

CONTRIBUTED PAPER

Impacts of a trophy hunting ban on private land conservation in South African biodiversity hotspots

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Abstract

Private land conservation areas (PLCAs) have become critical for achieving global conservation goals, but we lack understanding of how and when these areas respond to global pressures and opportunities. In southern Africa, where many PLCAs rely on trophy hunting as an income-generating strategy, a potential ban on trophy hunting locally or abroad holds unknown consequences for the future conservation of these lands. In this study, we investigate the consequences of a potential trophy hunting ban in PLCAs in two biodiversity hotspots in South Africa's Eastern and Western Cape provinces. We used semistructured interviews with PLCA managers and owners to elicit perceived impacts of an internationally imposed trophy hunting ban on conservation activities in PLCAs, and to probe alternative viable land uses. The majority of interviewees believed that both the economic viability of their PLCA and biodiversity would be lost following a hunting ban. Owners would primarily consider transitioning to ecotourism or livestock farming, but these options were constrained by the social-ecological context of their PLCA (e.g., competition with other PLCAs, ecological viability of farming). Our results suggest that a trophy hunting ban may have many unintended consequences for biodiversity conservation, national economies, and the livelihoods of PLCA owners and employees. Along with similar social-ecological studies in other areas and contexts, our work can inform policy decisions around global trophy hunting regulation.

KEYWORDS

biodiversity conservation, land use change, other effective area-based conservation measures, protected areas, resilience, social-ecological systems

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1 | INTRODUCTION

Protected areas (PAs) are considered a core strategy for protecting biodiversity (Chape, Harrison, Spalding, & Lysenko, 2005; Watson, Dudley, Segan, & Hockings, 2014). Recognizing that conservation goals cannot be reached by state-owned PAs alone, governments and conservation planners are increasingly looking to private land conservation areas (PLCAs) as a strategy to achieve national and global conservation targets (Mitchell et al., 2018; Stolton et al., 2014). In addition to offering cost-effective expansion of the conservation estate (De Vos & Cumming, 2019; Stolton et al., 2014), PLCAs also offer opportunities for protecting threatened and underrepresented habitats (Clements, Kerley, Cumming, De Vos, & Cook, 2019; De Vos & Cumming, 2019; Gallo, Pasquini, Reyers, & Cowling, 2009), curbing losses in natural land cover (Shumba et al., 2020), and increasing the connectivity of PA networks (De Vos & Cumming, 2019).

The capacity of both state-owned PAs and PLCAs to achieve their conservation objectives is dependent on their ability to continue funding their management activities (Di Minin & Toivonen, 2015; Watson et al., 2014). In many countries, government funding of state-owned PA management is either absent or insufficient (Di Minin & Toivonen, 2015), leaving PAs vulnerable to threats such as human encroachment, poaching, mining, and illegal resource use (Golden Kroner et al., 2019; Lindsey et al., 2014). PAs employ various financing strategies to overcome these difficulties, including nonconsumptive uses such as ecotourism and consumptive uses such as wildlife trade, bush meat sales and trophy hunting (Emerton et al., 2006). In southern Africa, wildlife-based land uses (such as hunting and ecotourism) have emerged as a financially viable alternative to farming, particularly in more marginal areas, due largely to legislation that enables private landholders to own and benefit commercially from wildlife (Child, Musengezi, Parent, & Child, 2012). Thus, a large network of PLCAs has emerged. In South Africa, PLCAs cover over double the land area covered by state PAs (Taylor, Lindsey, Nicholson, Relton, & Davies-Mostert, 2020), and for the most part receive no government funding or legal protection (but see De Vos & Cumming, 2019). Many of these PLCAs rely strongly on revenues generated from trophy hunting (Taylor et al., 2020).

Trophy hunting, particularly of iconic species such as the “big five” (lion, *Panthera leo*, elephant, *Loxodonta africana*, rhino, *Ceratotherium simum* and *Diceros bicornis*, leopard, *Panthera pardus*, buffalo, *Syncerus caffer*), remains a particularly controversial and polarizing form of consumptive wildlife use (Di Minin, Leader-

Williams, & Bradshaw, 2016; Lindsey, Balme, Funston, Henschel, & Hunter, 2016). Proponents of trophy hunting assert its importance as a conservation tool that, in addition to funding state PAs, offers incentives for conservation-based land uses to communities and private landholders, with positive outcomes for biodiversity and people (Cooney et al., 2017; Dickman, Packer, Johnson, & Macdonald, 2018; Frost & Bond, 2008; Lindsey et al., 2016; Naidoo et al., 2016). Trophy hunting of the big five species generates high revenues in a number of African countries (Di Minin et al., 2016; Frost & Bond, 2008). However, opponents object to the practice on moral grounds (Batavia et al., 2019), as well as often questioning the conservation and community benefits (Ripple, Newsome, & Kerley, 2016), and sustainability (Schulze et al., 2018) of the global trophy hunting industry. Renewed public interest after the infamous killing of a male lion in Zimbabwe, affectionately known as Cecil, by a wealthy American hunter in July 2015 has increased global pressure for the practice to be banned in Africa (Di Minin et al., 2016; Dickman et al., 2018; Lindsey et al., 2016). This is evidenced by the implementation of trophy import bans and several petitions being launched against the practice by the United States and other western nations (Di Minin et al., 2016; Lindsey et al., 2016), as well as bans and restrictions on transport of trophies by numerous airlines (Di Minin et al., 2016).

At present, global policy around trophy hunting is more informed by public pressure than by research and science (Bauer, Vasile, & Mondini, 2017; Dickman et al., 2018; Macdonald et al., 2017). Thus, increasingly vociferous public pressure on trophy hunting may effectively end trophy hunting in the not-too-distant-future regardless of the scientific evidence regarding its contribution to conservation objectives (Lindsey et al., 2016; Macdonald et al., 2017). The mechanisms through which an effective ending of trophy hunting could be achieved is through outright bans, or losing its financial viability due to trophy import bans or lack of international markets (Fears, 2017; Lindsey, Balme, Booth, & Midlane, 2012).

If trophy hunting is banned, there remain large knowledge gaps about the potential implications for conservation areas that rely on revenue generated through trophy hunting (Macdonald et al., 2017; Naidoo et al., 2016). Several studies have reported negative outcomes for both people and biodiversity from past hunting bans in African countries (Di Minin et al., 2016; Mabetta, Mweemba, & Mwitwa, 2018), while some have also investigated the impact of potential future bans, particularly for trophy hunting. Naidoo et al. (2016) demonstrated negative impacts for livelihoods and biodiversity in communal conservancies in Namibia in a simulated trophy hunting ban, and another recent Namibian-

focused study (Angula et al., 2018), identified widespread resistance to a hypothetical trophy hunting ban from rural communities, citing negative impacts on people's livelihoods. However, the implications of a potential trophy hunting ban on PLCAs, and how landowners would adapt to it, has not, to our knowledge, received any scholarly attention. One might expect that if, due to a trophy hunting ban, wildlife-based land uses are no longer a financially viable option, PLCA landholders may change land use (for example to livestock farming or cultivation), with consequences for biodiversity and livelihoods.

In this study, we investigate the perceived impacts of an internationally- or locally-imposed trophy hunting ban on the ability of PLCAs to retain conservation-based land uses in South Africa. We focus on South Africa because the country boasts one of the largest trophy hunting industries in sub-Saharan Africa (Lindsey, Alexander, Mills, Romañach, & Woodroffe, 2007; Taylor et al., 2020), with the majority of it being practiced on privately-owned land (Nelson et al., 2013). Trophy hunting generates an estimated at R1.96 billion per year (approximately USD130 million in February 2020), and a trophy hunting ban may thus have particularly widespread consequences for conservation-based land uses and livelihoods. We interviewed PLCA owners and managers in South Africa's Eastern and Western Cape provinces to assess the role that trophy hunting currently plays in the financial sustainability of PLCAs. We subsequently conducted further interviews with owners and managers of properties offering trophy hunting to understand their perceptions regarding the consequences of a trophy hunting ban for the financial viability of their PLCAs, what coping strategies or land use changes they would employ in the event of such a ban, and what they perceive the consequences would be for biodiversity conservation.

2 | METHODS

2.1 | Study area

Private land plays an important role in South African conservation (De Vos & Cumming, 2019; DEA & SANBI, 2009). South African PLCAs include private nature reserves, which are legally gazetted under the Protected Areas Act (Act 57, 2003); biodiversity agreements, which have legal status by virtue of a legally binding contract; and informally protected conservation areas, which are not legally recognized but receive some form of protection by the landholders and are managed at least partly for biodiversity conservation (Cadman, 2010). The majority of trophy hunting occurs on informally protected PLCAs, which receive no

funding or management support from the state (Cadman, 2010; Taylor et al., 2020). In the last few decades, the PLCA network in South Africa, and the informally-protected network in particular, has seen substantial growth largely as a result of economic drivers such as reduction in agricultural subsidies and opening of tourism markets (Child et al., 2012; Taylor et al., 2020). The contribution of informally-PAs to conservation is under-studied and somewhat controversial, as some of these farms may not adhere to practices that align with good environmental management, through for example over-stocking large mammals and introducing extralimital species (Castley, Boshoff, & Kerley, 2001; Cousins, Sadler, & Evans, 2010; Spear & Chown, 2009). On the other hand, many informal-PAs generate substantial income for conservation (through, for example, hunting permits that subsidize conservation outside of their boundaries Taylor et al., 2020), are effective at protecting natural land cover (Shumba et al., 2020), and conserve threatened biodiversity that is underrepresented in state PAs (Gallo et al., 2009). PLCAs that have been formally gazetted (and better studied) have been shown to play a critical role in improving habitat connectivity (Clements et al., 2019; De Vos & Cumming, 2019), conserving under-protected and threatened habitats (De Vos & Cumming, 2019), and protecting complimentary biodiversity to that on state-owned PAs (Gallo et al., 2009). The PLCA network is also spatially expansive, with informally-PAs comprising at least 14% of South Africa's land area; more than double that covered by state-owned PAs (Taylor et al., 2020).

Most informal-PAs operate as wildlife ranches, generating income from ecotourism, trophy hunting, "biltong" (dried meat) hunting, game meat production, and game sales. Trophy hunting is a major contributor to the wildlife ranching economy, generating R1.96 billion (USD127 million, March 2020) compared to the R0.65 billion (USD42 million) generated by biltong hunting, 0.16 billion (USD10.5 million) from game meat production, but smaller than the R4.32 billion (USD281 million) generated through live game sales (Taylor et al., 2020). Of the revenue generated by trophy hunting, the biggest proportion (47.1% in the Taylor et al., 2020 assessment) is estimated to go to the landowner through species fees. Additionally, landowners often (but not always) generate income from accommodation, meat processing and trophy handling. Other revenue is generated from paying guides and trackers, permits (thus supporting broader conservation activities) or private operators (such as professional hunters, transport agencies or intermediaries).

This study focused on PLCAs within the Eastern and Western Cape provinces of South Africa. The Eastern Cape province spans 169,000 km² and although it is one of the poorest provinces in the country it is extremely rich in

biodiversity, encompassing all three of South Africa's global biodiversity hotspots (Myers, Mittermeier, Mittermeier, Da Fonseca, & Kent, 2000). The Western Cape province spans 130,000 km² and contains two internationally recognized biodiversity hotspots (Myers et al., 2000). We focused our study on these two provinces because they contain both biodiversity hotspots and a large number and variety of PLCAs. Wildlife-based conservation is expanding in this region (Clements, Baum, & Cumming, 2016; Gallo et al., 2009; Selinske, Coetzee, Purnell, & Knight, 2015) and over a quarter of the priority areas identified by South Africa's Biodiversity Economy Strategy are located in these provinces (DEA, 2015).

2.2 | Data collection

To assess the extent to which PLCAs depend on trophy hunting for revenue, data on the revenues derived from trophy hunting during the 2013/2014 financial year were collected via semistructured interviews with the owners and/or managers (hereafter "landholders") of 72 randomly selected PLCAs, as part of a larger research program between 2014 and 2015 (Clements, 2016). These properties varied in size from 0.1 to 543.8 km² (mean 53.9 km²), and conserve seven of South Africa's nine biomes (forest, fynbos, grassland, Nama karoo, thicket, savanna, and succulent karoo) (Clements, 2016). Trophy hunting revenues reported in South African Rands were converted to United States Dollars using an average of the daily South African Reserve Bank exchange rate for the 2013/2014 financial year (1 USD = 10.00 ZAR). To gain insight into landowners' perceptions regarding the likely impact of a trophy hunting ban, we then undertook follow-up interviews in 2018 with the landholders of PLCAs that generate revenues from trophy hunting. As only 11 of the originally interviewed landholders were available for a follow-up interview, we augmented the sample by using snowball sampling (Newing, Eagle, Puri, & Watson, 2010). Interviews were undertaken with the landholders of 11 additional PLCAs that undertake trophy hunting. A total of 22 landholders were thus interviewed in 2018, 13 from the Eastern Cape and nine from the Western Cape province. The study adhered to Rhodes University's ethics policy (approval no.: ES18/11).

In the first round of interviews (2014/2015; $n = 72$), landholders were asked, in face-to-face interviews as part of a larger survey, what their total revenue was for the 2013/2014 financial year, and the proportion that was derived from trophy hunting, and other activities (e.g., ecotourism, live sales) (see Clements, 2016) for full description of methods and a copy of the questionnaire). In the second round of interviews (2018; $n = 22$), each

interview lasted between 30 and 45 min on average, with most interviews being conducted face-to-face, or alternatively via Skype. The questions posed to the landholders were open-ended and related to why the landholder undertakes trophy hunting, and the perceived impacts of an international trophy hunting ban to their PLCA's economic viability and biodiversity conservation objectives (Supporting Information Appendix S1). Landholders were also asked about possible coping strategies that they would implement in response to losing economic viability in the face of a trophy hunting ban, and constraints on transitioning to commonly mentioned alternative land uses. All participants consented to being audio recorded during the interview sessions and these recordings were later transcribed.

2.3 | Data analysis

We used data from the first round of interviews ($n = 72$) to calculate the proportion of landholders that relied on trophy hunting, as a fraction of their total revenue, and in the context of other activities that contributed to their overall income.

Data from the second round of interviews ($n = 22$) were analyzed by way of thematic coding, using the RQDA package in R (R Development Core Team, 2016). Codes (words or phrases representing a single idea) were identified and, based on critical reading of the transcribed interviews, allocated into broader themes (Aronson, 1995). The emergent themes were analyzed by finding patterns within the data that related to perceived impacts of a trophy hunting ban to PLCA economic viability, coping strategies and biodiversity conservation.

To investigate if there were particular groups among the landholders who were more or less inclined to retain wildlife-based activities and land uses in the face of a ban, a Principal Component Analysis was performed to identify trends in the coping strategy themes mentioned by landholders (R package: `vegan`; function: `rda`) (Oksanen et al., 2015). Thereafter, we performed a cluster analysis to identify distinct groups by employing Euclidean distance and Ward linkage (R packages: `vegan` and `stats`; functions: `vegdist` and `hclust`) (Oksanen et al., 2015; Ward, 1963). We used a Mantel-based comparison to determine the number of distinct clusters (R package: `cluster`; functions: `daisy` and `silhouette`) (Maechler et al., 2015).

3 | RESULTS

Of the random sample of 72 PLCA landholders interviewed from 2014 to 2015, slightly under a third (32%)

generated revenues from trophy hunting. Of those that undertook trophy hunting, revenues from this activity comprised, on average, 36% of their total annual revenue, though there was a considerable range (SD = 32%, minimum = 4%, maximum = 95%, $n = 72$). The non-trophy-hunting revenues were generated through ecotourism (32% of revenue on average), live game sales (15%), hunting for meat (“biltong” hunting) (12%), farming (2%) or events (1%), and other (2%) annual revenues from trophy hunting ranged from US\$756 to US\$600,000 (average = US\$71,168, SD = US\$136,179). Taken together, wildlife-based revenues thus comprised 95% of annual revenue, on average, while nonwildlife revenues (farming, events) comprised 5%.

More in-depth interviews with the landholders of 22 trophy hunting PLCAs in 2018 revealed that all landholders practiced trophy hunting for economic reasons, for example stating that “Trophy hunting is definitely the aspect that brings in the most money.” Two thirds of landholders also mentioned conservation reasons, for example “I have actively been involved in the game breeding side, the game lodging side, the professional hunting side,

the tourism and marketing side and I have never seen an environment that is so turnkey in articulating a gross conservation impact than hunting has.” Half of landholders mentioned passion as a reason; “I obviously have an interest and a passion in wildlife and for me it is a bit of a personal thing.” For many landholders, these three main reasons were intertwined. For example, one landholder stated that they practice trophy hunting “For conservation and obviously so it’s viable for us financially. As a business we do it and because we enjoy it and we do what we love.”

The majority of trophy hunting clientele were from the US, Canada and the European Union; 95% of landholders mentioned these three regions, while 45% mentioned other international countries. Just over half of landholders (55%) also received clientele from South Africa.

The majority (91%) of landholders believed that a trophy hunting ban would have a major negative impact on the economic viability of their properties. One landholder explained that “It would be colossal... a trophy ban would take out 50% of our income which although only 50% of our market it is probably 70% of our turnover. It comes

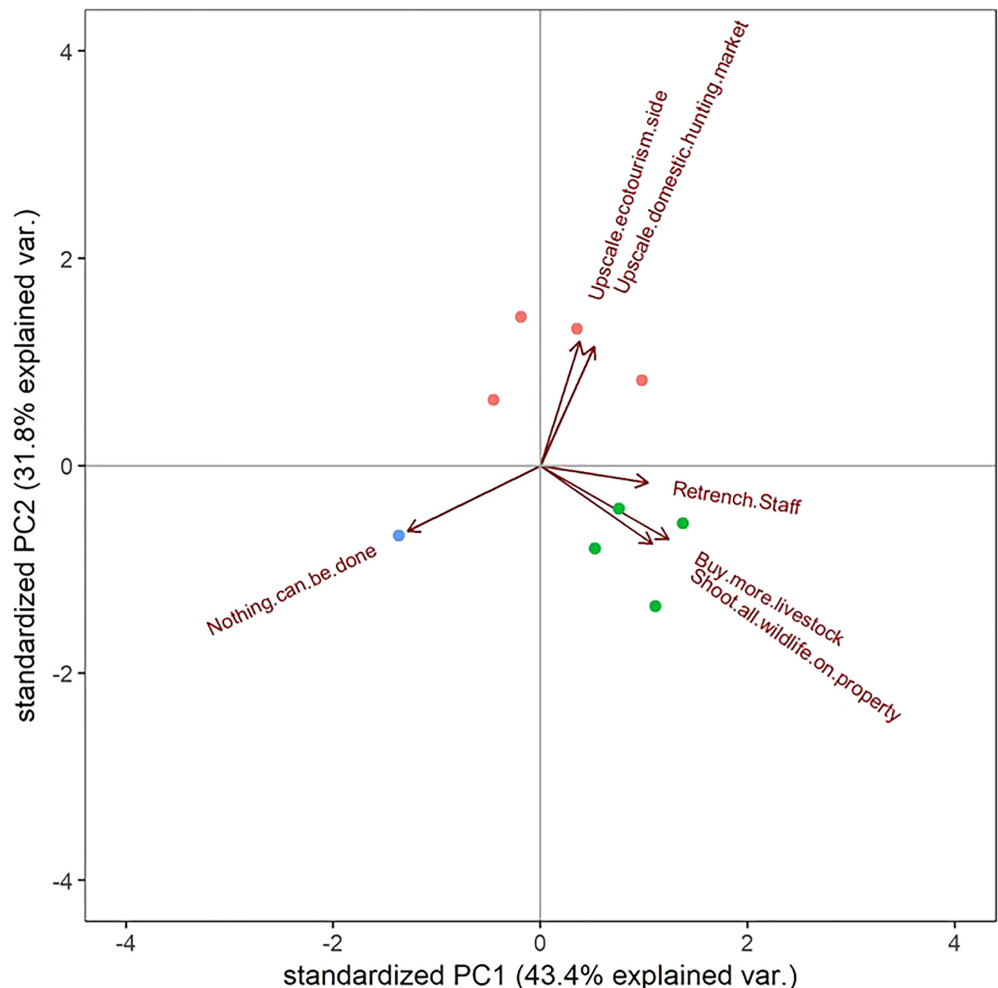


FIGURE 1 Biplot depicting the relative scores, on the first two principal components (PC), of possible coping strategies in response to a trophy hunting ban, as mentioned by the landholders of private land conservation areas (PLCAs). Data points indicate PLCA scores, with colors corresponding to three identified clusters

TABLE 1 Perceptions of 22 landholders regarding the constraints on transitioning to an alternative land use in the face of a trophy hunting ban

Alternative land use	Constraints on adopting the land use	Percent land-holders	Supporting quote
Ecotourism	Increased input costs associated with tourist infrastructure, employing more staff, marketing, water and electricity	55%	<p><i>“The cost involved from changing from trophy hunting to ecotourism is extremely high”</i></p> <p><i>“We would have to employ more managers and employ more staff. We would have to improve certain vehicles, we would have to spend more money on better lodges and that sort of thing”</i></p>
	Market is saturated, competition is too high	40%	<p><i>“It’s a flooded market. There are so many places around us doing it”</i></p> <p><i>“The ecotourism market is oversaturated and are struggling at the moment to put bums in beds”</i></p>
	Ecotourists demand higher standards than hunters for food, accommodation and big five experience	32%	<i>“Your foreign ecotourists they all want to see the Big five and then most of them are looking for five-star accommodation”</i>
	Less profitable than trophy hunting	27%	<i>“There is more limited turnover in ecotourism”</i>
	Requires more customers than trophy hunting	18%	<i>“You would need 30 times the amount of people doing tourism than you would in hunting”</i>
	Too far from market	9%	<i>“Not here I can tell you the boat won’t float. We are too far off the main tourist routes. There’s little tourist attraction here”</i>
Livestock farming	Marginal land	45%	<p><i>“Our property was run as a livestock farm previously, but it was heavily impacted, you must understand the terrain, its cliff faces. So, it’s huge valleys, there’s no other real land-use that would survive in that area other than hunting”</i></p> <p><i>“Where we live is marginal land, it can’t be used for much else”</i></p> <p><i>“I have had game and livestock and game seem to deal better with the drought”</i></p>
	Increased input costs associated with infrastructure for livestock	27%	<p><i>“If I had to re-fence the farm it would cost me over 10 million so economically, I don’t think it would be viable to go back into stock farming”</i></p> <p><i>“Alternatively start domestic farming with livestock, but the capital to start that would be massive. All the refencing everything, recamping the whole property, infrastructure to work the animals”</i></p>
	Predators, pests and diseases	18%	<p><i>“You could do livestock, but it will be very difficult to keep stock with all the predators around here”</i></p> <p><i>“We have tick-borne diseases here and the game are just much more well-adapted than the stock”</i></p>
	Stock theft	9%	<i>“Stock farming here was just not profitable because of things like stock theft”</i>
	Property too small	9%	<i>“Too small to have as a single-standing stock farm so I could sell it to other farmers in the area and they would expand it and integrate into their bigger setup”</i>

back to the per capita return on animals.” By contrast, the remaining 9% of landholders stated that a ban trophy hunting would not impact their viability; “*Hunting is just a part of what the farm does. It is about a tenth of what we bring in, so it wouldn't really impact our financial viability that much.*”

Based on their opinions and perceptions, three clusters of landholders emerged, with distinct coping strategies in the event of a trophy hunting ban impacting their economic viability (Figure 1; Mantel score = 0.78). The first group (pink cluster; 36% of landholders) was characterized by landholders who would transition to or scale-up other wildlife-based land uses such as wildlife utilization (live sale or hunting for meat) or ecotourism. For example, “*I would assume that we would migrate over to ecotourism and get the big 5 in. It would affect the farm a lot. It would impact particularly in winter months as we would have to sell more live game and have more visitors come.*”

The second group (green cluster; 36% of landholders) was characterized by landholders who would abandon a wildlife-based land use, and transition to livestock (Figure 1). These landholders also commonly mentioned that they would shoot all the wildlife on the property and retrench staff. One landholder stated that “*I think what we would probably have to do is first retrench our staff for the meantime and then look at the viability in terms of livestock farming. We can't do crop farming here because we don't have enough water and that sort of thing. The only other thing we could do is domestic livestock.*”

The third group (blue cluster; 27% of landholders) was characterized by landholders who either believed that nothing could be done to remain economically viable following a ban or had no interest in pursuing another land use (Figure 1). These landholders stated that they would likely sell their property in the event of a ban. According to one landholder, “*Economically [trophy] hunting has changed the game for us and to go back to anything else would just not be feasible for us. We only have 3500 hectares which isn't a lot of land,*” while another stated that “*I would sell immediately. There is zero interest for me in doing anything other than this, it is my biggest love and passion. I think honestly if there was a trophy hunting ban, I would sell the farm there's just no doubt about it.*”

Perceived challenges to transitioning to or scaling up ecotourism in the face of a trophy hunting ban included increased input costs, a saturated market, ecotourists demanding higher standards than hunters, ecotourism being less profitable and requiring greater volumes of customers than trophy hunting, and some properties being too far off the main tourist routes (Table 1). Perceived challenges to transitioning to livestock farming

included the property being too marginal and/or small, increased input costs, predators, pests, diseases and stock theft (Table 1).

The vast majority (95%) of landholders believed that a trophy hunting ban would have a negative impact on biodiversity conservation, mentioning likely declines in wildlife numbers, losses in wildlife value (related to live animal sales), damage to ecosystems, negative impacts on wildlife genetics and increased poaching (Table 2). One landholder, however, had a contradictory view, and believed that a ban would be good for conservation, stating that “*The animals would be able to live out their full lives, pass on genes properly, die when they are meant to die. Vultures and other scavengers would possibly emerge and live off carcasses.*”

4 | DISCUSSION

Trophy hunting is an important financial strategy for the viability of PLCAs in South Africa: a third of surveyed PLCAs generated at least a portion of their revenues from trophy hunting, and nearly all landholders who offered trophy hunting felt that it was important to their overall viability. This study is, to our knowledge, the first investigation of the possible impacts of a trophy-hunting ban that focuses specifically on single-landowner PLCAs. It shows that the impact of a trophy hunting ban on the financial viability of PLCAs in South Africa could be significant and lead to land use change on many PLCAs. Our results have important implications for the future of PLCAs, and the biodiversity and livelihoods they support, if a trophy hunting ban were to be imposed.

4.1 | Implications for land use

Our results showed that the majority of landholders with wildlife-based PLCAs (63%) would move away from a wildlife-based land use. This is somewhat in line with the findings of Angula et al. (2018), who showed that only 11% of surveyed Namibian conservancy residents would continue to support wildlife on communal land in the event of a trophy hunting ban, and that of Naidoo et al. (2016), who found that a simulated ban on trophy hunting significantly reduced the number of conservancies who could cover their operating costs.

In our study, only a third of landholders felt that they could scale up or adopt other wildlife-based land uses (i.e., ecotourism) to cover the financial deficit created by a trophy hunting ban. Biophysical constraints, such as being too far from the tourist routes, are commonly mentioned as the main constraint to upscaling ecotourism (Mgonja, Sirima, & Mkumbo, 2015; Pegas &

TABLE 2 Perceptions of 22 landholders regarding the impact of a trophy hunting ban on wildlife and ecosystems

Impact	Percent land-holders	Supporting quote
Decline in wildlife numbers	82%	<p><i>"I believe African wildlife wouldn't survive without trophy hunting because you have got to breed 4 or 5 animals to make a cent so that's conservation itself. And so, the trophy hunter is what drives this whole industry, without him at the top the whole industry collapses"</i></p> <p><i>"This is pretty much the precipice of the conservation front for wildlife at the moment and without it, everything would collapse. Animal numbers, I reckon, would drop below 25% throughout the country"</i></p> <p><i>"For a start, what we do now on our property is that based on the size of our property we can scientifically work out how many animals there should be on property. It is stocked on line on browsing/grazing capacity. So, we would have to cull game to make way for stock. The wild animals at the moment would be competition for stock farmers"</i></p>
Loss in wildlife value	68%	<p><i>"When you remove trophy hunting from the equation, if you remove that well it has no value. What are you breeding for? The underlying market value of a stud is the hunting exit strategy market value and if that falls to the wayside you lose the value of the stud"</i></p> <p><i>"The animals will lose value then and if the farmer sees no value for the wild animals on his property, he will either get rid of all of them or put less effort into them"</i></p>
Damage to ecosystems	68%	<p><i>"If you have a game farm or a game reserve your ecosystem is more in balance just on type of bushes and shrubs that you get here. You get many more 5-star grazing units on a game farm when it is stocked correctly"</i></p> <p><i>"If you look at Kruger or the Tuli Block for example they didn't do any hunting there and they decimated all the vegetation to such a degree that they all started saying of starvation and a break out of anthrax and killed all the animals indiscriminately. We are in the privileged positions as humans that if you do exercise control over animals you need to do so with some level of insight and if you don't have that long-term insight you cause long-term damage to ecosystems and variability to conservation efforts"</i></p>
Negative impact on wildlife genetics	45%	<p><i>"No interest or value for you to put new genes into the system and animals become inbred and exposed to diseases"</i></p> <p><i>"[trophy hunting] helps stimulate bringing about different genetic pools... and forces you to bring new genes into the system which further down the line enhances the gene pool"</i></p>
Poaching	18%	<p><i>"Guys would lose out on jobs and meat. They would make other options they would poach or hunt meat themselves"; "If you take away legal hunting your illegal hunting will flourish. Without hunting there are no incentives to collect traps and snares"</i></p>

Castley, 2014; Powell, Edwards, Powell, & Nieland, 2018), but in our study, financial constraints related to entering and competing in the tourism market were more common. For example, respondents mentioned barriers to entry (more infrastructure and staff may be needed to move from hunting to ecotourism operations, also see Clements et al., 2016), in addition to increased running costs, lower profit margins, and the higher competition in this sector (Table 1). While high-end ecotourism can be highly profitable (Clements et al., 2016) and many landholders seemed willing to shift to ecotourism, in most cases this would require significant investment, possibly from an outside source.

A third of surveyed landholders said they would transition to livestock farming, but many also mentioned both financial and ecological constraints to making this transition (Table 1). This result is perhaps unsurprising: many PLCAs moved away from livestock farming when government subsidies for farming were reduced, and ecotourism and trophy hunting became a more financially viable strategy (Child et al., 2012). Thus, transition options could be biome-dependent: many of our surveyed PLCAs were in areas where rainfall is erratic and farming conditions are difficult.

An interesting result was that one third of participants felt that there was either no other viable land use, or that they would not want to do anything else, as their passion

is for hunting. Constraints to adaptation therefore were not just biophysical and financial, but also related to personal identity, lifestyles and values (Biggs, 2011).

4.2 | Impacts on biodiversity and livelihoods

If two thirds of PLCA owners transitioned away from a wildlife-based land use, there may be important consequences for biodiversity. Many landholders perceived likely impacts on mammals, and certainly transitioning to livestock farms would be incompatible with keeping carnivores and possibly megaherbivores on the land. While two thirds of landholders believed that a change in land use would negatively affect ecological function, actual impacts are uncertain. Livestock farming might not necessarily be bad for biodiversity (Biggs, Reyers, & Scholes, 2006; Broom, Galindo, & Murgueitio, 2013; Duru et al., 2015), and well-managed livestock farms may in fact be better for ecological function than badly-managed game farms (Castley et al., 2001; Cousins et al., 2010; Spear & Chown, 2009).

Impacts on biodiversity, are, however, not the only concern. Our finding that 27% of landholders feel that they could no longer remain financially viable following a trophy hunting ban could have a significant impact on the livelihoods and well-being of landholders, as well as that of their employees. Many landholders mentioned that they would have to retrench staff in the event of a ban (Table 2), which may also lead to displacement of people off these properties (Spienburg & Brooks, 2014).

Save for a financial viability study on the consequences of a lion trophy hunting ban across tenure regimes (Lindsey et al., 2012), the limited research on the impacts of a (potential) trophy hunting ban on human livelihoods and well-being has thus far focused almost exclusively on communal conservancies (Angula et al., 2018; Naidoo et al., 2016). PLCAs owned by individual landholders most likely have different implications for livelihoods of both owners and employees to those of a communal conservancy, given the possibly greater financial agency of many private landholders, and the role they play in local socio-economic development in terms of employment creation, skills training and philanthropic development projects (Snyman, 2017). Thus, trophy hunting bans may have significant implications for livelihoods, development and social justice that stretch beyond the implications mentioned by landholders in this study.

4.3 | Implications for policy makers

Although our results were based on a small sample size, and only account for the perceptions of one type of

stakeholder (landholders), they nevertheless emphasize that urgent attention is needed from conservation policy makers and international NGOs. If trophy hunting is banned, our work suggests that the identification, development and support of alternative livelihood strategies should be prioritized, and their implications for biodiversity investigated. Such research and discussions could include how to enhance the biodiversity value of alternative land uses (such as sustainable livestock ranches), how to enhance local tourism or hunting markets, and financing to lower barriers of entry into high-end ecotourism (Clements et al., 2016).

The ethical concerns around the livelihood and human well-being impacts resulting from trophy hunting bans also merit attention in policy debates and require further research, including understanding the perceptions of different stakeholders across diverse social-ecological contexts. Since this study only interviewed landholders, we can draw only limited conclusions about the broader impacts of a trophy-hunting ban. Indeed, the impact of PLCAs (informal areas in particular) on livelihoods has been controversial in South Africa. While some researchers argue that PLCAs provide jobs, food, housing and skills (Snyman, 2017; Taylor et al., 2020), others point out that the conversion to game farms from agriculture resulted in many job losses and displacements and criticize the lack of social transformation in PLCA ownership post-Apartheid (Spienburg & Brooks, 2014). In our study, many landowners suggested that converting back to agrarian land uses or switching to ecotourism would be financially unviable. In these cases, it is unlikely that jobs lost from having to close trophy hunting operations would be replaced by new ones in new sectors. However, agrarian conversion might be more plausible in more favorable social-ecological contexts, and there are many potential benefits and costs to other stakeholders that were not considered by landowners in this study.

If trophy hunting is terminated, mechanisms to address the human impacts should adhere to the international mechanisms and procedures established to safeguard human well-being and human rights in conservation (Makagon, Jonas, & Roe, 2014). Safeguarding the rights of indigenous peoples is particularly important, including their rights to participate in decision-making, use and management of their natural resources as indicated in the UN Declaration on the Rights of Indigenous Peoples in 2007, and the Convention on the rights of indigenous and tribal peoples of 1989 (Makagon et al., 2014). For example, an international trophy hunting ban or an import ban on trophies from a country like Namibia (see Naidoo et al., 2016) can have a substantial impact on individual and community livelihoods. In

addition, such bans impact on the rights of communities which have decided to allow managed trophy hunting as a source of revenue in their communal lands.

Ultimately, it is important to consider strategies that recognize that PLCAs (and other areas where trophy hunting is currently practiced) are complex social-ecological systems. PAs are created by people, for people, and are shaped by the social, political, economic and environmental landscape in which they exist (Cumming, 2016; Cumming et al., 2015; Palomo et al., 2014). They are able to respond to, and are affected by, the close interactions between social, economic, political and ecological factors, which occur across multiple scales (Cumming et al., 2015). Our results suggest that a hunting ban will have different consequences for landholders and stakeholders in different social-ecological contexts, and that cross-scale feedbacks from implementing such a policy change is likely to lead to a variety of unintended and potentially undesirable consequences in terms of biodiversity conservation and human livelihoods.

Taking a social-ecological approach to PLCAs, and PAs more generally, is important for exploring the impact of different policies on biodiversity conservation. In this case, it can help transcend the gridlocked debate around whether a ban would be good or bad. Rather, as we have demonstrated in this study, such a ban is likely to have differentiated effects. Given that an international ban is not in the control of the South African government, we suggest that a useful approach to complement this debate may be to pay more attention to building the capacity of PLCAs to cope with disturbances such as a possible trophy hunting ban, especially given the likely implications for conservation and livelihoods. Such a focus could increase the uptake of scientific evidence in the trophy hunting debate, and could serve to identify nontrophy hunting alternative sources of income in the event of a ban.

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AUTHOR CONTRIBUTIONS

All authors contributed to the design and writing of the paper. K. P. and H. S. C. conducted data collection and analyses. A. D. V. and H. S. C. led the writing of the manuscript. A. D. V. was responsible for submitting the manuscript and leading revisions.

DATA AVAILABILITY STATEMENT

Due to interview confidentially, data are not made available online. However, anonymous data can be requested, with motivation, from the authors via email.

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SUPPORTING INFORMATION

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

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