

Research Letters

Alignment of Cultural Interest and Conservation Priority in sub-Saharan Africa National Parks

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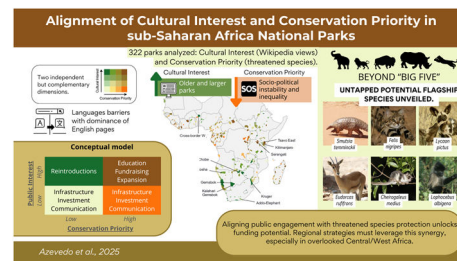
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HIGHLIGHTS

- Cultural Interest and Conservation Priority shape African parks in distinct ways.
- Older, larger parks attract more attention; inequality lowers conservation focus.
- Overlooked Central and West African parks may gain from culture-ecology alignment.
- Pangolins and red gazelle offer untapped conservation flagships beyond the iconic Big Five.

GRAPHICAL ABSTRACT



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ABSTRACT

Against the backdrop of accelerating biodiversity loss and limited conservation funding, understanding what drives interest in National Parks (NPs) is key to securing political and financial support. We analyzed 322 NPs across 44 sub-Saharan African countries, integrating digital visibility (Wikipedia page views) as a proxy for Cultural Interest with the relative proportion of threatened mammal species as a measure of Conservation Priority. We examined socio-geographic drivers of both dimensions and identified mammal species most associated with Cultural Interest. Park size, age, regional patterns, and colonial language influenced Cultural Interest, while socio-economic variables such as inequality and population density were more strongly linked to Conservation Priority. Results reveal geographic asymmetries: NPs in Austral Africa show high Cultural Interest but relatively lower Conservation Priority, Central and Western Africa harbor greater biodiversity threats but receive less attention, and Eastern Africa balances both dimensions. Although the 'Big Five' dominate attention, lesser-known mammals such as primates, small felids, and ungulates offer untapped potential to increase park visibility. Cultural Interest and Conservation Priority show limited alignment, exposing gaps between public visibility and ecological need. By positioning parks within a two-dimensional framework, we highlight opportunities for targeted communication, digital engagement, and financing strategies to bridge this divide and strengthen conservation agendas.

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Introduction

Africa hosts over 8,000 protected areas, covering around 15% of land and 18% of coasts (UNEP-WCMC, 2023). These Protected and Conserved Areas (PCAs) play a critical role in safeguarding biodiversity, particularly for large mammals (Joppa et al., 2008). Yet, they are increasingly threatened by external pressures including habitat loss, land-use change, overexploitation, and connectivity loss from infrastructure expansion (Newmark, 2008). Simultaneously, persistent human-wildlife conflicts, aggravated by incompatible land uses and climate-related stressors, undermine local food security and ecosystem stability (Chapman et al., 2022). Sub-Saharan Africa is a stronghold for the world's megafauna, but vertebrate species in the region are projected to face the sharp increases in extinction risk by 2060 (Lindsey et al., 2022). These pressures intensify in Central and West Africa, where bushmeat trade is both a driver and a consequence of armed conflict, functioning as a safety net for rural populations in times of crisis and as a source of meat for soldiers in remote areas (Rist et al., 2024).

Mammals, in particular, provide a critical lens through which to assess conservation priorities, given their ecological roles and prominence in global conservation agendas (Lacher et al., 2019; Milner-Gulland et al., 2024). Biodiversity conservation frameworks based on hotspots and related prioritization tools have long emphasized regions where high endemism coincides with high threat, aiming to maximize species protected per unit investment (Mittermeier et al., 2011). However, efforts to enhance the resilience and effectiveness of African PCAs are constrained not only by ecological pressures, but also by historical and structural challenges. The legacy of exclusionary governance persists in many systems, where top-down management and inequitable benefit-sharing exacerbate human-wildlife conflicts and undermine local support (Stone et al., 2022). Moreover, National Parks (NPs) with high biodiversity value often overlap with regions marked by socio-political instability, poverty, and inequality, complicating conservation efforts (Stone et al., 2022). In this context, socio-cultural values, perceptions, and behaviors play a crucial role in shaping conservation outcomes, underscoring the need to integrate these dimensions alongside ecological evidence (Bennett et al., 2022).

A field illustrating this shift is Conservation Culturomics, which harnesses digital data to examine human-nature relationships at scale (Correia et al., 2021). Defined as the analysis of digital data to understand human-nature interactions (Ladle et al., 2016), conservation culturomics can capture signals of salience otherwise impossible to quantify through conventional methods, revealing broad cultural dynamics around protected areas (Correia et al., 2018; Souza et al., 2024). Although internet penetration remains low in African regions, digital traces offer a powerful tool to study large-scale patterns of public interest in biodiversity (Veríssimo et al., 2024). The viral case of Cecil the lion, killed in Zimbabwe's Hwange National Park in 2015, illustrates how online attention can rapidly transform a local event into a global conservation issue, amplifying debates and influencing international policy agendas despite limited responses within Southern Africa (Stone et al., 2022). This link between digital attention and conservation outcomes highlights the value of integrating culturomic data into spatial planning, advocacy, and governance strategies (Turnbull et al., 2023).

In sub-Saharan Africa, where nature-based tourism is a vital economic sector, the cultural appeal of national parks extends beyond iconic species (Ferrari, 2020). Factors such as infrastructure, socio-economic conditions, political contexts, and global recognition through designations such as UNESCO World Heritage status all influence tourism demand (Kagochi and Durmaz, 2024). Additionally, colonial languages (e.g., English, French, Portuguese, German, Italian) may shape engagement and cultural interest in National Parks, either facilitating or hindering them through communication barriers, cultural perceptions, political policies, and the overall tourist experience (Sène-Harper and Séyé, 2019). Understanding how these variables influence digital attention and cultural engagement is critical for

advancing conservation goals (Jepson et al., 2017; Souza et al., 2021).

Here, we explore and map the alignment between Cultural Interest and Conservation Priority in sub-Saharan African National Parks (NPs), where Conservation Priority is measured by the relative proportion of threatened mammal species. By positioning the parks within this two-dimensional space, we identify the socio-geographical and biological factors driving patterns of Cultural Interest and Conservation Priority. This approach allows us to categorize parks into distinct conservation-communication profiles, creating a practical framework for tailoring strategies in resource allocation, tourism development, and science outreach based on each park's unique position within this conceptual landscape.

Material and methods

Data compilation

We included 322 National Parks (NPs) officially designated in sub-Saharan African countries as listed in the World Database of Protected Areas (WDPA; UNEP-WCMC, 2023). The category of National Parks were chosen on WDPA Database due to their conservation importance and visibility, often serving as flagships for biodiversity protection and nature-based tourism in Africa.

To quantify public attention, we used digital trace data from Wikipedia page views, following the methodology of Guedes-Santos et al. (2021). We retrieved daily page view data in six major colonial languages using the R packages 'tidywikidataR' and 'pageviews', covering the period from July 2015 to May 2024. To account for differences in page creation dates, we calculated the average number of daily views for the periods when the pages were available online during this interval. To estimate Conservation Priority, we overlaid IUCN range maps and occurrence records of terrestrial mammals with NP boundaries from GBIF (the Global Biodiversity Information Facility), focusing on the proportion of threatened species (Vulnerable, Endangered, Critically Endangered) relative to the total mammal checklist of each NP (details on the conceptual framework and analysis in Box 1).

BOX 1.

Conceptual Framework: Public Interest and Conservation Priority Dimensions

Our framework operationalizes two central dimensions to characterize the visibility and conservation relevance of National Parks in sub-Saharan Africa. Cultural Interest (public Interest) reflects the extent of public attention or engagement with a protected area, here estimated through Wikipedia page views across different colonial languages (English, Spanish, German, French, Italian, and Portuguese). Digital trace data offers a proxy for collective attention and perceived cultural visibility. This approach is grounded in culturomics, which interprets digital activity as an indicator of human-nature relationships and conservation salience. Conservation Priority refers to the ecological value of a park in terms of threatened mammalian species it harbors. Drawing from IUCN and GBIF data, we focused on the presence and proportion of species classified as Vulnerable (VU), Endangered (EN), and Critically Endangered (CR) within each NP. We assume that parks supporting a higher share of threatened fauna should be prioritized in conservation agendas, aligning with global efforts to avert species loss. Both dimensions are conceptualized as continuous latent constructs. This dual-axis model allows us to map, compare and position NPs within a two-dimensional space defined by public interest and ecological relevance. By positioning National Parks along these gradients, we can identify their relative standing in terms of cultural visibility and ecological relevance, revealing potential disparities and opportunities.

We also gathered a suite of socio-geographic predictors potentially associated with Cultural Interest and Conservation Priority. These included accessibility (distance to nearest international airport), socio-economic indicators (GNI-PPP per capita, Gini Index, population density), political regime type, and national indices of peace and environmental performance. All sources and variable details are in Supplementary Table S2.

Statistical analysis

To uncover latent constructs underlying Cultural Interest and Conservation Priority, we apply an Exploratory Factor Analysis (EFA) analysis to reduce dimensionality. After identification of the constructs through EFA, a linear regression was conducted to examine the relationship between two dimensions. Then, we used Generalised Linear Models (GLM) to explore the relationship between the two dimensions and the socio-geographic drivers. Finally, to identify which threatened mammalian species are most strongly associated with Cultural Interest in National Parks, we performed a Random Forest regression. This analysis allowed us to identify the main species driving Cultural Interest. Further detail is provided in Supplementary Material S2.

Results

Of the 322 National Parks assessed, 20 (6.2%) did not have a Wikipedia page available in any language (see Table 1 in Supplementary Material S1). These NPs are in Cameroon (5), Liberia (6), and Nigeria (2), with Ethiopia, Gambia, Guinea-Bissau, Guinea, Kenya, Namibia, and Sierra Leone having one park each. Among the 302 NPs with a Wikipedia page, 88.8% had a page in English, 77% in French, 74.8% in German, 73.3% in Spanish, 52.8% in Italian, and 27.6% in Portuguese. Only 52 parks had a Wikipedia page in all 6 languages covered in the study, most of them in Austral Africa (42.3% - 22 parks), located in countries such as Angola (4), Madagascar (4) and South Africa (3). The other 11 parks in this region are distributed among 7 other countries. The Central Africa region has the lowest number of parks (6) with pages in all six languages accessed. The diversity of languages with Wikipedia page available ranged from 2 to 312, but 15.23% of them had more than 50 languages available, and only 4.64% had more than 100 languages (Fig. 1). Daily page views varied widely, ranging from 1 to an average of 600 daily views.

Relationship of cultural interest and conservation priority

The Exploratory Factor Analysis (EFA) revealed that Cultural Interest and Conservation Priority together explain 56% of the total variance in the observed socio-geographic variables. This result indicates that the model captures a substantial portion of the underlying data structure. Of the retained factors, Cultural Interest explains 43% of the total variance and 77% of the variance within the latent structure, underscoring its dominant contribution. In contrast, Conservation Priority accounts for only 13% of the total variance and 23% of the variance within the latent structure. Moreover, a simple linear regression revealed no significant relationship between Cultural Interest and Conservation Priority ($\beta = -0.033$, $p = 0.439$). Regardless of the presence of outliers in the regression, the relationship between the two components remained

independent (Fig. 2).

The Generalized Linear Model (GLM) revealed that larger and older NPs were significantly associated with higher Cultural Interest (Table 1). Gross National Income also emerged as a significant predictor, suggesting that parks in countries with higher national income per capita tend to have greater Cultural Interest. Conversely, for Conservation Priority the model identified income inequality, global peace index, and population density as significant predictors (Table 1). Higher income inequality and population density were associated with lower Conservation Priority, while countries with lower global peace indices (less peaceful) tended to have higher Conservation Priority. Political regimes also played a significant role, with autocratic regimes associated with higher Conservation Priority compared to more democratic regimes.

To assess the contribution of threatened mammals to Cultural Interest, a Random Forest model was applied to the top 30% most popular and bottom 70% least popular NPs. For the top 30%, the optimized model explained 51.86% of the variance in Cultural Interest, suggesting additional factors beyond species presence are associated with Cultural Interest. The percentage increase in mean squared error (%IncMSE) highlighted a diverse set of species, predominantly classified as Vulnerable, spanning carnivores, ungulates, primates, and pangolins. The most strongly associated species included red-fronted gazelle (*Eudorcas rufifrons*; %IncMSE = 11.10), forest elephant (*Loxodonta cyclotis*; %IncMSE = 8.68), cheetah (*Acinonyx jubatus*; %IncMSE = 6.18), and lion (*Panthera leo*; %IncMSE = 6.15). For the bottom 70%, the model explained 56.36% of the variance, showing a more stable fit due to lower Cultural Interest variability. The species with the highest %IncMSE values included ground pangolin (*Smutsia temminckii*; %IncMSE = 11.35), black rhinoceros (*Diceros bicornis*; %IncMSE = 9.78), grey-cheeked mangabey (*Lophocebus albigena*; %IncMSE = 8.28), and leopard (*Panthera pardus*; %IncMSE = 7.05) (Fig. 3). See Supplementary Table S4 for additional species.

Discussion

While Cultural Interest is primarily influenced by park- and country-level socio-economic factors such as size, age, and gross national income, Conservation Priority is shaped by broader structural conditions, including income inequality, population density, and regime type. Notably, the presence of threatened mammal species was moderately associated with Cultural Interest, although species presence does not explain public engagement alone. This implies that while charismatic or vulnerable species may boost cultural visibility, other drivers are likely at play. Despite the lack of alignment between Cultural Interest and Conservation Priority, understanding the positioning of parks within this two-dimensional space offers strategic opportunities to: i) mobilize support for endangered species; ii) attract tourists and researchers with

Table 1

Summary results of Generalised Linear Model (GLM) relating the socio-geographic variables, political regime type and the Environmental Performance Index to Cultural Interest and Conservation Priority. Values represented are estimated model coefficients (β slope) and respective confidence intervals and significance.

Predictors	Cultural Interest			Conservation Priority		
	Estimate	95% CI	p-value	Estimate	95% CI	p-value
Area	0.029	0.02, 0.04	<0.001***	0.002	-0.01, 0.02	0.8
Age	0.028	0.02, 0.04	<0.001***	0.001	-0.01, 0.02	0.9
Accessibility	-0.005	-0.02, 0.01	0.4	0.004	-0.01, 0.02	0.6
Gini Index	-0.007	-0.02, 0.01	0.3	-0.039	-0.06, -0.02	< 0.001***
Global Peace	0.007	-0.01, 0.02	0.3	-0.018	-0.03, 0.00	0.041*
Population	0.001	-0.01, 0.01	0.9	-0.022	-0.04, -0.01	0.006**
GNI	0.016	0.00, 0.03	0.036*	-0.002	-0.02, 0.02	0.9
EPI	0.001	-0.01, 0.01	0.9	-0.010	-0.03, 0.01	0.2
Regime						
Autocracy	0.019	-0.05, 0.09	0.6	0.111	0.02, 0.20	0.021*
Democracy	0.051	-0.02, 0.13	0.2	0.047	-0.05, 0.15	0.3

CI = Confidence Interval; GNI = Gross National Income; EPI = Environmental Performance Index.

“.” 0.1; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

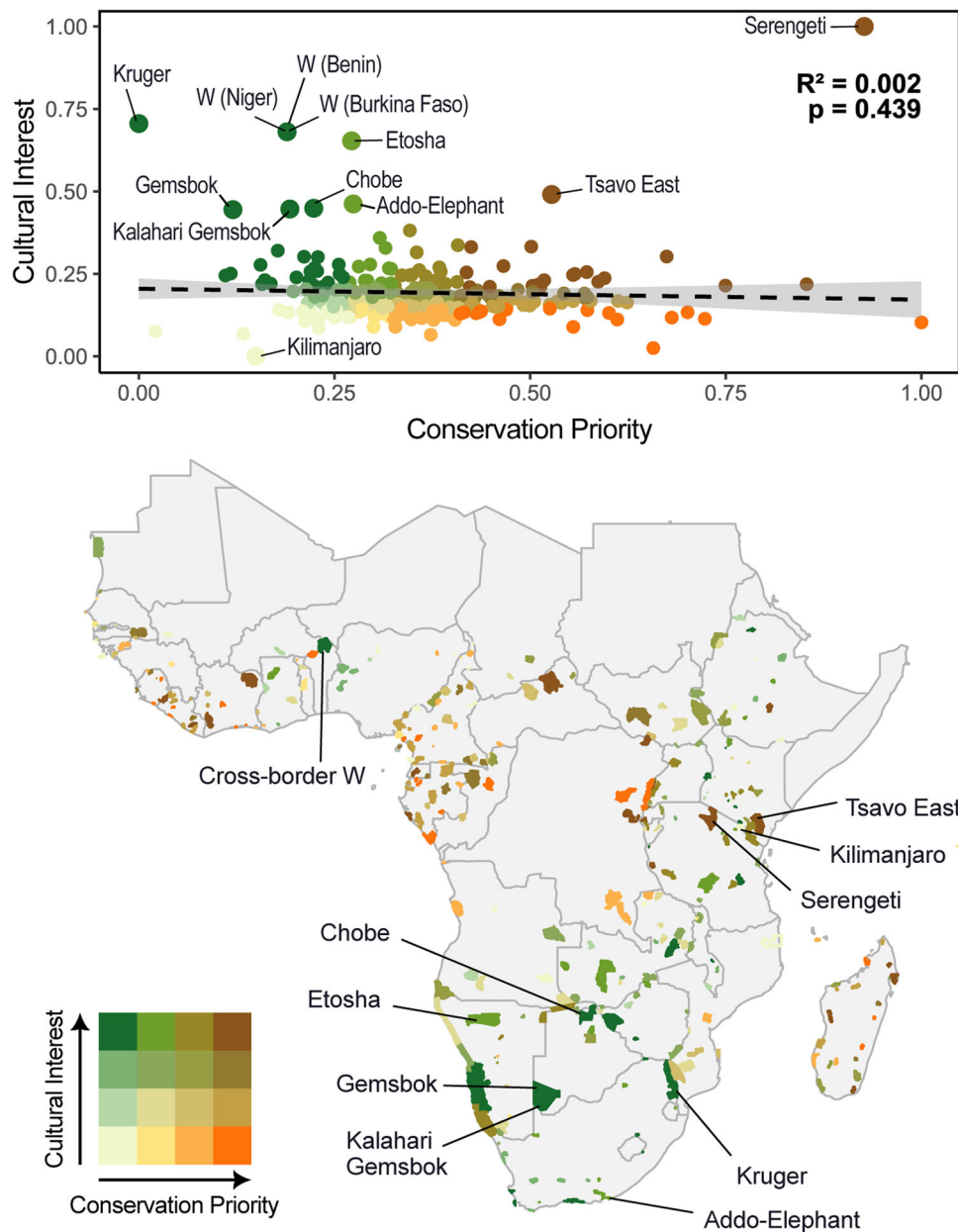


Fig. 2. Alignment between Cultural Interest and Conservation Priority of the National Parks (NPs) from sub-Saharan Africa. Highlighted are the NP that are outliers in the regression. Above = linear regression between the two factors Cultural Interest and Conservation Priority, showing the outliers National Parks (NPs); Below = bivariate map representing the alignment of Cultural Interest and Conservation Priority of the National Parks (NPs).

Interest, reflecting how nature-based tourism in wealthier countries could sustain international visibility and reinforces cultural recognition. Flagship parks such as Kruger, Serengeti, Etosha, the transfrontier Benin-Burkina-Niger W, Addo-Elephant, and Kalahari generate substantial economic returns from tourism, where each visitor produces significant welfare gains (Gupta et al., 2023; Saayman et al., 2012).

While deserts and savannas from Austral-Eastern regions concentrate the highest Cultural Interest values, Conservation Priority relies among specific savannas and tropical forests in Central-Western Africa, and appears to be shaped by sociopolitical instability. These patterns are consistent with recent projections showing that future mammal extinction hotspots are strongly concentrated in African tropical forests, while savannas and steppes have also been repeatedly identified as priority regions for conservation (Divieso et al., 2024). Our GLM results show a consistent negative association between Conservation Priority and both the Gini Index and population density. This is concerning, as a recent

assessment of protected area performance in sub-Saharan Africa highlighted a pattern of failure and deterioration, defined as when an area maintains healthy lion populations (above 50% capacity) but with insufficient management capacity to mitigate current threats, from the Central-Western region (Robson et al., 2022). High inequality further undermines conservation, as poor communities are compelled to meet immediate needs over ecological goals (Holland et al., 2009). Thus, is particularly alarming that Madagascar, which has one of the highest poverty rates in the world, hosts parks such as Mantadia, Ranomafana, Montagne d’Ambre, Masoala, and Marojejy, which rank among the highest Conservation Priority values. These parks protect rare and threatened endemic species, such as lemurs, fossas, and small carnivores (Garbutt and Austin, 2023), and could have the conservation efforts compromised. Parks in the Democratic Republic of the Congo, Ivory Coast, and Liberia, are also among the highest conservation priority parks; countries with a strong history of human-wildlife conflict and

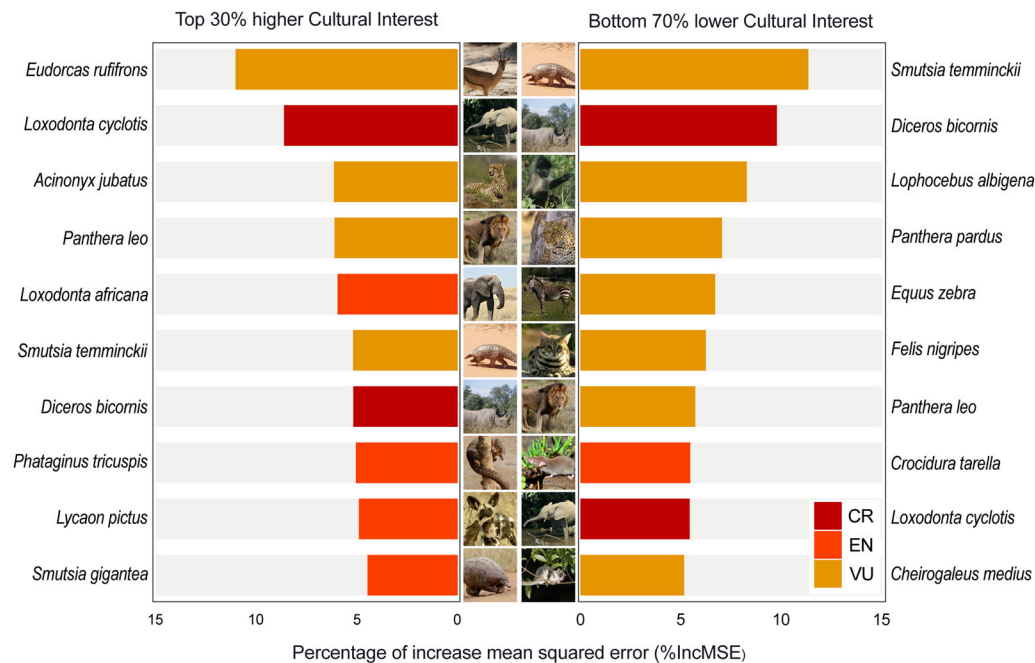


Fig. 3. Influence of the top 10 mammal species on the Cultural Interest of National Parks, based on % Increase in Mean Squared Error (MSE) from the Random Forest analysis. Data is divided into the NPs with 30% higher (left) and 70% lower (right) score of Cultural Interest. Bars are coloured according to the IUCN Red List threat categories: VU = Vulnerable, EN = Endangered, and CR = Critically Endangered. Note: *Crocidura tarella* are represented by a *Crocidura russula* photograph.

political instability (Rist et al., 2024). Without institutional capacity, adequate funding, skilled personnel, and public support, even the best conservation plans are likely to fail (Himes et al., 2024).

Political regime emerged as a strong predictor of Conservation Priority, with higher scores in countries with an electoral autocratic regime. Nine of the ten top-priority NPs are placed in countries with this kind of regime, mostly from Democratic Republic of Congo, Tanzania, Côte d'Ivoire and Madagascar. While this may reflect centralized environmental mandates or external funding support, it also raises important questions about how governance models interact with conservation priorities. In Africa, these challenges may be linked to limited capacity and vision to reconcile conservation with its socio-economic aspirations (Sandambi, 2025). Striving to regain sovereignty over natural resources to prioritize immediate economic benefits over long-term conservation, may lead to unsustainable exploitation and increased threats to species (Andersson, 2018). Many Central-West Africa NPs remain underfunded, poorly managed, and vulnerable to civil conflict, undermining their ability to safeguard threatened species (Robson et al., 2022). Moreover, biodiversity data availability itself correlates with electoral democracies, with armed conflict undermining monitoring (Zizka et al., 2020). Other important parks from electoral autocracies —Lobéké in Cameroon, Nouabalé-Ndoki and Odzala-Kokoua from Congo, Pendjari in Benin, Ivindo in Gabon, Mgahinga in Uganda, and Volcano in Rwanda— are UNESCO World Heritage Sites, an influential mechanism for international protection and recognition (Houhounha and Moukala, 2023). Despite their high Conservation Priority, these parks show low Cultural Interest, suggesting they could benefit from tailored management strategies that enhance their visibility and draw greater attention to the threatened species they harbor.

Species-level patterns provide practical insights for strengthening conservation strategies for communication and funding. The random forest analysis highlights species most relevant in the Cultural Interest-Conservation Priority space. Members of the “Big Five” were identified, except the African buffalo (*Syncerus caffer*), but other species like pangolins (*Smutsia spp.*) and the black-footed cat (*Felis nigripes*) also emerged as relevant, despite limited ranges or association with wildlife trafficking (Simo et al., 2023). These results underscore the large contrasts

between regions: in Southern and Eastern Africa charismatic megafauna species dominate among the most popular parks, reflecting the consolidation of savanna tourism; while Central-West Africa harbors threatened species with more restricted or even endemic distributions (as some primates and small carnivores) under weak institutional capacity and low visibility (Bauer et al., 2021).

Africa's biodiversity, allows for many additional species to be considered as iconic wildlife symbols (see Table 4 in Supplementary Material S2). Public attention is dynamic and responsive to media narratives, as species like leopards and black rhinos occur in both popular (e.g., Kruger and Serengeti) and lesser-known ones (e.g., Kilimanjaro and Amboseli). Parks positioned at the intersection of threatened species richness but low Cultural Interest could therefore benefit from targeted storytelling, sponsorship models, or even novel financing mechanisms such as tokenization to reinforce conservation agendas (Buckley and Mossaz, 2018; Chalkias et al., 2024). Given the substantial funding gaps affecting African PAs (Mukanjari et al., 2021), particularly post-COVID-19 (Gupta et al., 2023), digital engagement may represent a cost-effective and scalable strategy to reinforce conservation agendas and secure new streams of support.

Concluding remarks

Digital tools and practices are transforming society's relationship with the natural world. Traditionally, collecting large-scale data on these interactions has been a costly and labor-intensive process. However, the growing interest in the intersection between the digital and the natural, driven by the widespread presence of digitalization in everyday life, has enabled new forms of analysis.

Our results highlight how intrinsic characteristics, language, inequality, and governance influence both conservation priorities and cultural visibility. The Austral African region stands out for high cultural appeal despite low conservation priority, while Central-Western Africa shows the reverse, likely reflecting differences in conservation history, access, and colonial legacy. Digital exclusion, visible in the absence of multilingual Wikipedia pages or limited editorial activity, reinforces disparities that shaped both the origins and current representation of

protected areas.

Addressing these imbalances requires strategies beyond conservation models. We propose a conceptual framework with four operational scenarios, each carrying distinct implications: parks that combine ecological significance and public visibility, where investments in education, engagement, and resource mobilization are most effective; areas with symbolic appeal but lower ecological priority, suited for restoration and reintroduction; sites of high conservation value but low visibility, which require targeted infrastructure and communication; and places lacking both, where institutional vulnerability demands urgent intervention.

Finally, lesser-known, narrowly distributed, and rare species hold untapped potential to galvanize new support. These insights emphasize the need for integrative strategies that connect ecological relevance with cultural resonance, ensuring conservation remains inclusive and adaptive within evolving socio-digital landscapes.

CRedit authorship contribution statement

KA conceived the ideas together with RL, and JH. KA designed the methodology together with FA-M and JH; KA collected and analysed the data; KA led the writing of the manuscript; RL, JH, FA-M, ACMM, PG and MM reviewed and improved the manuscript. All authors contributed critically to the drafts and gave final approval for publication.

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Declaration of competing interest

The authors declare no competing interests.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:<https://doi.org/10.1016/j.pecon.2025.11.004>.

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