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Sustainable protected areas: Synergies between biodiversity conservation and socioeconomic development

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Abstract

1. Reconciling conservation and socioeconomic development goals is key to sustainability but remains a source of fierce debate. Protected areas (PAs) are believed to play an essential role in achieving these seemingly conflicting goals. Yet, there is limited evidence as to whether PAs are actually achieving the two goals simultaneously.
2. Here, we investigate when and to what extent synergies or trade-offs between biodiversity conservation and local socioeconomic development occur. To explore these relationships, we collected data across a wide range of socioeconomic settings through face-to-face survey with PA managers from 114 African and European PAs using structured questionnaire.
3. We found synergies between biodiversity conservation and socioeconomic development for 62% of the PAs, albeit with significant differences between African (55%) and European PAs (75%). Moreover, the sustainability of PAs in conserving biodiversity was strongly correlated with the empowerment of the PA management and the involvement of local communities in PA planning and decision-making processes.
4. Our results demonstrate that for PAs to promote synergies between biodiversity conservation and local socioeconomic development, and to enhance their long-term sustainability, they should invest in the empowerment of their respective management and involvement of local communities in their planning and management activities.

KEYWORDS
Africa, biodiversity conservation, Europe, local community, PA management, protected areas, socioeconomic development

1 | INTRODUCTION

Despite increasing conservation efforts, biodiversity has been continuously declining globally (Butchart et al., 2010; Hoffmann et al., 2010; IPBES, 2019) and poverty rates still remain 'unacceptably' high (World Bank, 2018). As human populations in biodiversity hotspots continue to grow (The Eat-Lancet Commission, 2019), the biodiversity crisis is expected to worsen, and consequently the number of critically endangered species is expected to rise (Hoffmann et al., 2010). Protected Areas (PAs) play an indispensable role in the fight against declining biodiversity (Bruner et al., 2001; Coetzee et al., 2014; Geldmann et al., 2014; IPBES, 2019; Laurance et al., 2012) as they protect biodiversity against growing anthropogenic pressures such as poaching and excessive resource use. For instance, case studies show that the level of protection provided to PAs is correlated with higher species richness (Jones et al., 2019). Consequently, the coverage of the PAs network around the globe has tremendously increased in recent decades (Barnes et al., 2016), and as of 2021 stood at 15.53% of the terrestrial land (UNEP-WCMC IUCN & NGS, 2021).

Nonetheless, it is still unclear whether the expansion of the PAs network promotes both conservation and local socioeconomic development objectives simultaneously or promotes biodiversity conservation at the expense of local socioeconomic development. It is also not clear whether socioeconomic development-oriented activities of PAs (e.g. the attraction of tourism to support local socioeconomic development) have adverse effects on the ecosystem inside PAs (e.g. poaching, increased pollution, vulnerability to forest fire, soil erosion, habitat loss). Achieving both conservation and local socioeconomic development goals simultaneously requires coordination between the two goals. PAs should have a strategy to coordinate their conservation plans with the development initiatives of local communities living in and around them (CBD, 2009; Oldekop et al., 2016). Similarly, the development motives of the local communities should not be advanced at the expense of biodiversity conservation, otherwise neither conservation nor local socioeconomic development would be sustainable (Cardinale et al., 2012).

Although some studies show that at a global scale the economic benefits of PAs are less controversial (Waldron et al., 2020), the effect of PAs on local socioeconomic development remains uncertain. Hence, finding the right balance between local socioeconomic development and biodiversity conservation goals remains a dilemma for both conservation and development (Adams et al., 2004). PAs may achieve positive conservation outcomes by excluding local communities and restricting or denying access to resources from PAs through strict law enforcement (Coad et al., 2015; Holmes, 2013). This success, however, might come at economic and social costs to local communities, which, in turn, may cause local resentment and negatively affect biodiversity conservation in the long term (Mariki et al., 2015; West et al., 2006). On the other hand, if access to resources from PAs is not limited, overexploitation of resources may lead to biodiversity degradation inside PAs (Fischer, 2008; IPBES, 2019; Laurance et al., 2012). This suggests that there is unavoidable interdependency between local socioeconomic development and biodiversity conservation, which requires both conservationists and development actors to coordinate their activities to advance both conservation and development goals simultaneously.

Nonetheless, due to limited data availability (Geldmann et al., 2013; Laurance et al., 2012; Oldekop et al., 2016), there is a critical scarcity of evidence on whether biodiversity conservation and local socioeconomic development goals are actually reconcilable or whether there is an inherent trade-off between the two goals (Otero et al., 2020). Moreover, we know little about how sustainable PAs themselves are, and what factors are correlated with their sustainability level. This knowledge, however, is urgently needed to design efficient and effective conservation interventions that enhance the conservation efforts of the international community while also contributing to the socioeconomic development of local communities. Hence, our study aims at providing crucial empirical evidence on the predictors of the sustainability of PAs. In this study, we define sustainability as an indicator for the extent to which the PAs have succeeded in achieving biodiversity conservation, economic and social goals simultaneously. We used the change in the abundance of mammals and birds as a proxy for biodiversity conservation in PAs. Thus, PAs that have achieved improvement both in the abundance of mammals and birds, and in local socioeconomic conditions would have higher sustainability index value than those PAs that have reported a declining trend in one or both of the two variables (i.e. biodiversity conservation and socioeconomic development). Furthermore, we identify the factors that are correlated with the emergence of synergies between biodiversity conservation and local socioeconomic development goals.

2 | METHODS

The study is mainly based on primary data collected through face-to-face surveys with PA managers using structured questionnaire. In our questionnaire, we explicitly informed our respondents that participation in our survey and filling in our questionnaire was purely voluntary (see Appendix). Respondents were given the option to opt out (if they want to) at the beginning of the survey. They consent to participate in the survey by choosing 'yes' to the willingness to participate question at the beginning of the questionnaire. To conduct our survey across African and European PAs, we obtained appropriate ethical approval (Application 2018_6) from the Ethics Council of the Max-Planck Society (see Appendix). We selected our sample PAs from the World Database of Protected Areas (WDPA, 2018) based on four main criteria: (1) PAs in the category of national parks, (2) the possibility of getting abundance data at least for one species from Living Planet Database (LPD), IUCN SSC A.P.E.S database and/or other reports (Table S1) to cross-validate our questionnaire data, (3) possession of permits from governments of the countries to conduct surveys in PAs, and (4) the possibility of finding a PA manager willing to participate in our survey and fill in our questionnaire.

We compiled a standardized dataset on the three important pillars of conservation in socio-ecological systems (biodiversity conservation, economy and society) from 114 PAs (48 European and 66 African PAs) using a structured questionnaire (see also Laurance et al., 2012). PA managers were asked to report changes in indicators of biodiversity conservation (proxied by the change in the abundance of mammals and birds) and socioeconomic development in their PAs over a 10-year period (2007/2008–2017/2018). In our study, PA managers were chosen because we believe that PA managers would be the most suitable experts to evaluate the performance of their PAs and report the change in the socioecological variables related to their PAs. In this study, the PA manager refers to any person from the top management of the PAs, who has the knowledge about the plans, management and activities of the PAs and their performance.

We collected data on the change in the abundance of 464 species of mammals and birds from 48 European and 66 African PAs. We cross-checked the validity of our data on the change in the abundance of mammals and birds with data collated from the Living Planet database (LPD) (LPD, 2018), the IUCN SSC A.P.E.S. database (A.P.E.S.; Heinicke et al., 2019) and other published and unpublished reports (see Table S1). We obtained data from these sources on the abundance of 103 species of mammals and birds for 25 PAs (see Table S1). Then, based on the time-series data obtained from these sources, we calculated the average change in the abundance of the species in the dataset and compared it with the rate of change reported by PA managers in our survey.

We found that in 81% of the cases there was an overlap between the rates of change reported by the PA managers and the average rate of change in the abundance of species calculated from LPD, A.P.E.S. database and other sources (see Table S1). On the other hand, the socioeconomic data obtained from face-to-face surveys administered with PA managers were cross-validated with an independent survey conducted with NGOs working in and around 22 PAs. It was found that the overlap between the rates reported by PA managers and NGOs ranges from 62% to 100% (see Table S2). Furthermore, the reliability of our results was corroborated by their consistency with other studies in the literature in many aspects. For example, our results revealed that there is a positive and strong correlation between national socioeconomic development and wildlife conservation inside PAs, which was consistent with the findings of Barnes et al. (2016). Similar to Craigie et al. (2010) and Bauer et al. (2015), we also found a negative trend in the abundance of top mammalian predators in Africa. Furthermore, consistent with the findings of Laurance et al. (2012) (in the tropics) and Rada et al. (2019) (in Europe), we found that biodiversity has been declining within protected areas in Europe and Africa.

2.1 | Statistical analysis

To conduct our statistical analysis, we first constructed three indices for the three important pillars of socio-ecological systems: biodiversity, economic and social indicators. The biodiversity index measures the average change in the abundance of mammals and birds in the 10 years prior to our survey and it takes a value of −1, 0 or 1(where −1, 0 and 1 represent a declining, stable and increasing trends, respectively). However, in our models, we used transformed values of the biodiversity index, which range from 0 to 1. To transform the original values, we added 1 to all values and then divided the sum by 2 (consequently −1 becomes 0 and 0 becomes 0.5 and 1 remains the same). The transformation enabled us to put different indices on the same scale, and facilitated the comparison of different composite indices. Moreover, the transformation made the interpretation of the model results easier.

The composite indices of socioeconomic variables measure the change in different indicators of socioeconomic situation of local communities living around our sample PAs. We constructed two composite indices for social indicators (pro-conservation behaviour and attitude) and one index for economic indicators (PA related economic benefits index). The *pro-conservation behaviour index* measures the change in the behaviour of local communities over 10-year period (e.g. resource use behaviour, encroachment into the territories of the PAs, compliance with the rules and regulations of the PAs) (see Table S3 for the list of indicator variables). The *attitude-index* measures the change in the attitude of the local communities towards PAs, wildlife and PA authorities over 10-year period (see Table S3). The *economic benefits index* measures the change in PA-related economic benefits to local communities (e.g. PA-related employment, income, tourism). The economic benefits index in our study does not represent the change in the general economic condition of local communities rather it is limited to PA-related economic benefits (see Table S3). After constructing the indices, we transformed the values of the indices from their original values ranging from −1 to 1 to values ranging from 0 to 1.

Finally, to investigate the sustainability of our PAs network, we constructed the *PA sustainability index*, which was used as the dependent variable in our PA sustainability models. The sustainability index was computed as a composite index by combining the biodiversity, economic and social indicators (i.e. weighted mean of the four variables related to the important pillars of socio-ecological systems). We gave more weight (of 0.5) to biodiversity conservation, as we believed that the fundamental objective of PAs is to conserve biodiversity), and equal weights (of 1/6 each) were given to the three variables related to local socioeconomic situation, represented by behavioural and attitudinal changes of local communities, and economic benefits to local communities. The operational definition of PAs sustainability in this study is that PAs that achieved an improvement in the abundance of mammals and birds over the 10-year period preceding our survey at least without worsening the socioeconomic condition of the local communities are considered as sustainable (Gardner et al., 2013; Roe, 2008).

In our study, in addition to analysing the predictors of the sustainability of PAs, we also focused on whether there is synergy or trade-off between local socioeconomic development and biodiversity conservation. In this analysis, we assumed that synergy would be achieved when both biodiversity and socioeconomic development indices were improving in the 10 years preceding our survey. For example, synergy occurs when both biodiversity index and socioeconomic development index improve and trade-off between the two variables occurs when one increases and the other declines.

We also constructed various indices for the predictors of the sustainability of PA and synergies between biodiversity conservation and local socioeconomic development. To measure the impact of threats to biodiversity conservation on PAs sustainability and the emergence of synergy, we constructed *threat intensity index*, which was composed of three indices (habitat loss, resource use-based threats and general human pressure) (see Table S4). Furthermore, to investigate the impact of the empowerment of PA management, we constructed the PA management empowerment index, based on five questions related to PA management (e.g. training, resource sufficiency, autonomy) (see Table S5). We also constructed an index measuring the involvement of local communities in the decision-making process and conservation activities of PAs. This index was computed from six local community involvement related questions (e.g. participation in decision-making, and nature conservation and protection, considerations given to local cultural values) (see Table S6).

Furthermore, we controlled for the size of PAs, their IUCN management category, and the distance to the nearest city both in PAs sustainability and synergy models (see Table S7). The distance from the PAs to the nearest city was measured as the shortest Euclidian distance between the PAs (WDPA, 2018) and the nearest city (Natural Earth, 2018) using gDistance function from RGEOS package in R (Bivand & Rundel, 2019). We included the distance from PAs to the nearest city to account for the impact of proximity to commercial centres on PAs sustainability. Finally, to account for the national socioeconomic context, we included the Human Development Index (HDI) (Barnes et al., 2016; Geldmann et al., 2018; Gray et al., 2016). Furthermore, we included country as random effects in our statistical models to control for other socio-political contexts. We checked for two variants of HDI values (i.e. HDI in 2017 and the change in HDI values from 2010 to 2017) and found that the results were similar.

To analyse the data, we used Bayesian Hierarchical Regression Models with a Gaussian response distribution. The dependent variable in our sustainability models was a sustainability index that rangers from 0 to 1 (i.e. it possibly assumes all the values within this range). As a random effect, we included country with all possible random slopes and the correlation parameters between the random intercepts and random slope terms (Barr et al., 2014; Schielzeth & Forstmeier, 2009). To control for spatial autocorrelation, we additionally included a Gaussian process over longitude and latitude for each PA (McElreath, 2016) by using the function 'gp' from the R package 'BRMS' (Bürkner, 2017). Before running the models, we z-transformed all covariates to a mean of zero and a standard deviation of one (Schielzeth, 2010).

The model was fitted in R (R Core Team, 2017) by using the function 'brm' from the R-package 'BRMS' (Bürkner, 2017). We used 2000 iterations over four Markov Chain Monte–Carlo (MCMC) chains, with a 'warm-up' period of 1000 iterations per chain, which resulted in 8000 usable posterior samples (Bürkner, 2017). To check the convergence of the models, we inspected the MCMC results, which showed stationarity and convergence to a common target. *Rhat* values were all below 1.01 (Gelman et al., 2013). We had no divergent transitions after warm-up. As we had no prior information, we ran the models with weakly informative priors with a standard normal distribution (mean of 0 and standard deviation of 1).

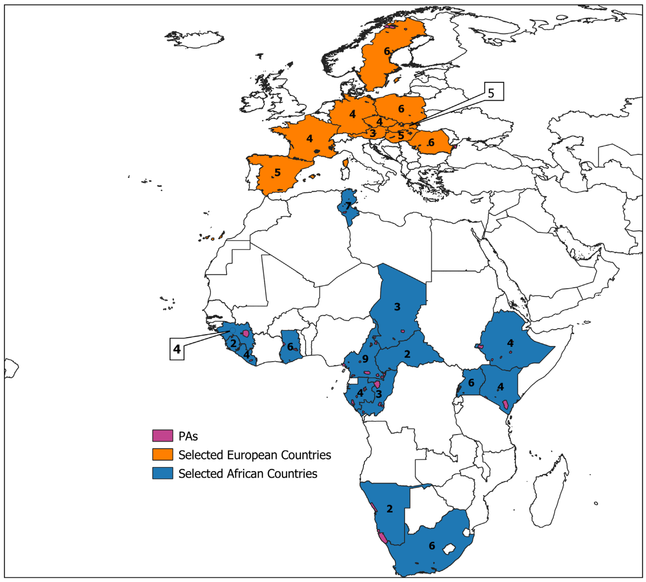

FIGURE 1 Map of African and European countries selected for the study. The numbers stand for the number of PAs selected from each country. For the list of the PAs from each country, see Table S8

3 | RESULTS

We collected data on 464 species of mammals (n = 174) and birds (n = 290) from 48 European and 66 African PAs (Figure 1), with a mean ± SD of 22.1 ± 14.7 species per PA. Almost 57% of the species in our data were from African PAs and the remaining 43% were from European PAs. The average size of African PAs was 2253 km^2, whereas the average size of European PAs was 570 km^2. On average, African PAs were 36 years and European PAs were 45 years old. The majority of the PAs were in IUCN management category of II (70%) (Table S8).

3.1 | Biodiversity changes in PAs

Our results revealed that in the 10 years preceding our survey, more than 40% of the species were declining in almost 27% of African PAs and 15% of European PAs (Figure S1). In 12% of African PAs, more than 60% of the species of mammals and birds were declining. Top mammalian predators were one of the worst affected group of species in African PAs, and have shown a declining trend in almost 43% of the PAs (Figure S2). In Africa, the other worst affected group of species were insectivorous mammals and small mammalian predators. In Europe, the worst affected group of species were seed-eating birds followed by piscivorous and insectivorous birds, and small to medium non-predatory mammals (Figure S3). In general, African PAs were performing better in terms of the conservation of birds than mammals, whereas in European PAs birds were declining more drastically than mammals (see Figure S3 and also Gatiso et al., under review).

3.2 | Change in socioeconomic variables

We found that in 44% of African and 17% of European PAs, there was a decline in pro-conservation behaviour of local communities living around the PAs over the 10 years preceding our survey (Figure S4). Several African PAs reported an increase in encroachment into their territories by local communities for agricultural expansion and grazing, and less compliance with the rules and regulation of PAs. In only 19% and 9% of African and European PAs, respectively, there was an improvement in pro-conservation behaviour of the local communities. In most of the European PAs, pro-conservation behaviour of the local communities has remained stable over the 10-year period (74%).

The majority of the PAs both in Africa (58%) and Europe (51%) reported that the attitude of the local communities towards the PAs and PA authorities had shown an improvement (Figure S4). Only 15% and 9% of the PAs in Africa and Europe, respectively, reported a decline in the attitude of local communities towards PAs. Our results revealed that even though the attitude of the local communities was improving in the 10 years preceding our survey, pro-conservation behaviour of the local communities was still declining.

Finally, 41% of African PAs reported that there was an improvement in PA-related economic benefits to local communities living in and around them, whereas 81% reported an improvement in such benefits in Europe (see Figure S4). While 20% of African PAs reported that PA-related economic benefits to local communities living in and around the PAs declined, none of the European PAs reported a decline in such benefits (see Figure S4).

3.3 | Sustainability status of PAs

With respect to our composite sustainability index (composed of biodiversity and socioeconomic development related variables), using univariate t-test, we found that African PAs were less sustainable than European PAs ($t = -5.276$, $df = 97$, $p < 0.01$). More than 30% of African PAs had a sustainability index score of less than 0.5, while almost all European PAs scored more than 0.5 (Figure 2).

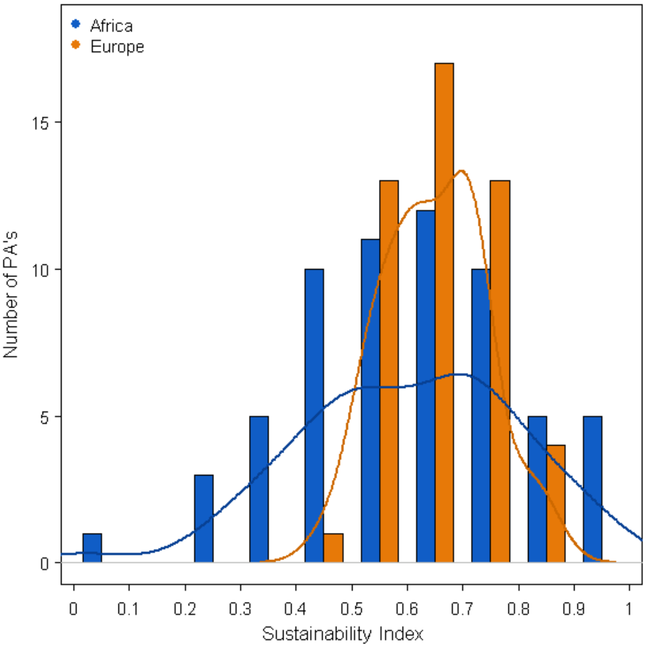

FIGURE 2 Sustainability status of PAs. Sustainability of the PAs increases as the value on the horizontal axis increases from 0 to 1. A value of zero indicates that all the outcome variables (biodiversity, social and economic variables) were declining, and a value of 1 indicates all the outcome variables were improving

In 18% of African PAs, the sustainability index was negative (indicating that most of the sustainability indicators were declining in the10 years prior to our survey), while it was declining in only one European PA (Figure S5).

A closer look into the components of the sustainability index using univariate t-tests revealed that over the 10-year period prior to our survey, there was no statistically significant difference between African and European PAs in terms of the change in biodiversity conservation ($t = 0.341$, $df = 104$, $p = 0.734$), the attitude of local communities ($t = -0.111$, $df = 102$, $p = 0.912$) and pro-conservation behaviour of the local communities ($t = -1.561$, $df = 94$, $p = 0.122$) (see Figure 3). However, in terms of PA-related economic benefits to local communities, European PAs performed better than African PAs in the 10 years prior to our survey ($t = -4.18$, $df = 104$, $p < 0.01$).

Our Bayesian Regression Model results revealed that PA sustainability was strongly correlated with the involvement of local communities in the decision-making process of PAs, the empowerment of the PA management, the national socioeconomic context and the threat intensity the PAs were facing (Figure 4 and Figure S6). PAs that involved local communities more in their decision-making processes and conservation activities were found to be more sustainable than those with a low level of local community involvement. Moreover, PAs with more empowered management were more sustainable than PAs that reported less empowerment of their management. Our results also indicated that the national socioeconomic context of the country where

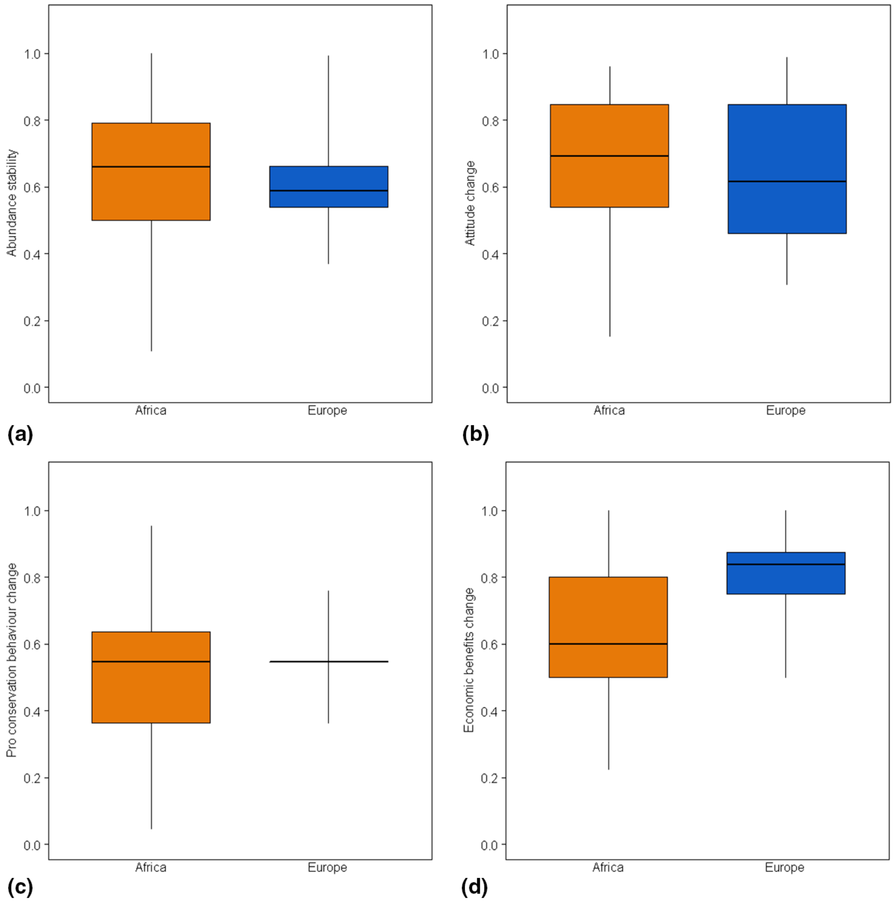

FIGURE 3 Comparison of components of PA sustainability index (a. biodiversity, b. attitude, c. pro-conservation behaviour and d. economic benefits by continent

the PAs were located was strongly correlated with the sustainability of the PAs. PAs from countries with higher HDI were more likely to be sustainable than those from low HDI countries. This could be due to the fact that countries with higher HDI may not have many 'disturbance-sensitive' species such as large predatory and non-predatory mammals. On the other hand, this could also be because of the fact that developed countries are able to allocate sufficient resources (e.g. financial, human) to effectively protect biodiversity in their PAs. Furthermore, the higher the intensity of threats that the PAs were facing, the lower the prospect of the PAs being sustainable. The threat intensity was found to be positively corelated with the degradation of biodiversity in the PAs and adversely affect their ability to contribute to the local socioeconomic development.

3.4 | Biodiversity conservation and local socioeconomic development: Synergies or trade-offs?

Our results revealed, on average, a positive association between the local socioeconomic development and biodiversity conservation in the 10 years prior to our survey (Figure S7). On average, PAs with better conservation outcomes were more likely to report positive socioeconomic outcomes (see Figure S7).

We also found that, while in 33% of the PAs, biodiversity conservation and socioeconomic development moved (or changed) in opposite directions (which is considered as a trade-off between the two variables in this study), in 62% of the cases both conservation and socioeconomic outcome variables showed improvement (we consider this as synergy) (see Figure 5). The likelihood of synergy occurring in African PAs was relatively lower (55%) compared to European PAs (71%) ($\chi^2 = 9.158, p < 0.01$) (see Table S9). In 10% of African PAs, both conservation and socioeconomic development indicator variables were declining in the 10 years preceding our survey. Furthermore, our results show that there was statistically significant relationship between achieving synergy and having a higher sustainability index ($t = -4.62$, $p < 0.01$). The sustainability index of PAs that have achieved synergies was 0.874, while PAs with trade-off between socioeconomic development and biodiversity conservation had sustainability index of 0.697.

We found that the likelihood of achieving synergies between socioeconomic development and biodiversity conservation is positively correlated with better national socioeconomic development (HDI), higher local community involvement and more empowered PA management, and negatively correlated with PAs exposure to more threats to biodiversity conservation (see Figure 6).

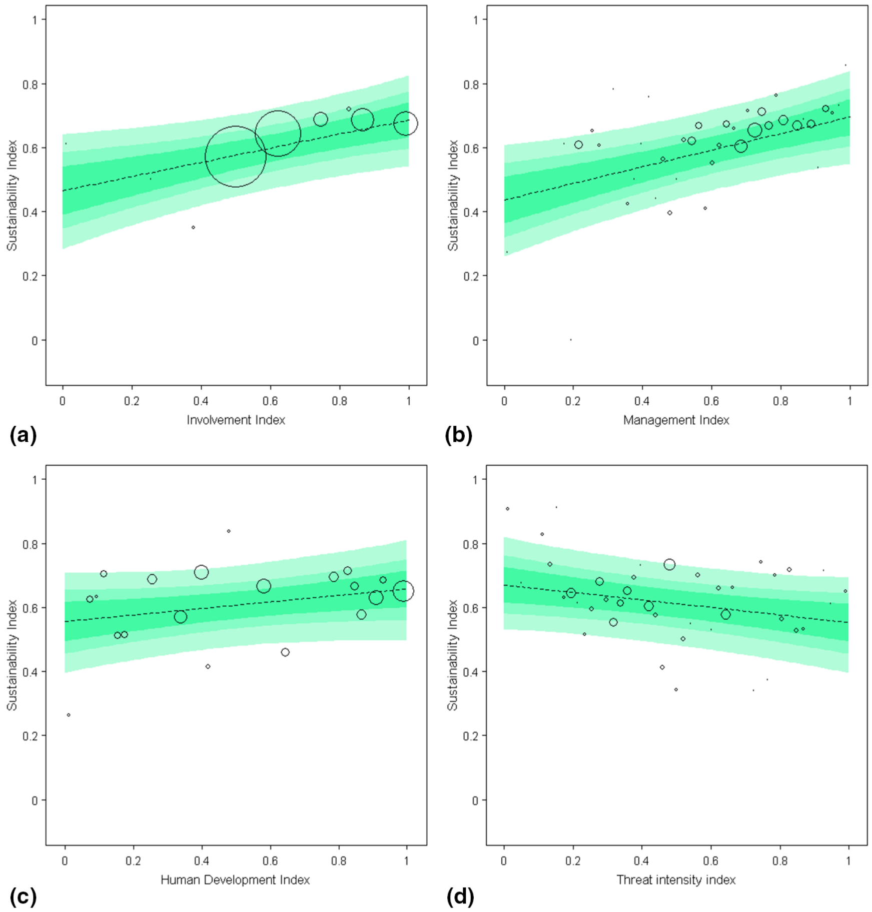

FIGURE 4 Relationship between the sustainability of PAs and (a) community involvement index, (b) PA management empowerment index, (c) HDI and (d) threat intensity index. These relationships are obtained from Bayesian regression model estimates given in Figure S6. The dashed line depicts the expected mean of the predicted posterior distribution, the coloured areas are depicting the 67%, 87% and 97% credibility intervals, the size of the bubbles corresponds to the number of PAs

4 | DISCUSSION

Our results underline that achieving biodiversity conservation and socioeconomic development goals simultaneously is possible. However, it requires concerted efforts in terms of empowering the management of PAs, involving the local communities in the planning and decision-making process of PAs, and combating threats to biodiversity inside and outside of the PAs. Our data revealed that there were more synergies between biodiversity conservation and local socioeconomic development than trade-offs between the two goals (see also Oldekop et al., 2016). In fact, the PAs seem to play a crucial role in reconciling the two seemingly conflicting objectives of sustainable development. These results concur with the findings of previous studies that have shown that protected areas do play a positive role for poverty reduction (Ferraro et al., 2011), improving the well-being of local communities (Naidoo et al., 2019) and biodiversity conservation (Bruner et al., 2001; Geldmann et al., 2014). This is very encouraging particularly in Africa, where conflict between poverty reduction and conservation efforts is frequently reported (FAO, 2008). But depending on different factors, the extent of synergies and trade-offs between local socioeconomic development and biodiversity conservation varies from country to country and from PA to PA.

Our results show that the likelihood of synergies is positively correlated with HDI, involvement of local communities in PA planning and management decision-making process and empowerment of the PA management. In our models, we included country as random effects to control for any country level differences (e.g. socio-political context). Moreover, our results revealed that sustainability of PAs is strongly correlated with the empowerment of PA managers and the involvement of local communities in PAs' decision-making processes. PAs with more empowered management and that involved local communities in their planning and decision-making process were more likely to be sustainable. In addition, PAs with stricter protection according to IUCN management category were relatively more sustainable than PAs with IUCN management category that allow sustainable resource use. However, according to our data, the impact of the PAs' IUCN management category on their sustainability was not as strong as the involvement of local communities or empowerment of PA management. Thus, our results emphasize that PAs, in addition to strict law enforcement, should focus more on empowering their management (Geldmann et al., 2018; van Kerkhoff et al., 2019) and involving the local communities in their planning and decision-making process (Andrade & Rhodes, 2012; Mariki et al., 2015; Norris et al., 2018).

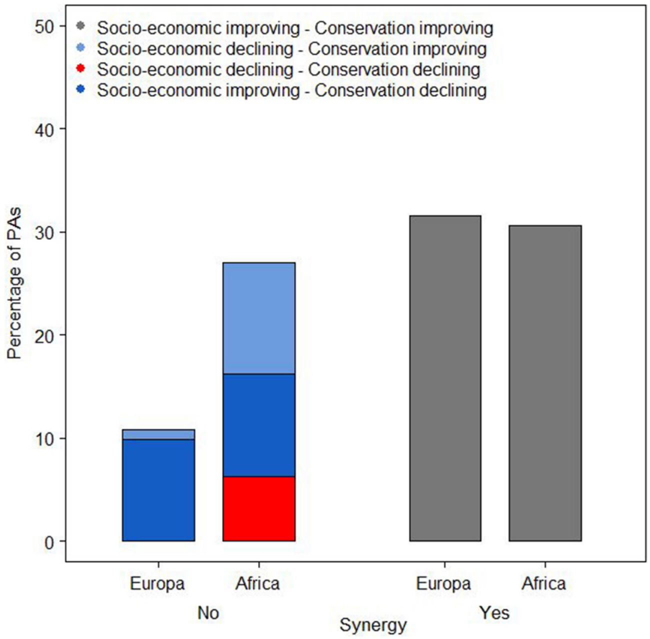

FIGURE 5 Synergies and trade-offs between conservation and socioeconomic development. The percentages in each category are from the *total number of PAs* in our sample (i.e. the summation of all categories would be equal to 100%). The change in the abundance of mammals and birds is used as an indicator for biodiversity conservation outcome. Socioeconomic development is composed of three indices: Attitude, pro-conservation behaviour and PA-related economic benefits. In this study, PAs that achieved improvement both in conservation and socioeconomic development are considered as achieving synergy. To concentrate only on positive synergies, we deliberately excluded PAs that reported a decline in both conservation and socioeconomic development, which may indicate negative synergy

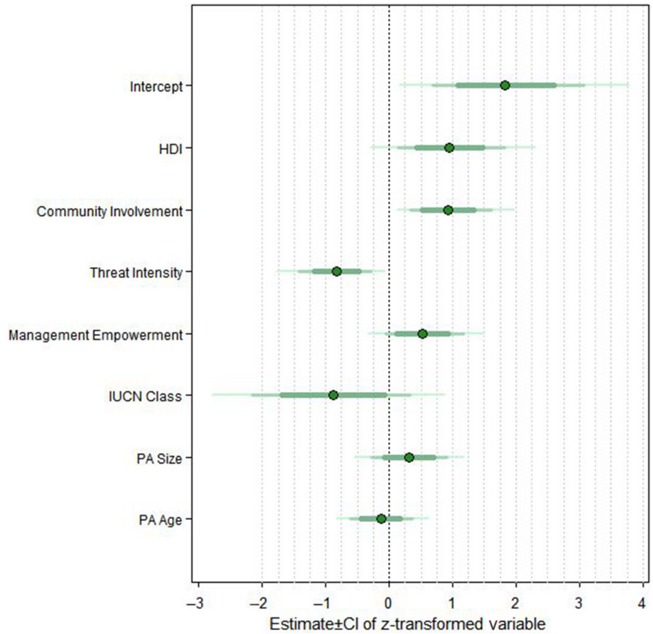

FIGURE 6 Predictors of synergy between socioeconomic development and biodiversity conservation. The plot shows the estimates (mean of the posterior distribution; dots) and the 67%, 87%, 97% credibility intervals (green lines). The dependent variable is synergy, which assumes a value of 1 if both socioeconomic development and conservation were improving in the 10 years prior to our survey and 0 otherwise. IUCN class is a dummy variable that assumes a value of 1 if the PA is strictly protected and has IUCN category of Ia, Ib and II and assumes 0 otherwise. For the definition of other variables, see Table S7

4.1 | Why is community participation so important for PA sustainability?

The involvement of local communities in PAs planning and decision-making processes, and biodiversity conservation could be important for four major reasons. First, it creates a feeling of ownership to local communities, fostering their participation in biodiversity conservation (Campbell & Vainio-Mattila, 2003), and reducing their resentment towards PAs and their management. Studies have shown that resentment and revenge killings of wildlife strongly contribute to biodiversity degradation inside PAs (Mariki et al., 2015). Second, the involvement of local communities makes it difficult for illegal hunters and poachers to evade the law enforcement authorities of the PA, as local communities could participate in exposing the rule breakers (Gatiso, 2019). This makes law enforcement easier and saves costs for the PA management, which usually has limited resources for law enforcement. Third, community-driven approaches allow more flexibility and provide PA managers the opportunity to tap into local and indigenous conservation knowledge (Cooney et al., 2017). Furthermore, community-driven approaches enable conservation strategies of PAs to be locally adaptive and, hence, allow the PA management to respond faster to changes in the socio-ecological contexts around the PAs than the top-down approaches. Fourth, the participation of local communities in the planning and decision-making process of PAs increases the acceptability of the PAs' rules and regulations, and, therefore, enhances the compliance of local communities with the PA rules (Andrade & Rhodes, 2012; Mariki et al., 2015). Nonetheless, we acknowledge that if the involvement of local communities in PAs planning and decision-making process is not properly coordinated, it may have a negative impact on biodiversity conservation by shifting priorities away from conservation (Dupke et al., 2019). Thus, the process of involving local communities in the planning and decision-making process of PAs should be carefully planned and managed to promote conservation and local socioeconomic development goals simultaneously.

4.2 | Empowering PA management for sustainability

Our results also underline that the empowerment of PA management plays a crucial role in enhancing the sustainability of PAs. For PAs to protect their biodiversity sustainably, PA managers should have the autonomy and resources to meet the needs of individual species in the PA and be able to synchronize their management plans and activities with the local socioeconomic settings. In addition, PA managers should have the required training to transition their management strategies from the customary 'fence-and-fines' approach to the one that involves local communities in the planning and decision-making process of PAs (Cooney et al., 2017; Norris et al., 2018). The empowerment of the PA management and the availability of resources, funds and conferment of authority to effectively respond to the multifaceted challenges of biodiversity conservation and to adapt to the changing ecological and socio-economic context in and around PAs plays an important role in enhancing the sustainability of PAs (van Kerkhoff et al., 2019). This may require, for example, modifying the contents of PA management training, which currently focus primarily on natural sciences and give less attention to social sciences (Bennett et al., 2017). Social science-based training could provide crucial insights into the behaviour of local communities and enable PA managers to use incentives and other market-based instruments to achieve sustainable biodiversity conservation (Gatiso et al., 2018).

4.3 | Behavioural and attitudinal changes for PA sustainability

Our results underscored that despite the commendable improvement in the positive attitude of the local communities towards PAs, PA authorities and wildlife, there was a decline in pro-conservation behaviour both in Africa and Europe, although the reported decline was higher in Africa than in Europe. This could be due to two major reasons. First, there could be a time lag between attitudinal changes and behavioural changes. Most of the time behavioural changes come after changes in attitude (Chaiklin, 2011). Second, psychological research has shown that the link between 'verbal attitude' and 'overt behaviour' might be weak (Farjam et al., 2019; Wicker, 1969). People may not always act as they state verbally. They may overstate positive attitude but when it comes to the actual behaviour (manifested by action) the positive attitude may not be reflected in positive behaviour on a one-to-one basis. This suggests that PAs should have separate strategies designed to target the behaviour and the attitude of local communities to promote conservation in the long term. For example, awareness creation campaigns may be sufficient to achieve changes in attitude, but it may require the awareness campaigns to be accompanied by incentives (e.g. financial or other economic incentives) to achieve behavioural changes.

In summary, the mere establishment and expansion of PAs may not be sufficient for the long-term success of conservation efforts (Geldmann et al., 2018; Watson et al., 2014). Our results emphasize that the empowerment of PA management and the involvement of local communities in the planning and decision-making processes of PAs is crucial for the success of PA conservation efforts in the long run. In this regard, our results strongly suggest that the post-2020 biodiversity conservation targets should have specific strategies to enhance the effectiveness of PAs in reconciling the objectives of biodiversity conservation and local socioeconomic development. The expansion of PAs network needs to be accompanied by strategies and plans for the empowerment of PA management and involvement of local communities in PAs' decision-making process.

Finally, we acknowledge that our study might have some limitations. As it is the case with all survey-based studies, there could be some residual bias (strategic or non-strategic) from the side of the respondents. We tried to reduce this bias by explaining the objective of the research and the independence of our institutions from any political or other motives, which bolsters the confidence of the respondents to report honestly. Moreover, we cross-validated the responses of PA managers with data from other independent databases (such as LPD, IUCN SSC A.P.E.S).

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CONFLICT OF INTERESTS

There are no conflict of interests. But, we would like to mention that Aletta Bonn, the co-author of this paper, is an Associate Editor for People and Nature, but was not involved in the peer review and decision-making process.

AUTHORS' CONTRIBUTIONS

Conceptualization: T.T.G. and H.S.K.; Funding acquisition: H.S.K., A.B., M.W., A.F., K.W. and L.B.; Formal analysis: T.T.G., H.S.K., L.K., M.B., A.B., L.B., A.F., M.H., K.W., M.W., I.O.-N. and T.S.; Methodology: T.T.G., H.S.K., L.K., M.B., A.B., L.B., A.F., M.H., K.W., M.W., I.O.-N. and T.S.; Writing—original draft: T.T.G.; Writing—review and editing: T.T.G., H.S.K., L.K., M.B., A.B., L.B., A.F., M.H., K.W., M.W., I.O.-N. and T.S.

DATA AVAILABILITY STATEMENT

The data used in this study are publicly available through Zenodo (https://zenodo.org/record/6401123#.YkWApzVCQ2w). Nonetheless, due to the sensitivity and confidentiality of the information they contain, the data are anonymized.

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