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The Impact of COVID-19 in Protected Areas Management: A Review of Emerging Challenges, Responses, and Future Research Lines in the Post-Pandemic Context

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Abstract

The COVID-19 pandemic and the multiple associated changes in human activities and mobilities have implied the emergence of (new) challenges for the sustainable management of protected areas. With the objective of identifying and categorizing these emerging challenges, the responses implemented to address them, and their future implications, we developed a systematic literature review on the implications of COVID-19 crisis for protected areas management. Based on 56 articles published in 2020 and 2021, our findings offer (a) descriptions of the studies conducted, (b) multiscale effects of the pandemic on Protected Areas, (c) changes in the public use of Protected Areas during the pandemic, (d) managerial adaptation during the pandemic, (e) rethinking Protected Areas management both mid- and long-term, (f) and an emerging research agenda on Protected Areas. Overall, our results show broad agreement about the pandemic's early cascading effects, both positive and negative, on the management of Protected Areas, and the behavioral and mobility patterns of their users. Three years have passed since the start of the pandemic, from which decision makers can leverage several lessons to be prepared for future crises; especially when it comes to achieving compatible levels of resilience and adaptability between the users of these areas and the institutions in charge of Protected Areas management.

Keywords protected area, environmental management, COVID-19, literature review

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1. Introduction

Protected areas (PAs) are systems that enable economic development, the promotion of sociocultural and pro-environmental values, the enjoyment of natural land- and soundscapes, the boost of psychological and physical health, among other benefits (Cumming et al., 2021; Jones et al., 2021, Qiu & Zhang, 2021). PAs act as drivers for adaptation of regions threatened by the exploitation of nature resources, the transformation of landscapes, and even the outbreak of disease (Hockings et al., 2020; Ma et al., 2021). The conservation and restoration of ecological and cultural heritage particularly depend on the existence of such areas (Phua et al., 2021). As such, PAs management is done under strict conservation-focused policies and tends to be conditioned by several socio-political and economic factors (Díaz-Sánchez & Obaco, 2021; Smith et al., 2021). In that sense, PAs are highly susceptible to disruptions related to their geographical location, management capacity, governance, and funding sources (Mandić, 2021; Miller-Rushing et al., 2021).

PAs have been favored with a growing public support and interest, after the flourishing of outdoor recreation in the 1960s and ecotourism in the 1980s (KC, 2021). However, both despite and somewhat because of such increased popularity, many PAs have experienced environmental damage and degradation, conflicts between users, and pollution (Cahyadi & Newsome, 2021; Spenceley et al., 2021). The financing of PAs' management has been a topic of discussion, especially for those PAs highly dependent on tourism as a primary source of income, for the irregularity of such industry makes PAs more vulnerable to contemporary changes such as the ones caused by the pandemic (Meredith et al., 2021; Souza et al., 2021).

In March 2020, COVID-19 was declared a pandemic, the first of the 21st century. Because of the multiple policies introduced to cope with the health crisis and the subsequent shift in global mobility flows, PAs experienced changes in their operation conditions and use patterns (Jones et al., 2021, Smith et al., 2021; Waithaka et al., 2021). As noted by Jenkins et al. (2021), the pandemic was an experiment that exposed underlying constraints in the management of PAs and the involvement of different stakeholders in response to contemporary crises.

In the context of this study, PAs are understood as natural landscapes, officially recognized and managed to fulfill conservation functions, concurrently providing values and services for humanity (McGinlay et al., 2020). These areas are typically designated within national or regional legal frameworks, which stablish various protection categories and regulate the types of uses to which PAs may be subject. As suggested, PAs provide means for sustainable livelihoods and the quality of life of the adjacent communities that are inseparably linked to their geography, resources, and services. Given these conditions, this article aims to identify central issues related to the management of PAs during the COVID-19 pandemic, chiefly by integrating and analyzing emerging research concerns related to that context. To that aim, we conducted a standalone systematic literature review that assembles existing evidence and information on the topic as it has emerged. In our review, we sought out literature able to provide answers to three research questions:

Q1: What approaches have been used to analyze implications of the pandemic in the management of PAs?

Q2: What has the COVID-19 pandemic implied for PAs?

Q3: What gaps in knowledge about PAs in relation to the pandemic need to be addressed in future research?

Including the foregoing introduction, this article is structured in five sections. Next, in Section 2, we describe the method and steps followed in our study. In Section 3, we summarize the major findings of our systematic literature review, which we further discuss in Section 4. Lastly, in Section 5, we present our conclusions, as well as future research lines.

2. Method

To analyze the literature addressing PAs during the COVID-19 pandemic, we conducted a standalone systematic literature review. Firstly, we conducted a query in Scopus, an accessible multidisciplinary database encompassing a wide variety of scholarly journals, which allowed us to set publication dates of both 2020 and 2021 as a preliminary filter. Furthermore, we selected this database to ensure that the articles included have undergone thorough quality control and a peer-review process, which warrants their credibility and relevance. From there, our query

was based on the criterion of "Title, abstract or keywords" provided by the database using the following combination of terms:

(Covid-19) OR (coronavirus) OR (pandemic) OR (SARS-CoV-2) AND (conserved areas) OR (protected areas) OR (natural areas) OR (national parks) OR (protected natural parks)

In the second stage, we implemented a screening process based on a common-sense evaluation of the consistency of the titles, keywords, and abstracts of the articles with our topic of interest. To be specific, the articles had to provide relevant information on PAs before the pandemic, compare such information with a mid-pandemic situation, and/or examine emerging issues and the response of management entities after the beginning of the pandemic. Furthermore, we did not limit this study to a specific territorial domain and have included articles that investigate the phenomenon of interest at an international, national or site scale. Moreover, concerning the locations studied, research settings in the articles had to be natural areas with official protection; therefore, we excluded articles presenting research conducted on urban parks, coastal and rural areas that have not been classified as any type of PA. We also excluded articles addressing topics beyond the scope of research on PAs in relation to the pandemic or discussing themes in highly specific fields within applied sciences, chemistry, biology, and medicine, among others. As a result of the second stage, the number of viable articles dropped from 988 to 63.

In the third stage of the literature review, we imported the articles into Mendeley reference manager software and read their full-text versions to assess their suitability for the review. As a result, 56 articles remained, excluding seven lacking consistent information related to the context of the review. Figure 1 outlines the various stages followed in the review.

To obtain data of interest, we cataloged the articles, extracted and dissected the information therein, and pulled and coded relevant findings from the text. We grouped the findings according to six groups with our research questions in mind (Table 1). The first group, (a), describes features extracted from the articles, including type of publication, temporal distribution, territorial scale, study location(s), methodology, and data source(s). After reviewing the content of the articles, we identified implications of the pandemic discussed from different viewpoints and at different scales and thereafter categorized them accordingly in groups (b)–(e), as shown in Table 1. Sixth and last, group (f) summarizes the research gaps within the articles reviewed.

Figure 1 Stages of the Systematic Literature Review

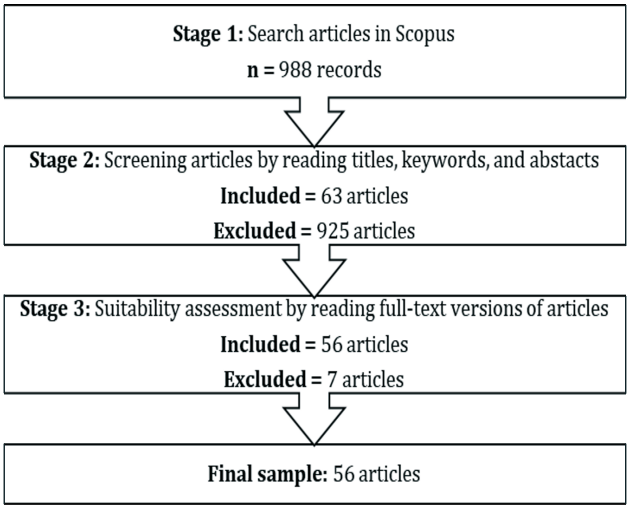


Table 1 Research Questions and Themes of Analysis in the Systematic Literature Review

Question	Group of findings
Q1	a. Description of the studies
Q2	b. Multiscale effects of the pandemic on PAs
	c. Changes in the public use of PAs
	d. Managerial adaptation during the pandemic
	e. Rethinking PAs management at a mid- and long-term
Q3	f. Emerging research agenda

3. Findings

Following, findings will be described as mentioned in the groups identified in Table 1. As for Table 2, it lists the articles that populated our review and indicates which findings were drawn from which article(s) according to groups (b), (c), (d), and (e).

Table 2 Summary of the Articles Reviewed and Findings per Thematic Group

Author(s) and year	Group of findings				Author(s) and year	Group of findings			
	b	c	d	e		b	c	d	e
Anand and Kim (2021)	x				Miller-Rushing et al. (2021)	x		x	x
Bates et al. (2020)	x		x		Moore and Hopkins (2021)		x		
Bhammar et al. (2021)	x			x	Moya Calderón et al. (2021)		x		
Cahyadi and Newsome (2021)	x	x	x		Ndlovu et al. (2021)	x		x	
Cumming et al. (2021)	x			x	Neupane et al. (2021)	x			
Díaz-Sánchez and Obaco (2021)	x			x	Oberle et al. (2021)	x			x
Falk et al. (2021)		x	x		Phua et al. (2021)	x		x	x
Ferreira et al. (2021)		x			Primack and Terry (2021)		x	x	
Harris et al. (2021)		x			Qiu et al. (2021)		x		
Hockings et al. (2020)	x		x	x	Qiu and Zhang (2021)		x		
Hymas et al. (2021)	x				Ramli et al. (2021)		x		
Jenkins et al. (2021)	x	x	x		Reaser et al. (2021)	x			x
Jones et al. (2021)			x		Saladié et al. (2021)		x		
KC (2021)	x		x	x	Samdin et al. (2021)		x		
King et al. (2021)				x	Seong et al. (2021)		x		
Koju et al. (2021)	x				Seong and Hong (2021)		x		
Kovács et al. (2021)		x			Singh et al. (2021)			x	x
Kroner et al. (2021)	x			x	Smith et al. (2021)	x	x	x	x
Kupfer et al. (2021)		x	x		Souza et al. (2021)	x		x	x
Lebrun et al. (2021a)		x			Spenceley et al. (2021)	x	x	x	x
Lebrun et al. (2021b)		x			Sumanapala and Wolf (2021)		x	x	x
Lee et al. (2021)		x			Tan et al. (2021)			x	
Loos (2021)	x			x	Terraube and Fernández-Llamazares (2020)	x			
Ma et al. (2021)		x	x	x	Terry et al. (2021)	x			
Mandić (2021)	x			x	Waithaka et al. (2021)	x		x	x
McGinlay et al. (2020)		x	x	x	Xiao et al. (2021)		x		
Meredith et al. (2021)	x			x	Yang et al. (2021)		x		
Miller et al. (2021)		x			Zukerman et al. (2021)	x			

Note. (b) multiscale effects of the pandemic affecting PAs, (c) changes in the public use of PAs, (d) managerial adaptation in PAs during the pandemic, and (e) rethinking PAs management at a mid- and long-term.

3.1 Group A: Description of the Studies

As shown in Table 3, we reviewed 56 articles, 46 of which presented original research following an empirical approach. By methodology, 28 of the articles used a quantitative methodological approach. Those studies used instruments and data sources such as surveys, public statistics, culturomic metrics, search volume data, topographical information, and use of light at night, sound levels, and motion data. In multiple cases, more than one source was exploited. The quantitative data was subsequently used to construct indexes and statistical models to explain the phenomenon studied. By contrast, nine of the articles reported studies involving qualitative research methods, including structured questionnaires, interviews, focus groups, field observations, and content analysis. Across the sample, the use of secondary data was

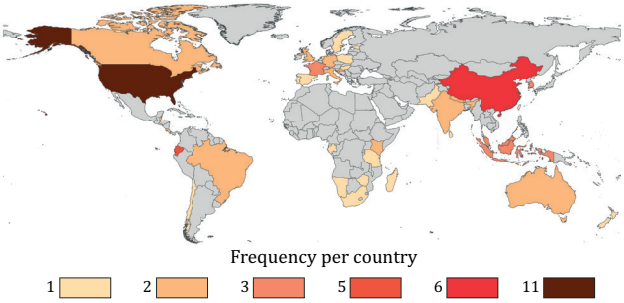
also common, including press articles, official reports, and websites from PA agencies and government entities, along with social media posts. This was due to the novelty of the topic and the limited academic literature on it when the articles were written. Lastly, nine articles reported mixed methods, usually while combining official statistical data with information provided by managers and staff from PAs.

Table 3 Descriptive Attributes of the Articles Reviewed

Attribute		Number of articles
Type of article		
	Research paper	40
	Review papers	8
	Other	8
Methodological approach		
Empirical	Quantitative	28
	Qualitative	9
	Mixed	9
	Conceptual	10
Publication date		
	2020	4
	2021	52

In relation to the geographical approach adopted on the reviewed articles, 12 of the studies reported analyses from an international perspective, in cases located in two or more countries or regions of the world. Among those, four provided a global overview of the impacts of the pandemic; four provided information from cases in multiple countries on every continent except Antarctica; two presented analyses at the continental level, and the remaining two contrasted cases in two countries each. Along other lines, 10 of the articles presented national-level analyses, whereas 25 presented site-level ones. In the articles analyzing cases at the international, national, and local levels, 41 countries were represented. The countries included relatively often in academic studies were the United States (11), China (6), and Ecuador (5). As Figure 2 shows, there was a spread scholar interest according to geographical domain. Although, countries from Latin America; Africa; Eastern and Southern Europe; and West, North, and Southeast Asia; and Oceania, have remained underexamined. The 10 remaining articles presented studies following a conceptual approach, thus do not examine specific locations or regions.

Figure 1 Distribution of Locations Examined in the Articles Reviewed



Note. Source: Author's own elaboration

The production of academic work increased significantly in the second year of the pandemic, with 52 articles published in 2021. Nonetheless, in the 46 empirical articles, the temporality of the data varied. Four of the articles presented data collected exclusively before the pandemic and used it to explain current behavioral patterns or to predict future events. In 26 articles, the presented studies analyzed data predominantly collected between April and October 2020; while in 15 articles, the studies collected data both before and during the pandemic, mostly between 2019 and 2020, to measure and compare pandemic-induced changes or impacts. Lastly, one article presented a study that analyzed data collected in both 2020 and 2021.

3.2 Group B: Multiscale Effects of the Pandemic on PAs

3.2.1 The Role of PAs in Mitigating Future Health Risks

Although the pandemic has been called an unprecedented event, past epidemics had comparable impacts, including the decimation of local populations and macroeconomic and social challenges and adaptations in Asia, Africa, and South America (Anand & Kim, 2021, Hymas et al., 2021). Reaser et al. (2021) have noted that during the introduction of agriculture and the domestication of wild animals for livestock, similar zoonotic spillovers were experienced. These authors considered that the causes behind the global spread of pathogens were human encroachment upon natural habitats, unregulated changes in land use, and intensified wildlife trade. Despite such a checkered past of humans and nature, Oberle et al. (2021) and Terraube and Fernández-Llamazares (2020) have characterized PAs as pivotal tools in implementing

nature-based solutions and in containing the effects of novel diseases.

3.2.2 Environmental Implications in the Early Stage of the Pandemic

Several articles underscored the positive environmental impacts of the temporary cessation of manufacturing activities, urban traffic, and travel. Such impacts included the reduction of disturbances and sound levels in and around PAs (Miller-Rushing et al., 2021), improved air and water quality, decreased water usage, and a decline in roadkill of wild animals (Phua et al., 2021; Smith et al., 2021; Terry et al., 2021; Waithaka et al., 2021). In view of those trends, Bates et al. (2020) have encouraged collective and multidisciplinary research approaches to address the emerging changes in human mobility and their impacts on ecosystems. The pandemic period in question was also an opportunity to evaluate behavioral changes in wildlife. On that count, Zukerman et al. (2021) in Zimbabwe, and Koju et al. (2021) in Nepal, found that reduced tourism-related disturbances brought positive benefits for wildlife. In absence of visitors, wildlife roamed to more favorable locations in search of water and food; or reproduced at a greater rate.

In relation to changes on human activity on PAs, 14 of the articles mentioned a severe growth of illegal activities attributed to the deviation of security personnel and other complex socioeconomic drivers (Phua et al., 2021; Smith et al., 2021), especially in countries of Africa and Latin America (Hockings et al., 2020). Mining, grazing and logging, charcoal burning, wildlife poaching, and fishing of high-value species, have all intensified in the first year of the pandemic (Cahyadi & Newsome, 2021; Loos, 2021; Miller-Rushing et al., 2021; Ndlovu et al., 2021; Neupane et al., 2021; Souza et al., 2021; Spenceley et al., 2021). The increase of communities' dependence on the extraction of natural resources and on cross-boarders trespassing to engage in those activities (Bates et al., 2020; Cumming et al., 2021; Koju et al., 2021) raised alarm over the unsustainable use of land and resources. Along similar lines, several tourism areas were likely to be converted into new settlements and agricultural lands (Waithaka et al., 2021).

3.2.3 Country-Level Economic Impacts on PAs

Even before the pandemic, PAs faced managerial, structural, and systemic constraints (Bhammar et al., 2021). The pause of worldwide productive sectors and industries during the pandemic caused the narrowing of public budgets, tourism revenues, development aids, and philanthropic funding. As expected, fundamental operations in PAs were disrupted, which spurred them to cut costs and to delay, if not cancel, current and near-future conservation projects (Smith et al., 2021; Spenceley et al., 2021). Phua et al. (2021) and Waithaka et al. (2021) have studied the state of terrestrial and marine PAs at a regional and global level. According to their findings, during the early stage of the pandemic, countries in Africa and Latin America reported cuts in employment and salaries, and in Asian countries patrol, research, and monitoring were affected. By contrast, countries in North America, Europe, and Oceania did not face such impacts on government funding but did witness an important reduction in tourism revenue that caused shifts in operational priorities.

In the literature, the role of tourism as a catalyzer and booster for economic development, communities' participation, improvement of local livelihoods, human–wildlife conflicts reduction, and reduction of pressure on land and marine landscapes has been acknowledged (KC, 2021; Meredith et al., 2021). However, during the pandemic, tourism was both a driver and a victim of the virus's spread and the subsequent pause of international mobility. Per Díaz-Sánchez and Obaco (2021), the drastic reduction of tourism to the Galapagos Islands in Ecuador meant a loss in revenues by 35% to 55% in the first year of the pandemic. During the same period, a higher percentage (+70%) of income loss was reported by Mandić (2021) near Croatia's Plitvice Lakes National Park. Anand and Kim (2021) found that the reduction in economic activities and in tourist mobility around PAs prompted variation in the night-time use of lights in Africa, while in Nepal, many tourism entrepreneurs forcedly retreated to agricultural work (Neupane et al., 2021).

On a more positive note, Jenkins et al. (2021) have found that the context favored collaborative approaches between different agencies of territories (e.g., county, state, and federal partners) toward the sustained use and management of resources in a PA of the U. S. Beyond that, Cahyadi and Newsome (2021) have shown that Indonesia's government established

strategies to support its tourism industry in terms of finances, education, operation, marketing, and health regulations. Nevertheless, Kroner et al. (2021) cast doubt on recovery packages focused on economic recovery that undermined conservation efforts in the process. Indeed, they found that various countries began subsidizing extractive and polluting industries and eased access to permits needed to build new infrastructure near or inside PAs, while limiting and reducing budgets for environmental protection.

3.3 Group C: Changes in the Public Use of PAs

3.3.1 Perceived Health Effects of PAs

Given the COVID-19 pandemic's relationship with health-related issues, it is no surprise that the perceived benefits of PAs for people's well-being were a topic in the articles reviewed. As a case in point, Ferreira et al. (2021) conducted an exploratory analysis of COVID-19's on outdoor tourism practices in Portugal's Peneda-Gerês National Park and found that, among domestic tourists, there was an emerging perception that outdoor spaces were less conductive to the spread of the virus. Jenkins et al. (2021) similarly detected a correlation between the resurgence in visitors to PAs and the need to cope with the psychological and physical impacts of isolation. By extension, Lee et al. (2021), Qiu and Zhang (2021) and Qiu et al. (2021) analyzed the perceived restorative effects of PAs during the pandemic. Their findings include the effectiveness of forests as spaces for relieving stress and the fascinating stimuli of natural soundscapes on people that have experienced mental fatigue, loneliness, and sadness in their everyday environments due to lockdowns.

3.3.2 Perceived Risks and Protective Behaviors in PAs

The analysis of perceived risks of visiting PAs was another widely examined topic in the articles reviewed. Therein, Ramli et al. (2021) have found a moderating effect of perceived risk in the relationship between revisit intention and the demographic characteristics of visitors, their motivation, and destination image. Samdin et al. (2021) have added that perceived risks can be divided into ones related to expected services and others to visitors' safety and found that the availability of health- and safety-related information had become the most relevant predictor of perceived risks. In other analyses, Seong and Hong (2021) and Seong et al. (2021) identified an optimistic bias and a more positive social attitude toward natural outdoor settings and PAs, where they perceived fewer risks than in urban areas. According to Falk et al. (2021), domestic tourists' adaptation has derived from protective travel behaviors developed during the pandemic. Tourists and visitors were more aware of the hygienic and sanitary conditions of tourism sites and preferred areas with lower economic activity density such as those surrounded by national parks. Moya Calderón et al. (2021) as well as Ma et al. (2021) have added that travel costs also derived adaptation among domestic visitors when adjusting their behavior to hazards such as the pandemic.

Additionally, Xiao et al. (2021) have stressed concerns about health risks associated with overcrowded spaces and analyzed social carrying capacity with a focus on visitors' tolerance to encounters in PAs. They found that COVID-19 prevention strategies implemented within parks have significantly impacted the tolerance to crowds and served to enhance visitors' positive emotions regarding pandemic-associated risks. In addition, Jenkins et al. (2021) have reported that first-time visitors perceived crowding differently than repeat ones, and the incorporation of safety guidelines may have negatively influenced visitors to divert to non-established trails to avoid crowds.

3.3.3 Shift of Domestic Visitors to Nearby Destinations

In their respective studies in Hungary and the U.S., Kovács et al. (2021) and Kupfer et al. (2021) identified a shift in the mobility-related trends of domestic visitors who showed considerable interest on inland rural destinations, including PAs. Moya Calderón et al. (2021) have reported that domestic visitors in Costa Rica felt relatively safe on the outdoors in relation to the spread of the virus and expressed a stronger sense of solidarity with the local economy. According to the articles reviewed, the restrictions on international travel and lack of alternative leisure activities in cities were behind such trends (Ferreira et al., 2021; McGinlay et al., 2020; Moore & Hopkins, 2021).

Tan et al. (2021) found that despite the vulnerability of short-distance markets, they have exhibited stronger adaptability and recovery rates than long-distance markets in China. Similarly, Yang et al.

(2021) discovered that during the pandemic, domestic visitors to PAs in the U.S. preferred shorter stays in closer destinations, in contrast to their behavior during other crises, such as wildfires, when they chose to further travel and longer stays. To understand the recent increase in domestic tourism, Lebrun et al. (2021b) and Lebrun et al. (2021a) found significant relationships between memory, physical activity, and education, and between arousal and the experience of residents when visiting PAs of France and China. Furthermore, extraordinary contexts such as the pandemic have a moderating effect on such relationships; that should be considered by managers in the design of experiences for domestic visitors.

Concerns related to visitors' actions have also emerged. Cahyadi and Newsome (2021) identified a lack of environmental awareness among domestic tourists in Indonesia, especially in relation to the cleanliness of tourism sites, and underscored an egocentric approach to visiting PAs, in which the dominant focus is personal enjoyment, not learning or discovery. To that, Moore and Hopkins (2021) added that a lack of familiarity with park regulations can explain conflicting behaviors among visitors. In further analyzing compliance with public health guidelines, Harris et al. (2021) observed that adolescents and young adults were more likely to adopt risky or carefree behavior in the early stages of the pandemic; however, that likelihood dropped from 90% to 60% in Miller et al.'s (2021) analysis conducted later that same year, probably due to a better understanding of the pandemic.

3.3.4 Consequences of Increased Visitation at PAs

As high interest in PAs eventually translated into overcrowding, multiple areas reported record visits, parking and traffic problems, conflicts between visitors and residents, and increased vandalism and littering (Kupfer et al., 2021; Ma et al., 2021; Miller et al., 2021; Souza et al., 2021; Spenceley et al., 2021). Consequences mentioned in the studies reviewed were disturbances to ecologically sensitive and remote areas, waste management issues, habitat fragmentation, microclimate disruption, reports of aggressive animal behavior, as well as increased number of accidents and rescues performed in natural areas (Kovács et al., 2021; Saladié et al., 2021; Sumanapala & Wolf, 2021). In like manner, urban PAs received special attention due to their proximity to large human populations (Moore & Hopkins, 2021; Primack & Terry 2021). These areas suffered trampling of vegetation, erosion, the widening of existing trails, and the unauthorized creation of new trails, as well as more noise pollution due to high-speed traffic on typically empty roads (Terry et al., 2021).

3.4 Group D: Managerial Adaptation During the Pandemic

3.4.1 Managerial Constraints and Measures Implemented in Response to Pandemic-Associated Risks

Following the declaration of the pandemic, multiple PAs adapted their operation mechanisms. Surveillance, training, and planning sessions were held remotely, while scientific research, wildlife monitoring, and fieldwork were halted, which led to a rise in desk-based research (Hockings et al., 2020; Ndlovu et al., 2021; Phua et al., 2021). Although the circumstances allowed enhanced data sharing and the consolidation of projects, some stakeholders did not have the means to adapt to virtual communication (Smith et al., 2021). The initial lack of vital administrative staff, park rangers, and seasonal support staff, as well as the reallocation of duties hindered the capacity to respond to emergencies (Miller-Rushing et al., 2021; Waithaka et al., 2021). Enforcement capacity was reduced, while the maintenance of infrastructure and other routine management tasks were postponed or abandoned. Furthermore, per Bates et al. (2020) and Singh et al. (2021), the work overload on staff and the fear of contagion affected their PAs staff's health, causing symptoms of fatigue, anxiety, and stress. Additionally, the staff faced difficulties accessing medical aid during the first months of the pandemic.

After several countries lifted their mobility restrictions, concern was to prevent contagion and guarantee the welfare of staff and visitors. Frequent sanitizing, use of facemasks, installation of barriers, and cash payments bans were among the protocols mentioned in the articles reviewed (Ma et al., 2021; Souza et al., 2021). Attending to the social distancing and health protocols imposed by governments, PAs were encouraged to provide low-density outdoor activities (Miller-Rushing et al., 2021). Some PAs completely or partly closed their facilities, reduced day-use quotas, limited group activities, or implemented reservation systems (Jenkins et al., 2021; Moore & Hopkins, 2021). They also introduced educational

material, signage, and codes for responsible recreation (Cahyadi & Newsome, 2021; Kupfer et al., 2021; Spenceley et al., 2021; Sumanapala & Wolf, 2021; Waithaka et al., 2021). PAs from the U.S. reduced access to research facilities and collections, and implemented smaller field teams, causing an increase on the use of vehicles for individual trips (Miller-Rushing et al., 2021). Smith et al. (2021) and Phua et al. (2021) identified a stronger collaboration between management authorities and security forces, volunteer corps, or the community itself, to make up for the decrease in patrolling capacity and the increase in illegal activities in the vicinity of PAs.

3.4.2 Public Engagement With PAs

Activities to enhance community engagement with PAs and moderate interactions between humans and biodiversity were affected during the pandemic, including the cancelation or limitation of environmental education and cultural events (Smith et al., 2021). In some PAs web-based activities were implemented, incorporating webinars, live webcams, and digital tours. Social media became an important means to share visual materials, allowing public participation in conservation-related issues, and providing real-time information about park visitation (Jones et al., 2021; Moore and Hopkins, 2021; Waithaka et al., 2021). Miller-Rushing et al. (2021) found that despite the sharp decrease in public interest in PAs, there was higher remote engagement. This contributed to the increase of visitors to PAs after the eventual lockdown ease.

3.4.3 Response of PAs Managers to the Increase in Visitation

The high numbers of visitors in PAs made new management adaptations complicated. In response to overcrowding and noncompliance with regulations, the authorities introduced and enforced additional protocols to manage visitors' flows to and within those areas (McGinlay et al., 2020). These protocols involved the application of early booking systems, timed entries, one-way paths and alternative paths, the reduction on the carrying capacity of facilities, and mobile applications to monitor the number of users on the same path (Jones et al., 2021; Miller-Rushing et al., 2021; Primack & Terry, 2021; Spenceley et al., 2021). Such changes in mobility dynamics sparked interest in analyzing management strategies. On that topic, Jones et al. (2021) gathered the residents' perspectives on the suitability of strategies to manage the reopening of a PA in Croatia. Among their results, residents expressed discontent with unrestricted access. They preferred a phased reopening of the area; however, they were concerned that the strategy was insufficient to control crowds. Along similar lines, KC (2021) has mentioned the need to adapt marketing strategies to mitigate overtourism but still encouraged domestic tourism, as well as the co-creation of experiences with visitors. Falk et al. (2021) have supported those notions and pointed to the importance of appealing to the attractiveness of natural value and the health benefits of time spent in nature as means to maximize the benefits of domestic tourism.

3.5 Group E: Rethinking PAs Management at a Mid- and Long-Term

At least 21 articles have made significant contributions to rethinking PAs as social and ecologically resilient areas after the pandemic. Hockings et al. (2020) summarized that possibility in three scenarios. The first one, an eventual "return to normal" (Hockings et al., 2020, p. 14), a perspective on which the overall context before the pandemic was already negative and former constraints would remain poorly addressed. The second one, a pessimistic scenario in which the reinterpretation of regulations favors faster economic recovery rather than environmental conservation; and afterwards, the world would face an economic depression and a declining biodiversity. And the third one, a positive transition to a greener economy. KC (2021), King et al. (2021), and Meredith et al. (2021) have discussed the underlying need of fostering strong socioecological systems to cope with the implications of such crises and supported the adoption of a management model that favors people-PAs relationships. With such a model, the adaptation to disease outbreaks would be easier in both the short and long term, and nature-based spaces would become accessible for equitable use and health restoration (Smith et al., 2021).

Kroner et al. (2021), Loos (2021), Mandić (2021), and Spenceley et al. (2021) have drawn attention to the escalation of unemployment and food insecurity in sensitive regions of the Global South, and to the premature decrease in public engagement, revenues, and conservation efforts within PAs, in the global context.

On that topic, various recommendations are included in the articles reviewed. For instance, the reinforcement of awareness about conservation (Oberle et al., 2021; Reaser et al., 2021), the training of managers and staff and the professionalization of rangers (Singh et al., 2021), the empowerment of different stakeholders (Cumming et al., 2021; KC, 2021; Waithaka et al., 2021), the use of technologies to enhance remote participation and exchange of ideas and information (Miller-Rushing et al., 2021; Phua et al., 2021), and the update of risk assessments and emergency response protocols to attend the constraints that PAs face (Ma et al., 2021).

Lastly, concerns related to the role of tourism in communities and the future of the activity were highlighted. Several authors have pondered the opportunity to shift into sustainable financing models that do not rely on large numbers of visitors and proposed complementary measures for economic recovery (King et al., 2021; Sumanapala & Wolf, 2021). Some actions being the creation of alternative revenue streams, income bases, and funding mechanisms; products innovation; thorough assessment of the effects of visitors' spending; and proper expenditure and pricing policies (Bhammar et al., 2021; Díaz-Sánchez & Obaco, 2021; Meredith et al., 2021; Souza et al., 2021; Spenceley et al., 2021).

3.6 Group F: Emerging Research Agenda

The pandemic and the subsequent recovery stages have provided a wide array of topics for research. Hymas et al. (2021) and Reaser et al. (2021) have heralded the time as an opportunity to develop interdisciplinary studies incorporating multiple dimensions of analysis from fields such as the social sciences, economics, and natural sciences, among others. This integrated approach would allow a deeper understanding of the drivers that trigger challenges in PAs during a crisis (Loos, 2021). In the articles reviewed, authors welcomed the use of innovative methods and tools of research, including culturomic metrics (Souza et al., 2021), iDNA monitoring and the remote sensing of biodiversity (Anand & Kim, 2021; Bates et al., 2020; Terraube & Fernández-Llamazares, 2020), individual travel data (Falk et al., 2021), and tracking and video records to analyze visitor flows (Phua et al., 2021; Zukerman et al., 2021).

Because most of the data for empirical analysis in the literature reviewed was obtained in 2020, it is plausible to continue with longitudinal studies that monitor and evaluate the pandemic's impacts across longer periods. At the same time, there are opportunities to continue conducting case studies, especially in poorly studied locations, which provide closer, relatable information for managers from other locations (Harris et al., 2021). Likewise, a participatory approach is advised to stimulate the participation of stakeholders and the use of updated information in decision-making processes (Saladié et al., 2021).

4. Discussion

Among the approaches followed in the reviewed articles, most involved analysis from a pragmatic approach and yielded useful, practical results based on comparable, replicable methods. In the early literature, there is a wide agreement that the pandemic has affected human mobility—causing an "anthropause" according to Koju et al. (2021, p. 2)—that caused a rapid decline in PAs' resources and revealed the volatility of tourism as source of income. Several remarks in the articles aligned with statements from Smith et al. (2021), namely that the crisis reinforced management models that neglected local livelihoods, intensifying communities' vulnerability and unequal access to values and services provided by PAs.

At the same time, many problems pinpointed in this review predated the pandemic and had only worsened during this period (Cumming et al., 2021; Loos, 2021). Wildlife trade, overcrowding, disproportioned stakeholders' participation, financial instability, and limited management capacity are only some of the issues that needed and still ought to be addressed. The resolution of many of those issues prior to the conclusion of the pandemic relies on several factors such as political and social determination, the policies and activities promoted in PAs, as well as the markets that are stimulated.

Consistency in emphasizing the importance of implementing adaptive and preventive management empowers the ability to address not only the ongoing challenges faced by PAs, but also to effectively respond to new arising crises (Kroner et al., 2021). The need for carefully thought-out and informed plans for spatial use, (Kupfer et al., 2021; Ma et al., 2021), is presented as an enabler for effective management

strategies in the articles reviewed. Meanwhile, using carrying capacity based on a maximum number of visitors as the only instrument of management was considered insufficient by authors such as McGinlay et al. (2020). For it, management approaches based on emotions and/or perceptions such as limits of acceptable change or social carrying capacity surged as proper alternatives (Xiao et al., 2021).

Additionally, the pandemic tested the communication capacity and manager's preparedness to keep up with rapid exchanges of information and constant mobilities that characterize modern societies.

As previously mentioned, visitors to PAs have altered their perceptions and behavior during and due to the pandemic, yet there remained a strong desire to engage in outdoor activities. The emerging discussions on travel intention, risk perception, and adaptive behavior have provided valuable outcomes to feed management and marketing strategies that consider visitors' motivations and experiences. The bolstered bond between people and environment, and the fast adaptation of domestic visitors, had been both a call of attention for PAs managers to think of strategic decisions and planning, and to seize this momentum to enhance the acceptance of management measures and regulations introduced during the pandemic. This is especially relevant for PAs placed in regions highly dependent on international tourism markets, as well as in destinations facing problems such as overtourism or environmental degradation.

On another note, in this context, debates on public health issues are not surprising; but the appreciation of PAs' potential to positively impact visitor's wellbeing and the subsequent call to integrate these areas to public health strategies emerged as one of the most valuable learnings on this subject-matter. That is, the health crisis was an opportunity to improve PAs management and people's engagement with nature and to acknowledge the increasing discourses of building greener, healthier, and more sustainable societies, as suggested by Hockings et al. (2020). Lastly, recalling Hymas et al. (2021) and Reaser et al. (2021), epidemics and pandemics have happened before, but the conditions in which the COVID-19 pandemic developed were different. In this sense, the existence of convenient technologies and means for connectivity, the fast study of the virus with daily follow up and updates, the soon introduction of vaccination; all of this and more has allowed to cope with the consequences of the pandemic, generating learnings that can be leveraged to be prepared for future crisis.

5. Conclusion

This paper has reviewed mounting concerns related to PAs during the pandemic, with particular focus on the body of research published in the first two years of the crisis. As seen, there was a clearly great interest in analyzing the role of PAs in a context that transformed human mobility and the experiences of people who make use of those areas. The topic has been approached from sundry points of view and on various territorial scales, such that the articles complemented each other and were often in agreement about the needs identified. The global perspective adopted in the literature encompasses the social, ecological, and economic implications of the pandemic for PAs, their management, and public use. Nonetheless, in terms of territorial perspectives, despite the wide representation in areas of study and geographical domains, studies dealing with site-level analysis were predominantly conducted in the so-called Global North.

Full of hope discourses referring to a change in global mobilities towards sustainability and the appreciation of the potential of PAs have stood out. However, many of the recommendations and conclusions identified in this review have been overly general and nonspecific, especially ones from the pandemic's early stages. There is thus ample room for improvement for future research, especially because some articles lacked details about the data sources and methods used, as well as depth in the results and their implications. The articles reviewed have also shed light on the relevance of tourist activity for PAs, as captured by the number of studies analyzing related topics. However, given that most data were collected in the first year of the pandemic, those studies still failed to capture, much less analyze, the changes experienced by visitors in the long term, or the success of actions implemented in response to the pandemic and the possibility of reapplying them hereafter.

The acceleration in the problems that PAs regularly experience remains to be of interest. The understanding of how the implication of a global crisis persists in management and mobilities and the study of the mechanisms applied to deal with those issues will pertain in future crises. Moreover, the pandemic functioned as means to recognize the capacity of indivi-

dual resilience and self-determination to adapt to changing contexts; but also, it shed light on the capability of communities to return to their usual routines as soon as mobility obstacles were removed. The remaining questions will be whether this individual adaptive capacity can be effectively translated to the governance institutions in charge of creating management plans and policies in PAs; and whether PAs will be able to thrive despite contemporary, and yet unexpected, changes such as those caused by the COVID-19 health crisis.

As of the writing of this article, after three years, the pandemic has been officially called off. The crisis, that quickly developed into a complex social phenomenon, which effects broadened and conditioned decision-making processes at the government and at the site level, is already over. As quickly it expanded, it seems to be gone, and it is hardly talked about in today's daily news. After vaccination, the full opening of international borders and the recovery of traditional mobilities, what remains is to extract lessons that help to ensure the adaptability of places and destinations in the face of future crises. This makes the studies on post-pandemic transformations in PAs noteworthy and still relevant.

Our review has contributed to further reflection and wider examination of emerging opportunities for the future of PAs. Additional research could also involve the analysis of the reconfiguration of activities developed in PAs and the engagement of stakeholders in their governance and management. Such research could involve analyzing the capacity of governments and managers to adapt to crises, to establish collaborative networks, and to achieve the sustainable, effective functioning of PAs. Future studies could also focus on analyzing visitors' behavior and flow patterns when traveling towards and into PAs, to shed light on the lingering effects of a potential future crisis.

Lastly, our findings have some limitations that warrant consideration. For one, because most of the empirical studies analyzed information from 2020 or before the pandemic, certain relevant issues remain underexamined. The first year of the health crisis was the most restrictive in terms of mobility, and vaccination began in 2021; thus, analyzing management strategies and visitors' behavior and risk perception in the second and third years of the pandemic may yield additional findings. At the same time, to ensure that the articles reviewed had sufficient academic quality, we limited our review to literature available on Scopus database. Thus, articles published in journals not indexed in that database were automatically excluded. Added to that, most of the articles were written in English—although not exclusively—, meaning that articles written in other languages remain for future review.

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