

Importance of private and communal lands to sustainable conservation of Africa's rhinoceroses

Hayley S Clements^{1,2*}, Dave Balfour³, and Enrico Di Minin^{1,4,5}

A new path for rhinoceros (rhino) conservation is needed. Recent data signal the alarming impact of poaching on populations in Africa's rhino stronghold, the state-run Kruger National Park (South Africa), which today supports one quarter the rhinos than a decade ago. We aggregated African rhino population data, highlighting the growing role of private and community rhino custodians, who likely now conserve >50% of Africa's rhinos. Their contribution has been enabled by a supportive policy and economic environment, but this arrangement is becoming more difficult to sustain as costs associated with protecting rhinos skyrocket and revenue-generating options become insufficient. Some privately held rhino populations are small or intensively managed, raising questions about their conservation value. As the role of private and community custodianship becomes increasingly central to the protection of Africa's remaining rhinos, its resilience must be strengthened through implementation of adaptive policies that incentivize rhino conservation. We outline policy pathways to provide an enabling environment for rhino conservation beyond state parks.

Front Ecol Environ 2023; 21(3): 140–147, doi:10.1002/fee.2593

Despite substantial investments in their protection, the world's rhinoceros (rhino) species remain on the brink of extinction due to poaching to supply Asian markets with their horn (Emslie *et al.* 2018). Asian rhino species survive only in small numbers, with just 30 Sumatran (*Dicerorhinus sumatrensis*), 18 Javan (*Rhinoceros sondaicus*), and 2200 greater one-horned (*Rhinoceros unicornis*) rhinos left in the wild (IUCN 2020). In contrast, in Africa the white rhino (*Ceratotherium simum*) population grew from less than 100 individuals in the early 20th century to more than 20,000 in 2012, thanks to effective conservation measures in

South Africa and subsequently other range states (Emslie and Brooks 1999). While the black rhino (*Diceros bicornis*) population in Africa declined from an estimated 100,000 individuals in 1950 to 2500 in the early 1990s, numbers have since doubled as a result of conservation measures (Emslie and Brooks 1999; Emslie *et al.* 2018).

South Africa stewards the largest number of rhinos in Africa, supporting 81% of the white rhinos and 33% of the black rhinos remaining on the continent (Figure 1). Until the past decade, by far the largest populations of South Africa's rhinos were found in the state-run Kruger National Park. The park has, however, become a poaching hotspot, with figures released in 2021 signaling 76% and 68% declines in the white rhino and black rhino populations over the past decade, respectively (SANParks 2021). A further 14.7% decline in white rhino numbers was estimated during 2021 (SANParks 2022). These declines are alarming yet not surprising, given predictions that white rhinos may soon be extirpated from the park (Di Minin *et al.* 2015; Nhleko *et al.* 2022).

Data on rhino populations and their management are not routinely released by many range states and sites. To contextualize rhino declines in Kruger National Park, we sought publicly available rhino population data for African countries, disaggregated by state, private, and communal land types where possible. We consider the implications of an emerging shift in rhino conservation from state to private and communal lands, and conclude by charting a new path for rhino conservation.

In a nutshell:

- Poaching is causing rhinoceros (rhino) numbers in key state-run South African parks to decline at alarming rates
- At least half of the remaining African rhinos are now maintained on private or communal landholdings, a proportion that continues to grow; however, the cost of protecting rhinos is increasing
- Policy needs to ensure an enabling environment for rhinos on private and communal lands, with incentives that are greater than the costs of rhino conservation
- This requires responsive policy and context-specific decision making around rhino trade, hunting, and management

■ The growing role of private and community rhino custodians

Available data suggest that the total number of white rhinos on the continent is declining (Figure 1). In South Africa,

¹Helsinki Lab of Interdisciplinary Conservation Science, Department of Geosciences and Geography, University of Helsinki, Helsinki, Finland (*clementshayley@gmail.com); ²Centre for Sustainability Transitions, Stellenbosch University, Stellenbosch, South Africa; ³Centre for African Conservation Ecology, Zoology Department, Nelson Mandela University, Port Elizabeth, South Africa; ⁴Helsinki Institute of Sustainability Science, University of Helsinki, Helsinki, Finland; ⁵School of Life Sciences, University of KwaZulu-Natal, Durban, South Africa

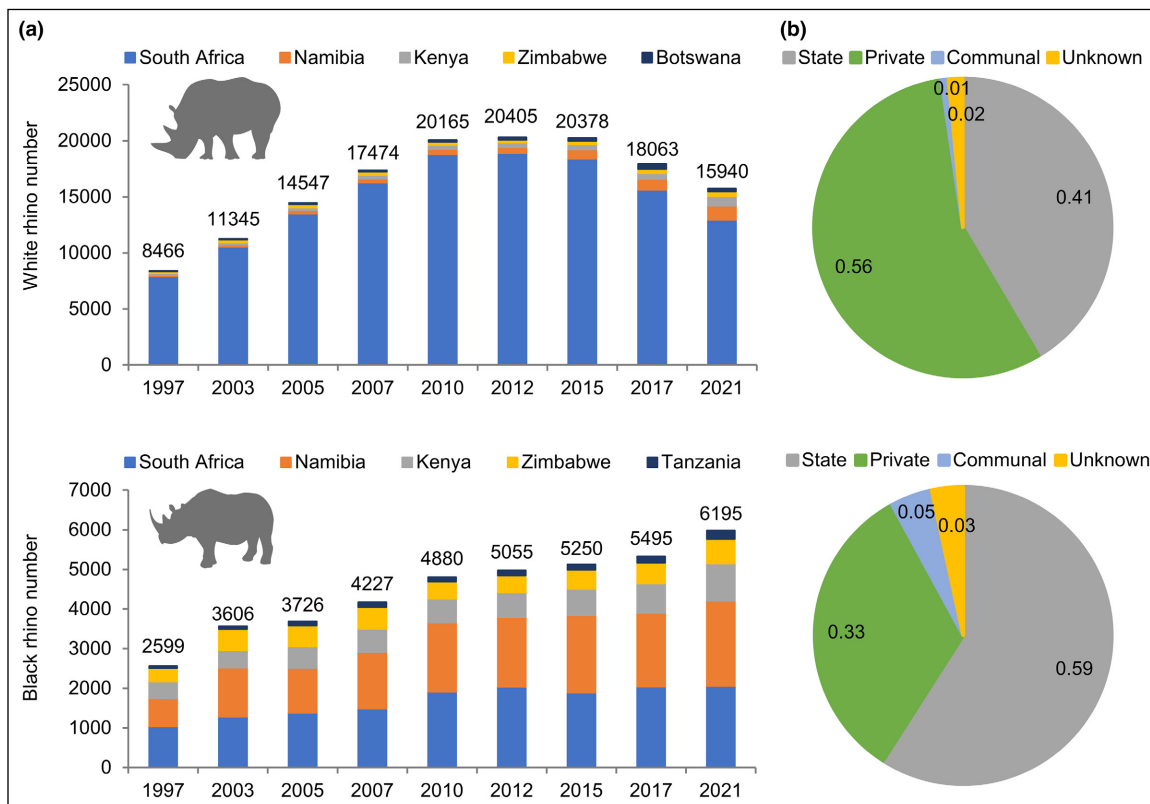


Figure 1. Within the countries that conserve 99% and 97% of white rhino (*Ceratotherium simum*) (top) and black rhino (*Diceros bicornis*) (bottom) populations, respectively, (a) number of white rhinos and black rhinos from 1997 to 2021 and (b) proportion of white rhinos and black rhinos across different land tenure types in 2021. Data sources are provided in WebPanel 1.

declines over the past decade are largely due to decreasing rhino abundance in several state parks (Figure 2) (Ferreira and Dziba 2021). The majority (>66%) of rhinos on state land in South Africa are conserved by two organizations: South African National Parks (SANParks), a national authority that manages Kruger National Park and six other national parks containing rhinos, and Ezemvelo KwaZulu-Natal Wildlife, a provincial authority that manages nine provincial parks containing rhinos. Ezemvelo has reported declining rhino numbers in its parks over the past decade due to poaching (Figure 2).

Over the same decade, the estimated number of white rhinos on private land in South Africa has steadily increased (Figure 2). As a result of these divergent rhino population trends on state and private lands, the proportion of the country's white rhinos on private land increased from 25% in 2010 to 53% in 2021 (Figure 2). This means that, collectively, private landholders in South Africa now support the largest number of white rhinos on the continent. A lower but still substantial proportion (~25% over the past decade) of South Africa's black rhinos are conserved on privately held lands (Figure 2). At present, there are fewer rhinos on communal land in South Africa (an estimated 1% and 6% of white rhino and black rhino populations, respectively) (Ferreira *et al.* 2022).

The relative contribution of private land to national rhino numbers is similarly important in the other core African rhino

range states (Figure 1). As of 2018, 88% and 76% of Zimbabwe's black rhino and white rhino populations, respectively, were conserved on private lands (Emslie *et al.* 2018), as were 27% and 75% of Namibia's black rhino and white rhino populations, respectively (CITES 2019; Kötting 2020); incidentally, 7% of Namibia's black rhino population lives in community conservancies (Kötting 2020). Likewise, as of 2016, 45% and 72% of Kenya's black rhino and white rhino populations were conserved by private landholders (KWCA 2016).

It is important to note that rhino ownership and land ownership are not necessarily equivalent, due to complex and diverse property rights. For example, in some countries rhinos can be privately owned (eg in South Africa), whereas in other countries rhinos are owned by the state or by no one ("res nullius") but private and communal landholders can serve as their custodians and derive financial benefits from associated ecotourism, regulated rhino hunting, and/or trade (eg black rhinos in Namibia). Furthermore, some communities of people reside on state lands. Thus, private and communal landholders can be rhino custodians but not necessarily rhino (or land) owners.

In aggregate across the African continent, the proportion of white rhinos and black rhinos on private land in 2021 was over one-half and one-third, respectively (Figure 1). In addition, 5% of black rhinos were held on communal land, largely in Namibia and South Africa. In light of the ongoing rhino declines in Kruger National Park, contributions of private and

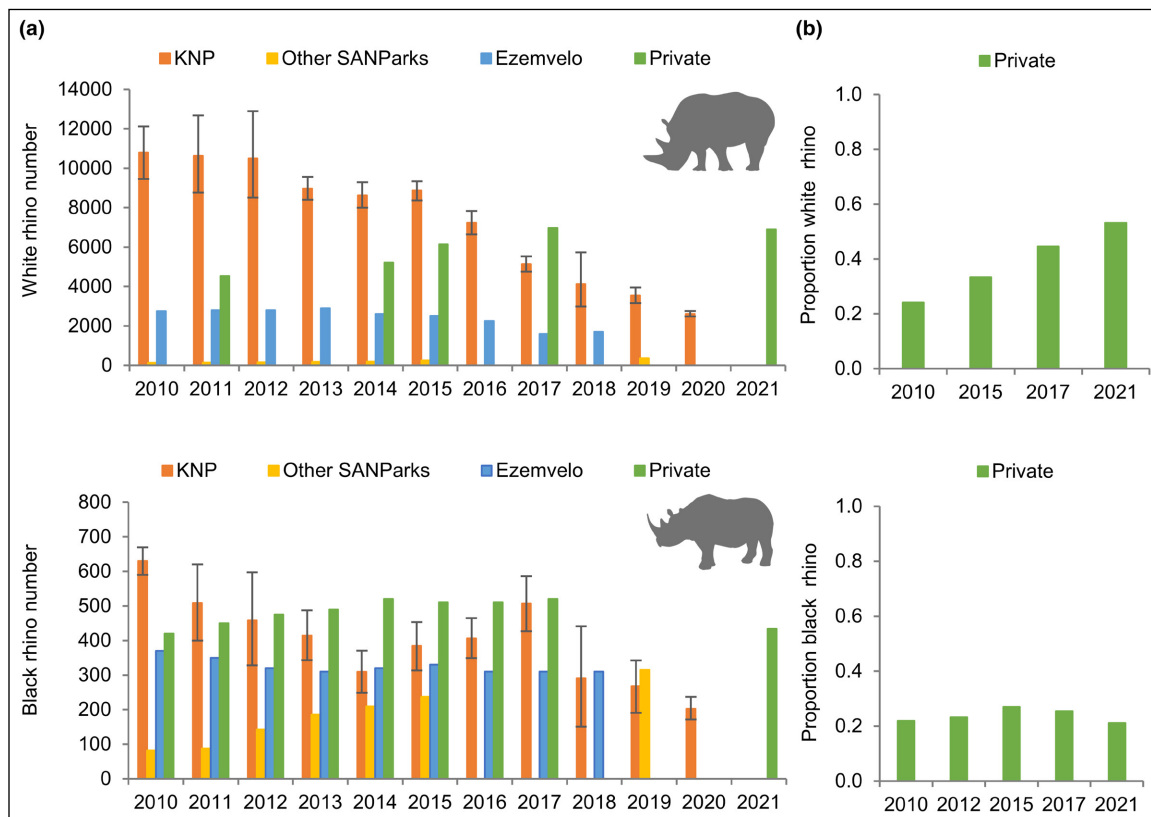


Figure 2. (a) Number of white rhinos (top) and black rhinos (bottom) in South Africa over time in Kruger National Park (KNP), other South African National Parks (SANParks), Ezemvelo KwaZulu Natal Wildlife Provincial Parks (Ezemvelo), and on private land (Private). Error bars (95% confidence intervals) are included for KNP values. (b) Proportion of white rhinos (top) and black rhinos (bottom) in South Africa over time on private lands. Data sources are provided in WebPanel 1.

communal landholders to rhino custodianship are likely to be growing.

■ Incentives for private and community rhino custodianship

Over the past century, private and communal wildlife ranches and conservancies have emerged as a competitive land use in several southern and eastern African countries (Child *et al.* 2012; Snyman *et al.* 2021). Revenues (and therefore livelihoods) in these areas are generated through wildlife-based tourism and/or consumptive wildlife uses, including hunting for meat or trophies, wildlife sales, and meat sales (Snyman *et al.* 2021). Such land uses are dependent on policies that enable landholders to generate wildlife-based revenues that are competitive in relation to alternative land-use options such as agriculture (Child *et al.* 2012). The nature of these policies varies between countries. In South Africa, for instance, private landowners can acquire full ownership rights to the wildlife on their properties, whereas in Kenya rights are more limited, particularly for consumptive wildlife uses, with revenues arising largely from wildlife-based tourism (Brehony *et al.* 2020).

In addition to giving rise to private wildlife ranches, wildlife-use policies enabled the emergence of community-based

natural resource management, most notably in Namibia and Zimbabwe, with wildlife hunting and tourism revenues flowing (at least partially) to communities (Child *et al.* 2012; Bollig 2016). Community-based conservation is less well developed in South Africa, where land ownership became concentrated in the hands of a white minority during the Apartheid regime (Hall 2004). Since the adoption of democracy in 1994, South Africa has endeavored to rectify these inequities through a land reform program (Hall 2004). The National Biodiversity Economy Strategy places emphasis on transforming the wildlife economy to be more inclusive of individuals and communities that were previously disadvantaged under Apartheid (DEA 2015).

Wildlife can be a profitable form of land use in semi-arid African savannas, creating more jobs and economic growth than livestock (Jansen *et al.* 1992; Child *et al.* 2012; Taylor *et al.* 2020). Wildlife ranches and conservancies have also been shown to contribute substantially to habitat and wildlife conservation (Kiffner *et al.* 2020; Shumba *et al.* 2020; Taylor *et al.* 2021). Private wildlife ranches in South Africa cover at least 17% of the country's total land area, an extent twice that of state parks (Taylor *et al.* 2020). Communal and private conservancies in Kenya cover 11% of the country's land area and support 65% of the wildlife (Snyman *et al.* 2021).

Wildlife-based land uses are not a panacea for sustainable development, however, particularly in areas with high densities of people or low densities of wildlife, or in remote and inaccessible regions (Child *et al.* 2012; Winterbach *et al.* 2015). Some private wildlife ranches also intensively manage some of their species, particularly species with high live-sale prices due to trophy hunting demand (eg African buffalo [*Syncerus caffer*], sable antelope [*Hippotragus niger*]) (Cousins *et al.* 2008). Intensive management entails intervening in social dynamics (eg control over breeding) and resource provision (eg supplementary food, water, and shade), with managed species typically kept in confined fenced camps: the higher the management intensity, the less “wild” the population (Child *et al.* 2019; Taylor *et al.* 2021). In reality, because ranches are positioned along a continuum of management intensity (Rubino and Pienaar 2018; Child *et al.* 2019), the potential trade-off between managing a wildlife ranch for conservation versus financial viability is more pronounced on some ranches than others (Clements and Cumming 2017).

This potential trade-off on private land becomes especially pertinent when considered in light of limited state budgets for conservation. Funding shortfalls impede the expansion of state-run parks and can result in existing parks being poorly managed and ineffective (Craigie *et al.* 2010; Lindsey *et al.* 2021; Scholte *et al.* 2022). Many African state parks attempt to increase funds through wildlife-based tourism and consumptive wildlife uses (Snyman *et al.* 2021). In South Africa, most national parks and many provincial parks charge visitor entrance and accommodation fees, for example, although hunting is not permitted. However, given that conservation (not financial viability) is the primary mandate of state parks, coupled with pressure to provide jobs and affordable public access, park revenues often fail to cover operating costs (Lindsey *et al.* 2021). Government funding is used to cover deficits, but this support is shrinking and is commonly inadequate for all identified needs (Lindsey *et al.* 2021). Because of the limited resources available to state parks, maintaining populations of at-risk species on private and communal lands has become a key aspect of conservation (and development) in several countries (DEA 2008; Stolton *et al.* 2014; Snyman *et al.* 2021).

It is within this context that rhino custodianship on private and communal lands has emerged. Private landowners in South Africa have been included in rhino conservation since the 1960s (Linklater and Shrader 2017). The opportunity to purchase white rhinos from their last remaining population in the Ezemvelo-managed Hluhluwe-iMfolozi Park (and more recently from other national parks), as well as to offer limited trophy hunting at high prices, provided financial incentives to private wildlife ranchers to conserve and trade rhinos (Adcock and Emslie 1994; ‘t Sas-Rolfes *et al.* 2022). Private and communal landholders have increasingly become black rhino custodians since the early 2000s, commonly facilitated through the Black Rhino Range Expansion Project (WWF South Africa 2019). In addition to limited and tightly regulated

trophy hunting, as well as live sales, rhinos can also contribute to a wildlife-based tourism experience; surveys have shown that the most sought-after species by visitors to South African parks are leopards (*Panthera pardus*), lions (*Panthera leo*), rhinos, and cheetahs (*Acinonyx jubatus*) (Lindsey *et al.* 2007; Di Minin *et al.* 2013). In South Africa, one-quarter of private owners of white rhinos offer rhino trophy hunting, 45% trade in live rhinos, and 62% undertake wildlife-based tourism (Clements *et al.* 2020).

Rhino hunting occurs to a more limited extent in Namibia and to a very limited extent in Zimbabwe (Di Minin *et al.* 2016; ‘t Sas-Rolfes *et al.* 2022). Namibia’s Rhino Custodianship Programme provides custodial rights to communal conservancies wanting to conserve rhinos for tourism on their land, usually in partnership with tour operators and nongovernmental organizations (Muntiferung *et al.* 2017). The presence of black rhinos on these conservancies is correlated with higher community benefits from wildlife-based tourism (Naidoo *et al.* 2011).

■ The cost of rhino protection

Reestablishing rhinos on private and communal lands outside poaching hotspots over the past half-century appears to have effectively spread poaching risk across many, typically smaller properties. In South Africa over the past half decade, poaching losses have been lower on private land (0.5% of private white rhinos poached in 2019) than in Kruger National Park (6.1%) and provincial parks (3.1%) (Ferreira and Dziba 2021). We could find only one published figure for what SANParks spends toward fulfilling their stated objective of “Sustainable rhino populations monitored and increased”: ZAR 25.6 million (US\$1.7 million) or ZAR 8600 per rhino (US\$520 per rhino) in 2020 (SANParks 2021), where ZAR is the South African rand. Even if this is an extremely conservative figure, it is markedly less than the average spent by private properties on rhino security: ZAR 28,600 per rhino (US\$2200 per rhino) in 2017 (Clements *et al.* 2020).

This difference in average resourcing per rhino between Kruger National Park and private land highlights the funding challenges encountered by state parks (Lindsey *et al.* 2021) and may help explain the lower poaching rates on private land. It is also possible that the large size of Kruger National Park (20,000 km²) and its rhino population (2607 white rhinos) makes rhino security more challenging than in much smaller areas (averaging ~100 km² and 34 white rhinos) (Clements *et al.* 2020; Ferreira and Dziba 2021).

While the white rhino populations maintained on private land in South Africa have experienced lower poaching rates than populations on state land, whether this trend continues and what its outcome will be for the conservation of the species is uncertain. It is unknown whether a continued decline of rhinos in Kruger National Park will displace poaching to these other properties. In addition, the annual costs of rhino security are increasing: >ZAR 1.5 million (US\$116,000) per

property on average in 2017 (Clements *et al.* 2020) versus ZAR 2.2 million (US\$152,000) per property in 2021 (P Jones pers comm). At the same time, there has been a 75% drop in the price of live white rhinos sold at auction over the past decade, indicating that investing in rhinos has become less attractive (Clements *et al.* 2020). This sharing of rhino conservation, and its growing cost, with private and communal landholders raise important practical, ethical, and policy questions.

■ Implications of putting rhino conservation in private and community hands

Rhino conservation on private and communal land is often less an objective than an emergent outcome of an enabling environment (eg policies that allow wildlife use, an associated economy including wildlife-based tourism, trophy hunting demand, and so on). But this environment is becoming less viable for landholders with business objectives and more challenging for most rhino custodians regardless of motivation, due to the rising costs of protecting rhinos from poaching. Private and communal landholders with rhinos receive no direct government funding to support anti-poaching activities, although such costs may in some cases be tax deductible. Landowners pay related expenses directly; indirectly from revenues generated on their properties from trophy hunting, wildlife-based tourism, and live rhino sales; or in some instances via donor funds. On the other hand, these landholders are not burdened by the constitutional mandate imposed on state parks to protect national natural heritage regardless of available resources (Ferreira and Dziba 2021).

Unencumbered by such a mandate, some South African landholders are disinvesting from white rhinos, no longer able or willing to justify the growing security costs, which do not translate into higher wildlife-based tourism or hunting revenues (Emslie *et al.* 2018; Clements *et al.* 2020). The COVID-19 pandemic also greatly reduced tourist and hunter visits (van der Merwe *et al.* 2021). Rhino disinvestment is not yet a majority trend, with most rhino owners maintaining stable populations and a small portion (15%) actually investing in more rhinos (Clements *et al.* 2020). Consequently, rhino numbers are still increasing on private land although through consolidation of rhinos onto fewer properties. Some private landholders may also be maintaining or increasing their rhino populations in the hope that international trade in rhino horn is eventually legalized, enabling them to generate additional revenue through the harvest and sale of renewable rhino horn (Clements *et al.* 2020). If an effective means of sustainably financing rhino conservation does not materialize, further disinvestment in rhinos by private landholders seems likely. It is also unclear how communities will be able to cover such high rhino protection costs in the absence of increased donor or partner funding or other revenue streams, therefore limiting the potential to create and sustain more inclusive conservation systems.

In addition to concerns about the financial sustainability of private and community rhino conservation amidst increasing security costs (by almost 50% in only 3 years), white rhinos on some private properties in South Africa are intensively managed (supplied with supplementary feed and kept at substantially higher-than-natural densities in small camps where sex ratios are managed). These properties conserve rhino numbers but not necessarily naturally breeding populations that maintain evolutionary processes and contribute to ecosystem function (Child *et al.* 2019).

Private white rhino populations range in size from one to over 1000, with a median of 18 rhinos per property in 2018 (Clements *et al.* 2020); thus, the contribution of private ownership to conservation varies considerably. Only 15% of privately maintained white rhino populations were considered “intensively managed” in 2015 (Child *et al.* 2019), but this proportion may increase if intensive management proves to be more effective at protecting rhinos from poaching. The differences in poaching rates between state parks and private land suggest that a trade-off exists between large, extensive areas such as Kruger National Park that promote ecological integrity of rhino populations but are difficult to secure, and smaller, more fragmented (and in some instances intensively managed) sites that facilitate more effective mitigation of poaching but potentially compromise on the “wildness” of rhino populations and their ecological function (Child *et al.* 2019; Taylor *et al.* 2021).

Maintaining small populations of rhinos on private and communal lands is not the only conservation strategy under debate. Moving some white rhinos to other countries, including Australia, has also been proposed; one such multi-million-dollar project has received extensive support from the private sector, zoos, and governments (Hayward *et al.* 2018). Establishing extralimital populations of African rhinos, however, is a very-low-priority action given that 800 white rhinos are already in captivity around the world. Furthermore, the project will divert funds and expertise away from more important in-situ conservation activities (Hayward *et al.* 2018). The reality is that, at present, rhinos on private and communal lands in range states are the only major complement to state parks. It is therefore imperative to consider – in the context of high poaching pressure, a diminished live-rhino trade market, and a wildlife-based tourism industry devastated by the COVID-19 pandemic – how incentives can be structured to achieve rhino conservation objectives as opposed to intensive rhino management or disinvestment. In this process it will also be useful to improve evidence-based consensus concerning at what point intensification of rhino management becomes inappropriate from the perspective of rhino conservation.

■ Charting a new path for rhino conservation

Governance of rhino conservation is currently influenced by policies at international as well as national scales. At

the global scale, the Parties to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) specify which species (and their derivatives) can be traded across national borders and the conditions associated with such trade. Although this seems intuitively beneficial for protecting threatened species, it can also have unintended consequences: for instance, when trade restrictions prevent generation of revenues that could be put toward species conservation (Challender *et al.* 2019). The Convention emphasized the importance of considering local livelihoods in wildlife trade regulations through the adoption of Resolution 16.6 (CITES and livelihoods). This means that the implications of trade restrictions for both species conservation and local livelihoods (as well as feedbacks between the two) must be carefully considered, which requires in-depth understanding of local social–ecological systems (Di Minin *et al.* 2022). However, a recent review of proposals to prohibit species trade under CITES suggests that such an understanding is uncommon (Challender *et al.* 2019).

It has been proposed that a more appropriate first measure for conserving threatened species could be the development of context-appropriate conservation programs in partnership with local people, as opposed to the “blunt instrument” top-down approach of an international trade ban (Abensperg-Traun 2009; Challender *et al.* 2019; Chanyandura *et al.* 2021). Rhino horn trade is currently banned in practice by CITES, although restricted trade may be possible under certain conditions, with important implications for revenues that could be used to sustain rhino conservation on private and communal lands by at least partially offsetting rising security costs (Challender and MacMillan 2014; Chanyandura *et al.* 2021; Di Minin *et al.* 2022). The majority of South African rhino owners support rhino-horn trade (Clements *et al.* 2020; Rubino and Pienaar 2020). There is a need for context-specific research into the implications of retaining versus lifting current CITES conditions, considering the complex linkages between local livelihoods, dynamic wildlife economies, and emergent outcomes for rhino numbers.

Also at the international scale, there is growing pressure to ban trophy hunting, which was an instrumental activity in enabling the recovery of African rhino populations and is currently a key revenue source to fund rhino protection († Sas-Rolfes *et al.* 2022; Di Minin *et al.* 2021). As with trade regulations, consideration of the local contexts in which trophy hunting takes place is essential, as are the likely implications of restrictions on hunting for both local livelihoods and rhino conservation (Parker *et al.* 2020).

At the national scale, concerns about the intensive production of white rhinos on private land in South Africa are resulting in calls for policy revisions, in part due to the perceived impact on the country’s global reputation for conservation (DEFF 2020). Notably, there is considerable diversity in private rhino owner objectives and rhino management strategies (Rubino and Pienaar 2018; Clements *et al.* 2020). Fewer than

half of white rhino owners would consider rhino intensification (Clements *et al.* 2020). Rather than only restricting intensification (risking further disinvestment in rhinos), it is imperative that future policy enables new incentives that encourage rhino conservation in more extensive systems. For example, could landholders that conserve rhinos in extensive systems qualify for a more favorable tax structure? Could they be eligible for carbon credits or rhino bonds, given the role of rhinos in carbon cycling? Could they receive certifications for extensive management that increase the value of their wildlife-based tourism and hunting offerings?

Incentives can also extend to newly developing options. For example, Wildlife Credits is a Namibian initiative that crowdfunds donations to support payments to communal conservancies linked to conservation performance, including rhino sightings and monitoring. One Africa similarly crowdfunds for members of the public to become shareholders supporting conservation business, including rhino conservation (Sullivan *et al.* 2021).

With respect to Africa’s rhino populations, the substantial contribution of private landholders and the growing contribution of communal landholders have thus far been enabled by a supportive economic and policy environment. As their role becomes an increasingly important complement to conservation efforts in state parks, it is crucial that the resilience of this role be maintained or increased by adaptive policy to ensure the incentives of rhino conservation remain greater than the growing costs († Sas-Rolfes *et al.* 2022; Chanyandura *et al.* 2021; Di Minin *et al.* 2022). Moreover, increased transparency by states about rhino numbers and their management is critical for understanding where and how best to conserve them. Availability of up-to-date data on rhino populations, poaching rates, and security costs can aid in identifying and quantifying long-term trends in rhino populations across land tenure types, inform their conservation, and help raise public awareness and support.

■ Acknowledgements

HSC acknowledges funding from Kone Foundation and a Jennifer Ward Oppenheimer Research Grant. EDM acknowledges funding from the European Research Council – EU’s Horizon 2020 Research and Innovation Program (grant agreement 802933).

■ Data Availability Statement

Data are already published and publicly available, with sources properly cited in the text.

■ References

† Sas-Rolfes M, Emslie R, Adcock K, and Knight M. 2022. Legal hunting for conservation of highly threatened species: the case of African rhinos. *Conserv Lett* 15: e12877.

- Abensperg-Traun M. 2009. CITES, sustainable use of wild species and incentive-driven conservation in developing countries, with an emphasis on southern Africa. *Biol Conserv* **142**: 948–63.
- Adcock K and Emslie R. 1994. The role of trophy hunting in white rhino conservation, with special reference to BOP parks. In: Penzhorn BL and Kriek NPJ (Eds). Proceedings of a symposium on rhinos as game ranch animals. Onderstepoort, South Africa: South African Veterinary Association.
- Bollig M. 2016. Towards an arid Eden? Boundary-making, governance and benefit-sharing and the political ecology of the new commons of Kunene region, northern Namibia. *Int J Commons* **10**: 771–99.
- Brehony P, Tyrrell P, Kamanga J, *et al.* 2020. Incorporating social-ecological complexities into conservation policy. *Biol Conserv* **248**: 108697.
- Challender DWS and MacMillan DC. 2014. Poaching is more than an enforcement problem. *Conserv Lett* **7**: 484–94.
- Challender DWS, Hinsley A, and Milner-Gulland EJ. 2019. Inadequacies in establishing CITES trade bans. *Front Ecol Environ* **17**: 199–200.
- Chanyandura A, Muposhi VK, Gandiwa E, and Muboko N. 2021. An analysis of threats, strategies, and opportunities for African rhinoceros conservation. *Ecol Evol* **11**: 5892–910.
- Child BA, Musengezi J, Parent GD, and Child GFT. 2012. The economics and institutional economics of wildlife on private land in Africa. *Pastoral Res Pol Pract* **2**: 18.
- Child MF, Selier SAJ, Radloff FGT, *et al.* 2019. A framework to measure the wildness of managed large vertebrate populations. *Conserv Biol* **33**: 1106–19.
- CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora). 2019. Consideration of proposals for amendment of Appendices I and II, CoP18: transfer of the population of *Ceratotherium simum simum* of Namibia from Appendix I to Appendix II. Geneva, Switzerland: CITES.
- Clements HS and Cumming GS. 2017. Positives and pathologies of natural resource management on private land conservation areas. *Conserv Biol* **31**: 707–17.
- Clements HS, Knight M, Jones P, and Balfour D. 2020. Private rhino conservation: diverse strategies adopted in response to the poaching crisis. *Conserv Lett* **13**: e12741.
- Cousins J, Sadler J, and Evans J. 2008. Exploring the role of private wildlife ranching as a conservation tool in South Africa: stakeholder perspectives. *Ecol Soc* **13**: 43.
- Craigie ID, Baillie JEM, Balmford A, *et al.* 2010. Large mammal population declines in Africa's protected areas. *Biol Conserv* **143**: 2221–28.
- DEA (Department of Environmental Affairs). 2008. National protected area expansion strategy for South Africa. Pretoria, South Africa: DEA.
- DEA (Department of Environmental Affairs). 2015. Biodiversity Economy Strategy (BES) for the Department of Environmental Affairs, South Africa. Pretoria, South Africa: DEA.
- DEFF (Department of Environment, Forestry and Fisheries). 2020. The high-level panel of experts for the review of policies, legislation and practices on matters of elephant, lion, leopard and rhinoceros management, breeding, hunting, trade and handling. Pretoria, South Africa: DEFF.
- Di Minin E, 't Sas-Rolfes M, Selier J, *et al.* 2022. Dismantling the poachernomics of the illegal wildlife trade. *Biol Conserv* **265**: 109418.
- Di Minin E, Clements HS, Correia RA, *et al.* 2021. Consequences of recreational hunting for biodiversity conservation and livelihoods. *One Earth* **4**: 238–53.
- Di Minin E, Fraser I, Slotow R, and MacMillan DC. 2013. Understanding heterogeneous preference of tourists for big game species: implications for conservation and management. *Anim Conserv* **16**: 249–58.
- Di Minin E, Laitila J, Montesino-Pouzols F, *et al.* 2015. Identification of policies for a sustainable legal trade in rhinoceros horn based on population projection and socioeconomic models. *Conserv Biol* **29**: 545–55.
- Di Minin E, Leader-Williams N, and Bradshaw CJA. 2016. Banning trophy hunting will exacerbate biodiversity loss. *Trends Ecol Evol* **31**: 99–102.
- Emslie R and Brooks M. 1999. African rhino: status survey and conservation action plan. IUCN/SSC African Rhino Specialist Group. Gland, Switzerland: International Union for Conservation of Nature.
- Emslie RH, Milliken T, Talukdar B, *et al.* 2018. African and Asian rhinoceroses – status, conservation and trade. A report from the IUCN Species Survival Commission African and Asian Rhino Specialist Groups and TRAFFIC to the CITES Secretariat pursuant to Resolution Conf 9.14 (Rev CoP17). Gland, Switzerland: International Union for Conservation of Nature.
- Ferreira S and Dziba L. 2021. Where are rhinos safest? *S Afr J Sci* **117**: 9–11.
- Ferreira S, Ellis S, Burgess G, *et al.* 2022. African and Asian rhinoceroses – status, conservation and trade. A report from the IUCN Species Survival Commission African and Asian Rhino Specialist Groups and TRAFFIC to the CITES Secretariat pursuant to Resolution Conf 9.14 (Rev CoP17). Gland, Switzerland: International Union for Conservation of Nature.
- Hall R. 2004. A political economy of land reform in South Africa. *Rev Afr Polit Econ* **31**: 213–27.
- Hayward MW, Ripple WJ, Kerley GIH, *et al.* 2018. Neocolonial conservation: is moving rhinos to Australia conservation or intellectual property loss. *Conserv Lett* **11**: e12354.
- IUCN (International Union for Conservation of Nature). 2020. The IUCN Red List of Threatened Species (v2020-1). Gland, Switzerland: IUCN.
- Jansen D, Child B, and Bond I. 1992. Cattle, wildlife, both or neither: results of a financial and economic survey of commercial ranches in southern Zimbabwe. Harare, Zimbabwe: WWF.
- Kiffner C, Thomas S, Speaker T, *et al.* 2020. Community-based wildlife management area supports similar mammal species richness and densities compared to a national park. *Ecol Evol* **10**: 480–92.
- Kötting B. 2020. Namibia's black rhino custodianship program. *Conservation Frontlines*. <https://www.conservationfrontlines.org/2020/04/namibias-black-rhino-custodianship-program>. Viewed 2 Dec 2022.
- KWCA (Kenyan Wildlife Conservancies Association). 2016. State of wildlife conservancies in Kenya report 2016. Nairobi, Kenya: KWCA.

- Lindsey P, Baghai M, Bigurube G, *et al.* 2021. Attracting investment for Africa's protected areas by creating enabling environments for collaborative management partnerships. *Biol Conserv* **255**: 108979.
- Lindsey PA, Alexander R, Mills MGL, *et al.* 2007. Wildlife viewing preferences of visitors to protected areas in South Africa: implications for the role of ecotourism in conservation. *J Ecotourism* **6**: 19–33.
- Linklater WL and Shrader AM. 2017. Rhino management challenges: spatial and social ecology for habitat and population management. In: Cromsigt JPGM, Archibald S, and Owen-Smith N (Eds). *Conserving Africa's mega-diversity in the Anthropocene: the Hluhluwe-iMfolozi Park story*. Cambridge, UK: Cambridge University Press.
- Muntifering JR, Linklater WL, Clark SG, *et al.* 2017. Harnessing values to save the rhinoceros: insights from Namibia. *Oryx* **51**: 98–105.
- Naidoo R, Stuart-Hill G, Weaver LC, *et al.* 2011. Effect of diversity of large wildlife species on financial benefits to local communities in northwest Namibia. *Environ Resour Econ* **48**: 321–35.
- Nhleko ZN, Ahrens R, Ferreira SM, and McCleery RA. 2022. Poaching is directly and indirectly driving the decline of South Africa's large population of white rhinos. *Anim Conserv* **25**: 151–63.
- Parker K, De Vos A, Clements HS, *et al.* 2020. Impacts of a trophy hunting ban on private land conservation in South African biodiversity hotspots. *Conserv Sci Pract* **2**: e214.
- Rubino EC and Pienaar EF. 2018. Understanding South African private landowner decisions to manage rhinoceroses. *Human Dimens Wildlife* **23**: 160–75.
- Rubino EC and Pienaar EF. 2020. Rhinoceros ownership and attitudes towards legalization of global horn trade within South Africa's private wildlife sector. *Oryx* **54**: 244–51.
- SANParks (South African National Parks). 2021. Annual report 2020–2021. Pretoria, South Africa: SANParks.
- SANParks (South African National Parks). 2022. Annual report 2021–2022. Pretoria, South Africa: SANParks.
- Scholte P, Pays O, Adam S, *et al.* 2022. Conservation overstretch and long-term decline of wildlife and tourism in the Central African savannas. *Conserv Biol* **36**: e13860.
- Shumba T, De Vos A, Biggs R, *et al.* 2020. Effectiveness of private land conservation areas in maintaining natural land cover and biodiversity intactness. *Glob Ecol Conserv* **22**: e00935.
- Snyman S, Sumba D, Vorhies F, *et al.* 2021. State of the wildlife economy in Africa. Kigali, Rwanda: African Leadership University.
- Stolton S, Redford KH, and Dudley N. 2014. The futures of privately protected areas. Gland, Switzerland: International Union for Conservation of Nature.
- Sullivan S, Urihkhob S, Kötting B, *et al.* 2021. Historicising black rhino in Namibia: colonial-era hunting, conservation custodianship, and plural values. Bath, UK: Bath Spa University.
- Taylor WA, Child MF, Lindsey PA, *et al.* 2021. South Africa's private wildlife ranches protect globally significant populations of wild ungulates. *Biodivers Conserv* **30**: 4111–35.
- Taylor WA, Lindsey PA, Nicholson SK, *et al.* 2020. Jobs, game meat and profits: the benefits of wildlife ranching on marginal lands in South Africa. *Biol Conserv* **245**: 108561.
- van der Merwe P, Saayman A, and Jacobs C. 2021. Assessing the economic impact of COVID-19 on the private wildlife industry of South Africa. *Glob Ecol Conserv* **28**: e01633.
- Winterbach CW, Whitesell C, and Somers MJ. 2015. Wildlife abundance and diversity as indicators of tourism potential in northern Botswana. *PLoS ONE* **10**: e0135595.
- WWF (Worldwide Fund for Nature) South Africa. 2019. Black rhino project translocates 200th rhino. <https://www.wwf.org.za/?28941/Black-rhino-project-translocates-200th-rhino>. Viewed 2 Dec 2022.

This is an open access article under the terms of the [Creative Commons Attribution](#) License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

Supporting Information

Additional, web-only material may be found in the online version of this article at <http://onlinelibrary.wiley.com/doi/10.1002/fee.2593/supinfo>