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COMMENTARY

Fostering local involvement for biodiversity conservation in tropical regions: Lessons from Madagascar during the COVID-19 pandemic

Estelle Razanatsoa[1] | Seheno Andriantsaralaza[2,3] | Sheila M. Holmes[4] | O. Sarobidy Rakotonarivo[5] | Anitry N. Ratsifandrihamanana[6] | Lalatiana Randriamiharisoa[7] | Maholy Ravaloharimanitra[8] | Narindra Ramahefamanana[9] | Dinasoa Tahirinirainy[10] | Jeannie Raharimampionona[11]

[1]Plant Conservation Unit, Department of Biological Sciences, University of Cape Town, Cape Town, South Africa

[2]Department of Plant Sciences, Faculty of Sciences, University of Antananarivo, Antananarivo, Madagascar

[3]Lemur Love Inc., San Diego, CA, USA

[4]Department of Wildlife, Fish and Environmental Studies, Swedish University of Agricultural Sciences, Umeå, Sweden

[5]École Supérieure des Sciences Agronomiques, Université d'Antananarivo, Antananarivo, Madagascar

[6]World Wide Fund for Nature –Madagascar, Antananarivo, Madagascar

[7]Madagascar National Parks, Antananarivo, Madagascar

[8]Community-based conservation, Aspinall Foundation Madagascar, Antananarivo, Madagascar

[9]Makirovana Tsihomanaomby Protected Area, Missouri Botanical Garden, Antananarivo, Madagascar

[10]Ankafobe Protected area, Missouri Botanical Garden, Antananarivo, Madagascar

[11]Conservation Unit, Missouri Botanical Garden, Antananarivo, Madagascar

Correspondence
Estelle Razanatsoa, Plant Conservation Unit, Department of Biological Sciences, University of Cape Town, Cape Town, South Africa.
Email: estelle.razanatsoa@uct.ac.za

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Abstract

Tropical ecosystems host a large proportion of global biodiversity and directly support the livelihoods of many of the world's poorest, and often marginalized, people through ecosystem goods and services and conservation employment. The coronavirus pandemic has challenged existing conservation structures and management but provides an opportunity to re-examine strategies and research approaches across the tropics to build resilience for future crises. Based on the personal experiences of conservation leaders, managers, and researchers from Madagascar during this period, we discuss the coping strategies of multiple biodiversity conservation organizations during the coronavirus pandemic. We highlight the vital role of local communities in building and maintaining resilient conservation practices that are robust to global disruptions such as the COVID-19 crisis. We argue that the integration of local experts and communities in conservation, research, and financial decision-making is essential to a strong foundation for biodiversity conservation in developing countries to stand up to future environmental, political, and health crises. This integration could be achieved through the support of training and capacity building of local researchers and community members and these actions would also enhance the development of

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strong, equitable long-term collaborations with international communities. Equipped with such capacity, conservationists and researchers from these regions could establish long-term biodiversity conservation strategies that are adapted to local context, and communities could flexibly balance biodiversity and livelihood needs as circumstances change, including weathering the isolation and financial challenges of local or global crises.

KEYWORDS
biodiversity conservation, capacity building, crisis management, equity and inclusivity, local communities, local leadership, Madagascar, tropical regions

1 | INTRODUCTION

Tropical areas host globally important ecosystems with high levels of biodiversity, but are also vulnerable to a diverse range of crises (Barlow et al., 2018), such as the current COVID-19 pandemic. Public health measures taken during the pandemic have reportedly affected many sectors, including biodiversity conservation (e.g. Barbier & Burgess, 2020; Bates et al., 2020; Buckley, 2020; Corlett et al., 2020; Ezeh et al., 2020; Lindsey et al., 2020). Economically and socially marginalized groups, including communities living around protected areas, have experienced acute challenges due to loss of income during the pandemic, leading to a greater reliance on natural resources (Drolet et al., 2015; Forti et al., 2020; Lindsey et al., 2020; Sheller, 2020). Such resources have long served as an important safety net for local communities, providing ecosystem services particularly in times of resource instability, scarcity, or stochasticity (Mbiba et al., 2019; Nerfa et al., 2020; Rasmussen et al., 2017). Elevated human threats to nature are further augmented by restricted operation of conservation agencies and a decrease in international conservation funding (Lindsey et al., 2020; Manenti et al., 2020; table 2). While the consequences of the pandemic for biodiversity are not yet fully understood (Bang & Khadakkar, 2020), our current management experiences as biologists and members of local and international conservation organizations and communities in Madagascar mirror those from past political, social, environmental, and health crises (Table 1, Figure 1). Such crises are common to the tropics, particularly in poverty-stricken countries like Madagascar (e.g Bang & Khadakkar, 2020; Schwitzer et al., 2014), and represent a recurring threat to biodiversity conservation. For example, economic and political decisions and crises in Madagascar severely damaged conservation efforts (Jones et al., 2019; Kauffman, 2006; Vieilledent et al., 2020) leading to environmental deterioration and biodiversity loss, despite efforts from international funding agencies (Jones et al., 2019; Kauffman, 2006; Mbaiwa et al., 2011). The COVID-19 crisis provides an opportunity to evaluate the efficacy of existing conservation strategies and research approaches across the tropics in the face of current challenges and to build resilience to future crises of all types (Miller, 2020).

We support many of the diverse recommendations for post-COVID management of conservation areas (e.g., Altieri & Nicholls, 2020), including changes in national policy (e.gAltieri & Nicholls, 2020; Barbier & Burgess, 2020) and increased financial support from the global community (Lindsey et al., 2020). However, we contend that a strong foundation based on local involvement in conservation, research, decision-making, and financial activities is essential for the long-term resilience of tropical biodiversity conservation in a changing world. In this commentary, we discuss the short-term responses to the coronavirus pandemic in Madagascar with regard to biodiversity conservation. Our own experiences as leaders of several local organizations in Madagascar (detailed in Table 1) highlight the vital role of local communities and resources in building and maintaining resilient conservation practices that are robust to global disruptions such as the COVID-19 crisis. Building upon these interim successes, we may be able to improve long-term conservation practices, not only for the island but also across tropical regions, by focusing on local capacity building. We suggest four (4) main actionable targets that will strengthen the resilience of communities and tropical conservation to future economic, environmental, and health crises.

2 | PRIORITIZE RESILIENT, SUSTAINABLE LIVELIHOODS FOR LOCAL COMMUNITIES

A vital component of reducing community vulnerability to future "disasters," while fostering increased resilience to economic fluctuation, is enhanced sustainable livelihoods (Sheller, 2020). Biodiversity hotspots in poverty-stricken countries are particularly vulnerable to crises through disruption of livelihoods and lack of viable alternative income-generating activities. Local communities in Madagascar and other tropical countries have adapted to crises by adjusting activities to generate additional income (Forti et al., 2020; Lindsey et al., 2020; Table 1), including increasing reliance on forest clearance for agriculture, logging, and charcoal production which are already considered major threats to biodiversity (Rakotomanana et al., 2013; Schwitzer et al., 2013; Tilman et al., 2017). People have also increasingly relied on subsistence small-scale agriculture and

TABLE 1 Non-exhaustive summary of the challenges and short-term local adaptation of conservation practices in Madagascar during the coronavirus pandemic, based on the experience of co-authors as managers and leaders of conservation agencies on the island

Conservation agencies	Managed areas	Main objectives	Challenges	Short-term adjustment
Madagascar National Parks (MNP)	43 protected areas with 27 National Parks, 14 Habitat/Species Management Areas or Special Reserves and 2 Strict Nature Reserves	To sustainably manage and conserve its 43 protected area network as representatives of the jewels of biodiversity and natural heritage of Madagascar. These Protected Areas constitute a lever of economic incentives for conservation and local development.	• Reduced funding (lack of tourism activity and cessation of research and associated fees) • Increase in illegal activities inside parks • Cessation of activities related to organizing social meetings with local communities • Late payments of local park committees' who oversee surveillance and patrols	• Prioritization of certain conservation activities: strengthen surveillance of fire-sensitive areas and areas prone to illegal activities • Minimal services in offices and increased teleworking • Telephone communication for reporting
Aspinall Foundation Madagascar	Maevatanana – Ambato Boeny in western Madagascar (8 sites), Ankeniheny Zahamena forest corridor (5 sites), Andriantantely forest (8 sites), and Vohibe forest (New Protected Area Nosivolo) in the eastern region (22 sites)	To help prevent the extinction of threatened species.	• Lack of communication infrastructure in some areas; limited communication with forest rangers • Cessation of activities related to the support of local communities • Cessation of environmental education and awareness activities • Difficulty in collection, transfer, and storage of monitoring data	• Phone communication for reporting • Forest rangers performed habitat and species monitoring alone • Greater reliance on local communities to continue conservation activities like reforestation and forest surveillance
WWF Madagascar	Priority landscapes in Madagascar: Corridor Marojejy-Tsaratanana, DIANA region, Mahafaly Plateau, and the Manambolo-Tsiribihina mangroves, Western Madagascar	To strengthen protected area management and restoration, support community-based natural resources management (including fuelwood), and develop alternative livelihoods for those communities. At the national level, WWF works on key high-impact sectors such as energy and fisheries and contributes to improving governance in the environmental sector through Malagasy civil society empowerment.	• Disruption of support to local partners that includes activities such as sensitization, regular meetings with locally based communities' management committee, joint patrols, some planned training sessions • Suspension of activities • Repatriation of displaced staff within Madagascar to their families • Reduced monitoring activities such as patrolling and surveillance • Reduced revenues for local communities	• Increased costs for Internet and health safety measures (sanitizer, masks, thermometers, moving staff around) • Contact tracing, repatriation, and ensuring staff safety • Reorganization of tasks for positions such as field agents and socio-organizers. These entail tasks that could be performed remotely such as entering field data into databases, undertaking phone surveys of communities, updating sensitization material • Teleworking, with the exception of central support positions for which physical presence at the office was essential (administration and finances, essential drivers/couriers), and only when appropriate safety measures were taken (transportation arrangements, masks, sanitizers) • Postponed all meetings, workshops, and training or limited the number of participants • Emergency support to local communities in the form of food supplies, hand washing kits, and sensitization on COVID-19 and the link between environmental degradation and pandemic

(Continues)

TABLE 1 (Continued)

Conservation agencies	Managed areas	Main objectives	Challenges	Short-term adjustment
Missouri Botanical Garden (MBG)	12 protected areas co-managed with local communities.	To maintain the good management of protected areas (PAs) through additional and adequate support to staff and local communities.	• Increase in illegal exploitation of natural resources inside PAs: local communities are looking for easy income such as hunting, logging, charcoal production • Group activities were canceled (e.g., training, workshops, awareness activities, and outreach community work) • Reduced supplementary income for local communities surrounding parks and in remote locations • Cancelled site visits for monitoring from MBG headquarter in Antananarivo • Farmer reliance on local markets led to a decrease in income from agricultural products • Inflation in vanilla prices in these locations	• Reduction in the number of participants from local communities in conservation activities • Reinforced (by new part-time recruited staff) patrol and controls of illegal exploitation in PAs; establishment of a community patrol team • Emergency funds provided to the local community and staff to help with equipment and needs for the reinforcement of activities during the pandemic:1-Rainforest Trust (for Ankafobe to support conservation activities: fire break and fire spotters) 2-RAG IUCN Save Our Species /UE (for Makirovana Tsihomanaomby and Ankarabolava Agnakatrika to support community vulnerabilities by participating in protected area patrols) which helped to solve challenges linked to additional staff salaries; 3- FAPBM (for Analalava and Oronjia) to distribute everyday necessities such as rice, oil, salt, and beans • Recruitment of firefighters to detect nocturnal bush fires • Local communities shifted to other income-generating activities (wood exploitation, charcoal production, and vanilla husbandry inside the protected areas) • Encouragement of local communities to work on their rice fields and other crops including beans and vegetables instead of planting cash crops

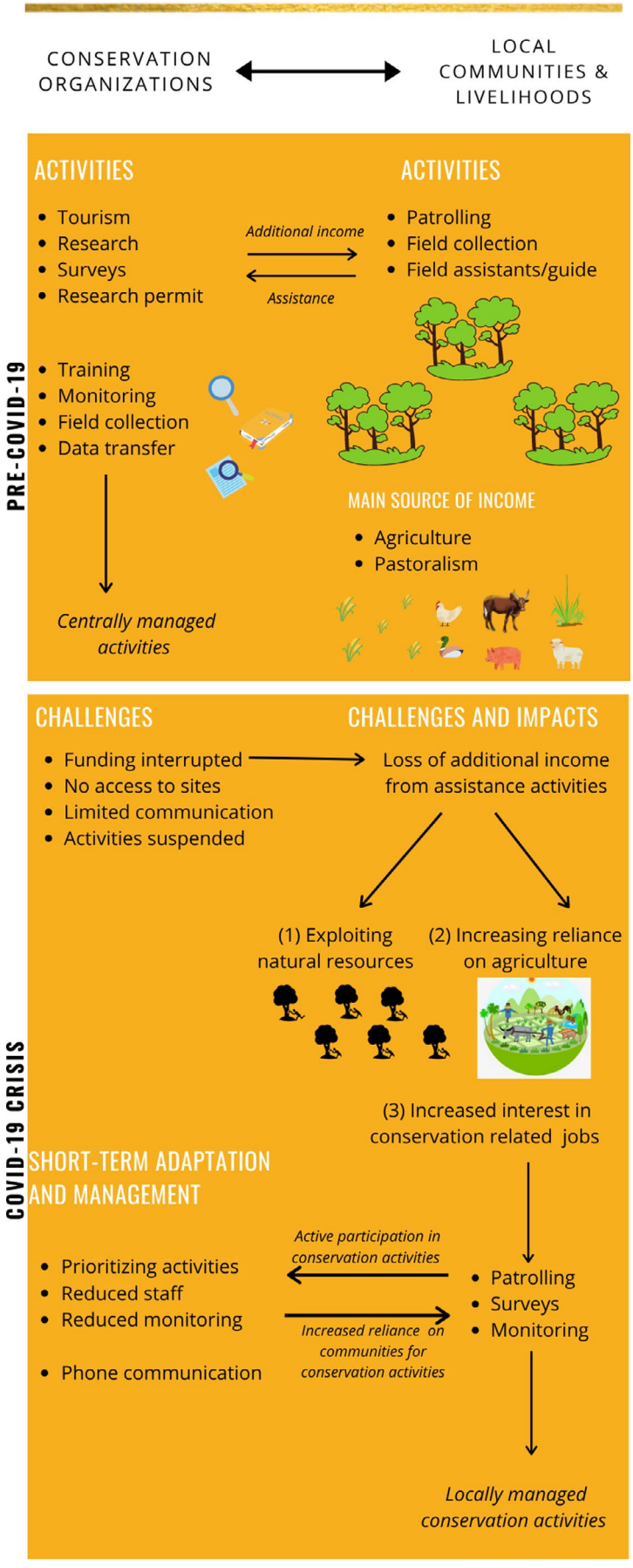

FIGURE 1 Conservation management challenges, strategies and livelihood activities adopted by organizations and local communities in Madagascar prior to and during the COVID-19 crisis. The top panel shows the interplay of activities undertaken by conservation organizations and local communities pre-pandemic. Despite mutual benefit, conservation organization activities were largely centrally managed, and the main source of income for communities was agriculture and pastoralism. The bottom panel describes the challenges experienced by conservation organizations during the COVID-19 pandemic that in turn put additional pressure on local communities due to loss of income. This affected livelihood strategies, including stimulated interest in conservation-related activities. Conservation organizations undertook short-term actions to mitigate the impacts of the pandemic in the short-term, including increased reliance on local communities, essentially shifting conservation management to a local scale

demanded jobs from conservation agencies in protected areas (Table 1, Figure 1). These short-term, often extractive, individual solutions demonstrate both conflict and co-dependence between conservation and community development, which will be further complicated by future environmental, economic, or health crises. To withstand future economic shocks, diversified livelihoods are needed (Ellis & Allison, 2004; Lendelvo et al., 2020; Roe et al., 2020). Lindsey et al., (2020) discuss in detail several possibilities for funding diversification, including domestic tourism and government support, but also international contributions like industry offsets, payments for ecosystem and cultural services, and debt-for-nature swaps. However, livelihood diversification should focus on non-extractive long-term income, including small livestock diversification and a combination of improved sheep husbandry, as these animals primarily consume grasses resulting in less dependency on forest resources, and poultry keeping as already practiced in some areas of southern Madagascar (Hänke & Barkmann, 2017; Kimengsi et al., 2019; Neudert et al., 2015). Collaborations between various stakeholders including conservation agencies, humanitarian organizations, and government could be established to prioritize interventions that reinforce the success of conservation actions (Guerrero et al., 2015), and improve livelihood resilience of local communities in the medium to long-term. These interventions could focus primarily on identifying communities' livelihood needs (Bennett, 2010), and ensuring conservation restrictions do not infringe upon these needs, but also on securing funds to allow a net improvement in local livelihoods and conservation activities. This would ensure adequate support to local communities that manage and depend on natural resources, especially during crises.

3 | EMPOWERING COMMUNITIES AND IMPROVING LOCAL MANAGEMENT BY INVESTING IN CAPACITY BUILDING OF LOCAL STAKEHOLDERS AND WORKFORCE

To foster sustainable and resilient conservation practices that can continue to benefit communities even during global disruptions, community conservation should be locally based (Roe et al., 2020). Improved benefit sharing and equitable use of natural resources with local communities were previously suggested to achieve this goal in Madagascar (Rakotomanana et al., 2013). Indeed, the reduced travel and local decision-making imposed on multiple organizations during the COVID pandemic have illuminated opportunities for NGOs to bolster local skill-building programs (Table 1). Developing skilled local teams with consideration for cultural, societal, and environmental context could facilitate the continuity of conservation programs while improving the livelihood of communities surrounding protected areas (Bennett, 2010; Vermeulen & Sheil, 2007). Empowering local communities to co-manage the protected areas with conservation organizations will entail local opportunity and management costs that should be considered early on in grant applications and evaluations. Community involvement could be fostered through a two-pronged approach:

a. Environmental education of primary school students is an efficient path to sustainable development in developing countries (e.g Abramovich & Loria, 2015; Ardoin et al., 2020). The exchange that exists between parents and children allows knowledge transfer at the intergenerational and intercommunal levels (Damerell et al., 2013; Duvall & Zint, 2007). In Madagascar, some rural children are aware of the environmental issues and can relate to them through experience (Korhonen & Lappalainen, 2004), despite the fact that environmental education is not included in the Malagasy school curriculum. However, surveys conducted in the eastern region showed that education based on locally meaningful materials and peer learning significantly improved environmental knowledge (Richter et al., 2015). Targeted biological education programs, such as that implemented in Costa Rica for 24 years, have proven to have a meaningful impact on community attitudes toward natural resources and conservation efforts (Cruz & Segura, 2010). A similar approach could be established across Madagascar to foster knowledge and appreciation of Madagascar's natural heritage by its future generations (Dolins et al., 2010; Richter et al., 2015). Moreover, initiatives such as the "green class" conducted in collaboration with conservation organizations have increased the extent of these environmental education programs (Schüßler et al., 2019). Combining programs associated with conservation projects with an enhanced school curriculum designed with the local context in mind, could help ensure the future of tropical biodiversity hotspots in developing nations.
b. Protected area management training can be targeted to increase equity within communities living around protected areas (O'Connell et al., 2019; Vermeulen & Sheil, 2007). Such training could include project management, survey methods, computer literacy (e.g., data input), and language skills (O'Connell et al., 2019). Such competency will foster improved natural resource management and protection through, for example, community-organized patrols. The inclusion and recruitment of local communities in government or NGO-led conservation management would provide more permanent livelihoods and a sense of pride and ownership, while being respectful of the values and norms of these communities (Andrade & Rhodes, 2012). Local communities can lead the management of natural resources and are more receptive to protected areas if they are organized, for example, in the form of local associations referred to as "Vondron'Olona eny Ifotony or VOI" in Malagasy (Andrade & Rhodes, 2012; Toillier et al., 2008). The management transfer of natural resources to local communities has proven successful, especially when it generates revenues such as those in Analamazaotra in eastern Madagascar and in marine protected areas across the western region (Dolch et al., 2015; Gardner et al., 2020).

Community-led management encourages conservationists and researchers to respect traditional knowledge, a highly recommended approach in conservation practices (Mbaiwa et al., 2011; McPherson et al., 2016). The result is greater community independence and investment in conservation success. This inclusive approach also concerns leadership positions among international conservation organizations, which should prioritize nationals and provide equitable benefits similar to their foreign colleagues. With an integrated co-management of conservation between local communities and stakeholders, the global community could facilitate exchange, and training along with funding assistance.

4 | IMPROVING ACCESS TO TECHNOLOGICAL TOOLS AND TRAINING IN TROPICAL REGIONS

The lack of adequate technological and communication tools, such as Internet access, is one of the challenges affecting conservation research and practices during this pandemic in Madagascar (Table 1). These technological advancements facilitate communications between local communities and conservationists, as well as organization of biodiversity monitoring and research activities, and are thus essential for continued conservation activities (Joppa, 2015). Communication barriers including poor telecommunications coverage, high costs for individuals, low literacy rate, and lack of phones can impede such networking, leading to misinformation or lack of information spreading fear and confusion (Lendelvo et al., 2020). Therefore, to support conservation networks, we must invest in communication infrastructure and access to digital technology to make basic, rapid communication tools more affordable and accessible. Increasing communications capacity will further help to foster collaboration and reduce travel within research and conservation and will ensure the equitable involvement of all parties in decision-making processes (Drolet et al., 2015; Joppa, 2015).

Novel non-invasive monitoring methods (e.g., robotics, acoustic recording systems), and associated data storage and processing capacity could alleviate both the need for on-the-ground researchers (if a situation calls for reduced activity) and the need for international research travel (Evans et al., 2020; Sheller, 2020). For instance, the SMART technology (Spatial Monitoring And Reporting Tool) used to conduct biodiversity monitoring and track illegal activities in various African countries including Madagascar (Jones et al., 2019; Joppa, 2015; Wilson et al., 2019) has not yet been adopted in all protected areas (Stephenson et al., 2019). Expanding the use of and training for such tools in the broader tropical region could help establish more resilient management networks (Jones et al., 2019). However, such an approach requires consultations and dialogues and must be co-designed between conservationists and local and indigenous community members (Muashekele et al., 2019; Shrestha & Lapeyre, 2018). Developing skilled local teams with appropriate cultural, societal, and environmental awareness and knowledge could facilitate a cross-cultural and interdisciplinary understanding of best practices for wildlife conservation and management (Shrestha & Lapeyre, 2018). Once skills and technology are established in tropical countries, local and international collaborations will be easily facilitated and will continue to foster professional development for local researchers and conservation practitioners.

5 | PRIORITIZING RESEARCH LED AND FACILITATED BY LOCAL CONSERVATIONISTS AND RESEARCHERS

As an important component of conservation, research conducted in tropical regions should include local academics or stakeholders in projects and grant processes wherever possible. Research in Madagascar is highly dominated by foreigners. Waeber et al., (2016) reported that of 3942 publications on Madagascar biodiversity between 1960 and 2015, 88% had lead authors based at institutions outside Madagascar. Moreover, although partnership between developed and developing country universities exists, there are often imbalances in capacity and funding (Ngongalah et al., 2018) which often affects power and credit during the course of a project. "Parachute research," where researchers from developing countries like Madagascar are not included in the conception and decision-making of projects, is common (Harris, 2004; Olufadewa et al., 2020). This may be partially attributed to the late stage of project development in which local researchers are typically involved as part of these university partnerships. To alleviate this, advance consultation with local academics and stakeholders could connect both parties early in the project development, ensuring that projects have local relevance and equitable leadership roles from the start. Also, publications and projects led by local researchers could promote a supportive international research community and collaboration. Capacity building should not be limited to degree programs but should generate publication experience, leadership skills, and areas of expertise for researchers and field managers, who may possess exceptional skills with biodiversity (e.g., parataxonomists; Janzen, 2004). This may require time and/or resources from international researchers and should be encouraged by the international community. Implementing a more rigorous system of collaboration that supports local leadership (including local and international co-principal investigators and local lead authorship on international research findings) will promote long-term career development and local independence.

6 | CONCLUSION

The experience gained in the COVID-19 pandemic has taught the conservation community the need to prepare for future crises. In this commentary, we proposed, based on experiences in Madagascar, that the inclusion and prioritization of local communities' needs, local

leadership, and research capacity could increase the resilience of conservation practices under crisis scenarios. We discussed opportunities for tropical regions, particularly in developing countries, to adopt long-term strategies to prepare for local and international crises that have the potential to jeopardize conservation efforts. Key goals are providing equitable training and capacity building for locally based researchers and developing long-term collaborations with communities surrounding protected areas. Tropical regions have the capacity and the willingness to establish long-term strategies for the conservation of their biodiversity with the support of international communities through local empowerment, community organization, and national regulations. Strengthening local governance through the empowerment of local communities is in any case fundamental for biodiversity conservation and should be the focus of greater efforts in the coming years. It is therefore imperative to start devolving proper resources and authority to these communities, in close collaboration with conservation organizations, to enable them to do so. This pandemic is an opportunity to re-evaluate conservation aims and funding sources, most critically the role of conservation management, in improving local livelihoods. As these ecosystems directly support the livelihoods of many of the world's poorest people, we need to put local empowerment at the heart of post-pandemic conservation strategy.

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CONFLICT OF INTEREST

On behalf of all authors, I declare that there have been no involvements that might raise the question of bias in the work reported or in the conclusions, implications, or opinions stated in the present paper.

AUTHOR CONTRIBUTIONS

Estelle Razanatsoa (ER) and Seheno Andriantsaralaza (SA) involved in conceptualization and writing–original draft, and designed Figure 1. All co-authors involved in providing initial information that helped frame the paper and writing–review and, editing.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no data were created or analyzed in this study.

ORCID

Estelle Razanatsoa https://orcid.org/0000-0002-7219-1411
Seheno Andriantsaralaza https://orcid.org/0000-0002-6098-2056
Sheila M. Holmes https://orcid.org/0000-0002-6420-5510
O. Sarobidy Rakotonarivo https://orcid.org/0000-0002-8032-1431

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