



Conserving Africa's wildlife and wildlands through the COVID-19 crisis and beyond

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The SARS-CoV-2 virus and COVID-19 illness are driving a global crisis. Governments have responded by restricting human movement, which has reduced economic activity. These changes may benefit biodiversity conservation in some ways, but in Africa, we contend that the net conservation impacts of COVID-19 will be strongly negative. Here, we describe how the crisis creates a perfect storm of reduced funding, restrictions on the operations of conservation agencies, and elevated human threats to nature. We identify the immediate steps necessary to address these challenges and support ongoing conservation efforts. We then highlight systemic flaws in contemporary conservation and identify opportunities to restructure for greater resilience. Finally, we emphasize the critical importance of conserving habitat and regulating unsafe wildlife trade practices to reduce the risk of future pandemics.

The world is currently facing a major disease pandemic due to SARS-CoV-2 and its associated illness, COVID-19¹. Governments are taking drastic steps to stem disease spread, including international travel restrictions and lockdowns of hundreds of millions of people. These measures are having massive socioeconomic impacts, as businesses and industries halt or scale back operations. The world's stock markets have become volatile, and a global recession is imminent. Virtually all sectors of life are affected and will likely remain so for at least 6–12 months². Africa's economy could suffer from reductions in foreign investment, reduced inflows of remittances and foreign aid, and lower overall earnings³. Gross domestic products (GDPs) may contract by 4%, and governments face reduced tax revenues and devalued currencies, resulting in severe budget deficits and knock-on effects on African livelihoods⁴. Lockdown restrictions and economic turmoil could also compromise conservation of Africa's immensely valuable wildlife and wildlands, and the people who benefit from them.

Africa has nearly 2,000 Key Biodiversity Areas and supports the world's most diverse and abundant large mammal populations^{5,6}. Financially, the most apparent value of Africa's wildlife and wildlands stems from wildlife-based tourism, which generates over

US\$29 billion annually and employs 3.6 million people⁷. Trophy hunting, a subset of the tourism industry, generates an estimated ~US\$217 million annually over >1 million km² (refs. ^{8,9}). Tourism helps governments justify protecting wildlife habitat. It creates revenue for state wildlife authorities, generates foreign exchange earnings, diversifies and strengthens local economies, and contributes to food security and poverty alleviation (Table 1). Tourism generates 40% more full-time jobs per unit investment than agriculture, has twice the job creation power of the automotive, telecommunications and financial industries, and employs proportionally more women than other sectors¹⁰.

Africa's wildlife also attracts considerable foreign investment via funding for conservation efforts (Table 1). Contributors range from multilateral institutions and bilateral funding agencies to private foundations, philanthropists, zoos and non-governmental organizations (NGOs). Reliable data on the scale and composition of donor funding are scarce, but external support makes up a substantial proportion of the total funding for wildlife conservation (Table 1). For example, donor contributions account for 32% of protected area (PA) funding in Africa, reaching 70–90% in some countries¹¹.

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Table 1 | Impacts and examples of conservation funding sources in Africa

Funding sources for conservation	Regional impact and funding	Examples of funding supporting government wildlife authorities, NGOs and community-based conservation	COVID-19-related threats to funding
Photographic tourism	<ul style="list-style-type: none"> ~70 million visits per year to protected areas in Africa worth US\$10–50 billion⁶⁸ ~8.5% of continent's GDP⁷ 3.6 million direct jobs on the continent⁷ ~24 million indirect jobs 	<ul style="list-style-type: none"> ~50% (US\$30 million) of Kenya Wildlife Service's annual budget from tourism, supporting management in 39 national parks and reserves⁶⁹ ~80% of Zimbabwe Parks and Wildlife Management Authority's budget derived from tourism (including trophy hunting) (ZimParks, personal communication) ~80% of Kenya community and private conservancies' operating budget from tourism, covering >60,000km², supporting >3,000 rangers and >700,000 households⁷⁰ (D.K., personal communication) ~50% of Uganda Wildlife Authority's budget from gorilla-based tourism⁷¹ ~80% (US\$52 million) of South African National Parks' annual budget from tourism, supporting 19 national parks⁷² 	<ul style="list-style-type: none"> Closure of international travel, which could extend for months, reduces tourism Closure of domestic travel reduces tourism Economic recession reduces future international travel Fear of travel during COVID-19 pandemic reduces arrivals
Trophy hunting	<ul style="list-style-type: none"> ~US\$200 million annually, practised over an area of >1 million km² (refs. ^{8,9}) ~552,000 km² (43%) of PA extent in lion range dependent trophy hunting (R. Feber, personal communication) 	<ul style="list-style-type: none"> Supports budgets of 82 conservancies in Namibia covering ~20% of the country (162,000 km²), encompassing ~189,000 community members (9% of Namibia's population)⁷³ ~68% of Tanzanian PAs rely on income from trophy hunting, covering 250,000 km² ~38% of Zimbabwe's state-owned PAs are designated as hunting areas, as are large areas of community and private land (ZimParks, personal communication) 	<ul style="list-style-type: none"> Closure of international travel, which could extend for months, reduces hunting Economic recession reduces hunting Fear of travel during COVID-19 pandemic reduces arrivals Increase in blanket opposition to all wildlife trade
International aid	<ul style="list-style-type: none"> ~US\$833 million from 2010–2016 to combat illegal wildlife trade, of which ~US\$609 million to PA management estimated for the period 2000–2009 for the whole continent⁷⁴ Makes up an average of 32% of the management budget of PAs in Africa, up to 70–90% in some countries¹¹. >US\$6 million from the Association of Zoos and Aquariums members to African species in 2018⁷⁵ 	<ul style="list-style-type: none"> ~90% (~US\$3 million) of Northern Rangelands Trust's budget supporting 39 community conservancies across 42,000 km² (ref. ⁷⁶) ~25% (US\$3.35 million) of Gorongosa National Park's 2019 budget from bi- and multilateral cooperation partners⁷⁷ 40% (US\$120 million) of World Wildlife Fund's global budget from individual donors⁷⁸ ~35% (US\$12 million) of African Wildlife Foundation's 2019 budget from individual donors, ~30% (US\$10 million) from public sector donors⁷⁹ ~32%, 25% and 23% of Africa Parks' 2018 budget of US\$50 million donated by public institutions, individuals and foundations, respectively, supporting 15 parks across 105,000 km² in 9 countries⁸⁰ 58% (~US\$8 million) of Gorongosa National Park's 2019 budget from foundations, philanthropy and donations⁷⁷ >US\$11 million for Sheldrick Wildlife Trust in 2018–2019⁸¹, donated by individuals, corporations, private foundations and public charities, supporting PA management, lease fees, community education and outreach, and veterinary assistance across Kenya 	<ul style="list-style-type: none"> Economic recession reduces aid budgets Focus shifts to humanitarian and financial crisis relief
Philanthropy <ul style="list-style-type: none"> Individuals Corporations Foundations Zoos 	<ul style="list-style-type: none"> Makes up an average of 32% of the management budget of PAs in Africa, up to 70–90% in some countries¹¹. >US\$6 million from the Association of Zoos and Aquariums members to African species in 2018⁷⁵ 	<ul style="list-style-type: none"> 40% (US\$120 million) of World Wildlife Fund's global budget from individual donors⁷⁸ ~35% (US\$12 million) of African Wildlife Foundation's 2019 budget from individual donors, ~30% (US\$10 million) from public sector donors⁷⁹ ~32%, 25% and 23% of Africa Parks' 2018 budget of US\$50 million donated by public institutions, individuals and foundations, respectively, supporting 15 parks across 105,000 km² in 9 countries⁸⁰ 58% (~US\$8 million) of Gorongosa National Park's 2019 budget from foundations, philanthropy and donations⁷⁷ >US\$11 million for Sheldrick Wildlife Trust in 2018–2019⁸¹, donated by individuals, corporations, private foundations and public charities, supporting PA management, lease fees, community education and outreach, and veterinary assistance across Kenya 	<ul style="list-style-type: none"> Economic recession reduces philanthropic spending³⁸ Focus shifts to humanitarian and financial crisis relief Zoo closures limit income and conservation spending (215 of 238 American zoos and aquariums closed as of 23 March 2020⁸²; US museum and zoo community requesting US\$4 billion support⁸³)
Domestic expenditure	<ul style="list-style-type: none"> Variable, but often low 	<ul style="list-style-type: none"> ~50% (US\$30 million) of Kenya Wildlife Service's budget from national government⁶⁹ Only 3% of African Parks' 2018 operational budgets from national governments⁸⁰ 	<ul style="list-style-type: none"> Local economic recessions reduce national budgets Governments shift focus to humanitarian and financial crisis response and healthcare infrastructure

Funding from international aid is higher than estimated because spending has increased since previous estimates^{17,74} and estimates are not exhaustive. No comprehensive estimate for domestic governmental expenditure exists.

Wildlands and conservation areas provide critical resources for local people who benefit from using wildlife, grass, water, firewood and non-timber forest products. During times of distress such as economic downturns, people rely more heavily on such resources¹². In addition, Africa's wildlife provides important cultural and heritage values for multiple ethnic groups, and charismatic species have extensive symbolic value internationally¹³. Africa's wildlife also holds considerable 'existence' value—the value people derive from simply knowing it exists¹⁴.

The state of African conservation

The backbone of African conservation efforts is made up of 7,800 terrestrial PAs covering 5.3 million km², ~17% of the continent's land area¹⁵. PA coverage in some countries (notably in southern and East Africa) far exceeds the global average. In parts of Africa, vast transfrontier conservation areas transcend national borders, creating protected landscapes spanning hundreds of thousands of square kilometres. Most PAs are state-owned and managed by government wildlife authorities, often with substantial support from tourism and

hunting operators¹⁶. Increasingly, conservation NGOs and private sector entities cooperate with governments to manage state-owned PAs through collaborative management partnerships (CMPs)¹⁷. In addition, conservation efforts on private and community lands have grown in recent years^{18,19}, expanding wildlife habitat, buffering PAs, reducing edge-effects, improving ecosystem representation, securing seasonal migration areas, and meaningfully engaging and benefiting rural communities that live with wildlife^{20–22}. In Namibia, community conservancies account for 170,000 km², and in South Africa, game ranches cover 205,000 km², both exceeding the land area encompassed by state PAs^{19,23}. Community-based conservation (CBC) programmes have grown in the last 20 years, supporting millions of rural African livelihoods^{22,24}.

Despite impressive political commitment to conservation in Africa, the continent suffers severe and persistent funding shortages that hinder management effectiveness. Africa's state-owned savannah PAs with lions face recurrent budget deficits of US\$1.2 billion per annum, rendering wildlife susceptible to threats, while forest PAs are likely no better protected¹¹. Key threats include habitat loss, degradation, fragmentation, encroachment, poaching and climate change^{25–27}. These factors, combined with poor governance, poverty, increasing human populations and illegal wildlife trade, continue to drive wildlife declines across the continent^{11,28–30}. In particular, the loss of large mammals compromises ecosystem function^{31,32}. Thus, with few localized exceptions, African conservation was in crisis even before COVID-19 hit. The pandemic could amplify the crisis to catastrophic effect.

Environmental impacts of the COVID-19 crisis

Researchers have documented some positive environmental outcomes of the COVID-19 pandemic. For example, reduced industrial activity and mechanized transport have lowered emissions and air pollution worldwide³³. Some Asian countries (notably China and Vietnam) have taken steps to restrict trade that threatens wildlife. If regulated and enforced over the long term, such restrictions could reduce poaching in Africa for illegally sourced products that supply Asian markets. Gabon has banned consumption of bats and pangolins following the COVID-19 crisis³⁴. Transport restrictions due to lockdowns may curb trade in wildlife products and provide respite for PAs that suffer negative impacts of tourist congestion.

These positive environmental outcomes are likely temporary and prone to reversal when travel restrictions ease and countries return to business as usual. We argue that the net environmental impact of the COVID-19 crisis in Africa will be strongly negative because the crisis creates a 'perfect storm' of reduced funding, lower conservation capacity, and increased threats to wildlife and ecosystems (Fig. 1). Wildlife conservation arguably faces its most serious challenge in decades.

Reduced conservation funding

Governments face severe budget crises driven by the economic fallout of the COVID-19 pandemic and the cost of relief measures. Shortages will compel policymakers to cut anything perceived as 'non-essential'⁴. African wildlife authority budgets, already grossly inadequate, risk being slashed further, jeopardizing wildlife and wildlands.

Compounding these effects is the continent-wide collapse of wildlife-based tourism due to travel restrictions and traveller concerns (Fig. 2; Table 1). While previous shocks, for example, the 2014 Ebola epidemic and the 2008 financial crisis, markedly reduced tourism in some African countries, the negative, continent-wide impacts of COVID-19 on the industry are unprecedented in scale and severity³⁵. Some 90% of African tour operators have experienced >75% declines in bookings³⁶. Because tourism is the largest contributor to PA financing in some countries, lost revenues have major ramifications for state wildlife authorities, private concessionaires

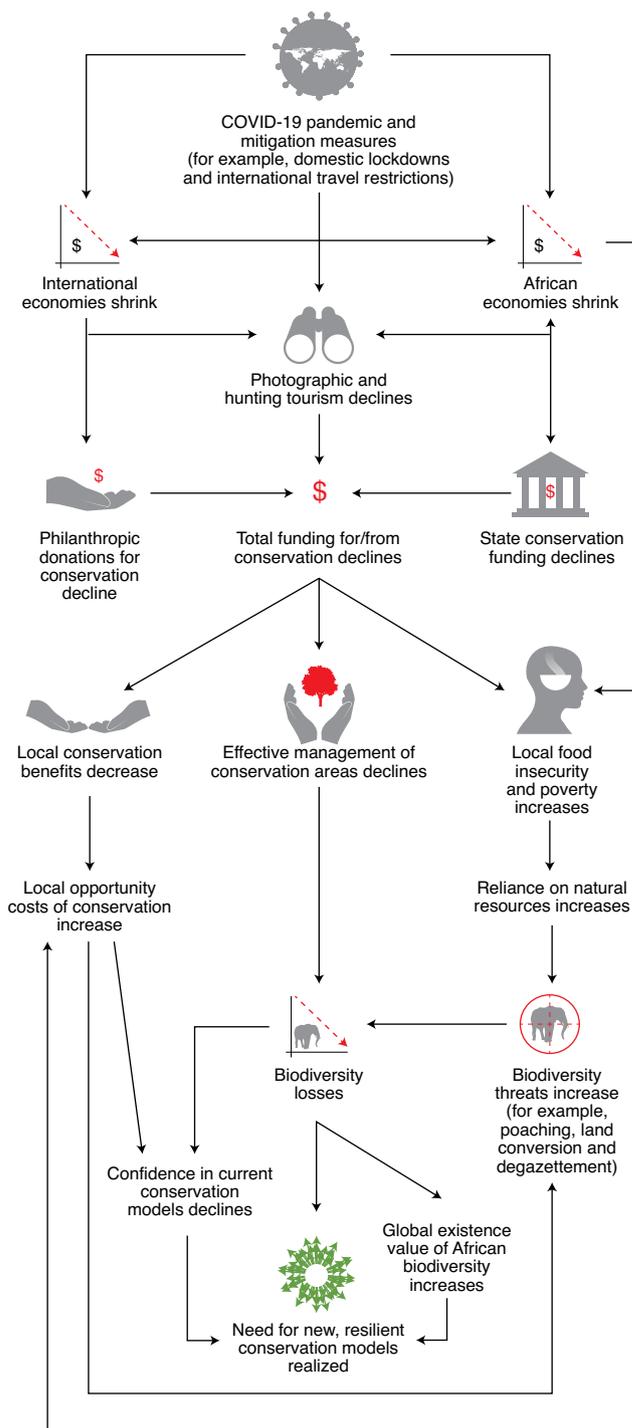


Fig. 1 | Schematic of the potential cascading impacts of COVID-19 on conservation in Africa. Arrows indicate the directionality of potential impacts among different elements in Africa's conservation framework.

and landowners, and community conservation programmes (Figs. 1 and 2)³⁷. Decreasing tourism revenue threatens millions of jobs and peripheral industries, severely impacting the livelihoods of some of the continent's poorest people (Box 1). For nations less reliant on wildlife tourism for conservation (for example, in the forest biome), the impact will be lower. However, if the industry is slow to bounce back, under-visited PAs developing nascent tourism products may be the last to see visitors.

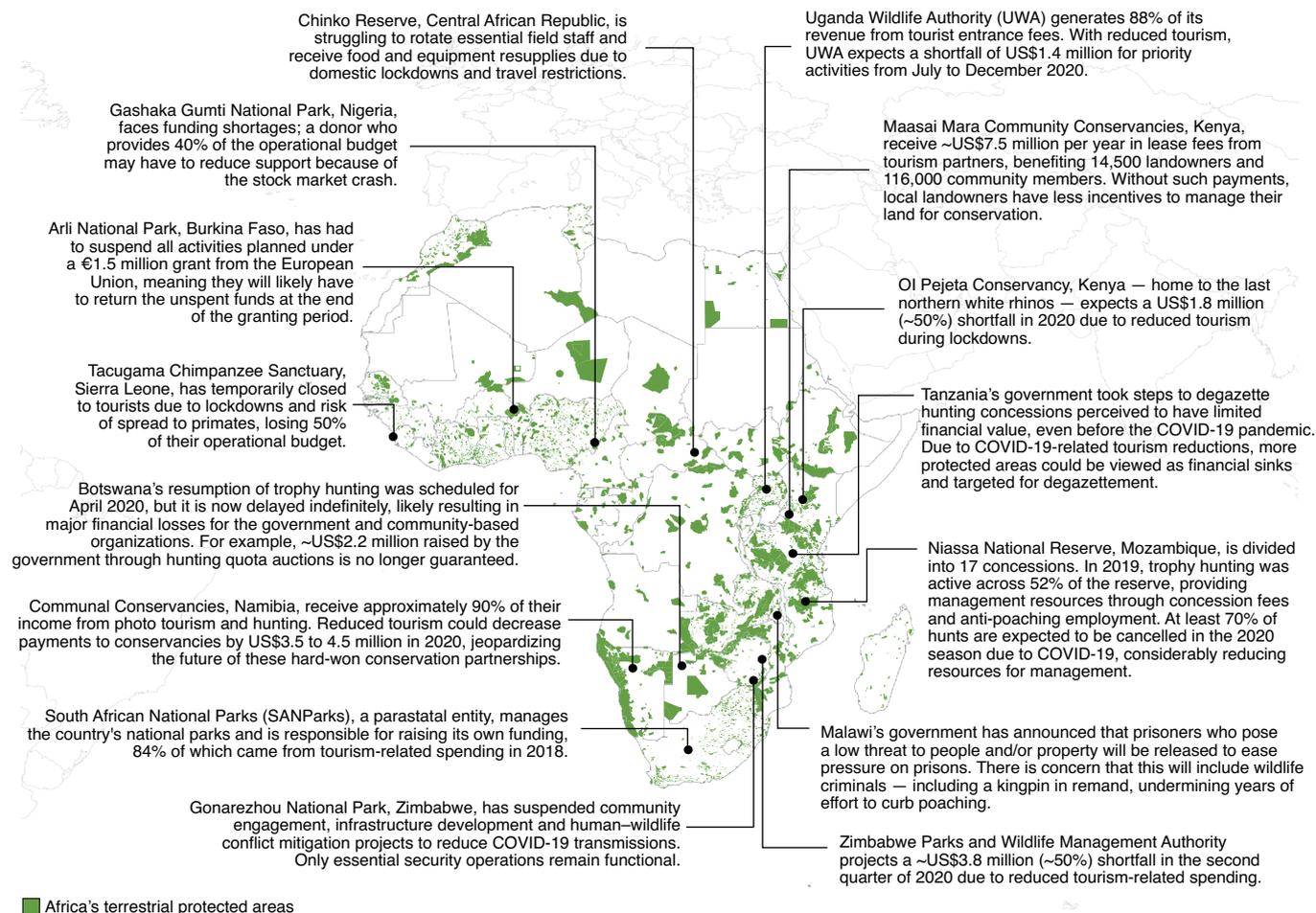


Fig. 2 | Examples of realized and potential impacts of COVID-19 on conservation in Africa, as of April 2020. 'Africa's terrestrial protected areas' refers to all nationally gazetted, terrestrial protected areas in Africa¹⁵. The source of each example is shown in Supplementary Table 1.

Beyond tourism revenue losses, we expect reduced donor funding for African conservation over the next 1–2 years and possibly longer due to flagging economies and shifting priorities. During the previous global financial crisis, total charitable giving in the United States dropped by 7% in 2008 and 6.2% in 2009³⁸, and conservation endowments declined in value by 40%³⁹. The current economic downturn and stock market volatility, to an even greater degree, may reduce capacity of private donors, corporations and foundations to give philanthropically. Restrictions on travel and gatherings have caused cancellation and postponement of key conferences and conservation fund-raising events. Many zoos are closed, and reduced revenues will likely limit support for in situ conservation efforts. The pandemic will also shift focus from conservation towards humanitarian causes. Some bi- and multilateral donor agencies increased funding to developing countries in response to the 2008 financial crisis⁴⁰, but the extent of the current economic and humanitarian challenges is such that any additional funding would likely be directed at those realms. Some emergency conservation funding is being organized in response to the crisis³⁶, though it will likely fall far short of offsetting losses.

Impaired conservation operations

Reduced funding is likely to constrain the ability of conservation practitioners to manage PAs and other conservation landscapes, force lay-offs of key staff, and prevent purchase of critical supplies³⁵ (Figs. 1 and 2, Box 1). In addition, COVID-related restrictions on

people's movements undermine the ability of practitioner agencies to undertake their conservation work, as reported by the author group's extended network of field colleagues (Figs. 1 and 2). Some lockdown policies in African countries prevent all but 'essential services'. Generally, anti-poaching seems to be permitted, but rotating staff and supplying field rangers with essential consumables may be disrupted, resulting in exhaustion and reduced morale of rangers (Figs. 1 and 2). Policies that prevent operations and activities deemed non-essential could have considerable impacts on community conservation, which often relies on regular meetings, interactions and collaboration among a variety of actors, often without access to remote communication technology (Box 1).

Increased conservation threats

Natural resources and the ecosystems that produce them face heightened pressure due to the COVID-19 pandemic. Plummeting tourism revenue and negative economic impacts of the pandemic will likely increase rural poverty. Simultaneously, COVID-19-related restrictions and budget constraints will impair conservation operations. Consequently, as detailed in Fig. 1 and Box 1, we expect increased poaching, tree cutting, artisanal mining, PA encroachment, agricultural conversion and possibly the ultimate degazettement of the most-affected PAs. With many ecosystems and wildlife populations already near tipping points, the current crisis may result in population declines, local extinctions of some species, and intensified disruptions of ecological processes⁶.

Box 1 | Impact of COVID-19 on local communities and conservation threats

People living on the periphery of PAs are often food-insecure, neglected by governments and heavily dependent on natural resources⁹⁶. However, they are the users of and potential custodians of natural resources. They bear costs of conservation (for example, through human–wildlife conflict, exclusion from natural resources, and, in some cases, loss of land), often without receiving commensurate benefits. For several decades, community-based conservationists have tested economic and engagement models to empower local communities to own and manage natural resources in the ecosystems where they live⁹⁷.

The COVID-19 crisis challenges these models. Impacts on community-based conservation and the tourism industry have massive economic implications for communities³. Loss of tourism and trophy hunting revenue can increase opportunity costs of conservation and the risk of land conversion. The sudden loss of wildlife-based revenue could erode communities', private landowners', and even governments' confidence in wildlife conservation as a reliable land-use option. Movement restrictions and social-distancing rules curtail engagement between conservation groups and communities, compromising hard-won trust with local people⁹⁸.

Besides the loss of tourism revenue, rural communities face financial hardship from the wider economic turmoil wrought by the COVID-19 pandemic and governmental responses. In some areas, livestock markets have closed, cutting off revenue streams for rural communities. Nearly 20 million jobs are at risk on the continent if the crisis continues³. Following lockdown-driven unemployment, people may return to rural homes, as has been observed for transnational labourers, many of whom returned to communities next to PAs near international borders⁹⁹.

Increased poverty and food insecurity will likely increase conservation threats. In the absence of financial capital reserves, food-insecure rural Africans could be attracted to the periphery



Homesteads at the periphery of the unfenced Gonarezhou National Park, Zimbabwe, Great Limpopo Transfrontier Conservation Area; 2009. Credit: Alexandre Caron

of PAs to draw upon natural resources¹⁰⁰. Anticipated effects include increased poaching, tree cutting for timber and charcoal, artisanal mining, PA encroachment by people and livestock, and conversion of natural habitat¹⁰¹. We expect the threat posed by the increase in consumption of bushmeat to be particularly severe, with anecdotal evidence reported from Tsavo East National Park (<https://go.nature.com/32rNQYH>). These threats will coincide with reduced funding, operational ability, and field presence of community conservancies, state wildlife authorities, private landowners, conservation NGOs, and tourism and hunting companies.

Following the emergency response to the crisis in the periphery of PAs, new models linking conservation and local development will be needed.

Risk of future outbreaks due to human impacts on nature

The COVID-19 pandemic, like the SARS-CoV 1 and Ebola epidemics, likely originated from human consumption of wild animals. Live wildlife markets create opportunities for pathogens to infect naïve domestic species or humans and trigger new diseases^{41,42}. In Africa, particularly in the tropical forest biome, bushmeat markets expose human populations to species identified as high risk for pathogen spillover, such as primates, bats and rodents⁴³. The combined effects of reduced conservation efforts and increased poverty could create a positive feedback loop where intensified reliance on natural resources spurs human encroachment into natural habitats, increases exposure to and consumption of wild animals, and amplifies future pandemic risks⁴⁴. Conversely, effective conservation of species and habitats has been directly linked to decreases in the number of viruses that animals share with humans⁴⁵. Adapted disease surveillance systems, especially for the wildlife–domestic–human interface, need to be developed and supported in emergence hotspots⁴⁶.

How can the world mitigate these risks?

The conservation crisis facing Africa must not be overlooked, even as governments and NGOs respond to the health and humanitarian crisis. While the current focus on health and the economy is critical, a longer-term perspective is vital. Supporting conservation efforts will help national and local African economies recover from the devastating impacts of COVID-19 by diversifying and bolstering economies, creating employment for rural citizens, and protecting

ecosystem services. Safeguarding wild habitats against encroachment can also help tackle a key root cause of emerging zoonotic diseases, lessening future pandemic risks. Reducing support for African conservation at this critical juncture could undo decades of progress. Here, we describe steps necessary to safeguard African wildlife and landscapes and associated rural populations during and beyond the COVID-19 crisis. We outline actions needed to (1) manage the immediate crisis; (2) tackle environmental destruction and address the ongoing threats of habitat destruction and illegal, unsustainable and/or unsafe wildlife trade; and (3) address systemic flaws in the current conservation model.

1. Manage the immediate crisis. African conservation will flounder unless the international community intervenes to provide crisis funding, recognizing conservation as an essential service and PAs as global public goods. The developed world is rapidly implementing mechanisms to bail out impacted businesses and industries, which in the United States runs into trillions of dollars. However, cash-strapped governments in developing countries lack such potential. Furthermore, no such mechanisms exist for supporting conservation specifically. Donors could unite to create an emergency fund for struggling wildlife authorities, communities, private landowners and conservation NGOs. In addition, key industries underpinning conservation efforts, such as tourism, need support, both via tax breaks and direct financial assistance, provided they can demonstrate ongoing investment into protection of the wildlands on which they depend. Realistically, the developed world

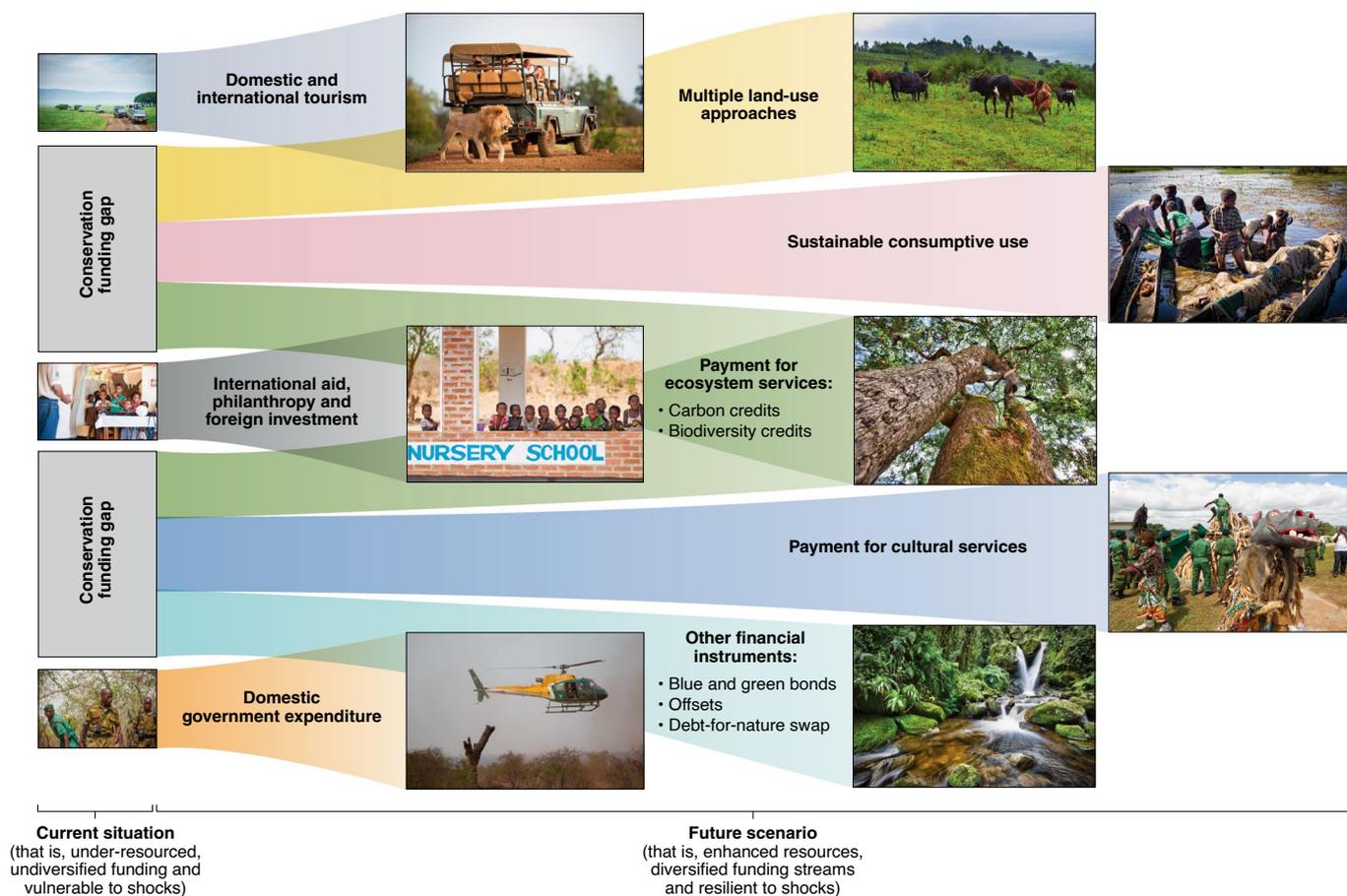


Fig. 3 | Conservation funding in Africa is insufficient, lacking diversity and vulnerable to shocks like the COVID-19 pandemic. Enhancing the magnitude and diversity of funding could increase resilience and efficacy. For more detail, see Table 2. Photograph credit: Morgan Trimble.

would have to be the primary source of such funding, from multi- and bilateral institutions, corporations and the public. International philanthropic foundations have an opportunity to intervene, make a transformational difference to conservation in Africa and help avert disaster.

Business as usual will not be possible for most conservation practitioners during the crisis. They will require strategic planning to prioritize critical activities and minimize risks of ‘overstretching’. They should emphasize maintaining crucial operations and retaining as many members of staff as possible, such that they can expand again when the crisis abates. Conservation practitioners and large NGOs in particular must cut wastage and excesses. NGOs should prioritize salaries for staff in Africa where possible, noting that salary protection schemes do not generally exist on the continent.

2. Defend against future disease outbreaks by regulating wildlife trade and minimizing habitat loss. China and Vietnam have taken steps to restrict trade and consumption of wildlife in response to the COVID-19 outbreak. Worldwide, governments and organizations should improve regulations and enforce existing laws to clamp down on unsafe wildlife trade practices that jeopardize human health or conservation objectives. Trade restrictions should be appropriate, proportionate and enacted with local buy-in and political commitment. Otherwise, unsustainable or dangerous trade may resume as soon as the immediate crisis abates. Efforts to stamp out unsafe and unsustainable practices should not, however, undermine legal components of the wildlife trade industry that are or could be well regulated, pose a controlled disease-transmission risk and support millions of livelihoods⁴⁷.

In addition to addressing the disease-transmission risk of the wildlife trade, governments and organizations should tackle the other critical drivers of infectious disease emergence including habitat destruction, which can be driven by industrial livestock production^{44,48}. In forest regions of the continent, logging and mining are encroaching into remote areas^{49,50}, likely facilitating disease spread into and amongst human populations, as seen in the Amazon⁵¹. Forest regions urgently require flexible funding mechanisms to prevent the sale of forest concessions and construction of development corridors through and unsustainable resource extraction from natural habitats. Such steps could also help protect Indigenous peoples from disease and from losing ancestral lands.

3. Address systemic flaws in the structure and function of conservation in Africa. The COVID-19 crisis has highlighted the fragility of conservation efforts in Africa and has exposed fundamental shortcomings (Fig. 3).

Baseline funding for conservation from African governments is simply inadequate. Many nations struggle with high poverty rates and do not have the luxury and the wealth to conserve African wildlife and wildlands alone. Currently, overreliance on short term, ad hoc external funding streams (including philanthropy) is unsustainable and insecure. Many PAs rely on a single, inadequate funding source. Tourism is a promising but insufficient source of conservation funding. Some African countries’ overreliance on international tourism to support conservation creates vulnerability to stochastic events. Few hold sufficient funds in reserve to finance conservation operations through hard times. Other countries do not benefit substantially from wildlife-based tourism at all (Fig. 4). Where tourism

Table 2 | Mechanisms to generate funding for conservation in Africa

	Funding source	Rationale	Steps to unlock or improve revenue stream	Examples
Diversify revenue streams from wildlife-friendly land use	Multiple land-use approaches (for example, livestock co-management)	When managed correctly, livestock can create resilient income for private and community landowners, while achieving ecological goals ^{22,61} .	Encourage and support competent governance systems and institutions working at appropriate spatial scales to ensure sustainable rangeland management in and around PAs, where applicable	OI Pejeta Conservancy, Kenya
	Sustainable consumptive use of wildlife	Revenue gained from sustainable consumptive use of wildlife (for example, game meat and trophy hunting) can provide income for local communities and wildlife authorities.	Where appropriate, devolve rights over wildlife to the lowest possible level, incentivizing landowners to sustainably manage their wildlife resources; ensure accountability, good management and transparency	Conservancies in Zimbabwe, Namibia's community conservancies, and well-managed state-owned concessions across multiple countries (noting that by no means all concessions are well managed)
	International tourism	Only a handful of African countries earn substantial tourism revenue to fund conservation, but many have potential.	Invest in infrastructure and protect wildlife assets, while developing enabling environments for tourism ^{55,73}	Botswana, Rwanda and others
	Domestic tourism	Domestic tourism may be less susceptible to global economic shocks and travel restrictions; growth could increase local and regional support for conservation efforts ⁵⁸ .	Increase domestic marketing, reduce barriers to access, offer prices and packages tailored to locals.	Nairobi National Park, Kenya
Increase domestic expenditure	Domestic government expenditure	Few nations invest in their PAs, yet PAs can contribute considerably towards national GDP and employment and provide ecosystem services.	Consider identifying a set budgetary allocation for the protection of nature, similar to the 2003 Maputo Declaration on Agriculture and Food Security; support alignment between development and conservation expenditure	In northern Kenya, research suggests economic returns from investment in conservation could exceed those from road construction ⁸⁴
	Endowments	Endowments can help buffer the risk of critical losses of operating revenue during financial crises and provide budget stability and continuity	Encourage governments, particularly those in the developed world, to help establish and fund national endowments to manage natural assets	~100 conservation endowments across 60 countries globally and at least 14 in southern and 93 in East Africa
	Financial instruments (offsets, blue and green bonds)	Rapid development in Africa risks widespread environmental degradation, but infrastructure- and resource extraction- offsets present enormous financial opportunities for conservation.	Consider mandating and improving mechanisms for offset payments to generate sustainable revenue to fund PA networks.	Construction of South African United Pulp Mill, and land set aside for new PAs
Increase international funding	Foreign investments and partnerships for PA management	Investments and collaborative management partnerships in PAs have increased in recent years, driven by substantial foreign investment and vastly improving conservation performance of some PAs ^{17,24}	Create enabling political and regulatory environments to attract investors and partners to help manage and support PAs and community lands	African Parks' network of PAs; Gorongosa National Park, Mozambique; Gonarezhou National Park, Zimbabwe
	Payments for ecosystem services	Carbon credits, one example of payments for ecosystem services, can help tackle both the climate and biodiversity crises ⁸⁵ , especially efforts focused on securing critical wilderness areas, including PAs ⁸⁶	Formalize, scale up, and require mechanisms for such payments for carbon emitters and adapt to include payment for standing carbon as well as avoided losses	Wildlife Works, Tsavo, Kenya (www.wildlifeworks.com)
	Payment for cultural services	Globally, branding, advertising, television, film and products make wide use of wildlife, including many endangered African species; corporations that derive profit from wildlife could contribute to ensure their persistence in the wild ⁸⁷	Encourage industry and business to contribute each time an animal appears in their adverts or media to raise money for wildlife conservation, habitats and animal welfare	Lion's Share Fund (www.thelionssharefund.com)
	Debt-for-nature swaps	Many countries are highly indebted with debt repayments consuming 22% of the continent's budgets ⁴ , and a comprehensive debt moratorium could release up to US\$50 billion ⁸⁸ ; Debt-for-nature swaps could forgive debt while mandating local investment in natural assets.	Adapt support for debt forgiveness ⁸⁹ to include directives to invest in conserving natural assets	Trialled in the Seychelles ⁹⁰

None of these funding sources are panaceas, and for many, logistical, ethical, social and ecological constraints may limit broad-scale application.

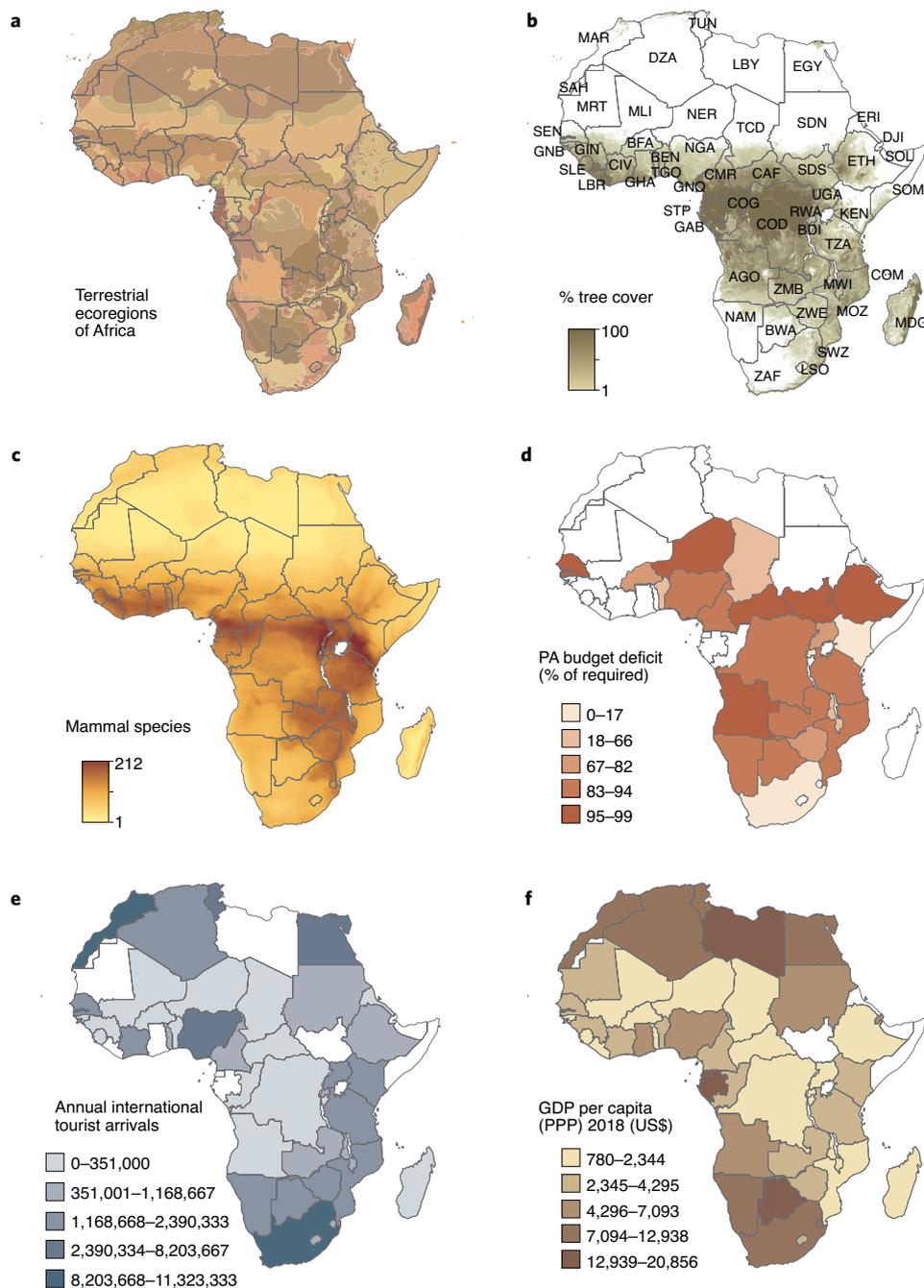


Fig. 4 | Heterogeneity of the African continent will shape the socioeconomic and environmental impacts of the COVID-19 pandemic and the appropriate response from conservation stakeholders. **a**, The terrestrial ecoregions of Africa⁹¹. **b**, Percentage tree cover with >10% canopy density in 2000⁹² (source: Hansen/UMD/Google/USGS/NASA). Countries are labelled with their ISO-3 codes. **c**, Mammal species richness⁹³. **d**, Funding deficits of national protected area networks in African lion range states⁹⁴. **e**, The average number of annual international tourist arrivals to African countries from 2016–2018⁹⁵. **f**, The GDP per capita (corrected for purchasing power parity (PPP)) in current US dollars of African countries in 2018⁹⁵. In **d–f**, countries are filled white where data were unavailable, and values were classified using the Jenks natural breaks method.

does flourish, the communities bearing the costs of wildlife often receive negligible benefits, disincentivizing conservation.

There is also a lack of sufficient, long-term, systematic support for African conservation from the Global North, who benefit considerably from Africa’s wildlife and lands, without contributing sufficiently towards its costs. Relative to their wealth, some African countries carry a disproportionately high burden from their conservation efforts and so, the international community should provide support

at commensurate levels, recognizing that Africa’s natural treasures are global assets; environmental services from Africa benefit the world through carbon sequestration; and African ecosystems play a critical role in safeguarding human mental and physical health^{11–13,52}.

Most fundamentally, there is insufficient alignment between conservation and human-development agendas. Here, we outline emerging opportunities to rethink and restructure conservation funding in Africa to improve long-term resilience (Fig. 3).

Increase the resilience of conservation. Africa is diverse, presenting an array of contexts in which conservation must be practised. Thus, the solutions we suggest must be tailored appropriately (Fig. 4).

3a. Recognize the reliance of development on natural assets. Effective long-term conservation in Africa depends on finding sufficient funding and building political and public will. Aligning conservation and development interests could help on both fronts. African economies depend considerably on ecosystem services, so this alignment can be supported in several ways, for example:

- (i) Quantify the value of natural assets and ecosystem services and incorporate those values into national budgets, balance sheets, and planning for natural resource use to reinforce the value of conservation.
- (ii) Position PAs in their broader landscapes as hubs for local development, service provision and even disaster relief. This has been achieved via collaborative management partnerships for some African PAs^{17,24}.
- (iii) Properly engage local people as stakeholders in conservation. Inside PAs, create forums that enable communities to participate in PA governance and ensure communities benefit from tourism to strengthen engagement. Outside PAs, promote policies that devolve resource and wildlife utilization rights to communities to support sustainable management and strengthen institutions that allow communities to optimize their economic opportunities⁵³.
- (iv) Encourage conservation organizations to work with development specialists on visible support for core community livelihoods, such as livestock and crop production, thereby earning public backing and increasing resilience of local communities to shocks such as the COVID-19 pandemic²². For example, if conservation organizations provide security or markets for livestock, local people would link those benefits to conservation; the 'herding for health' programme is testing this approach in northern Kenya and southern Africa⁵⁴.

3b. Support African civil society conservation efforts. With international conservation organizations limited by travel restrictions, there is an opportunity for national conservation organizations and civil society efforts to fill gaps. International partners should support local people and services by providing funding and sharing expertise remotely. Once the crisis has subsided, local conservation capacity will have increased and could continue to be supported, together with revived efforts by international NGOs.

3c. Diversify revenue-generating options from wildlife areas. The volatility of international tourism and decline in trophy hunting demonstrate the need to create local revenue streams that are resilient to global shocks (Fig. 3, Table 2). Only a handful of African countries earn substantial wildlife tourism revenue¹⁶. Others need to unlock tourism potential by investing in infrastructure and wildlife protection and creating an enabling environment for tourism^{55,56} (Fig. 3, Table 2). Conversely, some southern and East African nations heavily reliant on international tourism should foster domestic tourism to increase resilience to global shocks and build longer-term public support for conservation^{57,58}. With the trophy hunting industry apparently waning, due in part to pressure from Western anti-hunting advocates, PAs that currently depend on trophy hunting revenue should seek alternative income streams⁵⁹. Given the existing serious funding deficits for conservation in Africa (Fig. 4), collapse of the trophy hunting industry in the absence of alternatives carries grave ramifications for conservation across vast areas^{16,59}. Wealthier countries must contribute towards alternative and improved revenue-generating mechanisms to help pay for the management and opportunity costs of Africa's vast network

of semi-protected areas. In some contexts, livestock or sustainable use of wildlife can be compatible with conservation^{60,61}. In South Africa, a biodiversity economy strategy promotes bioprospecting and game ranching for hunting and meat-, skin- and leather exports as key revenue streams complementing eco-tourism⁶². Africa is developing at a rapid pace, and governments should use the 'biodiversity mitigation hierarchy' to diminish ecological damage and mandate offset payments to generate sustainable revenue for conservation⁶³.

3d. Increase domestic expenditure. Ultimately, for wildlife and wildlands to deliver on their economic potential, African governments must invest sufficiently to protect their own assets. After the crisis subsides, African nations could identify a set budgetary allocation for the protection of nature, similar to the 2003 Maputo Declaration on Agriculture and Food Security. National governments could also establish endowment funds with the help of foreign investment, mandate a biodiversity mitigation hierarchy, and develop green and blue bonds.

3e. Increase international funding. While greater domestic investment is desirable, substantially more financial support is needed beyond this. Emerging mechanisms for international governments, corporations, individuals and NGOs to provide funding include investments in PAs and community land, payments for ecosystem and cultural services, and debt-for-nature swaps (Table 2).

3f. Improve revenue distribution mechanisms. Africa needs improved mechanisms to effectively generate and disburse wildlife-related revenue and offset the opportunity, indirect and direct costs of wildlife. Such mechanisms need to recognize the role of governments, private landowners, and communities in Africa as custodians of global wildlife assets. Examples include: (1) direct payments by wealthy countries to African nations for setting aside wilderness, such as the payments made by Norway to Gabon⁶⁴; (2) land leases, whereby land is leased from owners and set aside for conservation to prevent conversion to less biodiversity friendly land use, as occurs, for example, in conservancies around the Maasai Mara⁶⁵; (3) biodiversity stewardship programmes that pay or incentivize landowners to practice conservation-friendly land management; (4) performance payment schemes that reward local people for conserving wildlife (as is being trialled in Mozambique, Namibia and Tanzania, for example, <http://wildlifecredits.com>); (5) 'conservation basic incomes' that compensate communities who protect nature⁶⁶; and (6) schemes and actions that reduce the cost of coexisting with wildlife⁶⁷.

Conclusions

The COVID-19 crisis threatens conservation efforts in Africa with a 'perfect storm' of reduced conservation funding, depleted management capacity, collapse of community-based natural resource management enterprises, and elevated threats. The crisis demands a concerted international effort to protect and support Africa's wildlife and wildlands and people that are dependent on them. African governments, the international community, donors and conservation practitioners should collaborate through decisive effort and adaptive management to minimize negative impacts. At this critical juncture, business as usual could be catastrophic, but decisive and collaborative action can ensure that Africa's wildlife survives COVID-19 and that more resilient conservation models benefit humans and wildlife for generations.

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References

1. COVID-19 Dashboard (JHU CSSE, 2020); <https://go.nature.com/39lfrey>

2. Ferguson, N., Laydon, D., Nedjati-Gilani, G. & Imai, N. *Impact of Non-Pharmaceutical Interventions (Npis) to Reduce COVID-19 Mortality and Healthcare Demand* (Imperial College London, 2020); <https://go.nature.com/3j8qjSv>
3. *Impact of Coronavirus (COVID-19) on the African Economy* (African Union, 2020); <https://icsb.org/covid19ontheafricaneconomy/>
4. Jayaram, B. K., Leke, A., Ooko-ombaka, A. & Sun, Y. S. *Tackling COVID-19 in Africa: An Unfolding Health and Economic Crisis that Demands Bold Action* (McKinsey & Company, 2020).
5. Wolf, C. & Ripple, W. J. Prey depletion as a threat to the world's large carnivores. *R. Soc. Open Sci.* **3**, 160252 (2016).
6. Ripple, W. J. et al. Collapse of the world's largest herbivores. *Sci. Adv.* **1**, e1400103 (2015).
7. *The Economic Impact of Global Wildlife Tourism - Travel and Tourism As An Economic Tool For The Protection Of Wildlife* (World Travel and Tourism Council, 2019).
8. Lindsey, P. A., Roulet, P. A. & Romañach, S. S. Economic and conservation significance of the trophy hunting industry in sub-Saharan Africa. *Biol. Conserv.* **134**, 455–469 (2007).
9. di Minin, E., Leader-Williams, N. & Bradshaw, C. J. A. Banning trophy hunting will exacerbate biodiversity loss. *Trends Ecol. Evol.* **31**, 99–102 (2016).
10. *Building a Wildlife Economy* (Space for Giants, UNEP & Conservation Capital, 2019); <https://go.nature.com/2ZDrwt2>
11. Lindsey, P. A. et al. More than \$1 billion needed annually to secure Africa's protected areas with lions. *Proc. Natl Acad. Sci. USA* **115**, E10788–E10796 (2018).
12. Galvani, A. P., Bauch, C. T., Anand, M., Singer, B. H. & Levin, S. A. Human–environment interactions in population and ecosystem health. *Proc. Natl Acad. Sci. USA* **113**, 14502–14506 (2016).
13. Stolton, S. & Dudley, N. *The New Lion Economy: Unlocking the Value of Lions* (Equilibrium Research, 2019); www.lionrecoveryfund.org/newlioneconomy
14. Macdonald, E. A. et al. Conservation inequality and the charismatic cat: *Felis felix*. *Glob. Ecol. Conserv.* **3**, 851–866 (2015).
15. *The World Database on Protected Areas (WDPA)* (UNEP-WCMC & IUCN, 2019); www.protectedplanet.net
16. Lindsey, P. A., Balme, G. A., Funston, P. J., Henschel, P. H. & Hunter, L. T. B. Life after Cecil: channelling global outrage into funding for conservation in Africa. *Conserv. Lett.* **9**, 296–301 (2016).
17. Baghai, M. et al. Models for the collaborative management of Africa's protected areas. *Biol. Conserv.* **218**, 73–82 (2018).
18. Mills, M. et al. How conservation initiatives go to scale. *Nat. Sustain.* **2**, 935–940 (2019).
19. Taylor, W. A., Lindsey, P. A., Nicholson, S. K., Relton, C. & Davies-Mostert, H. T. Jobs, game meat and profits: the benefits of wildlife ranching on marginal lands in South Africa. *Biol. Conserv.* **245**, 108561 (2020).
20. Western, D., Russell, S. & Cuthill, I. The status of wildlife in protected areas compared to non-protected areas of Kenya. *PLoS ONE* **4**, e6140 (2009).
21. Riggio, J., Jacobson, A. P., Hijmans, R. J. & Caro, T. How effective are the protected areas of East Africa? *Glob. Ecol. Conserv.* **17**, e00573 (2019).
22. Western, D. et al. Conservation from the inside-out: winning space and a place for wildlife in working landscapes. *People Nat.* **2**, 279–291 (2020).
23. *The State of Community Conservation in Namibia* (NACSO, 2018); <https://go.nature.com/30jMLiL>
24. Pringle, R. M. Upgrading protected areas to conserve wild biodiversity. *Nature* **546**, 91–99 (2017).
25. Strindberg, S. et al. Guns, germs, and trees determine density and distribution of gorillas and chimpanzees in Western Equatorial Africa. *Sci. Adv.* **4**, eaar2964 (2018).
26. Lindsey, P. A. et al. Underperformance of African protected area networks and the case for new conservation models: insights from Zambia. *PLoS ONE* **9**, e94109 (2014).
27. Ogutu, J. O. et al. Extreme wildlife declines and concurrent increase in livestock numbers in Kenya: what are the causes? *PLoS ONE* **11**, e0163249 (2016).
28. Craigie, I. D. et al. Large mammal population declines in Africa's protected areas. *Biol. Conserv.* **143**, 2221–2228 (2010).
29. Maisels, F. et al. Devastating decline of forest elephants in Central Africa. *PLoS ONE* **8**, e59469 (2013).
30. Robson, A. S. et al. Savanna elephant numbers are only a quarter of their expected values. *PLoS ONE* **12**, e0175942 (2017).
31. Dirzo, R. et al. Defaunation in the Anthropocene. *Science* **345**, 401–406 (2014).
32. Hempson, G. P., Archibald, S. & Bond, W. J. The consequences of replacing wildlife with livestock in Africa. *Sci. Rep.* **7**, 17196 (2017).
33. *Airborne Nitrogen Dioxide Plummets over China* (NASA Earth Observatory, 2020); <https://go.nature.com/397mtEl>
34. *Gabon Bans Eating of Pangolin and Bats amid Pandemic* (AFP, 2020).
35. Spenceley, A. *COVID-19 and Protected Area Tourism: A Spotlight on Impacts and Options in Africa* (World Trade Organization, 2020).
36. Hockings, M. et al. Editorial essay: COVID-19 and protected and conserved areas. *Parks* **26**, 7–24 (2020).
37. Spenceley, A., Snyman, S. & Eagle, P. F. J. *Guidelines for Tourism Partnerships and Concessions for Protected Areas: Generating Sustainable Revenues for Conservation and Development* (IUCN, 2017); <https://go.nature.com/3hapGpK>
38. Reich, R. & Wimer, C. *Charitable Giving and the Great Recession. Recession Trends* (Stanford Center on Poverty and Inequality, 2012).
39. Martin, M. *Managing Philanthropy after the Downturn: What is Ahead for Social Investment?* 10–21 (Viewpoint, 2010).
40. te Velde, D. W. & Massa, I. *Donor Responses to the Global Financial Crisis – A Stock Take* Global Financial Crisis Discussion Series (Overseas Development Institute, 2009).
41. Daszak, P., Cunningham, A. A. & Hyatt, A. D. Anthropogenic environmental change and the emergence of infectious diseases in wildlife. *Acta Tropica* **78**, 1–14 (2001).
42. Markotter, W., Coertse, J., de Vries, L., Geldenhuys, M. & Mortlock, M. Bat-borne viruses in Africa: a critical review. *J. Zool.* **311**, 77–98 (2020).
43. Olival, K. J. et al. Host and viral traits predict zoonotic spillover from mammals. *Nature* **546**, 646–650 (2017).
44. Di Marco, M. et al. Sustainable development must account for pandemic risk. *Proc. Natl Acad. Sci. USA* **117**, 3888–3892 (2020).
45. Johnson, C. K. et al. Global shifts in mammalian population trends reveal key predictors of virus spillover risk. *Proc. R. Soc. B* **287**, 20192736 (2020).
46. Jones, K. E. et al. Global trends in emerging infectious diseases. *Nature* **451**, 990–993 (2008).
47. Broad, S. *Wildlife Trade, COVID-19, and Zoonotic Disease Risks* (TRAFFIC, 2020).
48. Karesh, W. B. et al. Ecology of zoonoses: natural and unnatural histories. *Lancet* **380**, 1936–1945 (2012).
49. Edwards, D. P. et al. Mining and the African environment. *Conserv. Lett.* **7**, 302–311 (2014).
50. Kleinschroth, F., Healey, J. R., Gourlet-Fleury, S., Mortier, F. & Stoica, R. S. Effects of logging on roadless space in intact forest landscapes of the Congo Basin. *Conserv. Biol.* **31**, 469–480 (2017).
51. Castro, M. C. et al. Development, environmental degradation, and disease spread in the Brazilian Amazon. *PLoS Biol.* **17**, e3000526 (2019).
52. Green, J. M. H. et al. Local costs of conservation exceed those borne by the global majority. *Glob. Ecol. Conserv.* **14**, e00385 (2018).
53. Zahia, B. et al. Voices of the communities: a new deal for rural communities and wildlife and natural resources. in *Africa's Wildlife Economy Summit* 1–13 (UNEP, 2019).
54. Heyl, A. *Herd for Health* (Univ. Pretoria, 2017).
55. *Closing the gap. The financing and resourcing of protected and conserved areas in Eastern and Southern Africa. Jane's Defence Weekly* (IUCN ESARO, 2020).
56. Naidoo, R., Fisher, B., Manica, A. & Balmford, A. Estimating economic losses to tourism in Africa from the illegal killing of elephants. *Nat. Commun.* **7**, 13379 (2016).
57. *The Bio-economy Strategy* (Department of Science and Technology, 2013); <https://go.nature.com/2DLxAaw>
58. *Economic Crisis, International Tourism Decline and its Impact on the Poor* (World Tourism Organization & International Labour Organization, 2013); <https://go.nature.com/3hdpjKf>
59. Dickman, A., Cooney, R., Johnson, P. J., Louis, M. P. & Roe, D. Trophy hunting bans imperil biodiversity. *Science* **365**, 874 (2019).
60. Lindsey, P. A. et al. Benefits of wildlife-based land uses on private lands in Namibia and limitations affecting their development. *Oryx* **47**, 41–53 (2013).
61. Keesing, F. et al. Consequences of integrating livestock and wildlife in an African savanna. *Nat. Sustain.* **1**, 566–573 (2018).
62. *National Biodiversity Economy Strategy* (Department of Environmental Affairs, 2016); <https://go.nature.com/2B81bKt>
63. *The Mitigation Hierarchy* (Forest Trends, 2020); <https://go.nature.com/3h7Folf>
64. Dahir, A. L. Gabon will be paid by Norway to preserve its forests. *Quartz* (23 September 2019).
65. Bedelian, C. *Conservation and Ecotourism on Privatised Land in the Mara, Kenya: The Case of Conservancy Land Leases* LDPI Working Paper 9 (The Land Deal Politics Initiative, 2012).
66. Buscher, B. & Fletcher, R. Towards convivial conservation. *Conserv. Soc.* **17**, 283–296 (2019).
67. Dickman, A. J., Macdonald, E. A. & Macdonald, D. W. A review of financial instruments to pay for predator conservation and encourage human–carnivore coexistence. *Proc. Natl Acad. Sci. USA* **108**, 13937–13944 (2011).
68. Balmford, A. et al. Walk on the wild side: estimating the global magnitude of visits to protected areas. *PLoS Biol.* **13**, e1002074 (2015).

69. *Annual Report 2017* (Kenya Wildlife Service, 2017); <https://go.nature.com/3jdHli4>
70. *State of Wildlife Conservancies in Kenya* (KWCA, 2016).
71. Tumusiime, D. M. & Vedeld, P. False promise or false premise? Using tourism revenue sharing to promote conservation and poverty reduction in Uganda. *Conserv. Soc.* **10**, 15–28 (2012).
72. *Annual Performance Plan 2018/2019* (South African National Parks, 2018); <https://go.nature.com/32qNxx7>
73. Naidoo, R. et al. Complementary benefits of tourism and hunting to communal conservancies in Namibia. *Conserv. Biol.* **30**, 628–638 (2016).
74. *Analysis of International Funding to Tackle Illegal Wildlife Trade. Analysis of International Funding to Tackle Illegal Wildlife Trade* (World Bank Group, 2016); <https://doi.org/10.1596/25340>
75. *2018 Annual Report on Conservation and Science* (Association of Zoos and Aquariums, 2018); <https://go.nature.com/30n8Dd1>
76. *The Northern Rangeland Trust State of Conservancies Report 2018* (NRT, 2018).
77. *Our Gorongosa – A Park for the People* (The Gorongosa Project, 2019); <https://go.nature.com/393Wwpe>
78. *Financials* (WWF, 2019); <https://go.nature.com/30iFT5n>
79. *Consolidated Financial Statements* (African Wildlife Foundation, 2019); <https://go.nature.com/392BUOm>
80. *Annual Report - Unlocking the Value of Protected Areas* (African Parks, 2018); <https://www.africanparks.org/unlocking-value-protected-areas>
81. *2018 Annual Report* (Sheldrick Wildlife Trust, 2018).
82. *COVID-19 Update: Taking Action in Unprecedented Times* (Association of Zoos and Aquariums, 2020).
83. Lott, L. et al. *Aid for Museums Impacted by Coronavirus* (International Council of Museums, 2020).
84. Damania, R., Scandizzo, P. L., Mikou, M., Gohil, D. & Said, M. *When Good Conservation Becomes Good Economics: Kenya's Vanishing Herds* (The World Bank, 2019).
85. Malhi, Y. et al. Climate change and ecosystems: threats, opportunities and solutions. *Philos. Trans. R. Soc. B* **375**, 20190104 (2020).
86. Roberts, C. M., O'Leary, B. C. & Hawkins, J. P. Climate change mitigation and nature conservation both require higher protected area targets. *Philos. Trans. R. Soc. B* **375**, 20190121 (2020).
87. Good, C., Burnham, D. & Macdonald, D. W. A cultural conscience for conservation. *Animals* **7**, 52 (2017).
88. Munevar, D. *A Debt Moratorium for Low Income Economies* (Eurodad, 2020); <https://www.cadtm.org/A-debt-moratorium-for-Low-Income-Economies>
89. Lamble, L. Africa leads calls for debt relief in face of coronavirus crisis. *The Guardian* (25 March 2020).
90. *Seychelles Debt Conversion for Marine Conservation and Climate Adaptation* (Convergence, 2017).
91. Olson, D. M. et al. Terrestrial ecoregions of the world: a new map of life on Earth. *BioScience* **51**, 933–938 (2001).
92. Hansen, M. et al. High-resolution global maps change, 21st-century forest cover. *Science* **850**, 850–854 (2013).
93. Jenkins, C. N., Pimm, S. L. & Joppa, L. N. Global patterns of terrestrial vertebrate diversity and conservation. *Proc. Natl Acad. Sci. USA* **110**, E2603–E2610 (2013).
94. *International Tourism, Number of Arrivals* World Development Indicators (The World Bank, 2020); <https://go.nature.com/2CNGAva>
95. *GDP per capita, PPP (current international \$)* World Development Indicators (The World Bank, 2020); <https://go.nature.com/3h9zdxk>
96. Barrow, E. & Fabricius, C. Do rural people really benefit from protected areas - rhetoric or reality? *Parks* **12**, 67–79 (2002).
97. Dressler, W. et al. From hope to crisis and back again? A critical history of the global CBNRM narrative. *Environ. Conserv.* **37**, 5–15 (2010).
98. Mease, L. A., Erickson, A. & Hicks, C. Engagement takes a (fishing) village to manage a resource: principles and practice of effective stakeholder engagement. *J. Environ. Manag.* **212**, 248–257 (2018).
99. Chirindza, J. 23,000 Mozambicans return to the country in the last 24 hours. *O Pais* (26 March 2020).
100. Guerbois, C. & Fritz, H. Patterns and perceived sustainability of provisioning ecosystem services on the edge of a protected area in times of crisis. *Ecosyst. Serv.* **28**, 196–206 (2017).
101. Lindsey, P. A. et al. The performance of African protected areas for lions and their prey. *Biol. Conserv.* **209**, 137–149 (2017).

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Author contributions

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The authors declare no competing interests.

Additional information

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