



Anticipating the impacts of the COVID-19 pandemic on wildlife

The spillover of the coronavirus SARS-CoV-2 placed the relationship between humans and wildlife under a global spotlight. The subsequent fallout of the COVID-19 pandemic is now affecting wild animal populations and habitats through multiple pathways, with feedbacks that further impact human health and livelihoods. By disentangling these complex and interacting pathways, we can better understand the socio-ecological dynamics linking the people, wildlife, and ecosystems experiencing this shock. Such an understanding will facilitate the development and implementation of more effective responses to the current crisis, in part by informing the design of targeted policy interventions.

In a study published in *Frontiers in Ecology and the Environment* (Gaynor *et al.* 2016), we developed a framework for understanding how armed conflict affects wildlife populations and habitats through myriad pathways. While producing a range of unique environmentally destructive outcomes, armed conflicts can also create dynamics similar to those which have been seen during the COVID-19 pandemic: namely, profound disruptions to human communities, wildlife populations, and their interconnections. Here, we revisit our findings on

these pathways, emphasizing relevant analogs and lessons that may be transferable from war to the current COVID-19 pandemic, including the limitations of pathways leading to positive wildlife outcomes, concerns regarding weakened institutional support, and impacts of shifting wildlife use (Figure 1).

Positive outcomes of the COVID-19 pandemic for wildlife may occur when people cease their normal activities, as wild animals often flourish in areas that people avoid. This “refuge effect” has been documented in areas of armed conflict, such as North Korea’s demilitarized zone (Kim 1997). During the current pandemic, media accounts have documented cases of increased wildlife activity in national parks and urban green spaces as people have remained indoors (Zellmer *et al.* 2020), and there is evidence of reductions in wildlife–vehicle collisions in several states in the US (Nguyen *et al.* 2020). However, as we found in the case of armed conflict, the effects of the pandemic’s widespread institutional, social, and economic disruption on wildlife are likely to be overwhelmingly negative in most contexts. While benefits to wildlife are often transient, many of these negative impacts can persist over extensive temporal and geographic scales, compounded by interactions across pathways.

The COVID-19 pandemic is already weakening institutional support for conservation by interrupting funding streams, eroding protection of parks and vulnerable species, and forestalling vital

monitoring and research activities that make these impacts visible (Lindsey *et al.* 2020). As people reduce activity (including travel) to avoid or minimize transmission of SARS-CoV-2, reductions in tourism have led to critical revenue losses for parks around the world (Knorovsky 2020), and reductions in enforcement and human presence in protected areas have contributed to a rise in illegal activities like logging and hunting (Humphrey 2020). Conservation efforts may be further hampered by the economic downturn and associated withdrawal of governmental and philanthropic financial support, alongside the weakening and dismantling of environmental regulations under the guise of economic recovery (Davenport and Friedman 2020; Gonzales 2020). In our 2016 study, this weakening of conservation institutions represented the most important set of pathways linking armed conflict to wildlife, leading to marked wartime declines in animal populations (Daskin and Pringle 2018). The pandemic has reiterated – in the starkest terms – the lessons learned from previous catastrophes, including armed conflict: conservation and natural resource management efforts that invest in locally managed institutions are best situated to mitigate the negative impacts of the pandemic and foster resilience to future shocks.

Patterns of human migration and economic disruption associated with the COVID-19 pandemic are also likely to shift patterns of natural resource use, as

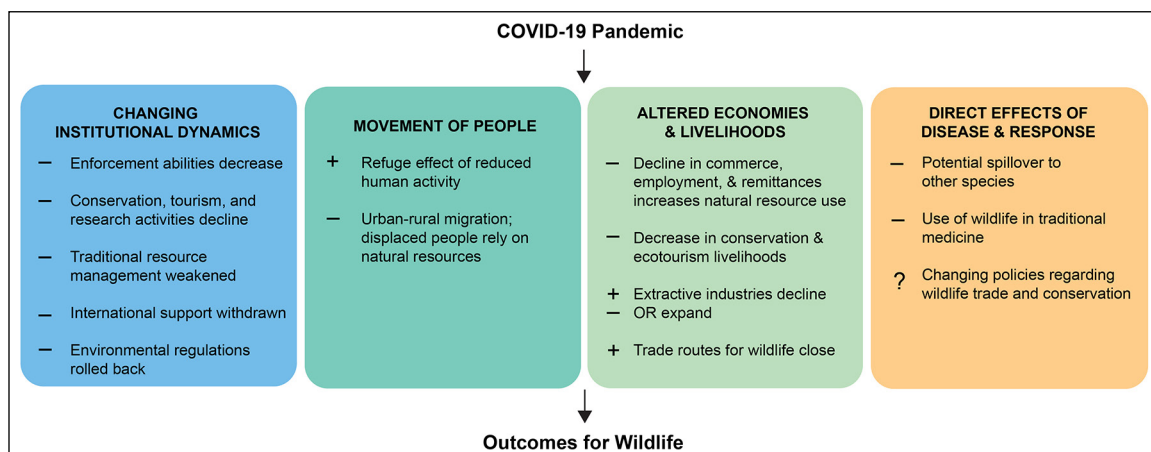


Figure 1. Diverse pathways link the COVID-19 pandemic, and its political, economic, and social fallout, to outcomes for wildlife. While some pathways benefit wildlife (+), most have detrimental consequences (–). Adapted from Gaynor *et al.* (2016).

observed in wartime (Gaynor *et al.* 2016). The pandemic and associated lockdowns have precipitated an exodus of urban populations to rural areas (Srivastava and Nagaraj 2020; Yacila and Turkewitz 2020), widespread job losses and declines in remittances, and disruption of food systems at multiple scales (Gunia 2020). The resulting economic and food insecurity, compounded by weakened enforcement of anti-poaching laws and interruptions in domestic meat supply chains, is likely to increase local demand for wild meat (Bowlin 2020), as found among people affected by armed conflict. While many policies proposed to forestall future pandemics seek to limit wildlife consumption (Yang *et al.* 2020), sweeping criminalization of the sale and consumption of wild meat may harm vulnerable human populations and weaken trust in institutions, as observed in West Africa after the 2013–2016 Ebola outbreak (Bonwitt *et al.* 2018). Policies that also provide food and livelihood alternatives, rather than primarily criminalizing consumers of wild meat, will likely be more effective and equitable than universal bans.

As we have seen after devastating armed conflicts, governments and other institutions now face difficult decisions about how to simultaneously promote economic recovery and public health. While conservation and environmental regulation may take a backseat, decision makers must remember that biodiversity and ecosystem health are closely tied to human well-being, and deprioritizing conservation may ultimately heighten socioeconomic woes (Brashares *et al.* 2014). Instead, decision makers and the public can choose to transform this disruption into a catalyst for major policy reforms that promote the well-being of people and wildlife, such as strengthening localized food supply chains and bottom-up conservation efforts and institutions (Evans *et al.* 2020), which

have proven successful in post-conflict scenarios (Bruch *et al.* 2016). As the pandemic continues to unfold, highlighting the pathways through which it is affecting wildlife and habitats may inform more holistic and context-dependent approaches to recovery that address the interlinked health of wildlife and people.

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Bonwitt J, Dawson M, Kandeh M, *et al.* 2018. Unintended consequences of the “bushmeat ban” in West Africa during the 2013–2016 Ebola virus disease epidemic. *Soc Sci Med* **200**: 166–73.

Bowlin N. 2020. Hunting and fishing provide food security in the time of COVID-19. *High Country News* 29 Apr.

Brashares JS, Abrahms BA, Fiorella KJ, *et al.* 2014. Wildlife declines and social conflict. *Science* **25**: 376–78.

Bruch C, Muffett C, and Nichols S (Eds). 2016. Governance, natural resources and post-conflict peacebuilding. London, UK: Routledge Press.

Daskin JH and Pringle RM. 2018. Warfare and wildlife declines in Africa’s protected areas. *Nature* **553**: 328–32.

Davenport C and Friedman L. 2020. Trump, citing pandemic, moves to weaken two key environmental protections. *New York Times* 4 Jun.

Evans KL, Ewen JG, Guillera-Arroitra G, *et al.* 2020. Conservation in the maelstrom of COVID-19 – a call to action to solve the challenges, exploit opportunities and prepare for the next pandemic. *Anim Conserv* **23**: 235–38.

Gaynor KM, Fiorella KJ, Gregory GH, *et al.* 2016. War and wildlife: linking armed conflict to conservation. *Front Ecol Environ* **14**: 533–42.

Gonzales J. 2020. Brazil minister advises using COVID-19 to distract from Amazon deregulation. *Mongabay Environmental News* 26 May.

Gunia A. 2020. How coronavirus is exposing the world’s fragile food supply chain – and could leave millions hungry. *Time* 8 May.

Humphrey C. 2020. Under cover of COVID-19, loggers plunder Cambodian wildlife sanctuary. *Mongabay Environmental News* 31 Aug.

Kim KC. 1997. Preserving biodiversity in Korea’s demilitarized zone. *Science* **278**: 242–43.

Knorovsky K. 2020. Madagascar’s tourism drought could fuel another crisis. *National Geographic* 20 May.

Lindsey P, Allan J, Brehony P, *et al.* 2020. Conserving Africa’s wildlife and wildlands through the COVID-19 crisis and beyond. *Nat Ecol Evol*; doi.org/10.1038/s41559-020-1275-6.

Nguyen T, Saleh M, Kyaw MK, *et al.* 2020. Special report 4: impact of COVID-19 mitigation on wildlife–vehicle conflict. Davis, CA: Road Ecology Center, University of California–Davis.

Srivastava R and Nagaraj A. 2020. No way back: Indian workers shun city jobs after lockdown ordeal. *Thomson Reuters Foundation News* 28 May.

Yacila RC and Turkewitz J. 2020. Highways of Peru swell with families fleeing virus. *New York Times* 30 Apr.

Yang N, Liu P, Li W, and Zhang L. 2020. Permanently ban wildlife consumption. *Science* **367**: 1434.

Zellmer AJ, Wood EM, Surasinghe T, *et al.* 2020. What can we learn from wildlife sightings during the COVID-19 global shutdown? *Ecosphere* **11**: e03215.