans seem to have an innate fondness for wild animals, sometimes called "biophilia". People in all parts of the world enjoy documentaries of wild species, birdwatchers gain happiness from their hobby, numerous conservation organizations are found in virtually all countries, and children need nature to develop their full potential. All such initiatives deserve strong encouragement, especially in recognizing the many ecosystem services that are provided by nature, and how nature's diversity helps people stay healthy and able to adapt to changing conditions.

People also need more opportunities to nurture their biophilia, especially by visiting nature without harming wildlife. New approaches to managing tourism could include using small boats to visit bird nesting populations, interesting monkeys, dolphins, coral reefs (glass-bottom boats).

3. Use mangroves to restore and expand the land and water supporting wild biodiversity. Visiting natural areas is an important way to promote health and feelings of well-being, so urban protected areas are an essential part of public health infrastructure, especially during the COVID-19 pandemic. The CBD's Aichi Target 11 called for the protected area estate on land to be increased to 17%, a figure that has been met by at least 88 countries. Increasing this figure to 25% could help address the overcrowding from tourism as well as deliver the many

other ecosystem services protected areas provide. Mangroves could be part of a national effort to expand the protected area estate and give more attention to protected area management categories that permit a resident population that does not disrupt the delivery of ecosystem services.

The oceans, too, need enhanced protection to ensure that marine resources remain productive. Some island nations, such as Palau, allow fishing only by their citizens and have established 80% of their territorial waters as no-take zones closed to fishing. An ambitious, but feasible, target is to protect a third of the oceans and associated mangroves to replenish fisheries, conserve biodiversity, and sequester carbon to support climate change adaptation.

4. Build cooperation to address climate, biodiversity, and emerging infectious diseases together. A biodefense approach addressing the COVID-19 pandemic, biodiversity, and climate change crises together could use economic incentives for greening national economies. Investments to support recovery of national economies could include effective responses to climate change rather than supporting fossil fuels (especially coal); such green investments yield more jobs per dollar invested than do fossil-fuel investments and are being embraced by the mayors of large cities in many parts of the world. The co-benefits for health could provide stronger support for such climate change mitigation measures. With sufficient information and motivation, at least parts of the private sector may well embrace such approaches, to the benefit of wild species and ecosystems.

CONCLUSIONS

COVID-19 has focused the world's attention on a global threat; globalization has enabled the spread of the pandemic. So can today's world respond by generating a new approach to development that will set Planet Earth on a new path to sustainable development? COVID-19 provides a powerful incentive and opportunity to address the interconnected issues of human health, climate change, and biodiversity loss in a coordinated and effective manner: to develop a biodefense system for Planet Earth.

The biodefense can start by ensuring that substantial post-COVID-19 stimulus funding is provided to environmental issues that could include: investments to conserve biodiversity and ecosystem services that serve significant public needs both immediately and in the long term; support rural livelihoods that encourage sustainable agriculture and forest conservation; provide means to enable urban people to become reintroduced to nature; address national climate change objectives, especially using distributed and low-carbon options such as solar power; and support cultural diversity that can apply traditional knowledge to modern sustainable development activities.