beyond COVID-19

preserving human health by reinventing our relationship with wildlife

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It is a harsh but unmistakable reality that the spread of zoonotic disease is most often a direct result of humanity's exploitation of and improper contact with wildlife.

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▲ Community wildlife rangers wear face masks while on patrol in the savannah of Kenya. These women are part of “Team Lioness” which is one of Kenya’s first all-female wildlife ranger units. © Will Swanson/IFAW

foreword

From our daily routines to our basic norms of social interaction, the spread of the COVID-19 pandemic has upended virtually all aspects of our collective lives. Few events in history have so strongly reinforced the close linkage between humankind and the world's wildlife.

The spillover of zoonotic diseases into human populations is by no means a new phenomenon. Across history, both recent and past, zoonotic diseases have affected people all across the globe. From severe acute respiratory syndrome (SARS) to avian flu to COVID-19—history has not failed to repeat itself. Yet now is a critical moment, a time when disease has affected a broad swath of the global human community at once, to reflect on the lessons that nature teaches us. Namely, that we must assume the role of responsible stewards of nature and wildlife, rather than the unsuccessful "masters" of it.

It is a harsh but unmistakable reality that the spread of zoonotic disease is most often a direct result of humanity's exploitation of and improper contact with wildlife. The threat comes not from the mere existence of that species of wild animal or even of the zoonotic disease itself, but from human behavior—from the tendency to cross lines that are starkly drawn in nature, but toward which humankind continues to turn a blind eye.

Despite society's trend toward urbanization and detachment from the natural world, the inherent connection between humans and nature remains critical. Animals live in every environment on earth and their presence or absence affects key well-being issues far beyond simple food security. Humankind remains not only interconnected with the global ecosystem at large but also highly dependent on functioning natural systems and the health of wildlife on a more local scale. Mounting evidence shows that biodiversity itself plays a critical role in controlling the spread of zoonotic disease, supporting the growing consensus that protecting biodiversity must be considered an essential component of public health plans—for the alternative will lead to a devastating repeat of the current public health crisis.

This report provides a scientific history and accompanying commentary that serve as reminders of how undeniably linked we are with the richness of the world's wildlife. But perhaps its deepest value is in discussing some of the greatest threats that sometimes characterize the relationship between humankind and wildlife, contributing to the transmission and spread of zoonotic disease. The scourge of the global wild animal trade dramatically escalates the risk of public health crises as the transportation and sale of animals and animal parts increases. Add to this a general degradation of habitat and biodiversity, which not only jeopardizes our ability to discover potential new medical treatments derived from nature, but also presents a slew of increased risks to human health, such as reduced water security, which can arise in the aftermath of a natural disaster. Our influence is far-reaching but our dominance over wildlife is nothing more than an illusion. This report presents a series of recommendations that can serve as building blocks to set a new vision for the future, redefining the boundary between humankind and the natural world and transforming our relationship with wild animals.

I welcome you to take this next step with *beyond COVID-19: preserving human health by reinventing our relationship with wildlife*. May it offer us all a comprehensive perspective on our role in the natural world and a blueprint through which to reduce the likelihood of future pandemics. The fate of humanity is intertwined with that of nature, and we must begin preserving it now, for the future of all species on this planet—including our own—depends on it.

To a more hopeful future.

Azzedine Downes
President and CEO

▲ A Kenyan ranger observes a herd of Zebra in Kajiado, Kenya. © Will Swanson/IFAW

introduction

A budding tree in the middle of a city square, a video of African elephants wallowing in a mud pit in the Maasai Mara savannah, bats quietly sweeping across the night sky in search of insects, a bumble bee covered in pollen ambling from flower to flower—all these scenes can elicit a smile. In fact, research has shown that just viewing and experiencing nature not only improves mood but reduces stress response and blood pressure.[1] Our connection with nature goes far beyond physiological responses: wild animals and their habitats are integral to the health and well-being of humans.

However, when people mistreat wildlife and their habitats, this positive relationship is turned upside down. We live in the age of the sixth mass extinction crisis, during which wild animals and their habitats are being lost at extraordinary rates due to overexploitation, habitat destruction and fragmentation, and other human activities.[2] These activities have led to climate change, desertification, and the extinction of many thousands of species and the risk to a million more in the coming decades.

The loss of species, habitats, and the ecological systems that support them is clearly bad on its own, but these events also disrupt our own health. The COVID-19 crisis has reminded us that there is no escaping the reality that the health of our bodies, economies, governments, and our very civilization is tied to our relationship with wild animals. Even before the COVID-19 crisis, zoonotic diseases—described as diseases that come from animals—caused an estimated one billion cases of illness and millions of deaths each year while costing the global economy hundreds of billions of U.S. dollars.[3]

In this report, we investigate why certain human activities such as wildlife trade and habitat destruction are leading to increased incidence of zoonotic disease outbreaks. Unprecedented human interaction with wildlife, high levels of animal stress, biodiversity loss, and extraordinary ecological disruption are some of the main culprits. We also look at other types of impacts that these activities have on people's health besides disease, such as reduced disaster resilience and water security resulting from habitat disruption and biodiversity loss. Using a case study of IFAW's work in Kenya, we also explore how conserving wild animals and protecting habitat can actually lead to positive health outcomes.

The good news is that there are many actions that can be taken to improve our relationship with wildlife and protect human health, from changes to international policy to changes at the country and community level. We can each do our part to reduce the likelihood of more pandemics caused by zoonotic disease by protecting wild animals and their habitats.

Studies have found that between 60 percent and 75 percent of emerging infectious diseases in humans derive from animals; and, of those zoonotic diseases, nearly 72 percent originate in wildlife.

human activities have increased disease incidence

New infectious diseases have become a more common occurrence in recent decades, and these diseases are predominantly zoonotic in origin.[4] Studies have found that between 60 percent and 75 percent of emerging infectious diseases in humans derive from animals;[5] and, of those zoonotic diseases, nearly 72 percent originate in wildlife.[6] Diseases such as severe acute respiratory syndrome (SARS), human immunodeficiency virus (HIV), avian influenza, and Nipah virus infection have sickened and killed millions of people while causing hundreds of billions of dollars in economic damage across the world.[7] The most recent novel coronavirus disease (COVID-19), in just a few months, has caused trillions of dollars in damage and killed hundreds of thousands at the time of this report. Diseases such as SARS spread quickly and then disappear, whereas others, such as HIV, linger in the human population over the course of decades and continually cost lives and livelihoods.

So why are disease outbreaks that originate in wildlife becoming more frequent? It perhaps comes as no surprise that the constant anthropogenic "provocation" of the natural world has elicited consequences that are as fierce on a microscopic level as they are on a macroscopic one. Human activities and their impacts—from habitat destruction and wild animal trade to globalization and climate change—are driving this dangerous trend.[8] Increased international commerce and travel create new opportunities for pathogens to cross geographic and ecological boundaries, emerging as new threats to human health. Climate change also has the potential to increase the likelihood of epidemics, especially with respect to waterborne infectious diseases transmitted by living beings (vector-borne).[9] The COVID-19 pandemic is an eye-opening example of the direct link between emerging infectious diseases and wild animal exploitation. Any activity that increases contact between wildlife and people, reduces biodiversity, or elicits stress responses in animals enhances the risk of zoonotic disease transmission and therefore, the likelihood of another devastating public health crisis.

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Habitat destruction, trade in wild animals, globalization, and climate change have all changed the ways in which people interact with wildlife. These activities increase the chances that diseases originating in wild animals will spillover to humans. We must change our relationship with nature in order to prevent the next pandemic.

▲ A captive moon bear in Vietnam pokes its snout through the rusty bars of a small metal cage. © IFAW

biodiversity loss and disease

The loss of species diversity over time has resulted in outcomes that are immensely harmful from a biological perspective as well as a societal one, escalating in both intensity and long-term impact. Unprecedented levels of habitat conversion and degradation are reducing biodiversity and disrupting ecosystem balance.[10] Human encroachment into natural spaces drives habitat loss and fragmentation, which subsequently lead to declines in species richness;[11] however, the few resilient species that do thrive in these conditions become widespread and abundant—characteristics that create the perfect opportunity for multi-host pathogens to emerge.[12] Examples including West Nile virus, Lyme disease, and hantavirus pulmonary syndrome[13] suggest that biodiversity loss can increase pathogen transmission and disease risk to humans. This phenomenon can occur through various mechanisms, including by changing (1) the abundance of the species that carries the disease; (2) the behavior of the species that carries the disease; or (3) the condition of the species that carries the disease.

One way that biodiversity reduces disease incidence is the dilution effect—the hypothesis that the more potential host species there are, the less chance a disease can spread. Unfortunately, human behavior has created situations where the dilution effect is suppressed by allowing some species to thrive while most species decline. For example, populations of white-footed mice have exploded in the eastern United States while other species have been completely lost from the area due to human activities, leading to increased Lyme disease. Additionally, the prevalence of the Sin Nombre virus in its primary reservoir species, the deer mouse, was found to increase as rodent species diversity declined.[14] This virus is associated with a mortality rate of 38 percent in humans when it progresses to hantavirus cardio-pulmonary syndrome, illustrating a deadly threat to humans that increases when biodiversity is threatened. Mounting evidence indicates that biodiversity plays a critical role in controlling zoonotic disease and supports the growing consensus that protecting biodiversity should be considered an essential component of public health plans.

wildlife trade and disease

The dividing line between humankind and wildlife has become increasingly blurred over time, bringing along with it the need to satisfy what has sadly become an insatiable demand for wild animal products across the globe. Whether to satisfy curiosity or a deeper desire to demonstrate wealth or social status, regardless of ecological impact, the demand for wild animal products has taken unprecedented forms—affecting innumerous species and leading to increased human contact with wild animals.[15] Wildlife capture and trade have evolved such that live animals and animal

products are moved on industrial scales from wild habitat into human-dominated spaces. The likelihood of zoonotic disease outbreaks rises dramatically as the transportation and sale of animals increases, due in part to the poor conditions in which the animals are often maintained and the greater likelihood of person-to-person disease transmission within densely populated urban regions.[16] Both SARS and COVID-19 are believed to have emerged as the direct result of the commercial sale of exotic animal species to supply an increasingly urbanized demand.[17] In both cases, people interacted with numerous species that were bought and sold in crowded and unsanitary conditions at wild animal markets where these diseases presumably originated.[18] Contact among different animal species at these markets provides new pathways for disease evolution and spread,[19] creating the perfect conditions for host species jumping events, which are among the most important contributors to zoonotic pathogen emergence.[20] For instance, a 2003 outbreak of monkeypox in the United States occurred when a shipment of infected African Gambian rats was sold to a pet dealer who subsequently housed the rats with prairie dogs. The prairie dogs contracted monkeypox, were sold as pets, and transmitted the disease to more than 70 people.[21] This outbreak is just one illustration of how serious public health concerns can arise when unfamiliar animal species mix and introduce a new disease to human populations.

HIV and Ebola are also examples of diseases that were introduced to human populations due to the wild animal trade. Expanded logging and mining in remote regions of Africa brought humans into sustained contact with the host animals, exposing them to these novel pathogens while also commercializing the trade in primate bushmeat.[22] HIV has caused 32 million deaths and infected 74.9 million people since 1980,[23] whereas Ebola has killed nearly 13,000 people and infected 18,000 more.[24]

▲ A Sunda pangolin that was successfully released into the wild after rehabilitation in Borneo. © M. Shavez/1StopBrunei Wildlife

Wildlife trafficking adds another dimension of threats to public health because it operates completely outside the confines of any official disease control program. A pilot study[25] documented various zoonotic pathogens in illegal bushmeat imported into the United States and called for further disease surveillance, a stark warning that has since gone unheeded. The wild animal trafficking industry is an extensive organized crime network worth an estimated US$20 billion globally each year, a black market comparable in size to narcotics and illegal firearms. This illegal trade threatens the survival of imperiled species like elephants, rhinos, pangolins, and vaquita porpoises.[26]

Wildlife capture and trade have evolved such that live animals and animal products are moved on industrial scales from wild habitat into human-dominated spaces.

case study: COVID-19

The COVID-19 pandemic has been one of the most socially and biologically widespread outbreaks in recent history, leaving virtually no corner of the globe untouched. On December 31, 2019, Chinese authorities reported a cluster of cases of pneumonia in the city of Wuhan, which eventually resulted in the identification of a novel coronavirus disease designated as SARS-CoV-2. On January 30, 2020, the World Health Organization (WHO) declared the outbreak of the disease (COVID-19) a Public Health Emergency of International Concern (PHEIC); and on March 11, the WHO declared the COVID-19 outbreak a pandemic.[27] Most countries accordingly declared it a PHEIC. Within just a few months, millions of lives had been altered through direct loss of life, stay-at-home orders, or severe economic hardship. At the time of this writing, according to the WHO, there have been approximately 10 million cases of infection[28] with more than 500,000 deaths globally. COVID-19 is estimated to have cost the United States US$2.14 trillion in just the first two months.[29] It is estimated that the pandemic will cost the global economy up to US$82 trillion.[30] Below are listed some of the current and most prominent adverse impacts of the COVID-19 pandemic on human health and well-being.

Millions of people around the world have been infected with COVID-19 and hundreds of thousands have died as a result.

public health

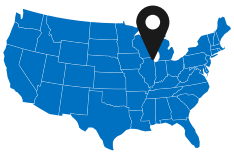
The most immediate consequences of COVID-19's spread are the direct impacts it has on human health in terms of morbidity and mortality. Millions of people around the world have been infected with COVID-19 and hundreds of thousands have died as a result. Unfortunately, despite these devastating numbers, there is still much that we do not know about how the disease affects the human body. COVID-19 is not a typical respiratory virus. In addition to affecting the lungs, the virus has been proven to damage the heart, liver, kidneys, and brain, as well as the endocrine and blood systems.[31] In particular, blood clotting has emerged as a major factor affecting disease severity and mortality in COVID-19 patients.[32] In some cases, clotting complications have led to amputations[33] and sudden strokes in young adults with either mild symptoms of infection or no symptoms at all.[34] In early autopsy data from Northwell Health, a healthcare provider in New York State, around 40 percent of COVID-19 patients who died after leaving the hospital appeared to have experienced major clotting events such as heart attack or lung clots.[35] Even those who recover from the virus are likely to face ongoing health concerns associated with the virus.

With the sudden outbreak of COVID-19, many health systems around the world have been largely unprepared and underequipped to manage a fast-paced pandemic. There is no readily available vaccine to combat this virus, and many hospitals around the world have reported shortages of testing kits, medicine, basic supplies such as personal protective equipment (PPE), and medical personnel. In extreme cases like Venezuela's outbreak, some doctors treating COVID-19 patients do not even have access to soap and water to wash their hands.[36] It is clear that the majority of public healthcare systems are not properly equipped and are unable to cope with the volume of patients needing care as a result of COVID-19. According to the WHO, there has been an unprecedented global market failure in the provision of PPE, compounding adverse mental and physical health impacts on healthcare practitioners, particularly those overseeing intensive care units, those most directly involved in the COVID-19 response, and even those in management.[37] As of the date of this writing, COVID-19 cases continue to increase, and many people around the world cannot effectively implement social distancing to reduce transmission. As our health systems struggle to keep up the fight against the virus, healthcare workers and resources are increasingly strained, further jeopardizing general public health and well-being.[38]

COVID-19 by the numbers

10,185,374
# of total infections

503,862
# of total deaths



In Chicago, Black residents have been **three times** as likely to be diagnosed with COVID-19 and nearly **six times** as likely to die from it in comparison to white residents.

Many countries reported a surge in gender-based domestic violence after stay-at-home orders were implemented. In South Africa alone there were **nearly 90,000 reports of violence against women** during the first week of lockdown.

In the US,
45 million people
have filed for unemployment.

It is estimated that the pandemic will cost the global economy up to
US$82 trillion.

economic impacts

In the early months of the pandemic, COVID-19 decimated the global economy, financial markets, and vulnerable industries such as manufacturing, tourism, hospitality, and travel. The International Monetary Fund (IMF) even described the global economic decline as the worst since the Great Depression of the 1930s.[39] According to the International Labour Organization, the disruption of the world's economies caused by the pandemic is expected to wipe out 195 million jobs globally in 2020.[40] The spread of COVID-19 has had a devastating impact on hourly workers and small businesses whose operations came to a full stop. Local businesses and the employees who sustain them are particularly vulnerable to the economic fallout. More than four out of five workers globally have been affected by full or partial closures, and workers in the informal sector, who account for at least 61 percent of the global workforce (or two billion people), will need income support just to survive and feed their families if their jobs disappear.[41] However, according to the IMF's data on policy responses to COVID-19, not all national economies are providing social protection or economic relief for their respective citizens,[42] leaving the most vulnerable without the option to stay at home and self-isolate. In the United States alone, the unemployment rate jumped to 14.7 percent in May 2020, the highest since the Great Depression.[43] More than 40 million people across the country filed for unemployment benefits—and roughly 21.5 million are currently receiving them—in the months following implementation of enforced closures,[44] and national debt is forecasted to surpass US$25 trillion amid spending to combat the virus.[45]

COVID-19 has undoubtedly shaken the world, and the true enormity of its toll will not be clear for some time. In addition to the devastating loss of human life, the physiological, psychological, social, political, and economic challenges associated with COVID-19 will compound for years to come. While the exact origins of the SARS-CoV-2 virus are still being hotly debated, multiple sources of evidence suggest that it emerged from a wild animal market, indicating that if we continue to exploit wild animals and disrupt habitats, we assume the risk of triggering the next catastrophic global health crisis.

In addition to the devastating loss of human life, the physiological, psychological, social, political, and economic challenges associated with COVID-19 will compound for years to come.

© Tikki Hywood Trust

Wild animals get stressed just like humans. Unfortunately, humans are putting a lot of stress on wild animals by destroying their habitat, capturing them, and putting them in cages. Stressed animals often have suppressed immune systems, which makes them more susceptible to disease and more likely to transfer disease to other animals (including people).

animal stress and disease

The animal kingdom is by no means immune to biological stresses. What fails to receive as much attention, however, is the number of those stresses that are a direct result of human activity. Wild animals are encountering an extraordinary number of human-induced stressors, including habitat loss, illicit trade, and climate change. These pressures can elicit what is known as a "stress response"—a cascade of events involving the animal's endocrine and nervous systems. This response is advantageous for an animal under natural conditions: when a wildebeest is being chased by a lion, the wildebeest's body puts growth and reproduction on hold while it focuses its immediate attention on increasing its heart rate, blood pressure, and blood sugar to help it escape the lion's attack. However, severe, acute, unpredictable, and chronic stressors may prevent the body from returning to its normal state, compromising the animal's health.

Stress response hormones in humans and animals are powerful suppressants of the immune system, making stressed wildlife more susceptible to disease. In fact, stress can affect patterns of disease in wild populations, making koalas more susceptible to chlamydia infections,[46] bats more vulnerable to Ebola virus infections,[47] and migratory birds more prone to avian influenza.[48] Stress can cause latent infections to recur and viral shedding to increase,[49] heightening the risk of disease transmission to other animals and humans.

Decreased food resources, increased crowding, and exposure to humans due to habitat loss all contribute to wildlife stress. Trade of live wild animals adds another layer of stressors including capture, transport, often inhumane conditions, and contact with unfamiliar animals in markets.[50] By creating these pressures on wildlife, we are increasing the risk of the next zoonotic disease outbreak.

habitat disruption and disease

The ecological repercussions of habitat destruction are profound. Regrettably, much of this destruction is caused by the encroachment of humankind into spaces that were once only used by wildlife. When people clear intact ecosystems for human use, habitats are lost or become fragmented, and many wild animals are displaced and often end up interacting with the humans and domestic animals that move there. This increased contact between humans, domestic animals, and wildlife also creates ample opportunities for new infectious diseases to emerge.[51] In 1999, the Nipah virus infected 265 people in Malaysia and Singapore.[52] The virus originated from contact between bats and pigs on industrialized farms. Deforestation forced the bats to forage in human-dominated landscapes. The sustained contact between those bats and pigs allowed the disease, which normally is carried by bats, to "jump species" to those pigs and spread within the broader, denser pig population. In the end, 105 people died and more than one million pigs were slaughtered, resulting in the loss of 36,000 jobs and US$120 million in exports.[53]

case study: lyme disease

Lyme disease is the most common tick-borne disease in temperate regions of North America, Europe, and Asia.[54] It is caused by the bacteria *Borrelia burgdorferi*. Lyme disease is curable with antibiotics for most people, but many suffer from chronic symptoms after infection and late-stage diagnosis including fatigue, brain fog, numbness, tingling, palpitations, dizziness, aches, and pain.[55] Tens of thousands of cases are reported annually and the number of annual cases continues to rise. Reported cases have tripled in the United States in the last 20 years.[56] The CDC documented 33,666 cases in 2018, and these reported cases may only be the tip of the iceberg; many cases go undiagnosed or unreported, and estimates suggest that there are likely hundreds of thousands of infections each year.[57]

The recent increase in infections can be attributed to urbanization and agricultural expansion, which lead to habitat fragmentation, land use changes, and vegetation structure changes.[58] The encroachment of humans into wild habitats leads to increased exposure to wild animals along forest edges and often a decrease in biodiversity, which favors more competent Lyme disease reservoir species like chipmunks, mice, and shrews. With the loss of species that are less likely to carry the Lyme disease bacterium to larval ticks, such as deer, raccoons, and opossums, the likelihood that a human will become infected is higher.

The CDC documented **33,666** cases of lyme disease in 2018.

In fact, researchers have found that a decrease in disruptive development, leading to less forest fragmentation, can result in fewer cases of Lyme disease in humans. In one study, researchers sampled tick density and *Borrelia burgdorferi* infection numbers in forest patches of varying sizes in New York State. Their results showed significant declines in both nymph tick density and infection prevalence when forest patches were larger.[59] Lyme disease trends illustrate that when humans encroach on habitat, fragment landscapes, and disrupt wild animal populations, we jeopardize public health and our collective well-being.

▲ A coyote explores the beaches of Cape Cod, Massachusetts. Coyotes have successfully colonized much of the eastern US in the absence of their wolf competitors. Some scientists believe that coyotes are helping to reduce Lyme prevalence by hunting small mammals that carry the disease. © Andrea Spence

▲ Wild rhinos roam the grasslands of Kaziranga National Park in Assam, India. © Scott Anger/IFAW

human well-being is linked to wildlife and nature

As shown by the emergence of zoonotic disease, human health is inextricably connected to biodiversity, wild habitats, and wild animal health. However, this relationship affects human health and well-being through more than just the spread of pathogens. Human-driven habitat degradation leads directly to increased risk of harm from natural disasters and reduced water security. On the other hand, if wildlife and their habitats are protected, human health is improved.

disruption to habitat increases disaster incidence

The negative impacts of habitat destruction by no means solely affect animals. Often it is humans who, perhaps inadvertently or even carelessly, disturb their immediate environment so deeply that they ultimately find themselves at greater risk of harm from natural disasters and reduced access to clean water and other essential resources. Floods, which affected more than two billion people worldwide between 1998 and 2017,[60] have been linked to habitat loss and accompanying ecosystem disturbances.[61] Coastal habitat destruction doubles the adverse impact of floods on humans and property, disproportionately impacting poor and otherwise vulnerable people and communities.[62] Similarly, habitat disturbances that trigger declines in water and air quality decrease quality of life for surrounding communities, with short- and long-term harm concentrated among disadvantaged populations.[63]

Wildfires, which have increased in both frequency and intensity in many parts of the world, claim ever more human life, health, property, and prosperity.[64] Fires that ravaged the Brazilian Amazon rainforest in 2019 were driven in part by widespread deforestation.[65] These fires are associated with immediate perils, including upticks in the incidence of respiratory illnesses,[66] as well as disruptions in

Mortality resulting from natural disasters is between four and five times higher in low- and middle-income nations relative to high-income nations.

access to fresh water.[67] Their well-documented, adverse public health impacts—both physical and psychological—underscore the connection between habitat loss and declining human well-being.[68]

Similarly, landslides associated with forest habitat loss and climate-driven changes to precipitation patterns are a growing threat to communities around the world.[69] Landslides are commonplace geological disturbances and can take place in any region.[70] According to the WHO, landslides killed 18,000 people and affected 4.8 million people worldwide between 1998 and 2017.[71] Deforestation and habitat disturbances are exacerbating this problem globally, jeopardizing both economic stability and public health.[72]

Although these disasters affect communities across the globe, their burden is disproportionately placed on developing regions. Mortality resulting from natural disasters is between four and five times higher in low- and middle-income nations relative to high-income nations.[73] The United Nations Institute for Disaster Risk Reduction found that residents of the world's poorest nations who were exposed to natural disasters between 1998 and 2017 were at least seven times more likely to die than their counterparts in the wealthiest nations.[74] People in the poorest countries were six times more likely than those in richer nations to sustain injuries, lose their shelter, be displaced, or need emergency support.[75] Disasters also amplify intrastate inequities, carrying with them the potential to exacerbate income inequality and to drive significant proportions of populations into poverty.[76] When we disrupt wild habitats, we set into motion a domino effect of increasing social inequity and division, potential for conflict, adverse human health impacts, and other threats to quality of life.

ecosystem health improves human health

As society recognizes that a healthy home environment ultimately produces a positive impact on human habitation, the same holds true for a functioning ecosystem and the resultant benefits for all its inhabitants. Thus, establishing positive relationships between humans and wildlife by protecting biodiversity and habitats supports public health and benefits communities on all scales. Emerging research has found that the presence of wild animals and maintaining the structure and function of ecosystems improves people's health and well-being both directly and indirectly. Contact with nature and access to natural areas has proven to directly improve physical health by reducing stress and exposure to pollution.[77] Even just viewing nature can restore concentration and improve productivity while physical exposure to natural environments leads to improved recovery from illness or acute stress events.[78] Multiple studies have also found robust evidence of mental health benefits associated with interacting with nature.[79] Wildlife protection is also key to food security. Biodiversity is critical to ecosystem services that support the agriculture industry including pollination, pest control, weed control, and soil health.[80]

Protecting biodiversity is perhaps the most effective form of preventive medicine available to humankind, and disruption of habitats depletes what is likely our greatest source of hope for treating deadly illnesses. Safeguarding animals and landscapes has important implications for public health and the treatment of both chronic and acute illnesses among human populations globally. Estimates suggest that half of antibiotics and cancer medicines, and up to 70 percent of all modern pharmaceuticals, can be traced to natural sources.[81] Among experts, calls for increased attention to the critical role of natural products in the development of medicines, including

cancer therapies, have been amplified in recent years.[82] The award of the 2015 Nobel Prize in Physiology or Medicine to scientists who discovered revolutionary natural products—including new therapies for malaria, river blindness, and elephantiasis—was celebrated as marking a "New Golden Age of natural products drug discovery."[83] Soon after, the United States' National Cancer Institute established its Program for Natural Product Discovery to encourage and facilitate examination of potentially lifesaving compounds drawn from the natural world.[84] We have only scratched the surface with respect to examining global biodiversity for medicinal properties; accordingly, we disrupt ecosystems at our own peril.[85]

Estimates suggest that, due in part to habitat destruction, we may be losing one or more important drugs every two years.[86] Compounds isolated from plants alone have supported some of the most significant developments in medical science, affording us medications like aspirin[87] and morphine[88] as well as critical vaccines.[89] Derivatives of the rare *Diplostephium rhododendroides* Hieron plant help control hepatitis C and diabetes.[90] Fungi have been similarly valuable, supporting the discovery of the antibiotic penicillin as well as the cholesterol medication lovastatin and the anti-transplant rejection drug cyclosporine.[91] Yet, while demand for such treatments surges globally, species are disappearing at an unprecedented rate. As we exploit wildlife and disrupt habitats around the world, potential cures for some of the most common and debilitating chronic human illnesses are vanishing before our eyes. This is what happens when we ignore the link between human well-being and wildlife protection.

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By preserving the function and structure of ecosystems, we are protecting ourselves from natural disasters, ensuring clean air and water, helping crops grow, and even improving individual human health outcomes. Just experiencing nature or seeing wild animals in their habitat can lead to reduced stress and blood pressure.

case study: Amboseli ecosystem, Kenya

▲ A herd of elephants in the Amboseli ecosystem of Kenya. © FAW-ATE/V. Fishlock

The Amboseli Ecosystem in southern Kenya is home to some of Kenya's largest thriving elephant populations (est. 2,000);[92] however, the only protected area is the 392-square kilometer Amboseli National Park.[93] Elephants are long-ranging mammals with home ranges of up to 3,000 square kilometers per individual.[94] The park is therefore too small to support this migratory species' ecological needs alone. It can only handle a maximum of 300 elephants,[95] leaving over 1,700 elephants in search of other territory. Elephants and other wildlife depend on the surrounding 5,700 square kilometers of Maasai community land for dispersal[96] and spend up to 80 percent of their time on these community ranches.[97]

The Amboseli Ecosystem in southern Kenya is home to some of Kenya's largest thriving elephant populations (est. 2,000).

Elephants use community group ranches not only as crucial corridors for migration to other protected areas, such as Tsavo to the east in Kenya, and Kilimanjaro Park to the south in Tanzania, but also seasonal dispersal areas for their physical and physiological needs. In 2008, the main stakeholders and owners of the land—the Maasai group ranches that surround the park, and the Kenyan government through the Kenya Wildlife Service (KWS) as custodians of the park—recognized that the threat of habitat loss, degradation, and fragmentation would lead to the loss of livelihoods and revenue from tourism. They opted to take steps to safeguard the land and ensure sustainability of the ecosystem by establishing an ecosystem management plan inclusive of the needs of animals, people and nature.

Identifying with this initiative, IFAW partnered with one of the group ranches, the Olgulului-Ololarashi Group Ranch (OOGR)—which surrounds more than 90 percent of the park[98]—the KWS, and other secondary stakeholders to secure critical elephant corridors and dispersal areas for elephants in OOGR community areas in the Amboseli landscape.

To achieve this goal, IFAW implemented a multi-year commitment to securing the Amboseli-Tsavo-Kilimanjaro landscape, using three key approaches:

Securing and protecting vital habitat for animals, people and nature:

- Securing 26,000 acres of Kitenden Corridor—one of the last remaining elephant migratory corridors connecting Kenya and Tanzania—and dispersal area by signing lease agreements with 2,600 indigenous landowners to protect the corridor.
- Collaboration with KWS to build capacity of 76 community wildlife rangers to conduct anti-poaching patrols and conflict mitigation to keep the area safe for animals and people, and serve as a key touchpoint for raising concerns and awareness of local community members.
- Partnering with the Amboseli Ecosystem Trust and KWS to facilitate the first official ecosystem management plan in Kenya from 2008–2018, which separates land use areas for conservation, livestock grazing, farming and settlement. The agreement was renewed for a further ten years until 2029.

Increasing coexistence, reducing human-wildlife conflict:

- Facilitating a rapid response approach to human-wildlife conflict cases—a problem that leads to more human and animal loss of life than poaching—enabling ranger support at incident sites within an hour.
- Partnering with KWS, OOGR and the School for Field Studies to gather elephant movement data and map wildlife corridors, settlement areas and potential threats so that planners and conservationists have vital information for more sustainable development that benefits biodiversity and communities.
- Helping the county government secure funding to rehabilitate the Northern Water Pipeline—ensuring access to clean water for at least 300 homesteads, 3,000 community members, and approximately 6,000 herds of livestock—to reduce competition between wildlife and humans for precious water resources, which subsequently leads to injuries and death.

Helping ensure basic community needs are met:

- Scholarships for community rangers and students to further their education, with several now having returned to serve as qualified staff in community health centers and most proceeding to support other members of their household to further their education.
- Engaged in plans of constructing a community service center to house a boarding secondary school for girls, a wildlife school, and an additional health clinic.
- Training female landowners of Kitenden Conservancy and facilitating income generation and business establishment to promote gender equality and empowerment of women and girls.
- Diversifying livelihoods by employing local rangers and developing Kitenden Wildlife Conservancy into a community owned income-generating conservancy with over 80 percent of landowners now having a bank account for the first time in their lives.

IFAW has worked to provide the necessary infrastructure and equipment to aid in the efficient and effective administration and management of the Amboseli National park as well as community group ranch conservation initiatives aimed at securing critical elephant corridors and dispersal areas in a way that is mutually beneficial to local community well-being. Compelling evidence supports the contribution of subjective well-being to human health and longevity.[99] These joint efforts to secure vital habitat, increase coexistence, and ensure basic needs of communities are met have not only contributed to increasing elephant population numbers according to the latest census reports, but to strengthening the health and well-being of community members living alongside them for years to come.

▲ Australians help plant trees to restore critical koala habitat that was lost in the record-setting wildfires of early 2020. © IFAW

bettering health by changing current policies

current policies are fragmented and inadequate

Policies and regulations on wildlife and human health, if present at all, are characterized by their fragmentation at both national and international levels. While national contexts vary significantly, legislation that examines or provides opportunities to regulate issues to do with wildlife and human health include laws directed at wild animal conservation and trade, fisheries management, animal health and welfare, public health, food safety, meat industry, import/export, markets and much more.[100] However, the primary purpose of most national wildlife legislation is to address problems arising from overexploitation of wildlife, with some also addressing invasive alien species.[101] Although many countries also have legislative provisions for animal health protection, including reduction of risks from zoonotic diseases through trade restrictions, quarantine requirements, and health inspection regimes, these are typically designed primarily to address trade and consumption of domesticated species. As a result, such provisions are rarely tailored to the specific dynamics and risks of wild animal trade[102] or mandates are scattered between different national agencies, leaving vast opportunities for zoonotic diseases to be introduced.[103]

Similarly, at the global level there is, at present, no single international agreement that provides guidance relating to wildlife and human health. Rather, international policy is piecemeal at best, with several conventions or agreements addressing only portions of the puzzle or mentioning the intersection of animal and human health but not much more, with policy left to be addressed separately by each country, if at all. International agreements that address wildlife and human health are outlined below.

Given the recent global pandemic and the high probability of another similarly devastating event occurring again, the absence of a coordinated international effort is no longer acceptable.

World Organisation for Animal Health (OIE):
The OIE has adopted various guidelines and standards governing trade in wild and domestic animals. The OIE also analyzes and disseminates information related to animal disease control; however, its focus has historically been on domestic animals and food security. Jointly with WHO and the Food and Agriculture Organization (FAO), the OIE operates the Global Early Warning System (GLEWS+), which aims to share data and improve risk assessments related to zoonoses, primarily in farmed animals.

World Trade Organization (WTO):
The WTO has established an Agreement on Sanitary and Phytosanitary Measures but its focus is to restrict the use of sanitary measures to prevent unjustified trade protection (Convention on Biological Diversity, 2014).

World Health Organization (WHO):
The WHO has established the International Health Regulations, a binding instrument "to prevent, protect against, control and provide a public health response to the international spread of disease." These include the power for the WHO to make temporary and standing recommendations on disease response with a primary focus on the movement of people and goods. Like the WTO Agreement, it includes a focus on *avoiding* unnecessary interference with international traffic and trade.

Several multilateral agreements address wildlife but do not fully address zoonotic diseases.

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES):
CITES is the principal treaty for regulating the international trade of wildlife. However, CITES was created to ensure international trade does not drive species to extinction. Therefore, CITES *only* applies to international trade in species of conservation concern and does not apply to the large amount of domestic trade, or international trade in species not under threat. It does not take public health issues into account in listing species or in evaluating individual trade transactions since matters relating to zoonotic diseases are outside of its current mandate.

Convention on the Conservation of Migratory Species (CMS):
The CMS works to ensure coordinated conservation efforts for threatened species that regularly cross international boundaries. Although the Convention does not address health risks of wild animal interactions, it touches upon them in Resolution 12.6, which calls for fully integrated approaches, at both national and international levels, to address Highly Pathogenic Avian Influenza and other animal borne diseases by bringing ornithological, wildlife, and wetland management expertise together with those traditionally responsible for public health and zoonosis, including veterinary, agricultural, virology, epidemiology, and medical expertise.[104] However, as with CITES, its focus is on a relatively small group of species, and it is up to national governments to set up domestic measures to ensure operationalization of such resolutions.

Convention on Biological Diversity (CBD):
The CBD was set up to ensure the conservation and sustainable use of biological diversity. Although not designed to address zoonotic diseases, it has recently highlighted the link between land use change and infectious disease in a State of Knowledge Review that was jointly commissioned with the WHO. This report provides an overview of the scientific evidence for linkages between biodiversity and human health and examines the shared drivers of emerging infectious diseases and land use change.

Given the recent global pandemic and the high probability of another similarly devastating event occurring again, the absence of a coordinated international effort is no longer acceptable. Suggestions to amend one or more of the conventions above to fully address zoonotic risks, or to create a new agreement specific to all wildlife consumption-related issues have materialized. Developing a coordinated global

approach is a critical but slow process, and must be handled with care to ensure any resulting solutions are thorough, legally binding, and not to the detriment of existing conservation regulations.

adopting a "one health, one welfare" policy

It is a worrisome reality that the current national and international systems for protecting habitats, regulating wildlife trade, preventing zoonotic disease risk, and combating wildlife crime are, at best, inadequate and, left as is, will not prevent the next pandemic. Given the potentially devastating global effect of zoonotic disease spillover events from wildlife, there is need to strengthen national and international policies, laws, and regulations that address this issue in a cohesive and coordinated manner.

Humans, animals, and ecosystems are inextricably linked. Healthy coexistence demands a holistic approach that reduces the risk of emerging zoonotic diseases. Governments must focus on the root causes of emerging zoonotic diseases—unnecessary or avoidable human interactions with wild animals and their habitats that compromise human, animal, and environmental health—by adopting a "One Health" and "One Welfare" approach that includes multi-layered solutions and policy changes at the local, national, and international levels.

A "One Health" approach encourages multiple sectors to communicate and work together to achieve better health outcomes for humans, animals, and ecosystems, and is particularly relevant for combatting the spread of zoonotic disease. "One Welfare" extends and complements the "One Health" approach by highlighting the interconnections between animal welfare, human well-being, and the environment, promoting the links between human welfare and environmentally friendly animal-keeping systems.

▲ Animal keepers hand feed rescued elephants at the Center for Wildlife Rehabilitation and Conservation near Kaziranga National Park in Assam, India. © Scott Anger/IFAW

action plan to safeguard human and wildlife health and welfare

To prevent the emergence of the next zoonotic pandemic and protect human and wild animal health and welfare, action under a "One Health, One Welfare" approach is required in the following specific policy areas at both national and international levels:

- habitat and biodiversity protection,
- wild animal trade and use regulation, and
- interface management between human, animal, and ecosystem health, including wildlife disease surveillance and monitoring.

These must be backed by significant investment in wildlife conservation and law enforcement, reducing demand for wild animals, and providing alternatives for those whose livelihoods will be affected by policy change.

Governments must focus on the root causes of emerging zoonotic diseases…by adopting a "One Health" and "One Welfare" approach.

national actions

National level responses will most likely be the fastest and most efficient way for any one government to reduce the risk of zoonotic diseases emerging from domestic markets while an international response is negotiated. Each country's needs will be different based on their particular domestic context but, in general, IFAW recommends the following:

- Preserve and protect intact habitats, especially in biodiversity hotspots, to reduce human-animal contact and decrease the likelihood of zoonotic spillover;
- Review and strengthen national wildlife and environmental legislation to safeguard biodiversity, public health and safety, and animal health and welfare, particularly relating to habitat conservation, wild animal trade, hunting and trapping, captive breeding, consumption, and ownership;
- Immediately halt high-risk trade and use of wild terrestrial animals, particularly mammal and bird species, in unsanitary/unsafe settings and urban wild animal markets, and in general, ensure that legislation on wild animal trade operates from a starting point where trade in terrestrial wild animals is prohibited, subject to limited exceptions that safeguard biodiversity, public health and safety, animal health and welfare, comply with all national and international laws in source, transit and consumer nations, and which can be effectively regulated and enforced. Such exceptions should include for scientific, conservation, and rescue/rehabilitation purposes, and for indigenous or local consumption where relevant;
- Ensure wildlife crime is treated as a serious crime, incurring meaningful penalties that deter and stigmatize wild animal consumption and use;
- Build capacity of law enforcement and judiciary agencies in charge of detecting, interdicting, and investigating wildlife crime and arresting, prosecuting, and penalizing wildlife criminals;
- Deny operational space for wildlife crime, including transactions taking place via online marketplaces and platforms;
- Address the needs of live animals seized in illegal trade by creating national and local plans and protocols that provide specialized training for customs and border officers, improve the welfare of seized animals, and strive to repatriate and release animals back to the wild whenever possible;
- Design interventions to change consumer behavior and reduce consumer desire for wild animals, their parts, and products;
- Transition those dependent on wild animal trade and the exploitation of wild spaces to alternative livelihoods;
- Integrate wildlife conservation and habitat protection into human health and sustainable development policy and planning, implementing a "One Health, One Welfare" approach from the local to the global scale;
- Ensure appropriate agencies have the mandate to conduct wildlife disease monitoring and surveillance and the capacity to undertake such work; and
- Substantially increase resources, including targeted actions within post-COVID-19 economic stimulus packages, to scale up efforts to protect wildlife habitats, combat wildlife crime, reduce demand for wild animals, and transition those whose livelihoods depend on wild animal trade to safer alternatives.

international actions

Although national level action is critical, a coordinated international effort between governments will ensure a global set of minimum requirements to minimize risks of human and wildlife interactions. IFAW urges governments to support the following international actions:

- Support global efforts to increase the amount of secure and intact habitat for wild animals, through the expansion of effectively and equitably managed, well-connected

protected areas and other place-based conservation measures, including a target in the CBD post-2020 Global Biodiversity Framework to protect 30 percent of land and sea by 2030;

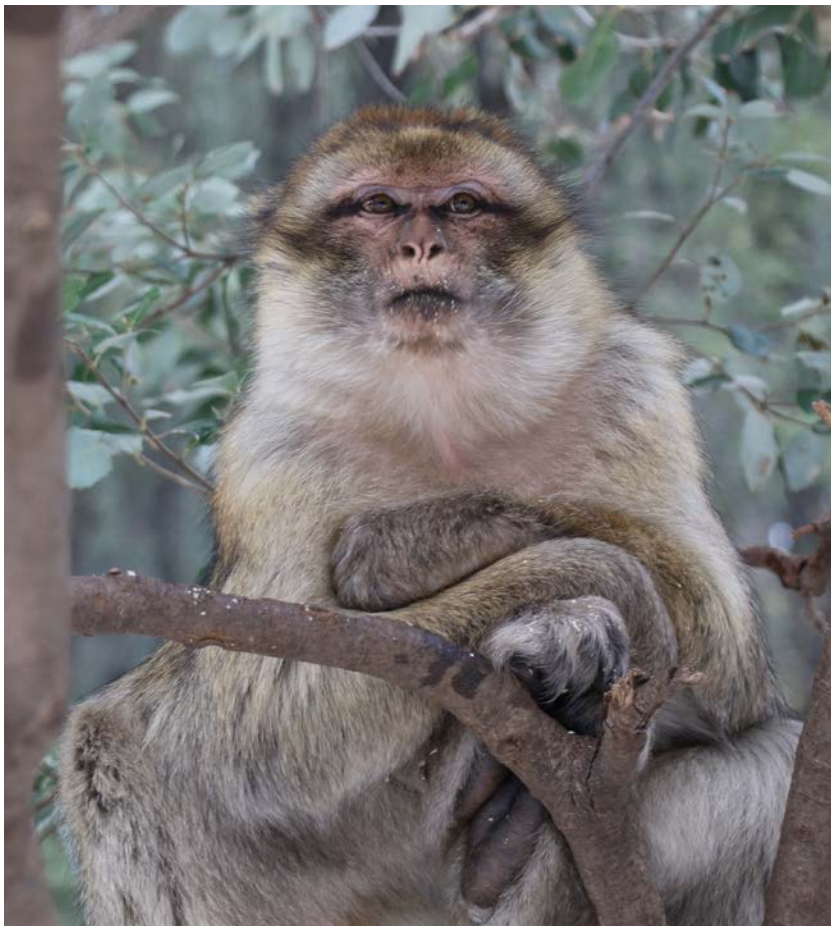
- Ensure the CBD post-2020 Global Biodiversity Framework includes strong targets on wild species protection and recovery, reducing overexploitation of wildlife and biodiversity conservation/public health, alongside a mechanism to hold nations accountable for how they implement the global goals at the national level;

- Expand the wildlife disease monitoring component of the OIE/WHO/FAO Global Early Warning System;

- Ensure guidelines and standards on capture, farming, trade, and consumption of wildlife developed by the OIE are highly precautionary, encouraging the phasing out of terrestrial wild animal markets in all but exceptional cases required to support subsistence and food security among local and indigenous communities where alternatives do not exist. These should be complemented by guidance from the WHO and FAO on the safe and hygienic operation of remaining markets;

- Develop an agreement or protocol to give legally binding force to restrictions on wild animal trade and use, either through a new body and/or alterations to existing mandates of wildlife conventions;

- Support efforts to ensure a more coherent global approach to transnational, organized wildlife crime, through dedicated pathways for intelligence and information sharing and capacity building. If necessary, consideration should be given to a new protocol to the UN Convention against Transnational Organized Crime (UNTOC) on wildlife crime, acknowledging that the time, energy, and resources needed to create such a protocol must not detract from ongoing efforts, including through existing informal cooperation agreements, like the International Consortium on Combatting Wildlife Crime (ICCWC);



▲ Barbary macaques, an endangered species of monkey that live mostly in Morocco, are illegally sold to be pets in Europe and North Africa. © IFAW

- Invest significant resources through overseas development aid to support habitat protection for global biodiversity hotspots, management of protected areas, diversify funding sources and income for communities living alongside wildlife, and support global efforts to fight wildlife crime, reduce demand for wild animal products, and transition those dependent on wild animal trade to alternative livelihoods; and

- Ensure any post-COVID-19 stimulus packages agreed by international financing mechanisms promote green growth and nature conservation, including consideration of further debt-for-nature swaps.

Most emerging infectious diseases originate from wildlife. But the critical point to understand is that the animals are *not* the problem. The problem is our relationship with animals.

conclusion

Most emerging infectious diseases originate from wildlife. But the critical point to understand is that the animals are *not* the problem. The problem is our relationship with animals.

Wildlife overexploitation—especially in the form of capture and trade—has become industrial scale enterprises, bringing both live wild animals as well as animal parts and products to all corners and potential markets across the globe. In most cases, these animals are held in unsanitary and decrepit conditions, leading to stressed animals in close confines and proximity. This resulting stress is critical because it suppresses immune systems leading not only to sicker animals, but also to the easier spread of disease among other animals and ultimately to humans as well. The SARS outbreak of the early 2000s and likely the COVID-19 outbreak are examples of how the wildlife trade industry has opened a wide door leading to both death and disease for so many.

Add onto this the fact that humans are simultaneously destroying habitat at unprecedented rates, which has led to many species declining, being displaced, or even becoming extinct. Research has consistently shown that reducing biodiversity and displacing wildlife leads to higher chances of zoonotic diseases that affect humans. Lyme disease is a particularly poignant example of how changing the face of an ecosystem can lead to more disease in people.

However, there are still actions that we can take both locally as well as on a global scale to begin to turn the tide, fixing the imbalance that we have created throughout the Earth. If humans choose to conserve habitat and preserve ecosystem health, we can then reap the benefits to our own health. Intact habitats not only provide clean air and clean water; they help protect us from natural disasters (which are becoming more prevalent due to climate change) with additional benefits of improving both food and water security. On an individual level, research shows that nature is directly beneficial to our health by reducing our stress, reducing blood pressure, and improving overall mental health. IFAW's work with Maasai communities in Kenya clearly demonstrates how a positive relationship with wildlife can lead to increased well-being for both people and animals.

Current policies and regulations at both the national and international levels do not address this intersection of wildlife and human health. This failure to address such a key connection is to our detriment. If nothing is done, it is almost assured that another COVID-19-like crisis will occur within our lifetimes as we continue to degrade habitat and overexploit wildlife. However, if governments are able to adopt *One Health* and *One Welfare* approaches that integrate human and animal health into policies and tangible actions, we can reduce the chances of zoonotic disease spillover, all the while protecting wildlife species and improving human health. Key steps to achieving this are for governments to increase habitat and biodiversity protection; further reduce, regulate, and monitor wild animal trade; and connect human health and environmental policy.

In the future, we will reflect on this critical time as an inflection point where we chose to either improve our relationship with wildlife, hence protecting ourselves from the next pandemic—or we chose to look the other way and face the dire consequences of our inaction. The strong links between animal, ecosystem, and human health have been demonstrated time and again; such links are inseparable—and thus, the path forward is clear. Governments and intergovernmental bodies must lead by example, enacting these measures immediately to safeguard the health of not only the world's animals but also of the global human population and the places we all call home.

glossary

Biodiversity: A measure of the variety and variability of species of organisms found in different ecosystems.

Dilution effect: Ecological theory that increased host diversity can decrease disease incidence through multiple mechanisms.

Emerging infectious disease: Infectious diseases that are newly recognized in a population or have existed but are rapidly increasing in incidence or geographic range.

Epidemic: Disease prevalence in excess of what would normally be expected in a defined community or geographical area (applies to a larger geographic area than an outbreak and smaller than a pandemic).

Habitat: The natural home or environment of an organism, composed of the physical (abiotic) factors, such as soil, moisture, and temperature range, as well as biotic factors, such as the availability of food and the presence of predators that make it possible for survival and reproduction.

Host species jumping or spillover: The ability of a virus, once introduced to an individual of a new host species, to infect that individual and spread throughout a new host population. Often seen in emerging viral diseases transmitted from a host to humans.

Intermediate host: An organism that becomes infected with a virus, potentially allowing it to mutate, and amplifying it so that it can subsequently infect new hosts (humans in the case of COVID-19) more readily.

Natural product: Any organic compound that is synthesized by a living organism; generally characterized by high structural diversity and unique biological or pharmacological activity.

Outbreak: Disease prevalence in excess of what would normally be expected in a defined community or geographical area (applies to a more limited geographic area than an epidemic).

Pandemic: The worldwide spread of a new disease.

Pathogen: An infectious agent (e.g., virus, bacterium, fungus, protozoan, helminth) that causes disease in its host.

Reservoir host: An organism in which a particular pathogen exists and reproduces naturally; usually the host and the pathogen have co-existed for a long time; and often (but not always), the pathogen causes mild or no disease in this organism.

Stress/stressor: Any stimulus that elicits a stress response in an organism.

Vector species: Any species that can carry and transmit a pathogen to another species.

Wildlife: In this context, wildlife refers to nondomestic animals.

Wildlife trafficking: The poaching of protected or managed species and the illegal trade in wildlife and their parts and products.

Zoonotic disease: A disease that is transmissible between humans and animals (and vice versa); in this context, can be caused by bacteria, viruses, fungi, protozoa, or prions.

▲ Olgulului Community Wildlife Rangers spread awareness of safety measures during the COVID-19 pandemic in Amboseli National Park in Kenya. They urge residents to stay home while they protect the wildlife. © Patrick Sayialel/IFAW-OCWR

acronyms

CBD: Convention on Biological Diversity

CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora

CMS: Convention on Migratory Species

COVID-19: coronavirus disease 2019

FAO: Food and Agriculture Organization

IMF: International Monetary Fund

KWS: Kenya Wildlife Service

OIE: Organisation for Animal Health

OOGR: Olgulului-Ololarashi Group Ranch

PHEIC: Public Health Emergency of International Concern

PPE: Personal Protective Equipment

UN: United Nations

WHO: World Health Organization

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If governments are able to adopt *One Health* and *One Welfare* approaches that integrate human and animal health into policies and tangible actions, we can reduce the chances of zoonotic disease spillover, all the while protecting wildlife species and improving human health.

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About IFAW

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