



# Impacts and Lessons Learned from the COVID-19 Pandemic for Protected and Conserved Area Management

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## 14.1 INTRODUCTION

The Coronavirus Disease 2019 (COVID-19) pandemic, caused by the SARS-CoV-2 virus that emerged in December 2019 (Zhou et al., 2020), has had numerous devastating impacts worldwide, the most significant being the death of over 6.5 million people (World Health Organization, 2022). One of the less discussed impacts is the effect that this pandemic has had on protected and conserved areas (PCAs) and how to implement any lessons learned for improved PCA management. Protected areas (PAs), which include national parks, nature reserves, and more, are defined as ‘...a clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values’ (Dudley, 2008). These areas are highly important to consider because not only do they conserve nature and biodiversity, but they also provide economic value to many communities, and can improve physical and mental well-being (Hockings et al., 2020).

Additionally, PAs provide food, clean water and medicines, and can buffer the effects of climate change: it is estimated that PAs worldwide store at least 12% of carbon on land (IUCN WCPA, 2021). Aside from PAs, conserved areas, which may not have the same level of restrictions as PAs or a primary conservation objective, are also important for conservation and livelihoods and can provide similar benefits. The term ‘conserved areas’ could be used more generally or could include ‘other effective area-based conservation measures’ (OECMs), which were defined by the Convention of Biological Diversity (2018) as ‘a geographically defined area other than a Protected Area, which is governed and managed in ways that achieve positive and sustained long-term outcomes for the in situ conservation of biodiversity, with associated ecosystem functions and services and, where applicable, cultural, spiritual, socioeconomic and other locally relevant values’. OECMs can cover a range of areas, such as Indigenous territories, fishing refuges and others, as long as they meet the IUCN World Commission on Protected Areas (WCPA) criteria for an OECM (IUCN WCPA, 2022) and are approved for addition in the UN Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) Protected Planet database.

PCAs are also important for the ‘One Health’ approach that is growing in popularity, which is defined as ‘a cross-sectoral and transdisciplinary approach that emphasizes the fundamental ways in which the

health of humans, domestic and wild animals, fungi, plants, microbes, and natural and built ecosystems are interdependent’ (Redford et al., 2022). This is particularly relevant in the context of COVID-19 as PCAs are an important form of protection against epidemics and pandemics as they maintain ecosystem integrity (Dobson et al., 2020) and can thereby suppress pathogen spillover—the process by which pathogens from animals ‘jump’ into humans (Reaser et al., 2021). It is estimated that 72% of zoonotic diseases have originated from wildlife (as compared to those from domestic animals) (Jones et al., 2008); PCAs act as a buffer and help reduce human exposure to emerging zoonotic infectious diseases (Ferreira et al., 2021) as they limit the contact between humans and other wild species that could transmit disease; conversely, land clearing leads to an increased risk of zoonotic disease transmission, especially in the tropics (Allen et al., 2017).

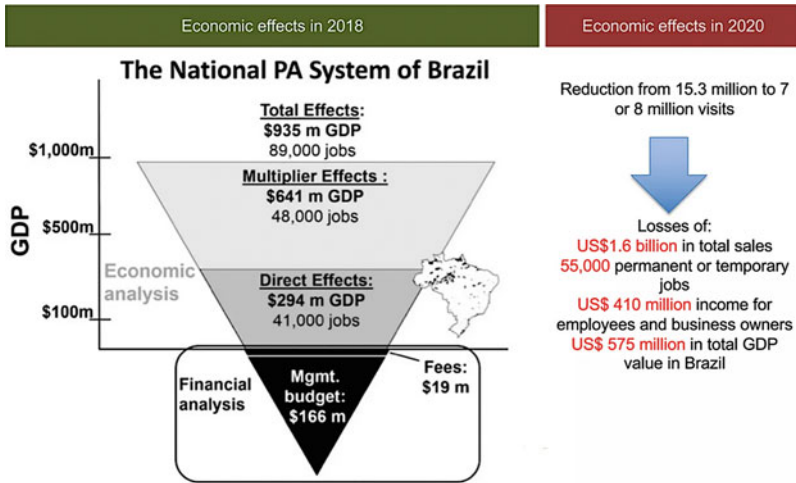
Given the clear value of PCAs, it is critical to monitor and assess the impacts of the COVID-19 pandemic on them. Insights from such an assessment can provide lessons to support strategic management decisions on PCA recovery and rebuilding, including improved management in the future. Assessments and recovery are needed across three categories: ecological, social and economic, each building on the one before. This approach will ensure that multiple key aspects of the issue are targeted for relief and recovery. Authorities, PCA managers, rangers, Indigenous peoples, local communities and other relevant stakeholders need to be involved at a site level in the rebuilding process to design adaptive and appropriate responses. Aside from the on-site support, knowledge generation on the lessons learned is also key to understanding how to prevent and address negative impacts in the future.

This chapter aims to piece together the expertise on this topic in the style of a review and further elucidate the effect of three major types of impacts from the COVID-19 pandemic—ecological, social and economic on PCAs (Fig. 14.1), including regional differences, where information was available. We draw insights from scientific articles and literature published by conservationists worldwide and from a dedicated IUCN WCPA ‘COVID-19 and Protected Areas’ Task Force. This chapter also discusses the lessons learned and their implications for public policies and improving PCA management, highlighting the IUCN Green List.

### Impacts of COVID-19 on protected and conserved areas

<b>Direct ecological impacts</b>	<ul style="list-style-type: none"> <li>• High-risk for non-human primates</li> <li>• Positive, but probably temporary, benefits for sensitive wildlife species due to reduced human activity in PCAs</li> </ul>
<b>Social impacts</b>	<ul style="list-style-type: none"> <li>• Indigenous people and local communities are highly vulnerable to COVID-19</li> <li>• Reduced management presence in PCAs can encourage illegal resource exploiters who can infect otherwise isolated communities</li> <li>• Reduced incomes and livelihoods</li> </ul>
<b>Economic impacts</b>	<ul style="list-style-type: none"> <li>• Loss of significant income for PCAs and communities</li> <li>• Reduced revenue and budgets for park agencies</li> <li>• Conservancies and community-based areas particularly impacted</li> <li>• Average recovery time is over 19 months</li> </ul>

Fig. 14.1 Summary of the ecological, social and economic impacts of the COVID-19 pandemic on PCAs



Analysis by Thiago Sousa, in Spenceley et al. 2021 in PARKS

Fig. 14.2 Economic impacts of the pandemic related to tourism in the Brazilian PA system

## 14.2 ECOLOGICAL IMPACTS AND SOLUTIONS

The COVID-19 pandemic has had several conflicting ecological impacts. Initially, it seemed as if nature could thrive again when lockdowns started occurring worldwide, as there had been many reports of wildlife re-occurring at sites and increases in species richness during these lockdowns (Manenti et al., 2020). Although there were positive effects including the increased breeding success of certain birds that are sensitive to human disturbance, and reduced road killings, there were also increases in invasive species and illegal hunting and fishing (Bennett et al., 2020; Manenti et al., 2020). This highlights the need to consider the various ecological implications of changes to human activities—especially for drastic changes such as during the lockdowns—on ecosystem functioning (Gilby et al., 2021). The negative ecological effects can be attributed to a reduction in patrolling, which greatly reduced the likelihood of detecting and responding to threats (Corlett et al., 2020). Researchers observed this globally, including with the illegal killing of birds on Italian islands (Manenti et al., 2020), and with wildlife poaching more than doubling in countries including Uganda and India during lockdowns (Athumani, 2020; Badola, 2020). In Bangladesh, poaching increased by 28 times during the 2020 lockdowns compared to 2019 (Rahman, 2021). However, there were reports that poaching decreased in other places, such as South Africa (Hockings et al., 2020).

Illegal land-use change was also a major ecological issue during the lockdowns. There were reports that illegal logging and natural resource extraction increased greatly in Nepal and Tunisia (Hockings et al., 2020). Countries with biodiversity-rich tropical forests experienced increased land clearing and mining as well (McNeely, 2021). Many parts of Asia, Africa and South America reported that deforestation increased during the pandemic (Fair, 2020), which has long-term implications for climate change; deforestation accounts for roughly ten per cent of anthropogenic greenhouse gas emissions (OECD, 2020) and even restoring these forests would not replace the carbon storage value of the older forests lost (Gibson et al., 2011). In the Brazilian Amazon, forest clearing increased by 28% in 2020 compared to the previous year (Escobar, 2020). Most of the land that had been cleared was changed into pastures for grazing cattle to support the beef industry in Brazil (McNeely, 2021).

In Bangladesh, these values were much higher—the number of forest loss alerts increased by 2,700% during the May 2020 lockdown period

compared to the same period in 2019 (Rahman, 2021); this underscores the importance of considering regional variations. These statistics are concerning, as land-use change due to resource extraction or agriculture is the driving cause for zoonotic pathogen emergence (Ferreira et al., 2021) and has caused more than 30% of new diseases reported since 1960 (IPBES, 2020). Supporting PCAs and the achievement of global targets such as 30 × 30 (to protect 30% of terrestrial and marine spaces by 2030) would help limit land-use change if there are effective and equitable measures in place to protect land.

New regulations on wildlife markets and the wildlife trade have resulted in another ecological impact from the COVID-19 pandemic, as the virus is thought to have originated in a market (Huanan Seafood Wholesale Market) where live wild and farmed animals were traded (Worobey et al., 2022). Markets with live animals, especially those under unregulated and poor sanitary conditions, are an ideal location for pathogens to spread because they contain stressed animals of different species from different locations in stacked and overcrowded cages, all interacting with humans (Aguirre et al., 2020). Even with the wildlife bans placed in China after the pandemic started, people have found legal loopholes, as the medicinal use of wildlife—which includes many species such as pangolins, bats and tigers—is not covered by the ban (Wang et al., 2020). These species all play unique roles in their ecosystems and impact the PCAs they live in. For instance, bats act as biological and economical pesticides, and are important pollinators and seed dispersers (Zhao, 2020). The suggestion that the pandemic started from bats has hurt their reputation and placed them at greater risk for actions such as mass slaughter and removal (Zhao, 2020), and it is unclear whether this will be a short or long-term impact.

That is why public education is important for both wildlife and ecosystem conservation (Zhao, 2020); it is crucial for the media and other platforms to improve their communication of the relationships between nature, the pandemic and society—misleading narratives can place further pressure on vulnerable ecosystems and species. Messages should be framed with nature as the solution and not the problem, and the impacts of human activities should be highlighted with clear calls to action (Gregg et al., 2021). It is important to consider the wildlife trade when discussing PCAs as the animals from this trade could be taken from PCAs, and if another pandemic emerges due to the wildlife trade, PCAs will be at risk again. PCA managers should work with authorities to establish strict legislation against illegally taking species from their premises. In addition, it is

important to have strong monitoring and enforcement systems in place, and consider means to avoid their disruption during a future pandemic.

Another group of animals that are at greater risk because of the pandemic are non-human primates such as apes, which are likely to be susceptible to many viruses that impact humans, such as Ebola and the SARS-CoV-2 virus (Melin et al., 2020). Primates play a key role in tropical biodiversity, forest regeneration and ecosystem health (Estrada et al., 2017). This is because many primates are frugivorous and can disperse seeds over long distances (Chapman et al., 2013). Apes that are habituated to humans, such as mountain gorillas, are at an even greater risk—an outbreak could devastate these gorillas and their ecosystem (Gillespie & Leendertz, 2020). Therefore, it is recommended that PCA managers add measures to limit or ban contact with great apes (Gillespie & Leendertz, 2020) with much greater caution and safety measures in place to protect them.

### 14.3 SOCIAL IMPACTS AND SOLUTIONS

In terms of the social impacts, it is important to consider the people that are directly involved with PCAs, such as rangers, local communities and Indigenous peoples. Rangers play a critical role for PCAs as they are on the frontlines protecting these areas from threats including illegal logging and hunting (Singh et al., 2020). In some countries, the pandemic resulted in rangers getting fired due to budget reductions from tourism and other funding sources, which adversely affected their livelihoods and reduced protection for the areas they worked in (Hockings et al., 2020). These trends contributed to the stress of unemployment, increased anxiety from job insecurity and reduced ranger welfare (Singh et al., 2020; Smith et al., 2021). As for the rangers who have been working during the pandemic, a study on ranger welfare (Singh et al., 2020) revealed that a significant proportion of rangers believed that the pandemic increased threats to PCAs and negatively impacted their life and work—a job that already contained numerous challenges before the pandemic (Belecky et al., 2019; Singh et al., 2020). This is because rangers were required to work longer hours and spend less time with their families due to staff cuts and increased threats to PCAs (Singh et al., 2020). This could be a short-term impact if management measures and policies swiftly improve to support rangers. Therefore, it is recommended that greater emphasis should be placed on their well-being and funding.

Additionally, Appleton et al. (2022) recently found that personnel and ranger numbers are insufficient for global targets such as  $30 \times 30$ , which likely plays a major role in current management deficiencies; therefore, it is crucial to keep current staff on board where possible.

In the same survey on rangers (Singh et al., 2020), it should be noted that more than four out of five rangers in Asia, Africa and Latin America believe that their job success is dependent on the help of local communities, which were severely impacted by the pandemic. The communities that live near PCAs typically benefit from tourism in some way and rely on it for their livelihoods, such as by receiving a proportion of the PCA fees (Maekawa et al., 2015) or from their own businesses; as tourism was heavily impacted by the pandemic, local communities were negatively impacted due to a reduced source of income (Hockings et al., 2020). Local communities may also contribute to PCA management, thereby serving as critical stewards for conservation.

Before the pandemic, many local communities were already facing extreme poverty and other challenges including food security and human-wildlife conflict; the pandemic exacerbated these struggles (Bhammar et al., 2021). Food security and human-wildlife conflict are important to consider as local communities and Indigenous peoples could be driven to hunting and consuming wild animals, which would not only affect the conservation of certain species and, therefore, impact their surrounding habitats, but could also expose individuals to zoonotic diseases; one example is the Ebola virus outbreak from 2013 to 2016 that originated in Western Africa (Koh et al., 2021). These interactions could lead to further problems for health and livelihoods, even though wild meat is an important source of nutrition in rural areas (Friant et al., 2020). However, solutions to this should be considered carefully, as other foods could also contribute to threats to PCAs due to habitat loss from land-use change. For instance, communities in the African Congo consume around 5 million tons of wild meat annually—the same amount meat by cattle ranching would require converting up to 25 million hectares of forest into farmland, an area roughly the size of Great Britain (Cooney & Nasi, 2014). Since wild meat includes many types of animals, it could be worth improving education on which species are safer and more sustainable to consume.

Another way to support communities local to PCAs is by increasing benefit sharing. Not only can benefit-sharing arrangements increase success for local communities, but they can also help achieve conservation



goals (Snyman & Bricker, 2019); benefit sharing increases the likelihood that communities will view PCAs positively and conserve their natural resources (Leung et al., 2018; Spenceley et al., 2017). Examples of benefit sharing include formalising revenue sharing, building capacity and skills, reducing human–wildlife conflict through mitigation or compensation, hiring local individuals for PCA management, increasing local sourcing for goods and offering grants to businesses (Bhammar et al., 2021). It is also important to include local communities when developing solutions for them so that they feel more empowered and motivated to protect these areas (Stolton et al., 2021).

Along with the local communities residing near PCAs, many PCAs overlap or share limits with Indigenous territories as well. Approximately 50% of Earth’s lands are occupied by Indigenous peoples and local communities, and their lands have less deforestation and lower emissions than other spaces, with substantial biodiversity value (Garnett et al., 2018; Sze et al., 2022). Therefore, it is important to recognise Indigenous peoples’ rights in these areas and their traditional knowledge systems. Indigenous peoples should be included in decision-making processes for their spaces as well, as they have been historically underrepresented and marginalised in conservation policy decisions (Forest Peoples Programme et al., 2020).

Aside from these aspects, the pandemic has also had a much broader social impact on mental health linked to access to natural spaces. Before the pandemic, people went to parks for recreation and education, but during the pandemic, people started visiting national parks and green spaces to maintain their mental and physical well-being (Kleinschroth & Kowarik, 2020; Miller-Rushing et al., 2021). For example, when restrictions were gradually lifted in European countries in the summer of 2020, visitor numbers increased significantly (McGinlay et al., 2020). This phenomenon demonstrates the importance of PCAs for people to manage stress and restore their mental and physical health during (and after) the COVID-19 pandemic (Mandić, 2021).

#### 14.4 ECONOMIC IMPACTS AND SOLUTIONS

The pandemic has had severe economic consequences for PCAs. Tourism is the most common use of PCAs and their largest financial contributor (Mandić, 2021; Spenceley et al., 2017); it contributes to gross domestic product (GDP), livelihoods, conservation funding (Snyman &

Bricker, 2019) and benefits local economies in numerous ways: money from tourists contributes to employment and businesses such as restaurants and tour services, which can enable individuals to learn new skills that can be applied to other industries as well (Leung et al., 2018). The World Travel & Tourism Council (WTTC) found that the COVID-19 pandemic caused a global loss of 62 million tourism jobs (not specific to PCAs) and \$4.9 trillion USD from tourism's contribution to GDP in 2020, with some improvement in 2021 (WTTC, 2022). Historically, terrestrial PCAs received approximately 8 billion visits annually (Balmford et al., 2015). The reduction in tourists due to pandemic travel restrictions was particularly severe for places that depend on tourism in Africa and South America (Hockings et al., 2020; Spenceley et al., 2021; Fig. 14.2); monthly surveys of African safari tour operators revealed that over 90% of them had experienced more than 75% fewer bookings or had no bookings at all since April 2020, and the number of bookings still had not fully recovered in their last survey in May 2022, though it did improve (Beekwilder, 2022). Therefore, the impacts from this could be considered short to medium term, depending on when there is a full recovery in tourism there.

Funding is already a serious problem for PCAs, which results in poor management and issues with achieving conservation objectives (Bhammar et al., 2021). It is estimated that only 20% of PCAs are managed properly, despite their significant importance (Dasgupta, 2021). PCAs that are properly managed can advance social development in the form of fair employment, sustainable food production and safe drinking water access (Stolton et al., 2015). Therefore, increased funding for PCAs is required to reach societal goals; it is estimated that 140 billion USD annually could protect 30% of terrestrial and marine areas effectively by 2030, which is only 0.16% of the global GDP, and less than one-third of the subsidies provided to activities that harm nature (Waldron et al., 2020). Protecting 30% of these areas could generate up to 454 billion USD per year in revenue for four sectors (PAs/nature, agriculture, forestry and fisheries) by 2050, and the avoided-loss value of ecosystem services could be 170–534 billion USD per year by 2050 due to avoided flooding, climate change mitigation, soil loss prevention and storm protection (data based only on mangroves and forests; the value including the other biomes would be higher) (Waldron et al., 2020). Thus, the returns could be over seven times greater than the investment needed, including both the avoided loss and the revenue values.

In especially vulnerable regions such as Africa, nearly all PCAs lack proper funding; it is estimated that more than 1 billion USD is required annually to save the iconic species and habitats there (Lindsey et al., 2018). Increased funding can improve management effectiveness by hiring and training staff, increasing infrastructure investment and promoting outreach (Bhammar et al., 2021). Staff training is particularly important, not only in terms of the policies to effectively manage PCAs, but also in terms of their commercial expertise to ensure that business and financial requirements can be properly addressed (Bhammar et al., 2021; Stolton et al., 2021). In addition, increased funding would have much wider implications, including lowering the risk of future pandemics. It is estimated that the costs to monitor and prevent disease spillover across a ten-year period would be only two per cent of the estimated costs of the COVID-19 pandemic (Dobson et al., 2020). Thus, the benefits for society are estimated to significantly exceed the costs of increasing PCA funding (Waldron et al., 2020).

Despite the need for additional funding and regulatory support for PCAs, a recent analysis showed that 16 out of 20 major economies invested in activities that undermined environmental protection measures instead of supporting them, as part of their pandemic recovery efforts (Golden Kroner et al., 2021). Additionally, at least 22 countries rolled back or weakened their environmental protection for PCAs or reduced budgets. Rollbacks for PCAs are commonly due to new authorisations for activities such as new industrial plants or housing development, and they have been increasing over the past two decades, including protected area downgrading, downsizing, and degazettement (PADDD) (Golden Kroner et al., 2019). These rollbacks have occurred at times when the public cannot be consulted, including during the lockdowns, and the processes to justify PADDD lack rigour compared to those required to create PCAs (Pack et al., 2016; Golden Kroner et al., 2021). Nonetheless, there are still certain countries that are supporting PCAs during the pandemic; for example, Kenya pledged support for PCAs by promoting tourism, with the employment of 5,500 community scouts (\$9.2 million USD) and 160 community conservancies (\$9.2 million USD). Additionally, Pakistan created a Green Stimulus Initiative, which includes plans to expand PAs and add 15 national parks that cover 7,300 km<sup>2</sup> (supported with \$24 million USD), create Pakistan's first National Parks Service, and around 5,000 new jobs (Golden Kroner et al., 2021).

Even though tourism will remain important for PCAs, it is important to reduce over-reliance on this sector and build resilience for PCAs. Therefore, more diverse and sustainable financing sources such as a combination of conservation trust funds, impact bonds and payments for ecosystem services are required in case one or more methods fail, especially in emergency situations such as the pandemic (Bhammar et al., 2021; Spenceley et al., 2021; Stolton et al., 2021). Another type of funding support is through official development assistance (ODA), defined as government aid that promotes and specifically targets the economic development and welfare of developing countries, which has proven to be a key resource in past emergencies and could be critical for protecting biodiversity-vulnerable nations (OECD, 2020). Additionally, subsidies that harm biodiversity and the environment, such as those for agriculture and fisheries, should be redirected to environmental conservation, including PCAs (Golden Kroner, 2021).

A promising approach to improve economic development linked to PCAs is through a collaborative relationship between communities, PCA managers and businesses (Stolton et al., 2021). Public–private partnerships (PPPs) and collaborative management partnerships (CMPs) between authoritative bodies, such as governments, and NGOs or other private bodies, have also shown to be effective tools for PCA management that have led to greater funding from increased donor confidence (Lindsey et al., 2021). It should be noted that each PCA exists in its own context and requires tailored approaches to increase economic development in its region (Stolton et al., 2021). In times of limited funding, resources should be maintained to continue to support staff to monitor and enforce protection and restoration, especially in places with high biodiversity and intact forests (Golden Kroner et al., 2021).

## 14.5 REGIONAL DIFFERENCES

It is clear that there were regional differences in the ecological, social and economic impacts of the pandemic on PCAs; Waithaka et al. (2021) found that, broadly, PCAs in wealthier nations have been able to manage the situation better than those in poorer nations. More specifically, the least affected regions were Europe, Oceania and North America, whereas the most severely affected PCAs were in Latin America and Africa. Eastern and Southern Africa were the most affected, and PCAs in Asia were moderately affected (Waithaka et al., 2021). However, this could also be

due to underreporting from parts of Southeast and Central Asia. Based on the findings of Waithaka et al. (2021) and Hockings et al. (2020), the regions that appear to need the most immediate assistance are Latin America and Africa. Therefore, plans to help these regions should be prioritised.

These regions can be supported by increasing diverse sources of funding for resources and technology to support online platforms and remote work, as well as training and capacity building, as many countries lacked those; in particular, over 80% of the countries from Africa surveyed (Algeria, Benin, Cameroon, Chad, Ethiopia, Ghana, Guinea-Bissau, Madagascar, Malawi, Mozambique, Niger, Nigeria, Rwanda, Sao Tome and Principe, Seychelles, Somalia, Sudan, Swaziland and Uganda) indicated that their ability to cope with the pandemic was most affected by insufficient funding (Waithaka et al., 2021), which is why this aspect is especially important. In addition, emergency response guidelines and contingency plans need to be improved upon, which applies to all PCAs worldwide.

#### 14.6 GREEN LIST GUIDANCE IN THE RECOVERY OF PCAs

One way that PCAs can begin to recover effectively from the pandemic is by using the Green List (IUCN & WCPA, 2017). The Green Listing mechanism enables PCAs to evaluate their challenges and bottlenecks and take corrective measures to remove impediments by fulfilling the criteria and components of the Green List framework. Combatting the impacts of COVID-19 on PCAs involves not only the elimination of high-risk factors, but also the adoption of ecological, social, economic safeguards. The Green List process validates and allows a monitoring mechanism for conservation efforts undertaken in areas and sites afflicted with high ecological, social and economic risks (Wells et al., 2016). There are four components in the Green List: Good Governance, Sound Design and Planning, Effective Management and Successful Conservation Outcomes, all of which can help improve the way PCAs are managed and enhance their contributions to conservation.

The Good Governance component within the Green List framework is the foundation towards building ecological, social and economic recovery pathways for PCAs. This component guarantees legitimacy and voice (criterion 1.1), achieving transparency and accountability (1.2), and

enabling governance vitality and capacity to respond adaptively (1.3). The Effective Management component is also crucial when discussing PCA management; this component has seven criteria that include: developing and implementing a long-term management strategy (criterion 3.1), managing ecological condition (3.2), managing within the social and economic context of the site (3.3), managing threats (3.4), effectively and fairly enforcing laws and regulations (3.5), managing access, resource use and visitation (3.6), and measuring success (3.7). These, followed by the other two components, can enable successful conservation in PCAs and provide an international benchmark for quality that motivates improved performance and helps catalyse ecological, social and economic recovery in a global network of PCAs, as well as their revitalisation and expansion. Ensuring better safeguards in the future for PCAs through the robust Green List mechanisms and rebuilding sites could benefit both people and nature (Hockings et al., 2019; Wells et al., 2016).

#### 14.7 LESSONS LEARNED AND RECOMMENDATIONS

It is critical that action is taken to safeguard PCAs, given their ecological, social and economic importance. The COVID-19 pandemic affected all three of these aspects of PCAs negatively in many parts of the world. Therefore, policies and management decisions to support PCAs and their rebuilding from COVID-19 are crucial and will have far greater implications beyond specific sites, such as supporting biodiversity, mitigating climate change, enhancing human health and supporting the economy (Kumar, 2010). It is important to consider a holistic ‘One Health’ approach (Osofsky et al., 2005) to PCA governance and management, which would require collaboration among experts from different fields, including human, animal and environmental health, to design and implement actions, policies and legislation that reflect research in this field (McNeely, 2021). It would also be beneficial for PCAs to consider using the Green List as a tool to help recover effectively (Hockings et al., 2019). Therefore, to summarise the key recommendations that were mentioned throughout this chapter, categorised as responses to the ecological, social and economic impacts of COVID-19 on PCAs:

*Responses to Address the Ecological Impacts:*

1. PCAs should be governed and managed effectively, supported by adequate regulations, institutions and funding, using a One Health approach. This approach could involve partnerships across sectors to monitor zoonotic diseases around PCAs and bans of certain visitor interactions with animals around PCAs, especially vulnerable species like great apes or those considered high risk, to reduce the chances of spillover. Tools including the IUCN Green List can support monitoring and encourage improvements to governance and management.
2. Legal protection measures, regulations and management to prevent illegal logging, poaching and wildlife being taken from PCAs (e.g. for live animal markets) must be strengthened; this will require the development of effective legislation and investment into management personnel and surveillance equipment. Community-led monitoring may also support this effort.
3. Habitat restoration and connectivity efforts should be intensified due to the increased deforestation during the pandemic, as well as the land-use change from intensive agriculture. Regions with the most land-use change should be prioritised. This will also help build ecological resilience and help prevent future pandemics.

*Responses to Address the Social Impacts:*

1. Working conditions for rangers and PCA staff should be improved, including humane policies (e.g. fair working hours). PCAs should try to retain as many staff members as possible, even during emergency situations like pandemics to prevent illegal activities in PCAs from increasing.
2. Benefit sharing should be increased for local communities by formalising revenue sharing in the law and creating more requirements to hire local staff in PCAs.
3. Indigenous peoples and local communities should be included in decision-making processes for PCAs that overlap with their territories for more inclusive governance. Their rights and Indigenous knowledge systems should also be respected more, with measures in place to uphold these.

*Responses to Address the Economic Impacts:*

1. Sustainable and diverse financing mechanisms should be in place, and emergency funds and ODA mechanisms should be created for PCAs that are heavily dependent on tourism, including those in Latin America, Africa and parts of Asia where tourism plays an integral role. Budget rollbacks that affect PCAs should also be avoided where possible.
2. A significant amount of funding needs to be provided to PCAs in Africa and Latin America to protect their unique and especially vulnerable wildlife and habitats, which should be prioritised based on the severe impacts the pandemic has had there.
3. There should be an annual investment from various sources of at least 140 billion USD into PCAs worldwide, as this could protect 30% of terrestrial and marine areas effectively by 2030, and the returns could be over seven times higher (including the projected revenues and avoided-loss values of \$454 billion and \$534 billion USD, respectively; Waldron et al., 2020).

Based on the ecological, social and economic impacts highlighted in this chapter, it is clear that each aspect plays a prominent role in the future of PCAs in different ways, and different management approaches should be taken to address each. Global policies, funding mechanisms and management plans should prioritise the more vulnerable regions first, namely, Latin America and Africa, to ensure that they receive adequate support to help their wildlife, communities and economies recover from the effects of the COVID-19 pandemic.

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