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Examining rural livelihoods relevant to human-lion conflict interventions within the communal conservancies of the Kunene Region, Namibia

J Heydinger[1], U Muzuma[2], M Brassine[3], R Vinjevold[4], C Packer[5]

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[1] Savannah River Ecology Laboratory, University of Georgia; University of Minnesota Lion Center. heydingerj@gmail.com
[2] Directorate of Scientific Services, Ministry of Environment, Forestry and Tourism, Windhoek, Namibia
[3] Lion Rangers Program, Namibia
[4] Integrated Rural Development and Nature Conservation (IRDNC), Namibia
[5] Department of Ecology, Evolution and Behavior, University of Minnesota, USA

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ABSTRACT
In the Kunene Region of northwest Namibia, desert-adapted lion (*Panthera leo*) numbers increased from the late 1990s to 2015. They have since declined by as much as two-thirds. This is primarily as a result of lions killed following human-lion conflict (HLC) incidents, within communal conservancy lands. HLC and conflict with other predators threatens pastoralists' already-tenuous livelihoods, eroding the economic instrumentalism pillar of the conservancy system. Our survey quantitatively and qualitatively examined pastoralists' livelihoods, perceptions of lions, and the efficacy of recently implemented HLC interventions in core lion range conservancies; it is a follow-up to a previous survey (Heydinger *et al*. 2019). Results show that livestock losses over the past decade likely exceed 80%. These losses are overwhelmingly attributed to the effects of drought and predators. Lions are considered the most problematic species, with 57% of respondents holding negative attitudes towards lions, while 84% say they do not benefit from having lions in their conservancy. Yet, problems with other predators, such as spotted hyaena (*Crocuta crocuta*) and black-backed jackal (*Canis mesomelas*), are more widespread. The effects of HLC interventions, including Lion Rangers, human-wildlife conflict Rapid Response Teams, an early-warning system, and predator-proof livestock enclosures (kraals), are not uniformly experienced and show no unequivocal improvement in respondents' attitudes towards lions. Results are discussed in the context of supporting pastoralists' livelihoods, and as part of an ongoing process for strengthening HLC interventions for the conservation of lions and other carnivores on communal lands.

Keywords: conservancies; desert-adapted lions; human-wildlife conflict; lion rangers; livelihoods; Namibia; social survey

INTRODUCTION

African lion (*Panthera leo*) populations living outside of fenced protected areas are an important part of the continent-wide conservation of the species (Jacobson & Riggio 2018; IUCN 2018). Even though lion populations within fenced protected areas are denser than those in unfenced territories, Africa's protected areas face dramatic funding shortfalls, exacerbated by the COVID-19 crisis and structural economic challenges (Packer *et al*. 2013; Lindsey *et al*. 2018, 2020). During the twenty-first century, lions' range has contracted to an estimated 10% of their historically recorded range (IUCN 2018). Free-ranging lion populations, particularly outside fenced protected areas, may prove more resilient if broad-based local support for their persistence can be achieved (Packer *et al*. 2013; Creel *et al*. 2013). Such populations may not be as susceptible to inconsistent governance or funding shortfalls.

One example of sustained lion population growth and recent range expansion comes from the desert-adapted lion population of the Kunene Region, in northwest Namibia. Currently covering a core range of approximately 40 000 km^2, up from approximately 7 000 km^2 in the 1990s (GRN 2017), the desert-adapted lions primarily inhabit communal conservancy lands which they share with semi-nomadic pastoralists and their livestock. Since the late 1990s, this lion population has rebounded from an estimated low of 20 individuals (Stander 2018), to an estimated 180 individuals in 2015 (GRN 2017). This period of recovery coincided with the growth of Namibia's communal conservancy system, a form of community-based natural resource management (CBNRM) where local people maintain qualified rights to manage and benefit from certain natural resources, including wildlife (Jones & Murphree 2001; Owen-Smith 2010). Since 2015, however, the population has declined to an estimated 57–60 individuals in 2022 (Heydinger *et al*. 2024).

The proximate driver of this decline has been lions killed in response to human-lion conflict (HLC). When lions invade conservancy farms, they are often killed in retaliation to preying upon and/or injuring livestock. No human deaths or life-threatening

injuries have been recorded from lions in the region since 1982. Even as the lion population was rebounding from 2000–2010, HLC incidents were responsible for 80% of (non-cub) lion mortalities (Stander 2018). This trend continued through the 2010s to the present. From 2021 through mid-2023, HLC has been responsible for at least 27 of 30 lions either being killed or permanently removed from conservancy lands (Heydinger unpublished data). At the same time lions have been responsible for at least 512 livestock deaths, including cattle, sheep, goats, donkeys (Lion Rangers unpublished data).

The ultimate driver of HLC is likely the dramatic decline in wildlife numbers coinciding with reduced rainfall and available vegetation for livestock and wildlife grazing and browse during the past decade. Since 2010, indicator prey species (gemsbok (*Oryx gazella*), springbok (*Antidorcas marsupialis*), and mountain zebra (*Equus zebra*)) numbers have declined by as much as 69–96% (NACSO 2023). Lion survival appears to have been similarly affected by the declining prey base (Heydinger *et al*. 2024), which may also have driven lions to increasingly switch to livestock as prey.

Increasingly erratic rainfall and rising daytime temperatures (Atlas of Namibia Team 2022) are beyond the control of local people, while high rainfall variability will likely remain a feature of this region's ecology. In contrast, HLC incidents can be minimised, provided lion movements are monitored, and proactive steps are taken to limit contact between lions, pastoralists, and livestock. In 2017, Namibia's Ministry of Environment, Forestry and Tourism (MEFT) published the Human Lion Conflict Management Plan for North West Namibia (NW Lion Plan, GRN 2017), a policy document outlining interventions for addressing the related challenges of reducing HLC and supporting pastoralists' livelihoods in the Kunene Region. Among the recommendations within this plan was activating and upscaling four HLC interventions. These include: a Lion Rangers programme (lionrangers.org), five Human Wildlife Conflict Rapid Response Teams, an early-warning system providing stakeholders with relevant lion movement information, and the construction of predator-proof kraals (details below).

Human social factors are increasingly acknowledged as an important part of fostering durable programmes aimed at conserving lions and other potentially dangerous wildlife (Dickman 2010; Hazzah *et al*. 2017). Though HLC may never be fully preventable, securing the future of lions on communal lands includes assessing what drives negative retaliation to HLC incidents by local pastoralists and working to transform these drivers. As part of ongoing efforts to limit HLC, we performed social surveys to ascertain the costs and benefits of living in conservancies in northwest Namibia, and local perceptions of desert-adapted lions as well as experiences of interventions aimed at limiting HLC. These surveys had four objectives:

1. Record the effects of recent drought-like conditions on livestock ownership among communal farmers within core lion-range conservancies by quantifying livestock ownership trends in these areas.
2. Record the effects of predation on livestock by predators during the same period in these areas.
3. Assess attitudes towards living with lions among survey respondents.
4. Assess attitudes towards, and the effectiveness of, human-lion conflict interventions, among respondents.

This effort is a follow-up to a 2017 study (Heydinger *et al*. 2019). The prior survey found large-scale livestock losses due to drought, the magnitude of which had been exacerbated by large carnivores. Lions were responsible for livestock losses averaging approximately NAD 53 070 (USD 2 900, 2022 value; CPI 2023) per household during preceding years. While most respondents (84%) stated they do not benefit from living with lions, 76% maintained it is important to continue to share communal lands with lions (Heydinger *et al*. 2019).

Our current survey adopts objectives from this prior survey, as well as focusing on the effectiveness of alternative HLC interventions, within areas suffering high levels of HLC. We also examine the interface of local livelihoods with the costs and benefits accruing to conservancy residents, as well as perceptions relevant to conservancies' effectiveness in helping mitigate the costs of living with potentially dangerous wildlife, focusing on lions and other large predators. The resulting picture suggests the conservancy system is struggling to deliver on aspects of its founding principles (Jones & Murphree 2001). Our analysis is based on the perspective that societal norms and values fostering pro-environmental behaviour may be just as important as ecological factors (Ostrom 2000; Muntifering *et al*. 2015). This work contributes to existing literature on the effectiveness of CBNRM structures to address the costs incurred by rural residents being charged with managing large, potentially dangerous wildlife. Specific to the context of northwest Namibia, this study provides a contemporary picture of rural livelihoods in a livestock-based economy following years of drought-like conditions. It provides practitioners and researchers with a case study which can contribute to managing and mitigating human-wildlife conflict in rural communities.

Study Area

The core range of the desert-adapted lions encompasses approximately 40 000 km^2 of unfenced communal conservancies and government-managed lands. This includes 11 communal conservancies, three tourism concessions, and a portion of the Skeleton Coast National Park (Figure 1; Table 1). We surveyed a subset of households within each conservancy in this landscape. In comparison, Heydinger *et al*. (2019) surveyed only three communal conservancies (Anabeb, Puros, and Sesfontein) totalling 7 597 km^2. Our expanded survey is due to a broader mandate for limiting HLC across the landscape, as well as the greater reach of our research team and the Lion Rangers. Our broadened scope therefore provides a more comprehensive picture of livelihoods and HLC in core lion range conservancies.

Table 1: *Communal conservancies and government-managed areas that were surveyed during this study (NACSO 2020).*

Conservancy	Human population	Area (km^2)
Anabeb	1 402	1 570
Doro !Nawas	1 242	3 978
Ehi-rovipuka	1 846	1 980
≠Khoadi-//Hôas	4 308	3 364
Omatendeka	1 985	1 619
Orupupa	2 024	1 234
Puros	641	3 562
Sesfontein	1 941	2 465
Sorris-Sorris	950	2 290
Torra	1 064	3 493
Tsiseb	2 415	7 913

Core desert-adapted lion range is dominated by the Namib Desert, running along the Atlantic coast, merging into the Nama Karoo biome along the western African escarpment, transitioning into the highland savanna further east, and bisected by ephemeral riverbeds running east to west. The soil is typically basaltic, shallow, rocky, and unproductive (Atlas of Namibia Team 2022). Rainfall is patchy and generally occurs during the wet season (January–May), increasing from west to east. The entire area falls within the ≤ 200 mm isohyet with high annual rainfall variability (≥ 60%). Prey species, including

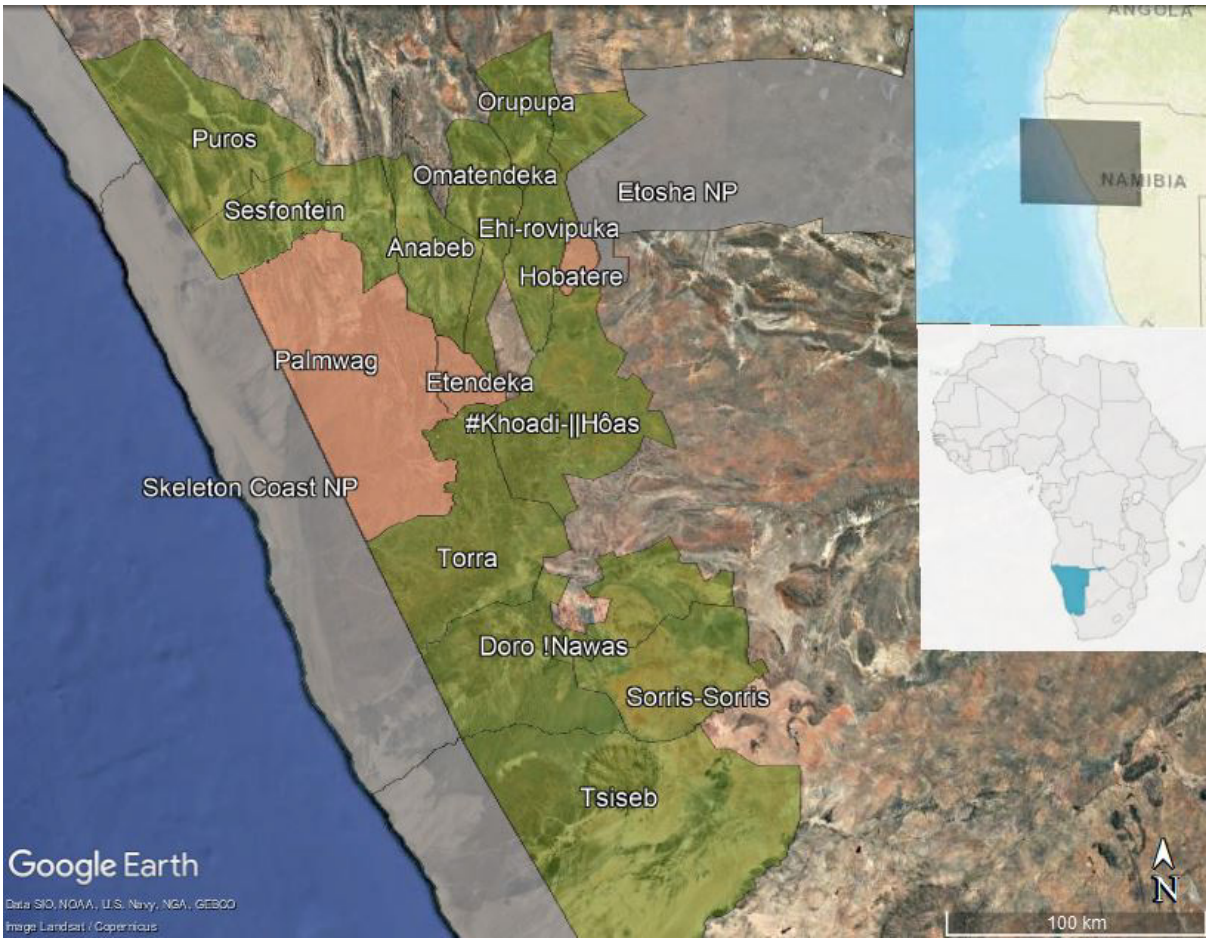

Figure 1: *Map of core lion range with conservancy and government-managed area boundaries within the Kunene Region. Communal conservancies are depicted in green; neighbouring concessions in beige; national parks in grey.*

gemsbok, springbok, mountain zebra, giraffe (*Giraffa camelopardalis*), and kudu (*Tragelaphus strepsiceros*), maintain seasonal movements, responding to localised rainfall and subsequent availability of grasses and browse. During the dry season (June–December), prey and livestock often congregate in ephemeral riverbeds.

Core lion range is home to approximately 19 800 rural residents, primarily Otjiherero- and Damara-speaking peoples whose primary source of income is derived from livestock farming of cattle (*Bos taurus*), sheep (*Ovis aries*), goats (*Capra aegagrus hircus*), and donkeys (*Equus asinus*). Households within the region typically suffer from low and uncertain incomes and limited financial opportunities (Mendelsohn *et al*. 2002; Collins *et al*. 2009). By Namibian standards, 38% of residents in Kunene are considered impoverished, while 24% are considered severely impoverished, based upon the cost of basic food needs (NNPC 2015), and 31% of residents report no sources of income, while fewer than 35% have access to electricity for lighting at home (NSA 2024). Livelihoods have been further hampered by a downturn in tourism-based income stemming from the COVID-19 pandemic (Lendelvo *et al*. 2020). Social prospects are also limited: Kunene has Namibia's highest primary school drop-out rates, with only 55% of residents completing primary school by age seventeen (UNICEF 2013).

Kunene is one of Namibia's most heavily degraded and drought-prone regions; over-utilisation of rangelands is caused by high concentrations of livestock in specific areas (NNPC 2015). Due to an intensive government borehole-drilling programme during the 1970s, much of the region is considered to be limited by available grazing rather than water (Bollig 2020). From 2000 to 2010, the region experienced a relatively wet period, resulting in wildlife and livestock increases (Owen-Smith 2010; NACSO 2020). From 2011 to 2017, extensive drought caused the decline of livestock numbers by as much as 67% (Heydinger *et al*. 2019), as well as indicator prey species (above). These challenges are likely to be exacerbated in coming years, as Kunene is projected to experience a 2–3°C temperature increase by 2060 (Atlas of Namibia Team 2022).

Background – Communal Conservancies and HLC Interventions

Following independence in 1990, Namibia's Nature Conservation Amendment Act (No. 5/1996) empowered communal area residents to form conservancies. These are gazetted institutions managing natural resources within a defined, community-agreed-upon jurisdiction, where residents may receive monetary benefits from natural resources. Based upon the tenets of CBNRM, communal conservancies stand upon four conceptual pillars: i) sustainable use as a conservation paradigm; ii) market-based valuing of resources (economic instrumentalism); iii) locals empowered with decision-making rights (devolutionism); and iv) local, collective proprietorship of natural resources (Jones & Murphree 2001). Though the intent of the legislation was to provide residents with ownership rights to wildlife, there remains a dearth of research examining the effectiveness of conservancies in Kunene for reconciling rural livelihoods with wildlife conservation.

Among the challenges facing core lion range conservancies has been persistent HLC. As many Kunene conservancies secured tenure to their wildlife, prey species numbers increased; so too did the number of lions and HLC numbers (Stander 2010; GRN 2017). Since 2009, the Namibian government has provided limited financial offsets to communal residents in the form of cash payments through a Human Wildlife Conflict Self Reliance Scheme (HWC SRS) (GRN 2018). Implemented by government, the HWC SRS devolves responsibility to conservancies to report human-wildlife conflict and disperse payments to affected residents. However, the funds made available through this programme only partially offset the cost of livestock losses and 92% of surveyed lion range conservancy members are dissatisfied with the programme (Heydinger *et al*. in press; Heydinger unpublished data).

Endorsed by government in 2017, MEFT's NW Lion Plan provided a series of interventions in addition to the existing HWC SRS. First was re-activating the local Lion Rangers programme, a CBNRM initiative whereby community-appointed conservationists are employed, trained, and equipped to monitor lions and limit HLC within their conservancies (Heydinger 2023). There are currently 49 Lion Rangers across all 11 core lion range conservancies. Based upon other successful CBNRM programmes in Kunene (Hearn 2003; Jacobsohn & Owen-Smith 2003; Muntifering *et al*. 2015), as well as on the Lion Guardians in Kenya and Tanzania (Hazzah *et al*. 2014; Dolrenry *et al*. 2016), Lion Rangers serve as liaisons between their communities and lions inhabiting communal areas.

Second was activating and capacitating five Human-Wildlife Conflict Rapid Response Teams (RRT). Employed by local NGOs, each RRT receives annual Lion Ranger training and is further capacitated with full-time use of a 4x4 vehicle. The primary responsibility of RRTs is to transport Lion Rangers across the landscape, respond to HLC in far-flung areas, and safely chase lions away from farms when other conflict prevention and mitigation measures fail.

Third was up-scaling an existing early-warning system. With the increasing availability of GPS/satellite and VHF collars at relatively affordable prices, research teams and MEFT have collared more than 45 of the region's estimated 57–60 adult lions. These collars provide location fixes relayed via the iridium satellite network to a secure online interface. Lion Rangers, RRTs, permitted researchers, and key government staff receive automated notifications by SMS when collared lions enter designated farming areas. On the ground, collar locations are also communicated to early-warning towers, which have been deployed in key HLC-hotspot farms. Standing 4–5 m tall, these towers alert farmers via bright lights and sirens when lions are within line of sight and are active round-the-clock. There are currently 14 early-warning towers across the landscape.

Finally, predator-proof livestock enclosures (kraals) have been deployed at approximately 120 farms in core lion range conservancies. These kraals are constructed with chain-link fencing and aluminium poles, wrapped in semi-transparent shade-netting, topped with barbed wire at three meters height, all cemented one-half meter into the ground. Predator-proof kraals are a proven method of deterring lions from attacking livestock when livestock are inside, with only one recorded incident of lions penetrating a poorly sited predator-proof kraal since the programme's inception. These kraals serve as a last line of defence, when monitoring and early-warnings fail to alert farmers to lions' presence.

Following the guidelines of the NW Lion Plan, the four interventions began in 2018. From 2016–2021, HLC incidents declined by 33% (MEFT unpublished data). However, early data from 2023 show a 38% *increase* in livestock losses compared to the 2021–2022 average. Our surveys are part of an ongoing effort to assess the reach and effectiveness of HLC interventions and the extent to which they have succeeded in fostering community tolerance of living alongside lions.

MATERIALS AND METHODS

Semi-structured surveys eliciting both quantitative and qualitative information were performed *in situ* at 323 farming homesteads (farms) across 11 communal conservancies in the Kunene Region from November 2021 to February 2022. Survey execution and ethical research practices replicate those previously approved by the University of Minnesota Institutional Review Board ensuring confidentiality and informed consent (see Heydinger *et al*. 2019). Surveys were primarily conducted with the heads of livestock-owning households, in the preferred language of the respondent, including English, Afrikaans, Otjiherero, and Khoekhoegowab. Sampling was limited to one respondent per household, though other family and community members were frequently present, provided input and were encouraged to participate. Surveys typically took 35–45 minutes. Topics included (i) demographic information; (ii) coarse-grain employment and income-source information; (iii) experiences regarding conservancy membership; (iv) household livestock data focusing on quantitative trends; (v) experiences and perspectives of predator species, emphasising lions; (vi) experiences and perspectives of HLC interventions. Responses were quantitative or categorical – e.g. when asked "what type of important benefits are you receiving from your conservancy" – responses were grouped where possible, such as "meat," "money," or "seeds for gardens." For livestock numbers, respondents were encouraged to provide precise quantitative values. However, if respondents were unsure about numbers they were asked to estimate. When a list of possible responses was available – e.g. "how common are lions in your conservancy": a) very common; b) common; c) rare; or d) absent – respondents were given the chance to answer freely. Where responses were categorised – e.g. "how would you describe the problems you have with lions: none, low, moderate, or serious?" – levels for none, low, etc., were not predefined, allowing respondents to use their personal discretion. Attitudes towards lions and HLC interventions were surveyed using a series of Likert Scale responses adapted from Heydinger *et al*. (2019) and were categorised based upon surveyors' discretion. Our approach facilitated open dialogue: whenever possible, comments were used to clarify responses and respondents were encouraged to elaborate. We believe respondents felt empowered to answer each question honestly. Survey protocols, including eliciting informed consent, replicated those previously approved (see Heydinger *et al*. 2019). All responses were recorded on standardised survey forms and captured in Microsoft Excel.

Summary statistical analyses were performed to describe the data. Pearson's second skewness coefficient was used to assess asymmetries in the probability distribution of the data:

$$Sk_2 = \frac{3(\bar{x} - Md)}{s}$$

where $\bar{x}$ = the mean of the sample, Md = the median, and s = the standard deviation. This measure was used due to its robustness in the face of outliers and ability to detect asymmetries in the data (Bruce & Bruce 2017). The coefficient of variation was used to test the relative variability of responses to survey questions:

$$CV = \frac{\sigma}{\mu}$$

where σ = the standard deviation of responses within a conservancy, and μ = the mean of responses within the conservancy. This measure is widely recognised for its versatility in comparing variability in data sets with different scales (Whitehead 2008). Pearson's correlation coefficient was used to test the strength of association between variables as their difference from the expected distribution:

$$r = \frac{\Sigma (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\Sigma (x_i - \bar{x})^2 (y_i - \bar{y})^2}}$$

where x_i = the values of the x-variable in the sample, $\bar{x}$ = mean of the values of the x-variable, y_i = the values of the y-variable in the sample, $\bar{y}$ = mean of the values of the y-variable (Bruce & Bruce 2017). Correlations $0.10 \leq |r| < 0.30$ are considered weak; $0.30 \leq |r| < 0.50$ are considered moderate; $|r| \geq 0.50$ are considered strong. Data were analysed and visualised using Microsoft Excel. Analysis was performed at the landscape and at a conservancy-by-conservancy level. Supplementary analyses are freely available online (Heydinger 2022).

RESULTS

Demographics and Income Sources

A total of 323 respondents from 110 different farming areas were surveyed. Basic demographic information is available in the supporting information (Appendix A). All respondents self-identified their cultural identity. More than 50% of respondents were age 50 or older: this is reflective of targeting the household head or person who could provide the most information about livestock.

Of the 171 people reporting consistent income, only 55 (17% of all respondents) receive consistent income that is primarily derived from sources other than government programmes (i.e. pension or subsidies for children). When only non-salaried or inconsistent incomes were reported, these were classified as occasional income. 95% of respondents (n = 306) reported at least one source of income, 25% (n = 82) reported at least two sources, and 3% (n = 10) reported three or more sources of income. Selling livestock was the most consistently reported source of income (52%; n = 167); an additional 11% (n = 37) reported selling livestock without listing it as an income source, likely indicating money from sale did not meaningfully contribute to a family's livelihood.

Livestock

Overall Trends

Among respondents, 91% (n = 294) reported currently keeping livestock. Summary statistics of livestock ownership are given in Appendix B. The rightward skew of all livestock species indicates livestock ownership is concentrated in certain households. To assess recent changes in livestock numbers, respondents were asked to compare current ownership of each species with the number owned three years ago. For cattle, no one reported an increase, 83% (n = 264) reported a decrease, and 16% (n = 51) reported no change. For sheep, 2% (n = 5) reported an increase, 82% (n = 259) reported a decrease, and 16% (n = 52) reported no change. For goats, 3% (n = 11) reported an increase, 93% (n = 297) reported a decrease, and 4% (n = 12) reported no change. For donkeys, 1% (n = 3) reported an increase, 82% (n = 260) reported a decrease, and 16% (n = 52) reported no change. When asked about the greatest threats to their livestock, the most frequently identified were drought (95%; n = 300) and predators (93%; n = 296).

Declining Numbers

Surveys in Anabeb, Puros, and Sesfontein conservancies (Heydinger *et al*. 2019) serve as a basis of comparison for changes in livestock ownership. Within these conservancies, ownership of cattle, sheep, and donkeys is skewed, being more concentrated within a few wealthier households (Appendix B). Livestock losses over the past decade have exacerbated this concentration. Since the early 2010s, mean cattle numbers have decreased by 97% (87% since 2017), sheep by 89% (72% since 2017), goats by 79% (56% since 2017), and donkeys by 84% (47% since 2017; Figure 2).

Diminished Herd Value

Heydinger *et al*. (2019) asked respondents to estimate the monetary value (in Namibian dollars; NAD) of an average-sized adult female for each livestock species. Based upon these estimates, the median value of a household livestock herd (all species combined) has decreased (Table 2). In 2017, the value of a median livestock herd was NAD 168 091 (USD 9 185; 68% decrease since the early 2010s), and by 2021/2 the value of a median livestock herd was NAD 58 560 (USD 3 200; 89% decrease since the early 2010s; 65% decrease since 2017). The total value of livestock lost across all households is approximately NAD 64.9 million (USD 3.5 million) since the early 2010s, and NAD 16.2 million (USD 883 317) since 2017. Again, these values represent only three of eleven surveyed conservancies.

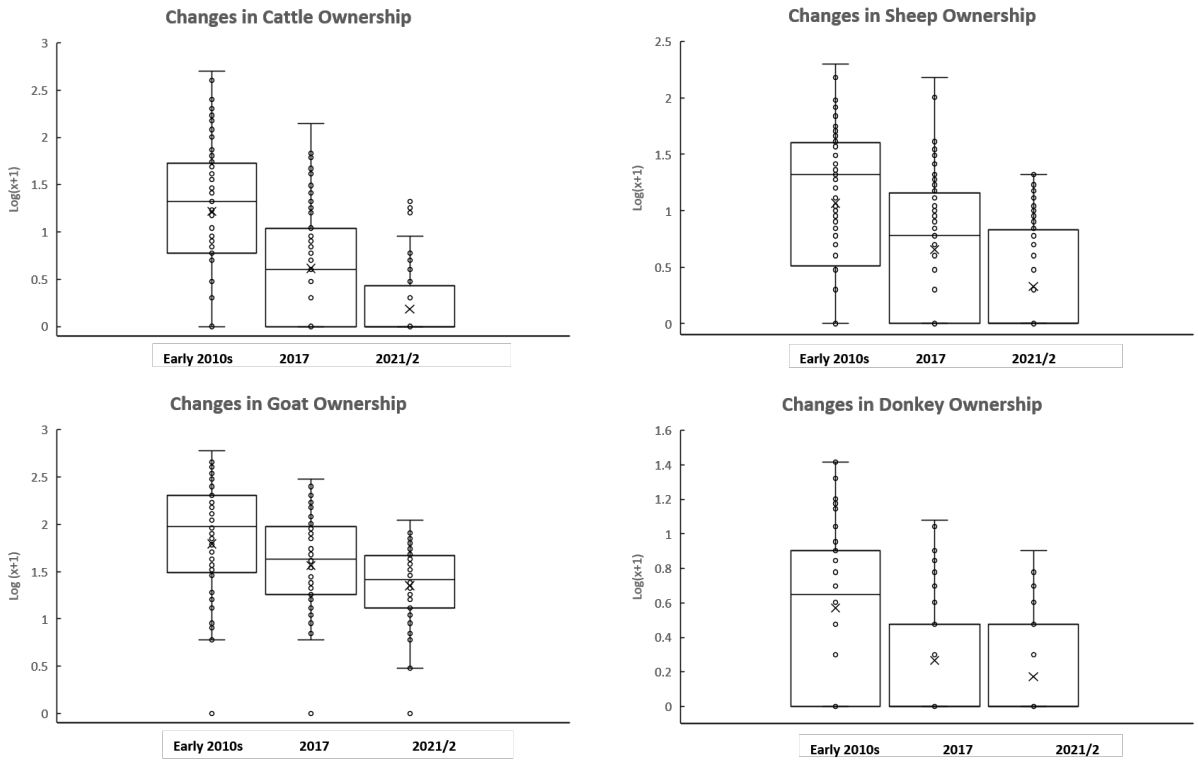

Figure 2: *Changing household-level ownership for each species for Anabeb, Puros, and Sesfontein, comparing 2021/2 ownership with previous survey results (Heydinger* et al. *2019). Responses as to number of relevant species owned have been log(x+1)-transformed for ease of visualisation, where x is the raw value. Boxes indicate interquartile range. Solid horizontal lines within the box visualise median response, while 'X' within the box visualises mean response.*

Table 2: *Changes in livestock ownership for Anabeb, Puros, and Sesfontein conservancies. Mean and median number of livestock owned per household; Skew, Pearson's second skewness coefficient, positive values indicate rightward skew among responses; Min, minimum number owned; Max, maximum number owned; Total, total number owned by all respondents; Responses, number of respondents for each specific type of livestock; Median NAD, the value of the median size herd for that species (cattle = NAD 10,048/head, sheep NAD 1852/head, goats NAD 2,342/head, donkeys = NAD 1519/head; 2022 values, CPI 2023; Oanda 2024).*

Cattle	Early 2010s	2017	2021/2
Mean	48.2	10.3	1.3
Median	25	4	0
Skew	3.622	4.041	3.925
Min	0	0	0
Max	500	140	20
Total	4,003	854	117
Responses	83	83	88
Median NAD	251,204	40,192	0

Sheep	Early 2010s	2017	2021/2
Mean	28.7	11	3.1
Median	20	5	0
Skew	2.430	4.718	1.675
Min	0	0	0
Max	200	150	20
Total	2,381	911	270
Responses	83	83	88
Median NAD	37,075	9,260	0

Goats	Early 2010s	2017	2021/2
Mean	143	71	30.7
Median	100	50	25
Skew	1.253	1.503	0.897
Min	0	0	0
Max	600	300	110
Total	11,867	5,894	2,698
Responses	83	83	88
Median NAD	234,222	117,120	58,560

Donkeys	Early 2010s	2017	2021/2
Mean	5.1	1.6	0.8
Median	4	1	0
Skew	1.731	2.058	1.955
Min	0	0	0
Max	25	11	7
Total	415	129	72
Responses	82	82	88
Median NAD	6,076	1,519	0

Table 3: *Frequency of responses to survey question "what predators do you have the most problems with, starting with the worst" by conservancy. Up to three responses were recorded per respondent. Percentages are relevant to the proportion of responses within a conservancy. Shaded cells indicate which predator species are considered most problematic within each conservancy.*

Conservancy	Lion		Leopard		Spotted hyaena		Black-backed jackal		Cheetah		Number of respondents
	%	n	%	n	%	n	%	n	%	n	
Anabeb	57	17	53	16	67	20	73	22	40	12	30
Doro !Nawas	28	5	67	12	67	12	61	11	33	6	18
Ehi-rovipuka	94	29	42	13	68	21	71	22	6	2	31
≠Khoadi-//Hôas	82	40	22	11	51	25	51	25	24	12	49
Omatendeka	50	16	53	17	72	23	53	17	56	18	32
Orupupa	23	5	45	10	91	20	64	14	23	5	22
Puros	68	21	42	13	81	25	65	20	6	2	31
Sesfontein	48	13	7	2	78	21	59	16	26	7	27
Sorris-Sorris	20	3	40	6	53	8	87	13	13	2	15
Torra	78	36	61	28	41	19	50	23	17	8	46
Tsiseb	5	1	59	13	59	13	59	13	36	8	22
Number of responses		186		141		207		196		82	323

Conservancy Challenges

Lack of Benefits

When asked whether they had received important benefits from their conservancy, 41% (n = 132) replied affirmatively, while 59% (n = 191) said they had not. Positive responses ranged from a low of 18% in ≠Khoadi-//Hôas (n = 9) and Orupupa (n = 4) to a high of 77% (n = 24) in Puros. Conservancy-by-conservancy responses differed from the expected distribution, ($\chi^2 = 50.9$, $p < 0.001$, df = 10, n = 323), indicating a respondent's conservancy was correlated with whether they reported receiving important benefits. When asked to specify benefits, the most frequent response was meat (67%; n = 89) from own-use hunting, followed by food parcels (31%; n = 41), employment (17%; n = 22), and access to water (16%; n = 21). When asked to identify the biggest challenges facing conservancy residents, the most frequent response was drought (51%; n = 165), followed by human-wildlife conflict (32%; n = 104), and predators (29%; n = 93). Though human-wildlife conflict encompasses a wider range of challenges than predators, there may have been overlaps in what respondents sought to convey in these responses – i.e. those responding human-wildlife conflict may have been including problems with predators in their response.

Predator Conflict

Livestock losses

When asked, "how often are you losing livestock to predators" 84% (n = 262) reported "at least a few times per year," while 66% (n = 207) reported a near-monthly basis. 99% (n = 310) reported having lost livestock to predators at some point. When asked whether they had ever received financial offsets for lost livestock through the HWC SRS, 37% (n = 112) of respondents stated yes, 51% (n = 166) have not, and a further 7% (n = 24) were unsure of receiving offsets or unaware of the programme.

Problematic Predators

When respondents were asked, "what predators do you have the most problems with, starting with the worst" lions were the species most frequently identified as the most problematic (38%; n = 123), spotted hyaena (*Crocuta crocuta*) were second (26%; n = 82), and black-backed jackal (*Canis mesomelas*) were third (15%; n = 48). When respondents were given the opportunity to name up to three problematic species, spotted hyaena were the most frequently identified (64%; n = 207), followed by black-backed jackal (61%; n = 196), and lion (58%; n = 186). Table 3 summarises conservancy-by-conservancy response frequency, when up to three responses were included. Answers differed between conservancies ($\chi^2 = 130.97$, $p < 0.001$, df = 10, n = 323), indicating a significant relationship between a respondent's conservancy and which predators they considered among the most problematic. Assessed on a species-by-species basis, there was an association between a respondent's conservancy and whether they considered lions ($\chi^2 = 38.44$, $p < 0.001$, df = 10, n = 323), leopard (*Panthera pardus*) ($\chi^2 = 21.09$, $p = 0.02$, df = 10, n = 323), and cheetah (*Acinonyx jubatus*) ($\chi^2 = 26.87$, $p < 0.01$, df = 10, n = 323) among the most problematic. For other species, the association between conservancy and species did not differ significantly from expected.

Respondents differ as to how common they believe lions are within their conservancy (Table 4). Conservancy-by-conservancy, responses differed from the expected distribution ($\chi^2 = 250.6$, $p < 0.001$,

Table 4: *Summary of responses to survey question: "how common are lions in conservancy". Values are the percentage of respondents stating lions are Very common, Common, Rare and Absent in their conservancy.*

Conservancy	Very common %	Common %	Rare %	Absent %	Number of respondents
Anabeb	63	27	10	0	30
Doro !Nawas	0	17	61	22	18
Ehi-rovipuka	58	19	23	0	31
≠Khoadi-//Hôas	31	52	17	0	48
Omatendeka	22	31	41	6	32
Orupupa	0	0	32	68	22
Puros	45	26	29	0	31
Sesfontein	73	27	0	0	26
Sorris-Sorris	0	21	57	21	14
Torra	20	47	33	0	45
Tsiseb	5	5	24	67	21
Number of responses	102	92	86	38	318

df = 10, n = 318). Though respondents were not asked to define what was meant by "very common," "common," etc., previous research indicates current lion prevalence is considered relative to past lion prevalence (Heydinger *et al*. 2019, Heydinger *et al*. in press).

Respondents differ as to how common they believe lions are within their conservancy (Table 4). Conservancy-by-conservancy, responses differed from the expected distribution ($\chi^2 = 250.6$, $p < 0.001$, df = 10, n = 318). Though respondents were not asked to define what was meant by "very common," "common," etc., previous research indicates current lion prevalence is considered relative to past lion prevalence (Heydinger *et al*. 2019, Heydinger *et al*. in press).

Lack of Benefits

When asked, "do you benefit from having lions in your conservancy" 76% (n = 248) responded "no". When asked, "how would you describe your attitude towards lions" 17% (n = 58) responded positively, while 57% (n = 190) described their attitude as negative. From conservancy to conservancy, responses differed significantly from the expected distribution ($\chi^2 = 104.11$, $p < 0.001$, df = 10, n = 321). There was a moderate positive correlation between whether or not a respondent reported benefiting from lions and their attitude towards lions ($r = 0.44$, $p < 0.001$, n = 312). When asked, "how serious a problem are lions in your conservancy" 54% (n = 175) considered lions to be a serious problem, 14% (n = 44) considered lions a moderate problem, while 30% (n = 98) considered lion problems to be low, or stated there were no lions in their conservancy. Responses differed significantly from conservancy to conservancy ($\chi^2 = 223.8$, $p < 0.001$, df = 10, n = 317).

When asked, "is it important for there to continue to be lions in your conservancy" 60% (n = 187) of respondents stated "no," 28% responded "yes," and 12% described their feelings as neutral or were unsure. There was a moderate correlation between whether a respondent benefited from having lions in their conservancy and whether they felt it was important for lions to persist in their conservancy ($r = 0.41$, $p < 0.001$, n = 302).

Knowledge and Perceived Effectiveness of HLC Interventions

Responses varied by conservancy as to respondents' level of engagement by, and attitudes towards HLC interventions (Figure 3; Table 5). Respondents differed across conservancies as to whether the Lion Rangers ($\chi^2 = 58.45$, $p < 0.001$, df = 10, n = 323) or RRTs ($\chi^2 = 70.05$, $p < 0.001$, df = 10, n = 320) had visited a respondent's farm, or whether a respondent had the early-warning system ($\chi^2 = 28.89$, $p < 0.01$, df = 10, n = 321) or a predator-proof kraal ($\chi^2 = 46.24$, $p < 0.001$, df = 10, n = 321) at their farm, signalling an association between a respondent's conservancy and the presence of that intervention (Figure 3). There was a strong positive correlation between positive attitudes towards the Lion Rangers and whether Lion Rangers had visited a respondent's farm ($r = 0.59$, $p < 0.001$, n = 320). There was a moderate positive correlation between positive attitudes towards the RRTs and whether RRTs had visited a respondent's farm ($r = 0.39$, $p < 0.001$, n = 317). By comparison there was a small but significant positive correlation between attitudes towards the early-warning system and whether respondents had the system installed at their farm ($r = 0.19$, p < 0.001, n = 306) and a non-significant correlation between attitudes towards predator-proof kraals and whether a respondent had a predator-proof kraal at their farm ($r = 0.002$, p = 0.96, n = 306).

Table 5: *Extension and perceived effectiveness of HLC interventions by conservancy. Values given indicate percent response.*

Conservancy	Have you heard of the Lion Rangers?			Have the Lion Rangers ever visited your farm?			What is your attitude towards the Lion Rangers?			Have you heard of the HWC Rapid Response Teams?			Have the HWC Rapid Response Teams ever visited your farm?			What is your attitude towards the HWC Rapid Response Teams?*		
	Yes	No	Unsure	Yes	No	Unsure	Pos	Neg	Unsure	Yes	No	Unsure	Yes	No	Unsure	Pos	Neg	Unsure
Anabeb	93	3	3	73	27	0	69	3	28	97	3	0	97	3	0	77	10	13
Doro !Nawas	78	22	0	61	39	0	61	0	39	61	39	0	33	67	0	17	17	67
Ehi-rovipuka	90	6	3	71	23	6	55	6	39	52	42	6	39	52	10	29	6	65
≠Khoadi-//Hôas	65	35	0	27	73	0	29	4	67	82	16	2	49	49	2	35	31	35
Omatendeka	88	9	3	50	41	9	50	6	44	56	34	9	38	53	9	38	6	56
Orupupa	32	59	9	9	82	9	9	0	91	5	90	5	0	95	5	5	0	95
Puros	100	0	0	48	52	0	71	10	19	87	13	0	43	57	0	65	6	29
Sesfontein	96	4	0	63	37	0	56	7	37	59	37	4	42	54	4	41	15	44
Sorris-Sorris	60	40	0	40	60	0	47	0	53	60	40	0	40	60	0	47	0	53
Torra	85	15	0	52	46	2	54	13	33	78	22	0	46	50	4	42	7	51
Tsiseb	59	41	0	45	55	0	55	0	45	18	82	0	18	82	0	23	0	77
Mean	79	20	2	49	49	2	50	6	44	64	33	2	43	53	3	40	11	50
Standard dev	0.198	0.187	0.027	0.181	0.175	0.037	0.169	0.042	0.189	0.265	0.257	0.031	0.223	0.218	0.035	0.195	0.087	0.219
Number of responses	255	63	5	158	157	8	161	18	143	206	107	8	138	171	11	127	34	160
Total responses	323			323			322			321			320			321		

Conservancy	Have you heard of the Early-Warning System?			Do you have the Early-Warning System at your farm?			What is your attitude towards the Early-Warning System?			Have you heard of predator-proof kraals?			Do you have a predator-proof kraal at your farm?			What is your attitude towards predator-proof kraals?*		
	Yes	No	Unsure	Yes	No	Unsure	Pos	Neg	Unsure	Yes	No	Unsure	Yes	No	Unsure	Pos	Neg	Unsure
Anabeb	83	13	3	20	77	3	76	0	24	100	0	0	30	70	0	90	7	3
Doro !Nawas	61	39	0	0	100	0	56	0	44	83	17	0	11	89	0	61	6	33
Ehi-rovipuka	58	42	0	19	77	3	62	0	38	97	3	0	55	45	0	83	3	14
≠Khoadi-//Hôas	36	62	2	6	91	2	28	2	70	88	13	0	31	67	2	53	19	28
Omatendeka	53	44	3	0	97	3	58	0	42	100	0	0	28	72	0	97	3	0
Orupupa	10	90	0	0	100	0	21	0	79	32	68	0	0	100	0	64	0	36
Puros	84	16	0	29	71	0	68	6	26	100	0	0	19	81	0	94	0	6
Sesfontein	56	44	0	7	93	0	52	0	48	96	4	0	19	81	0	85	7	7
Sorris-Sorris	40	60	0	13	87	0	40	0	60	87	13	0	14	86	0	73	0	27
Torra	52	48	0	15	83	2	26	7	67	96	4	0	53	47	0	73	12	15
Tsiseb	41	59	0	18	77	5	59	0	41	64	36	0	18	82	0	73	0	27
Mean	53	46	1	12	86	2	48	2	50	88	12	0	29	71	0	77	7	17
Standard dev	0.201	0.205	0.013	0.093	0.098	0.017	0.174	0.026	0.17	0.199	0.199	0	0.160	0.161	0.006	0.134	0.058	0.122
Number of responses	170	147	3	39	276	6	149	6	153	283	38	0	93	226	1	238	21	52
Total responses	320			321			308			321			320			311		

* Pos = positive; Neg = negative; Unsure = neutral/unsure.

For all HLC interventions, there was a weak positive or non-significant correlation between a respondent's attitude towards lions and whether an intervention had been or was currently present at their farm. There was a small but significant positive correlation between whether a respondent stated they were benefiting from having lions in the conservancy and whether they had an early-warning tower ($r = 0.23$, $p < 0.001$, $n = 312$), or predator-proof kraal at their farm ($r = 0.14$, $p < 0.05$, $n = 311$).

DISCUSSION

The overall picture emerging from these surveys is one in which CBNRM's economic instrumentalism is struggling to deliver. Livestock losses, diminished prey numbers, inadequate financial offsets following human-wildlife conflict, and inconsistent benefit distribution each undermine the economic pillar of the conservancy system (Jones & Murphree 2001). This appears to be negatively affecting not only livelihoods, but attitudes towards certain wildlife and the conservancy system.

Livelihood Effects of Livestock Losses

Livestock losses across core lion range conservancies have dramatically compromised the livelihoods and household wealth of farmers. Respondents point to the effects of drought and predators as the drivers of such losses. Such losses appear to be concentrated:

effectively exacerbating inequalities between relatively poor and well-to-do households. Because selling livestock is the most common source of income, livestock deaths compromise human wellbeing. Such losses seem to coincide with diminished rainfall since 2011. Our field work indicates that these losses are typical across Kunene's communal lands, while declines in prey species have been region-wide over the same period. In a country-wide analysis of human-wildlife conflict impacts within Namibia's communal conservancies, Tavolaro *et al*. (2022) found a strong negative correlation at the conservancy level between annual reports of livestock depredation and estimated ungulate abundance. In the context of northwest Namibia's decreased rainfall since the mid-2010s, drought may both be limiting livestock numbers and increasing the risk to livestock from predators as they struggle to secure enough wild prey to meet their energetic requirements. As Tavolaro *et al*. (2022) found no predictor variable for reported livestock depredation by lions, further research is needed to ascertain the linkages between livestock depredation by lions and decreased prey numbers during drought. Additionally, decreased ecosystem productivity affects not only wildlife, but livestock ranging patterns. By deploying GPS/satellite collars on livestock herds, Muzuma (2024) reveals how shared "lion-goat" space may be driving conflict in proposed wildlife movement corridors. As elsewhere in Africa, increased human population growth may further exacerbate human-lion interactions. The recently completed Namibia national census reveals a nearly 40% human population increase in the Kunene Region from 2011 to 2023 (NSA 2024).

Livestock losses to predators have affected 99% of households, including two-thirds on a near-monthly basis. Yet, financial offset payments from the HWC SRS are not reaching most pastoralists, and those that do reach the ground are often inadequate to replace the value of livestock lost (Heydinger *et al*. 2019). Comments from respondents indicate that offsets are rarely delivered, and that even when payments are made, they are too little and too late in coming, sometimes years late. Among those respondents

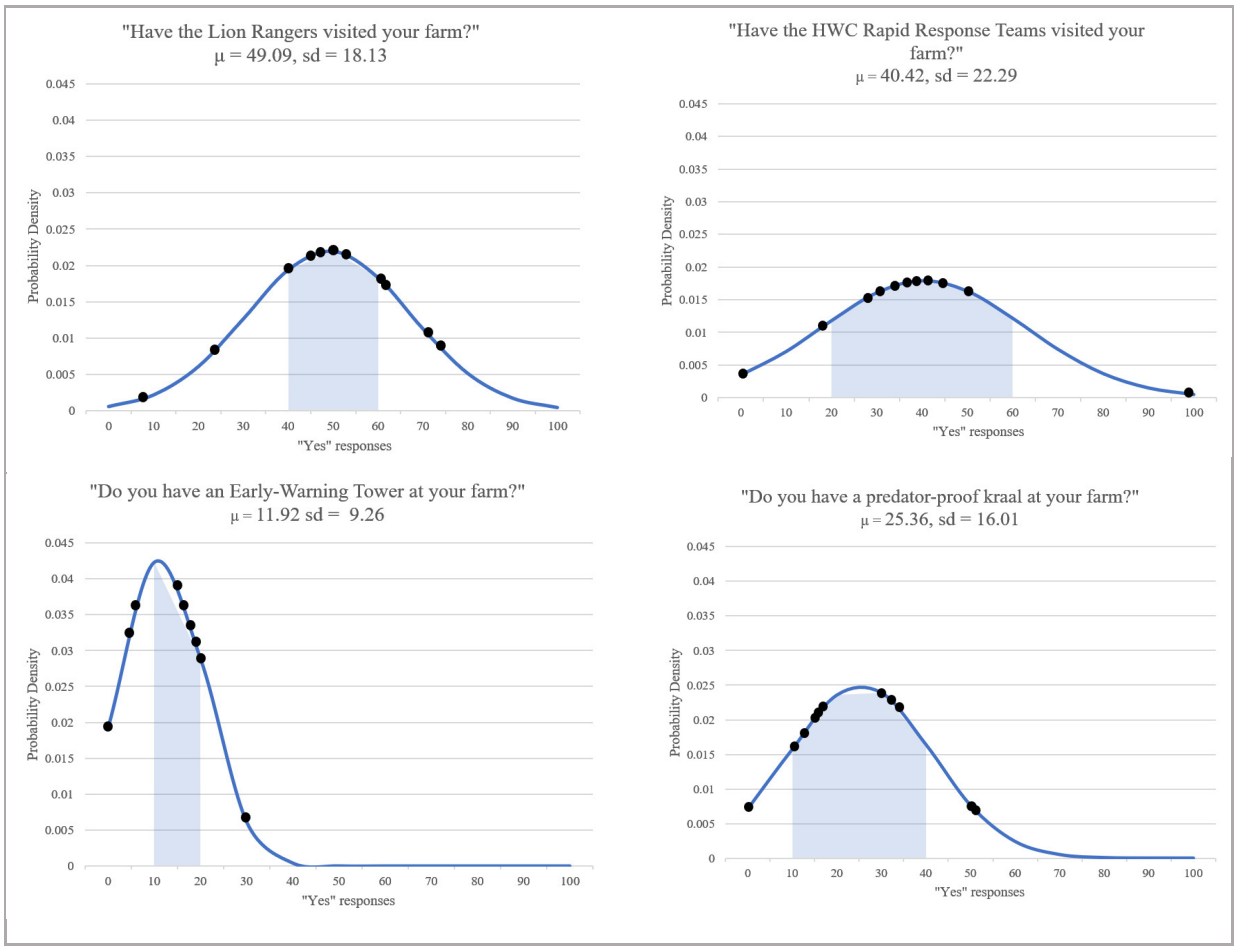

Figure 3: *Presence of HLC interventions across the landscape, by conservancy. Each point represents percentage of "yes" responses by conservancy, while the apex of the curve represents the mean. The blue line shows normalised distribution of responses and the shaded area indicates one standard deviation from the mean.*

critical of the offset payment system, many deemed the process by which claims are recorded, submitted, assessed, and potentially paid out as driven by local politics and favouritism. Problems surrounding power-sharing and equitability bedevil conservancy politics in northwest Namibia, including those inhabited by survey respondents (Heffernen 2022). While the structures of HWC SRS are meant to depoliticise offset payments at a national level, local power structures and management difficulties can undermine the programme's effectiveness.

Inadequate Conservancy Benefits

Livelihood challenges are further exacerbated by a lack of conservancy benefits. Those receiving benefits most frequently cited meat or food distribution, though many stated such benefits have declined since the drought and COVID-19 pandemic. Hunting by conservancies, whether for own-use and shoot-and-sell, or for trophy-hunting quotas, has also been greatly curtailed in recent years due to declining wildlife numbers (NACSO 2020), meaning that just as livelihoods are suffering from declining livestock numbers, conservancy benefits have also ebbed. Even so, the extent to which benefits (e.g. from hunting) had previously reached conservancy residents was already limited. A case study by Turpie and Letley (2021), emphasised accountable payment mechanisms within Namibian conservancies as an important part of ensuring residents were responsive to potential incentives stemming from natural resources. They show that inadequate internal oversight of financial systems compromises residents' trust in conservancy structures.

While CBNRM programmes have had mixed success in delivering benefits to participants (Dressler *et al*. 2010), it is logical that conservancy structures undermining participants' existing financial prospects, such as the keeping of livestock, will generate negative local attitudes. The misalignment of the costs incurred by conservancy members and the benefits accruing at the conservancy level, or to private firms such as tourism operators, calls into question whether conservancies are appropriate for housing potentially dangerous wildlife (Jones & Murphree 2004). The realisation of benefits, whether monetary or non-monetary, are part of the conceptual foundations upon which conservancies are built (Murphree 2008). Where monetary benefits are lacking, feelings of ownership leading to effective stewardship may provide an emotive foundation for communities to conserve, but communities must then be even *more empowered* to manage wildlife (Murphree 1989), rather than being constrained by external social and political forces. Whether conservancies were ever intended to provide meaningful rural socio-economic development has been called into question (Murombedzi 2012). The forthcoming Wildlife and Protected Areas Management Bill aims to devolve greater authority over wildlife use and clarity on land-use designations within communal areas, while promoting sustainable resource use and management, though this legislation has been under discussion for some time (Odendaal 2024).

Challenges from Predators

Challenges presented by predators reveal subtle differences across the survey landscape. Lions are considered the most problematic predator by the greatest number of respondents (38%). This may be due to a culturally mediated fear of lions (Heydinger *et al*. in press). It may also be due to lions killing multiple livestock per HLC incident. In recent years such 'mass-casualty' events have received nation-wide news coverage (Hartmann 2017, 2018). However, when respondents were asked to name up to three problematic predators, more respondents identified spotted hyaena (64%) and black-backed jackal (61%) than lions (58%). The association between a respondent's conservancy and whether they considered lions among the most problematic predators indicates that lion problems are spatially heterogeneous. No such association exists for spotted hyaena and jackals. The conservancies in which lions are considered most problematic are also those conservancies in which they are said to be the most common. Though spotted hyaena and jackal conflict receive less attention, more households might potentially benefit from interventions relevant for limiting human-hyaena and human-jackal conflict.

Attitudes Towards Lions

Perceptions of lions' occurrence coincide with lion monitoring data. Results from a lion population survey (Muzuma & Heydinger 2024) completed nearly one year after these social surveys, found lions were absent from Doro !Nawas, Orupupa, Sorris-Sorris, and Tsiseb conservancies. These are the only conservancies in which > 50% of respondents considered lions to be rare or absent – suggesting local pastoralists maintain some understanding of lion movements and prevalence. Though population surveys of other predators have not been attempted, local perceptions of, e.g., leopard, hyaena, or cheetah might be a useful starting point for estimating their population sizes.

Examined attitudes towards lions are most strongly correlated to whether respondents reported benefiting from them; this suggests a foundation for more proactive interventions focusing on financial benefits, rather than only limiting conflict. A recently implemented Wildlife Credits programme, whereby conservancies receive monetary benefits for living alongside lions based upon lion movement data (Heydinger *et al*. 2022; Conservation Namibia 2023),

may increase the number of respondents receiving benefits from lions. However, elsewhere in Namibia and neighbouring countries, increased tolerance for wildlife has been primarily linked to nonmonetary, rather than monetary benefits within CBNRM settings (Kansky *et al*. 2020). Why lions persist in certain conservancies may be driven by local tolerance for their presence, as well as by ecological conditions: lions have been shown to be adept at identifying and navigating through "corridors of [human] tolerance" (Dolrenry *et al*. 2020).

While our previous survey found 76% of respondents felt it was important for lions to continue to exist in their conservancy, 60% of respondents to our current survey felt it was *not* important for lions to continue to exist. The number of respondents stating they do not benefit from lions mirrors the previous survey (84%). We cannot attribute the difference in these results to changed geographic scope of our survey versus the previous one. Instead, the decline may have resulted from the added harms from livestock predation on top of the continued impacts of prolonged drought. An alternate possibility is that the existence of HLC interventions has raised the profile of HLC as a local issue with sociopolitical valence: in effect making people more critical of lion presence because they know HLC receives government and NGO attention (Heydinger *et al*. in press). Negative responses by people to human-wildlife conflict often reflect human-human relationships, such as political and socio-economic inequalities, or contrasting values, beliefs, or attitudes (Dickman 2010; Redpath *et al*. 2015). Follow-up surveys will be needed to further interrogate drivers of human attitudes towards lions and other potentially dangerous wildlife (Dickman *et al*. 2014). Among other topics these will include how respondents' sources of information are changing: e.g. our on-the-ground work increasingly finds social media to be a fount of, often inaccurate, information.

Extent of HC Interventions

HLC interventions appear to have had an uneven effect. While respondents generally viewed HLC interventions – the Lion Rangers, RRTs, early-warning system, and predator-proof kraals – favourably, many respondents were unaware of their existence. For the Lion Rangers (44%), RRTs (50%), and early-warning system (50%), approximately half of respondents stated a neutral or unsure attitude towards them – primarily because the respondent felt uninformed of their existence. While much of this can be attributed to interventions being spatially concentrated within HLC 'hotspots,' increasing deployment of these interventions, and better communication regarding their purposes, is needed. Interventions were not evenly distributed across conservancies, though it is worth noting these interventions have continued over the ensuing two-plus years. Simultaneously, attention should be paid to how the implementation of HLC interventions have transformed the social and political contexts of HLC (Jones & Murphree 2004). The existence of a strong positive correlation between attitudes towards the Lion Rangers and whether Lion Rangers had visited a respondent's farm suggests that greater landscape coverage by the Lion Rangers will improve not only awareness but attitudes. Yet, with no correlation between the presence of interventions and attitudes towards lions, simple proximity may not foster tolerance of lions.

To date approximately 120 predator-proof kraals have been erected at conservancy farms, free of charge to the livestock owners. These kraals have been provided specifically as a remedy to HLC. Yet, few pastoralists connect predator-proof kraals with the presence of lions within the landscape or connect predator-proof kraals with benefits from the presence of lions. Lion Rangers and other conservation personnel can engage with pastoralists to facilitate greater understanding of conservation benefits due to lions. Because predator-proof kraals are so positively received, their provision might best foster improved attitudes towards living with lions.

Supporting Livelihoods for Conservation

The overall picture is one in which pastoralists' livelihoods are in trouble in core lion range conservancies; echoing similar economic findings within the region (NNPC 2015; NSA 2021; IFRC 2022). While livelihoods have unquestionably been hampered by the recent drought, conservancies and supporting organisations are also not providing meaningful benefits to many residents. By eroding the economic instrumentalist pillar of the conservancy system, a lack of monetary benefits is already forcing many residents to question each conservancy's purpose. These challenges are exacerbated by HLC and conflict with other carnivore species. The current challenge is how to increase benefits without further sacrificing already degraded environments (NNPC 2015; Inman 2020a, 2020b) and diminished wildlife numbers, all under the shadow of environmental transformations stemming from climate change (Atlas of Namibia 2022). HLC interventions may provide limited mitigation, but these approaches require further refining, including strengthening of conservancy structures. More work and greater creativity will be needed to simultaneously support local livelihoods while fostering positive attitudes towards lions by limiting the negative outcomes of HLC.

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Appendix A: *Summary of demographic and livelihood information for respondents.*

Conservancy	**Number of respondents**	**% of respondents**
Anabeb	30	9.3
Doro !Nawas	18	5.6
Ehi-rovipuka	31	9.6
≠Khoadi-//Hôas	49	15.2
Omatendeka	32	9.9
Orupupa	22	6.8
Puros	31	9.6
Sesfontein	27	8.4
Sorris-Sorris	15	4.6
Torra	46	14.2
Tsiseb	22	6.8
TOTAL	323	100
Sex	**Number of respondents**	**% of respondents**
Male	210	65.6
Female	110	34.4
TOTAL	320	100
Cultural identification	**Number of respondents**	**% of respondents**
Herero	112	34.7
Himba	68	21.1
Damara	111	34.4
Riemvasmaker	14	4.3
Nama	5	1.5
Other	9	2.8
No response	4	1.2
TOTAL	323	100
Family size (median)		**Median**
Number of children		5
Number of grandchildren		2
Age range	**Number of respondents**	**% of respondents**
20–29	20	6.2
30–39	61	18.9
40–49	56	17.3
50–59	72	22.3
Pensioner*	104	32.2
Not recorded	10	3.1
TOTAL	323	100
Do you have income?	**Number of respondents**	**% of respondents**
Yes	179	55.8
Occasional	127	39.6
No	15	4.7
TOTAL	321	100
Sources of livelihood‡	**Number of respondents**	**% of respondents**
Pension	110	34.1
Selling livestock	167	51.7
Subsidies for children	27	8.4
Conservancy employee	21	6.5
Government salary	7	2.2
Tourism employee	12	3.7
Other (e.g. selling crafts)	33	10.2
TOTAL	377	

*Respondents either stating they were over 60 years of age or stating they did not know their age but estimated to be over 60, were recorded as pensioners.
‡Numerous respondents indicated multiple livelihood sources.

Appendix B: *Summary statistics of livestock ownership for all respondents. Mean and median number of livestock owned; skew, Pearson's second skewness coefficient, positive values indicate rightward skew among responses; min, minimum number owned; max, maximum number owned; total, total number owned by all respondents; count, number of respondents.*

Parameter [1]	**Cattle**	**Sheep**	**Goats**	**Donkeys**
Mean	4.5	8.2	38.3	0.9
Median	0	0	25	0
Skew	3.98	3.15	3.14	2.41
Min	0	0	0	0
Max	94	110	361	11
Total	1 460	2 646	12 329	276
Count	322	322	322	322