WILEY Conservation Science and Practice
A Journal of the Society for Conservation Biology

CONTRIBUTED PAPER

Managers' perceptions of protected area outcomes in Madagascar highlight the need for species monitoring and knowledge transfer

Aili Pyhälä[1*] | Johanna Eklund[2*] | Marissa F. McBride[3] | Mamy A. Rakotoarijaona[4] | Mar Cabeza[5]

[1]Development Studies, Faculty of Social Sciences, University of Helsinki, Helsinki, Finland

[2]Department of Geosciences and Geography, Helsinki Institute of Sustainability Science, Faculty of Science, University of Helsinki, Helsinki, Finland

[3]Harvard Forest, Harvard University, Petersham, Massachusetts

[4]Madagascar National Parks, Antananarivo, Madagascar

[5]Global Change and Conservation lab, Helsinki Institute of Sustainability Science, Faculty of Biological and Environmental Sciences, University of Helsinki, Helsinki, Finland

Correspondence
Johanna Eklund, Department of Geosciences and Geography, University of Helsinki, PO Box 64 (Gustaf Hällströmin katu 2), FI-00014 Finland.
Email: johanna.f.eklund@helsinki.fi

Funding information
Academy of Finland , Grant/Award Number: Grant nrs. 250444 and 257686; Ella and Georg Ehrnrooth's foundation; Waldemar von Frenckell´s foundation

Considerable effort has gone into assessing the effectiveness of protected areas (PAs) in preventing biodiversity loss, and PA impacts on local communities. However, little is known about how pressures are being perceived and dealt with by local PA managers and what perceptions managers have of biodiversity trends and human-induced pressures in the PAs they manage. We surveyed and convened a workshop with PA managers in Madagascar asking about the impacts of PA establishment. The managers reported that PAs have been successful in reducing threats. However, managers lacked specific knowledge of trends in species abundance, reporting the need for more species monitoring and knowledge transfer from scientific researchers. We argue that greater collaboration and exchange of knowledge between researchers, managers, and local communities is necessary to ensure that PA effectiveness research is of practical value and contributes to improved PA outcomes.

KEYWORDS

conservation outcomes, management, perceptions, protected areas, species trends

1 | INTRODUCTION

Protected areas (PAs) are one of the leading tools available for protecting biodiversity and continue to underpin conservation efforts worldwide. In recognition of their role, the need to expand the global PA network has been identified in international agreements (e.g., Convention on Biological Diversity, 2010) which calls (in Target 11) for a substantial increase in PA coverage worldwide. However, successful conservation extends beyond area-based targets (Barnes, Glew, Wyborn, & Craigie, 2018) and requires PAs be effective at safeguarding biodiversity and reducing human pressures both within and beyond PAs. Recent studies highlight that PAs are indeed able to reduce threats such as deforestation (Andam, Ferraro, Pfaff, Arturo Sanchez-Azofeifa, & Robalino, 2008; Eklund et al., 2016; Schleicher, Peres, Amano, Llactayo, & Leader-Williams, 2017), yet efficacy varies considerably (Barnes et al., 2016; Coetzee, 2017), with many PAs still experiencing species declines (Craigie et al., 2010; Geldmann et al., 2013; Laurance et al., 2012). This is particularly the case in developing countries where limited conservation funding, immediate needs of local communities, development pressures, and increasing demands on natural resources collide (Nakamura & Hanazaki, 2016; Oldekop, Holmes, Harris, & Evans, 2016; Pyhälä, Orozco, &

---

*Joint first authorship.

2 of 9 | WILEY Conservation Science and Practice
A journal of the Society for Conservation Biology
Open Access

PYHÄLÄ ET AL.

Counsell, 2016; Shackleton et al., 2016) to create considerable challenges in the effective management of PAs.

Given their role within conservation, it is essential to understand whether and why PAs are achieving success. Management effectiveness research aims to improve the way PAs are managed by investigating the relationship between management actions and ecosystem condition (Timko & Innes, 2009). However, the most commonly used tools for evaluating protected area management effectiveness (PAME) build on the framework developed by the International Union for Conservation of Nature (IUCN) (Hockings, Stolton, & Leverington, 2006), with an emphasis on the actual management process through rapid assessments using scorecards, such as the widely used Management Effectiveness Tracking Tool (METT), used by for example the World Wide Fund for Nature (WWF) and the World Bank (Coad et al., 2015). Most of these standardized tools often lack an assessment of the state of biodiversity or ecosystems (Coad et al., 2015), limiting analysis of how management relates to PA outcomes (Carranza, Manica, Kapos, & Balmford, 2014; Eklund & Cabeza, 2017; Nolte & Agrawal, 2013). In part, this issue stems from the ecological time-series data (importantly from both inside and outside PAs) required for rigorous impact evaluation of PA effectiveness, which is unattainable for many PAs, owing to constraints in budget, time, and staff.

To overcome the scarcity in empirical data, previous studies have sought to use researchers' perceptions of PA effectiveness (Laurance et al., 2012). A comparable source of information is the personal experience of PA managers whose day-to-day activities and interactions with the PA allows them to acquire useful situational knowledge (Cook, Wardell-Johnson, Carter, & Hockings, 2014; Fazey, Proust, Newell, Johnson, & Fazey, 2006; Fleischman & Briske, 2016; Raymond et al., 2010). Previous studies have shown that local managers possess specialist knowledge and may provide a useful complementary data source to inform the implementation of conservation actions (Cvitanovic, Marshall, Wilson, Dobbs, & Hobday, 2014; Vokou et al., 2014). Most of these studies have focused on climate change related adaptation in countries like Australia and the United States (Cvitanovic et al., 2014; Hopkins, Bailey, & Potts, 2016) and highlight managers' capability to identify threats, evaluate agency performance and identify obstacles to improving it. To our knowledge, however, no study has to date been carried out with PA managers in less-developed countries, where PA monitoring is often even more under-resourced and complementary data all the more needed.

To address this gap in PA effectiveness research, the aims of this study are twofold. First, to investigate local PA managers' perceptions of animal and plant population trends as well as human-induced pressures in PAs. Second, to gain insight into manager's perceptions on the various challenges they face on-the-ground in striving for effective management. The perceptions and opinions of those directly involved in management processes can provide valuable information on operational and political realities that may be missing from more standardized management effectiveness evaluations (Cvitanovic et al., 2014; Hopkins et al., 2016). However, we know little about the realities of PA governance and management on the ground.

To explore these questions we focus on the subnational level, given that global analyses reporting only at the country level may risk overlooking finer scale issues (Bradshaw, Craigie, & Laurance, 2015; Laurance et al., 2012). With the particular challenges for PA management that exist in developing countries, Madagascar provides an excellent setting with which to explore these questions. Having repeatedly been identified as high priority for conservation (Brooks et al., 2006), Madagascar also ranks as one of the poorest countries in the world. This, coupled with years of political instability, has placed further pressures on already threatened natural resources (Schwitzer et al., 2014) and led to considerable challenges for PA managers who struggle to balance the needs of local communities (Vuola & Pyhälä, 2016), with ensuring the viability of fragile ecosystems and species in the face of escalating human-induced pressures (Eklund et al., 2016; Gardner et al., 2018; Mayaux et al., 2013). Despite the political turmoil, Madagascar´s PA system has quadrupled in recent years, with an increasing trend toward establishing PAs for multiple-use purposes and with shared governance arrangements with local communities and Non-Governmental Organizations, rather than more traditional centrally governed PAs (Gardner et al., 2018). However, our study focuses on the centrally governed PAs, managed by Madagascar National Parks (MNP), to explore how these local managers might have perceived these recent changes.

2 | METHODS

2.1 | Data collection

Our study makes use of a mixed-method approach that combines surveys and an in-person workshop. First, we designed and administered a questionnaire to assess PA managers' perceptions regarding the impact, outcomes, and management experiences of PA establishment (see Supporting Information). With the help of the national institution in charge of PAs (MNP), the questionnaires were deployed to local PA managers in October 2014. We received completed questionnaires for a total of 26 PAs (Figure 1, and Supporting Information, Table S1) out of the 51 state governed PAs in Madagascar. The questionnaires were filled in by one representative for each PA, see Supporting Information Table S4 for respondent profiles. The questionnaire was comprised of three parts. Part I targeted perceptions of changes in animal and plant populations since establishment, Part II targeted perceived changes in levels of pressure inside and outside the PA
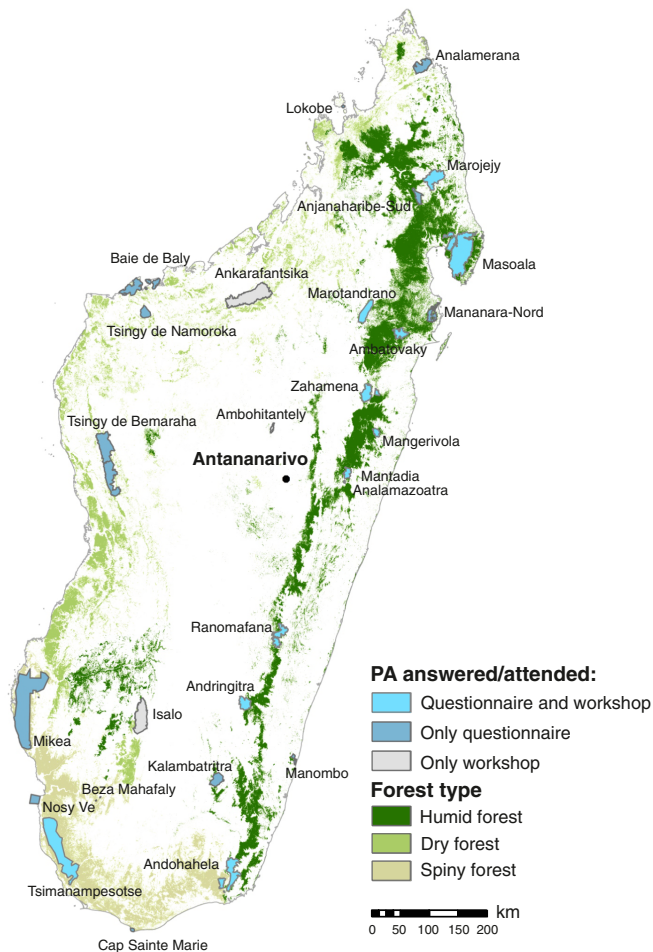
FIGURE 1 Map of protected areas represented through questionnaire answers and/or participation in Antananarivo workshop

since establishment, and Part III targeted perceptions of socio-economic factors related to PA management. For relevant questions in each part of the questionnaire, managers were asked to indicate the degree of certainty associated with their response (see Supporting Information, Table S2).

Following initial analysis of the questionnaire responses, we organized a workshop in Antananarivo in December 2014 with the aim of presenting to PA managers the results of our questionnaire and further contextualizing their responses, as well as to gather additional explanatory data. Seventeen participants (self-selected at the PA level) attended (2 PA managers, 13 PA heads of conservation, 1 MNP staff member, and 1 research associate, see Figure 1 for represented PAs). The first part of the workshop involved presenting the results of the questionnaire and engaging the participants in discussion around the results. The remainder of the workshop focused on identifying key issues for PA management that managers currently see as priority (see Supporting Information, Table S3), and learning more about their experiences working with local communities in and around their respective PAs. For both parts of the study, the managers were informed of the nature and scope of the study, and Free Prior and Informed Consent were obtained

from all participants. We also agreed that results will only be disseminated at an aggregated scale, so as to ensure the anonymity of the individual respondents and the PAs they represent. In this we followed the codes of ethics of the American Anthropological Association (American Anthropological Association, 2012).

2.2 | Analysis

For Part I of the questionnaire, average trends in species adundance since establishment of the PA were calculated across the eight species guilds used, following Laurance et al. (2012). Missing responses for many of the questions prevented further statistical analyses. For Part II, to assess the levels and changes in potential environmental drivers of change (threats), we pooled responses across the 26 PAs, and used bootstrap analysis (random resampling with replacement, 100,000 iterations) to calculate an overall mean and confidence intervals for each threat as an estimate of how significant a reported trend could be considered at the national level. For Part III, summary statistics were calculated using the quantitative responses, and any textual notes entered were compiled to assist in explaining the results. Response percentages were calculated using all ($n = 26$) respondents. For analysis, the questionnaire results ($n = 26$) were treated apart from the data collected at the workshop.

The workshop results were mostly qualitative and compiled in thematically structured notes and tables. In order to protect anonymity, we present our findings only in aggregate form and do not report PA-specific findings on species trends perceptions, confidence levels, or socioeconomic issues.

3 | RESULTS

3.1 | Questionnaire results

3.1.1 | Part I: Perceived changes in species trends and abundances

The strongest reported change in abundance was a decline since PA establishment in native trees of commercial value, which managers attributed to an "increase in fine wood needs" for trade, and that "the amount in the outside area of the PA can not satisfy the growing need for the city." Lemurs had an overall trend of increasing in abundance across the PAs. Trends and knowledge for other species groups were much more mixed, with high variation in reponses across the surveyed PAs (Figure 2a).

The responses for species trends revealed low levels of knowledge, with managers most likely to report trends with "medium" or "very low" levels of certainty (69–100%), and to leave responses blank (Figure 2b). Managers' comments reflect this, with most stating that their information came from sightings on patrol, but that no specific monitoring program was in place for that species. Similar comments were
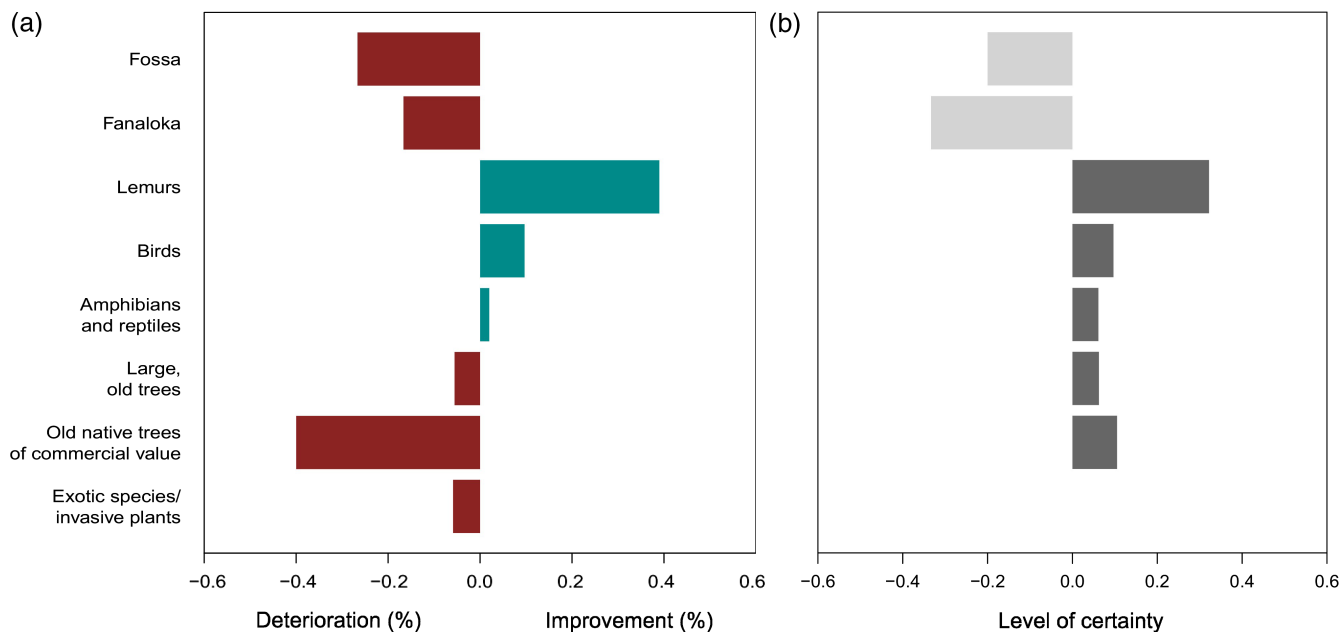
FIGURE 2 (a) Average trends in species abundance since park establishment across the 26 protected areas surveyed, and (b) average levels of certainty (scaled from low [−1] to high [1]) reported by managers in making their assessments of changes in species abundances. No bars are depicted where the average is 0, as in the case for "Exotic plants/invasive species" in panel (b)

made by managers during the workshop when discussing the results of the questionnaires.

3.1.2 | Part II: Perceived changes to threats inside and outside the PA

Most PA managers considered levels of the different threats to have been high (68–80%) prior to establishment of the PA, aside from the pet trade (27%), a pressure that has only begun to increase in more recent years. Overall, managers perceived a decrease in threats within PAs since their establishment (Figure 3a), in contrast to a perceived increase in pressures outside the PA.

Managers reported their responses with higher levels of certainty for threats than for trends in species abundances (Figure 3b). That said, many managers again noted the absence of consistent monitoring programs in place, and
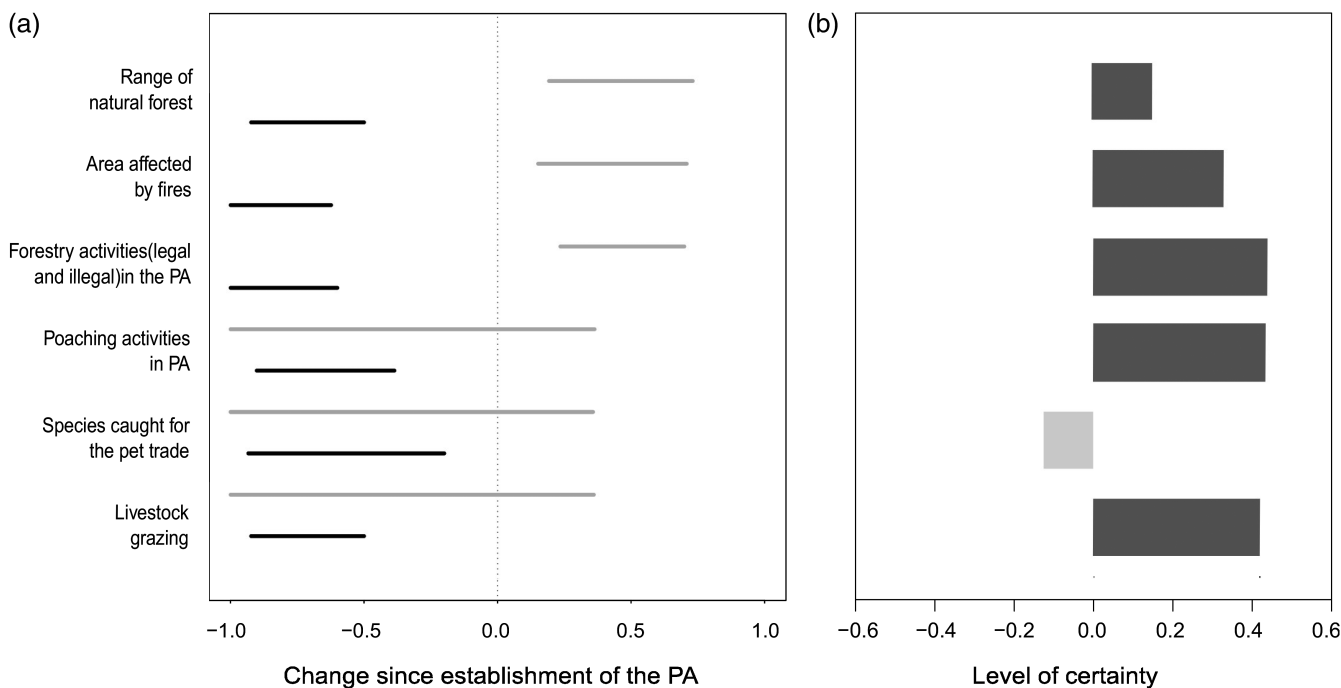
FIGURE 3 (a) Confidence intervals calculated for changes in the levels of six drivers of change since establishment in the protected area (PA), for outside the PA (gray lines), and inside the PA (black lines). Where lines do not cross the zero (dashed) line, this indicates trends are significant across the 26 surveyed PAs. (b) Average levels of certainty (scaled from low [−1] to high [1]) reported by managers in making their assessments for each driver of change

TABLE 1 Socioeconomic aspects of management reported by managers in Part III of the questionnaire

Issue	Responses (%)		
Local community involvement	Yes	No	No response
Local communities participated in the			
Creation of the protected area (PA)	62	19	19
Management of the PA	96	0	4
Managers currently collaborating with local communities	100	0	—
Collaboration with local communities has been			
Easy	15	—	—
Intermediate	62	—	—
Difficult	8	—	—
Did not answer	15		
Protective measures	Yes	Most difficult	Has worked best
Protective measures implemented in the PA			
Park rangers	31	16	8
Sanctions	85	68	16
Collaboration with local communities	26	4	68
Compensation	50	12	8

while inside PA boundary estimates were often based on patrol reports, the absence of patrols beyond PA boundaries means that their perceptions of increasing pressures primarily reflect their personal observations when passing through the area.

3.1.3 | Part III: Socioeconomic aspects

The large majority (85%) of PA managers reported using some form of sanctions (e.g., fines), and half (50%) have employed some form of compensation to the local communities. Only in 31% of the surveyed PAs are park rangers employed (Table 1). Of these, the conservation strategy they

view as most challenging to employ is sanctions (65%). While all respondents reported working directly with local communities, few (15%) reported it having been easy (Table 1). As one manager noted: *"The community participates in the management of the PA simply because of fear of the law in place, not because they are convinced [of the PA]."* Despite this, collaboration with communities was seen by far as the most successful approach (68%), in comparison with sanctions (16%), park rangers (8%), or compensations (8%).

3.2 | Workshop outcomes

Out of 24 issues initially identified by the workshop participants (see Supporting Information, Table S3), the top four issues that were prioritized for further discussion were: (1) Nonapplication of the law; (2) The role of the State in conservation; (3) Preventive and active fight against bush fires; and (4) Research partnerships for PAs. See Table 2 for an elaboration on each of these. Alongside the above challenges has been a sudden collapse in tourism in some PAs (a decline of up to 50% or more since 2008, that is, in the years following the political turmoil), resulting in a significant drop in revenues from park entrance fees. This, however, has not had equal impact across all parks, which continue to have starkly different visitor numbers, ranging from 0 to 25,000 tourists per year.

4 | DISCUSSION

4.1 | Managers' ability to assess PA outcomes in protecting biodiversity

Our results revealed PA managers to be more aware of broad threats than species-specific declines, and to perceive the establishment and management of PAs as having helped to reduce these pressures within PAs, while they remain high outside PA borders. Managers reported their responses with higher levels of certainty for threats than for trends in species abundances. For most species groups,

TABLE 2 Priority issues to address in protected area (PA) management, as identified and elaborated on by workshop participants

Priority issue	Description	Elaboration
Nonapplication of the law	While the necessary laws for PA management and conservation are in place, they are not being put into practice; there is noncompliance on the part of some actors "who seem to think they are exempt from the law."	Due to corruption and interference, offenses and illegal activities in PAs are still not judged according to the Protected Areas Law (Code des Aires Protegées, COAP).
Role of the State in conservation	PA managers feel that the State's principal role is to help raise awareness amongst local communities about the importance of abiding by national laws and helping with their enforcement.	PA managers feel that they, as managers, are currently expected to undertake this role, despite it being the responsibility of the State.
Preventive and active fight against bush fires	The continuous challenge of local communities using slash-and-burn (*tavy*) and the effects, threats, and risks that this poses to remaining forests and PAs.	Slash-and-burn is closely associated with the ongoing poverty experienced by rural communities who are left with few (if any) alternatives but to open up new land for their subsistence crop cultivation in order to feed their families and a growing rural population.
Research partnerships for PAs	While research topics proposed by past researchers are seen to be important, the outcomes are (a) not always shared with PA managers and (b) not always in line with the primary needs of the PA.	There is a lack of communication and collaboration between researchers and PA managers. Reports are often too long, unclear, and in a language other than French or Malagasy.

6 of 9 | **WILEY** Conservation Science and Practice *A journal of the Society for Conservation Biology* Open Access

PYHÄLÄ ET AL.

managers generally reported low levels of certainty, in large part due to insufficient monitoring of ecological and socioeconomic impacts, both in the short and long term (Gardner et al., 2013). Even without linking these results to empirical data on species trends, this suggests PA managers may not be able to act as useful surrogates to permit impact evaluation in the absence of ecological data and appropriate monitoring schemes. The low levels of certainty and low response rates for many species are also similar to the findings of Laurance et al. (2012) based on international researcher assessments, and suggesting they may be typical of tropical PAs.

Previous studies have provided mixed evidence as to whether managers can accurately assess trends (Carbutt & Goodman, 2013; Cook et al., 2014). Cook et al. (2014), for example, found that managers could make useful assessments but that their responses still contained evidence of bias, with misinterpretation of the question's intended scope, scale, and timeframe being one common source of error. We acknowledge that this may have been an issue in our study as well, and may explain the discrepancy between the increasing lemur population trends reported by managers in our study versus other reports highlighting declines (Schwitzer et al., 2014). Such discrepancies could arise from several sources of bias, such as observer or response biases. Clearly, some species groups are more charismatic than others, and managers are more likely to encounter highly visible species, than more cryptic species that might be difficult to spot and identify correctly. Over time, managers can develop their detection skills, and this could lead to a higher tendency to report positive trends. Similarly, an increased management and/or research focus on specific species in an area could lead to managers paying more attention to such species. These types of biases might have affected the managers' perceptions of trends and should be remembered when interpreting the positive trends reported for especially lemurs and birds. For questions referring to situational change since PA establishment, many of our respondents commenced their positions long after PA establishment (see Supporting Information, Table S4) and their responses may reflect differential interpretation skewed toward changes since their time at the PA. Finally, given we report aggregated results, the wide variability across PAs remains hidden in our study, not only in terms of physical locality and conditions, but also in terms of resources, accessibility, infrastructure, and activity, all of which may also drive some of the contradictions in our findings.

4.2 | Insights gained from manager-identified challenges to PA performance

Our study illustrates how the PA managers' perspectives can provide valuable insight into how pressures and threats are playing out at the local level, improved understanding of

which is vital, but often missing from the contemporary PA management literature. The challenges identified by managers (Table 2, especially the role of the state) are indicative of the importance of the quality of governance for PAs (Eklund & Cabeza, 2017; Worboys, Lockwood, Kothari, Feary, & Pulsford, 2015), and reflect more general findings about the role that management and capacity appear to play in ensuring PA effectiveness (Clement, Moore, & Lockwood, 2016; IUCN, 2005). Governance related challenges for effective PA management in Madagascar might have been heightened by the recent political instability, along with the political turmoil in 2009 and a lack of effective presidency in subsequent years. While it was encouraging to see local community involvement noted for all PAs, the lack of support (i.e., in the form of training and resources) and the ongoing difficulties (i.e., skepticism and mistrust on the part of both managers and local communities) suggest that PAs have yet to achieve the desired levels of genuine and equitable comanagement required to be effective (Schreckenberg, Franks, Martin, & Lang, 2016). In addition to the necessary support and training for PA managers, efforts exploring how to better implement co-management within a traditionally top-down governance structure such as MNP represents an important challenge (Gardner et al., 2018; St John, Keane, & Milner-Gulland, 2013). Given our results dealt with only state governed PAs, it would be valuable to explore how they might differ for the more recently established co-managed PAs and whether any lessons can be learned, particularly in relation to community involvement (Gardner et al., 2018).

4.3 | Potential for coproduction of knowledge between researchers and managers

One of the most pressing avenues for improving PA performance identified in the workshop was to strengthen PA ties to research. This aligns with a broader issue in conservation science, with many other studies also having identified the need to improve the contribution that conservation science makes to PA management in practice (Watson et al., 2016), given that despite the considerable research that takes place within PAs, the majority ends up being of limited practical value on the ground (Gardner et al., 2013; Rafidimanantsoa, Poudyal, Ramamonjisoa, & Jones, 2018). The managers in our study expressed a wish to collaborate more closely with researchers, and though they are highly educated in mostly relevant fields (see Supporting Information, Table S4), they lack the capacity, access, and time required to keep up with the scientific literature. While research partnerships exist between some universities and PAs in Madagascar, the lack of communication between researchers and local PA managers means that valuable data and information rarely ends up informing actual PA management (Rafidimanantsoa et al., 2018). Recommended steps identified by managers to address this problem include depositing reports and publications into easily searchable open-access platforms, providing

short research summaries in local or national languages, and collaborating with managers to ensure research questions are of high relevance for managers. This echoes similar recommendations from other recent studies investigating drivers behind the "research-implementation" gap (Cvitanovic, Hobday, van Kerkhoff, & Marshall, 2015; Gossa, Fisher, & Milner-Gulland, 2015; McNie, 2007; Toomey, Knight, & Barlow, 2017; Walsh, Dicks, & Sutherland, 2015). Involving managers in research design means that findings are more likely to be relevant and used to improve management (Dilling & Lemos, 2011; Kemp et al., 2015) and we argue that methods for the co-production and exchange of knowledge between researchers, managers, and local communities offer a way to better address the complexities of PAs and their management for both beneficiaries and managers (Bouska, Lindner, Paukert, & Jacobson, 2016; Colloff et al., 2017; Gardner, 2012; Reyers et al., 2010).

PAME evaluation exercises, such as the METT-tool, for example, already fulfill an important role in the assessment of PA performance beyond indicating outcomes, and this could be something to further expand upon in the future as part of improving the utility of PA management research. Bringing managers together to discuss management options can allow knowledge to be shared and help facilitate strategic planning (Cook et al., 2014) and thus allow an overall better understanding of the decision context in which management interventions take place (Carbutt & Goodman, 2013; Carranza et al., 2014; Hockings et al., 2006). Similarly, and as we experienced in our workshop, such tools can stimulate communication and participation of actors, whether PA managers or other users of PAME assessments at the site and system levels, and generally result in both a process and an outcome that is in some way useful for all (Coad et al., 2015).

5 | CONCLUSION

Despite the limitations of our study, we believe that the emerging patterns carry important messages worth considering. In places such as Madagascar where PAs have little resources for managing and monitoring flora and fauna, and most resources are used to fight threats, managers would rarely be able to serve as experts in providing species data, but may provide first hand assessments on threats and how to fight them, as well as on-ground knowledge of situational challenges that can inform PA research and reform initiatives. Our study also highlights the need to engage directly with managers about their perspectives and concerns regarding PA management. Considerable advances are being made in tools to evaluate PA performance, and increasing numbers of researchers are engaging in PA effectiveness assessments and reporting. Yet it remains unclear if such studies will influence PA effectiveness in the long term when the managers responsible for on-ground implementation remain unaware of such results, or of population trends in their PAs, as was the case in our study. This paper therefore acts as a call to strive for greater engagement and transfer of knowledge between managers and researchers in order to generate legitimate, effective solutions that are able to contribute to improved outcomes for PAs.

AUTHORS' CONTRIBUTIONS

M.C., A.P., M.M., M.R. conceived and designed the study, A.P., J.E., M.M, M.R. performed the data collection, A.P., J.E., M.M analyzed the data, A.P., J.E., M.M prepared figures and/or tables, and A.P., J.E., M.M., M.C. authored or reviewed drafts of the paper.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ORCID

Johanna Eklund https://orcid.org/0000-0003-1263-8151

REFERENCES

American Anthropological Association. (2012). *Principles of professional responsibility, AAA ethics blog.* Retreived from http://ethics.americananthro.org/category/statement/

Andam, K. S., Ferraro, P. J., Pfaff, A., Arturo Sanchez-Azofeifa, G., & Robalino, J. A. (2008). Measuring the effectiveness of protected area networks in reducing deforestation. *Proceedings of the National Academy of Sciences of the United States of America, 105,* 16089–16094.

Barnes, M. D., Craigie, I. D., Harrison, L. B., Geldmann, J., Collen, B., Whitmee, S., … Woodley, S. (2016). Wildlife population trends in protected areas predicted by national socio-economic metrics and body size. *Nature Communications, 7,* 12747.

Barnes, M. D., Glew, L., Wyborn, C., & Craigie, I. D. (2018). Prevent perverse outcomes from global protected area policy. *Nature Ecology and Evolution, 2,* 759–762.

Bouska, K. L., Lindner, G., Paukert, C. P., & Jacobson, R. B. (2016). Stakeholder-led science: Engaging resource managers to identify science needs for long-term management of floodplain conservation lands. *Ecology and Society, 21*(3), 12.

Bradshaw, C. J. A., Craigie, I., & Laurance, W. F. (2015). National emphasis on high-level protection reduces risk of biodiversity decline in tropical forest reserves. *Biological Conservation, 190,* 115–122.

Brooks, T. M., Mittermeier, R. A., da Fonseca, G. A. B., Gerlach, J., Hoffmann, M., Lamoreux, J. F., … Rodrigues, A. S. L. (2006). Global biodiversity conservation priorities. *Science*, *313*, 58–61.

Carbutt, C., & Goodman, P. S. (2013). How objective are protected area management effectiveness assessments? A case study from the iSimangaliso Wetland Park. *Koedoe*, *55*(1), a1110.

Carranza, T., Manica, A., Kapos, V., & Balmford, A. (2014). Mismatches between conservation outcomes and management evaluation in protected areas: A case study in the Brazilian Cerrado. *Biological Conservation*, *173*, 10–16.

Clement, S., Moore, S. A., & Lockwood, M. (2016). Letting the managers manage: Analyzing capacity to conserve biodiversity in a cross-border protected area network. *Ecology and Society*, *21*(3), 39.

Coad, L., Leverington, F., Knights, K., Geldmann, J., Eassom, A., Kapos, V., … Hockings, M. (2015). Measuring impact of protected area management interventions: Current and future use of the global database of protected area management effectiveness. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *370*, 20140281.

Coetzee, B. W. T. (2017). Evaluating the ecological performance of protected areas. *Biodiversity and Conservation*, *26*, 231–236.

Colloff, M. J., Lavorel, S., van Kerkhoff, L. E., Wyborn, C. A., Fazey, I., Gorddard, R., … Degeorges, P. (2017). Transforming conservation science and practice for a postnormal world. *Conservation Biology*, *31*, 1008–1017.

Convention on Biological Diversity. (2010). *Strategic plan for biodiversity 2011–2020—COP 10, decision X/2*. Montreal, Canada.

Cook, C. N., Wardell-Johnson, G., Carter, R. W., & Hockings, M. (2014). How accurate is the local ecological knowledge of protected area practitioners? *Ecology and Society*, *19*(2), 32.

Craigie, I. D., Baillie, J. E. M., Balmford, A., Carbone, C., Collen, B., Green, R. E., & Hutton, J. M. (2010). Large mammal population declines in Africa's protected areas. *Biological Conservation*, *143*, 2221–2228.

Cvitanovic, C., Hobday, A. J., van Kerkhoff, L., & Marshall, N. A. (2015). Overcoming barriers to knowledge exchange for adaptive resource management; the perspectives of Australian marine scientists. *Marine Policy*, *52*, 38–44.

Cvitanovic, C., Marshall, N. A., Wilson, S. K., Dobbs, K., & Hobday, A. J. (2014). Perceptions of Australian marine protected area managers regarding the role, importance, and achievability of adaptation for managing the risks of climate change. *Ecology and Society*, *19*(4), 33.

Dilling, L., & Lemos, M. C. (2011). Creating usable science: Opportunities and constraints for climate knowledge use and their implications for science policy. *Global Environmental Change*, *21*, 680–689.

Eklund, J., Blanchet, F. G., Nyman, J., Rocha, R., Virtanen, T., & Cabeza, M. (2016). Contrasting spatial and temporal trends of protected area effectiveness in mitigating deforestation in Madagascar. *Biological Conservation*, *203*, 290–297.

Eklund, J., & Cabeza, M. (2017). Quality of governance and effectiveness of protected areas: Crucial concepts for conservation planning. *Annals of the New York Academy of Sciences*, *1399*, 27–41.

Fazey, I., Proust, K., Newell, B., Johnson, B., & Fazey, J. A. (2006). Eliciting the implicit knowledge and perceptions of on-ground conservation managers of the Macquarie Marshes. *Ecology and Society*, *11*(1), 25.

Fleischman, F., & Briske, D. D. (2016). Professional ecological knowledge: An unrecognized knowledge domain within natural resource management. *Ecology and Society*, *21*(1), 32.

Gardner, C. J. (2012). Social learning and the researcher-practitioner divide. *Oryx*, *46*, 313–314.

Gardner, C. J., Nicoll, M. E., Birkinshaw, C., Harris, A., Lewis, R. E., Rakotomalala, D., & Ratsifandrihamanana, A. N. (2018). The rapid expansion of Madagascar's protected area system. *Biological Conservation*, *220*, 29–36.

Gardner, C. J., Nicoll, M. E., Mbohoahy, T., Oleson, K. L. L., Ratsifandrihamanana, A. N., Ratsirarson, J., … Davies, Z. G. (2013). Protected areas for conservation and poverty alleviation: Experiences from Madagascar. *Journal of Applied Ecology*, *50*, 1289–1294.

Geldmann, J., Barnes, M., Coad, L., Craigie, I. D., Hockings, M., & Burgess, N. D. (2013). Effectiveness of terrestrial protected areas in reducing habitat loss and population declines. *Biological Conservation*, *161*, 230–238.

Gossa, C., Fisher, M., & Milner-Gulland, E. J. (2015). The research-implementation gap: How practitioners and researchers from developing countries perceive the role of peer-reviewed literature in conservation science. *Oryx*, *49*, 80–87.

Hockings, M., Stolton, S., & Leverington, F. (2006). *Evaluating effectiveness: A framework for assessing management effectiveness of protected areas* (2nd ed.). Gland, Switzerland and Cambridge, England: IUCN.

Hopkins, C. R., Bailey, D. M., & Potts, T. (2016). Perceptions of practitioners: Managing marine protected areas for climate change resilience. *Ocean and Coastal Management*, *128*, 18–28.

IUCN. (2005). *World Parks Congress Recommendation V.1. Strengthening institutional and societal capacities for protected area management in the 21st century*. Gland, Switzerland.

Kemp, K. B., Blades, J. J., Klos, P. Z., Hall, T. E., Force, J. E., Morgan, P., & Tinkham, W. T. (2015). Managing for climate change on federal lands of the western United States: Perceived usefulness of climate science, effectiveness of adaptation strategies, and barriers to implementation. *Ecology and Society*, *20*(2), 17.

Laurance, W. F., Carolina Useche, D., Rendeiro, J., Kalka, M., Bradshaw, C. J. A., Sloan, S. P., … Zamzani, F. (2012). Averting biodiversity collapse in tropical forest protected areas. *Nature*, *489*, 290–294.

Mayaux, P., Pekel, J., Desclee, B., Donnay, F., Lupi, A., Achard, F., … Belward, A. (2013). State and evolution of the African rainforests between 1990 and 2010. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, *368*, 20120300.

McNie, E. C. (2007). Reconciling the supply of scientific information with user demands: An analysis of the problem and review of the literature. *Environmental Science and Policy*, *10*, 17–38.

Nakamura, E. M., & Hanazaki, N. (2016). Protected area establishment and its implications for local food security. *Human Ecology Review* in press, preprint, Retreived from http://hdl.handle.net/1885/110960.

Nolte, C., & Agrawal, A. (2013). Linking management effectiveness indicators to observed effects of protected areas on fire occurrence in the Amazon rainforest. *Conservation Biology*, *27*, 155–165.

Oldekop, J. A., Holmes, G., Harris, W. E., & Evans, K. L. (2016). A global assessment of the social and conservation outcomes of protected areas. *Conservation Biology*, *30*, 133–141.

Pyhälä, A., Orozco, A. O., & Counsell, S. (2016). *Protected areas in the Congo basin: Failing both people and biodiversity*. London, England: Rainforest Foundation-UK.

Rafidimanantsoa, H. P., Poudyal, M., Ramamonjisoa, B. S., & Jones, J. P. G. (2018). Mind the gap: The use of research in protected area management in Madagascar. *Madagascar Conservation & Development*, *13*, 15–24.

Raymond, C. M., Fazey, I., Reed, M. S., Stringer, L. C., Robinson, G. M., & Evely, A. C. (2010). Integrating local and scientific knowledge for environmental management. *Journal of Environmental Management*, *91*, 1766–1777.

Reyers, B., Roux, D. J., Cowling, R. M., Ginsburg, A. E., Nel, J. L., & O'Farrell, P. (2010). Conservation planning as a transdisciplinary process. *Conservation Biology*, *24*, 957–965.

Schleicher, J., Peres, C. A., Amano, T., Llactayo, W., & Leader-Williams, N. (2017). Conservation performance of different conservation governance regimes in the Peruvian Amazon. *Scientific Reports*, *7*, 1–10.

Schreckenberg, K., Franks, P., Martin, A., & Lang, B. (2016). Unpacking equity for protected area conservation. *PARKS*, *22*, 11–28.

Schwitzer, C., Mittermeier, R. A., Johnson, S. E., Donati, G., Irwin, M., Peacock, H., … Wright, P. C. (2014). Averting lemur extinctions amid Madagascar's political crisis. *Science*, *343*, 842–843.

Shackleton, C. M., Ruwanza, S., Sinasson Sanni, G. K., Bennett, S., de Lacy, P., Modipa, R., … Thondhlana, G. (2016). Unpacking Pandora's box: Understanding and categorising ecosystem disservices for environmental management and human wellbeing. *Ecosystems*, *19*, 587–600.

St John, F. A. V., Keane, A. M., & Milner-Gulland, E. J. (2013). Effective conservation depends upon understanding human behaviour. In D. W. Macdonald & K. J. Willis (Eds.), *Key topics in conservation biology* (p. 2). West Sussex, UK: Wiley-Blackwell. https://doi.org/10.1002/9781118520178.ch19

Timko, J. A., & Innes, J. L. (2009). Evaluating ecological integrity in national parks: Case studies from Canada and South Africa. *Biological Conservation*, *142*, 676–688.

Toomey, A. H., Knight, A. T., & Barlow, J. (2017). Navigating the space between research and implementation in conservation. *Conservation Letters*, *10*, 619–625.

Vokou, D., Dimitrakopoulos, P. G., Jones, N., Damialis, A., Monokrousos, N., Pantis, J. D., & Mazaris, A. D. (2014). Ten years of co-management in Greek protected areas: An evaluation. *Biodiversity and Conservation*, *23*, 2833–2855.

Vuola, M., & Pyhälä, A. (2016). Local community perceptions of conservation policy: Rights, recognition and reactions. *Madagascar Conservation & Development*, *11*, 77–86.

Walsh, J. C., Dicks, L. V., & Sutherland, W. J. (2015). The effect of scientific evidence on conservation practitioners' management decisions. *Conservation Biology*, *29*, 88–98.

Watson, J. E. M., Darling, E. S., Venter, O., Maron, M., Walston, J., Possingham, H. P., … Brooks, T. M. (2016). Bolder science needed now for protected areas. *Conservation Biology*, *30*, 243–248.

Worboys, G. L., Lockwood, M., Kothari, A., Feary, S., & Pulsford, I. (2015). *Protected area governance and management*. Canberra, Australia: ANU Press.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

How to cite this article: Pyhälä A, Eklund J, McBride MF, Rakotoarijaona MA, Cabeza M. Managers' perceptions of protected area outcomes in Madagascar highlight the need for species monitoring and knowledge transfer. *Conservation Science and Practice*. 2019;e6. https://doi.org/10.1002/csp2.6