CAPE LEOPARD TRUST

Mobi-kraal

A CAPE LEOPARD TRUST INITIATIVE

Conservation Kraal Challenge

Competition Guide

Testing Innovative Solutions to Improve Human-Predator Coexistence in Agricultural Landscapes

Mobi-kraal

A CAPE LEOPARD TRUST INITIATIVE

The Conservation Kraal Challenge seeks innovative designs for the “Mobi-Kraal” - an affordable, durable and mobile predator-proof kraal that will encourage coexistence between people and predators within agricultural landscapes by reducing livestock losses and protecting predators, biodiversity and critical ecosystems. Use your creativity and engineering know-how to conserve wildlife and to provide a practical solution to present to farmers suffering from stock losses.

The Conservation Kraal Challenge will be open for entries from 1 February to 30 June 2024. Participants stand a chance to win a cash prize of up to R50 000, and travel and accommodation costs valued at R 20 000 to help the Cape Leopard Trust develop and test their design.

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Contents

Foreword

This Guide provides an overview of the Conservation Kraal Challenge competition objectives, requirements, judging criteria and additional resources. A thorough understanding of this Guide and linked material should be gained before beginning the design process.

Please make note of the following:

- Teams must submit their entry through the online Entry Portal in the format laid out in Section 4 of this Guide between 1 February and 30 June 2024. Late submissions will not be accepted.
- Any additional queries regarding interest, registration or entry submission processes or requirements can be directed to mobikraal@capeleopard.org.za.

Registering for and submitting an entry to this competition will require acceptance of the Conservation Kraal Challenge Terms and Conditions. Completed submissions imply acceptance of the criteria of the competition as stated in this Guide brief and as clarified via query if necessary.

1. Competition Objectives

1.1. Introducing the Challenge

In the Western Cape, South Africa, leopards are the last free-roaming large predator, and the majority of potential habitat available to them is adjacent to crop and livestock farms and small towns (Beinart, 1998; Martins & Harris, 2013; Mann et al., 2019; Amin et al., 2022). Living in these shared agricultural spaces presents challenges, both for leopards and for people. The same can be said for the majority of South Africa's larger predator species that occupy areas in close proximity to livestock farming areas (Seoraj-Pillai & Pillay, 2017). Predators may opportunistically hunt livestock, causing significant economic damage (Van Niekerk, 2010; Kerley et al., 2018). Depredation or the threat of depredation has severe, multi-faceted effects on farmers economically, socially and emotionally. The cost of losing a cow calf or sheep, which are sometimes killed by predators in large numbers, can be devastating for farmers (Van Niekerk, 2010; Kerley et al., 2018). Not only does the farmer lose the animal's purchase or selling value, but also its future breeding potential.

If farmers do not have access to affordable and effective methods to prevent conflict, predators may be killed by farmers in retaliation using lethal measures

(Kissui, 2008; Thorn et al., 2013b; McManus et al., 2015; Drouilly et al., 2023), such as gin traps, guns and poisons, to eliminate the threat to their livestock. In addition, it establishes a negative connotation towards interactions with predators, and they are then labelled as enemies making it difficult to convince farmers that predators are necessary in the landscape to maintain a healthy ecosystem balance. Conflict with livestock has been shown to be a significant contributor to declining predator populations due to retaliatory killings after perceived and realised economic loss (Swanepoel et al., 2014; Lichtenfeld et al., 2015; LeFlore et al., 2019). When the livestock depredation rate increases, so does the rate of predator persecution in many cases (Ogada et al., 2003).

Research indicates that illegal retaliatory behaviour against predators blamed for livestock losses is often underreported but it is common, especially by people experiencing regular or high financial losses (Ogada et al., 2003; Thorn et al., 2013a; McManus et al., 2015). The reduction or outright removal of large predators from an area reduces both competition and predation for smaller predators and prey species (Owino, 2015), resulting in an imbalance of ecosystem structure that may have knock-on effects for biodiversity and ecosystem services relied upon by humans (e.g. crop pollination, water retention, etc.).

A radical and creative strategy is required to transform negative interactions between people and wildlife into mutually holistic coexistence. To be effective, this strategy needs to be devised and executed in partnership with people living in agricultural landscapes, and scalable.

1.2. Innovating a beneficial solution

Coexistence between people and predators within agricultural landscapes requires a change in the way communities interact with nature, produce food and perceive predators. Proactive mitigation measures that could prevent livestock losses and conflict are often overlooked yet should be prioritised on the conservation agenda. Herding of livestock remains one of the best mitigation strategies to prevent livestock depredation. However, herders cannot effectively protect livestock at night, when most predators are active. The best solution in many cases is to secure livestock in a predator-proof kraal (protective enclosure) overnight (Ogada et al., 2003; Woodroffe et al., 2007; Owino, 2015; Lichtenfeld et al., 2015; Manoa, 2016; Kerley et al., 2018; Van Eeden et al., 2018), especially when animals are young or vulnerable. A predator-proof kraal protecting livestock at night also makes herding a more attractive option for many farmers, which in turn can aid job creation and more economic options for rural communities.

For many farmers a permanent structure is not a viable option as livestock may roam over large mountainous areas and farmers may need to continually shift their herds to prevent overgrazing and the spread of disease. Through discussions with

farmers in leopard conflict areas, the Cape Leopard Trust (CLT) has identified the need for an affordable, mobile, predator-proof kraal to better protect livestock from predation, to safeguard environmental integrity, improve food security and farmer predator interactions. Investigations reveal that there is a significant gap in the market for an effective and mobile (light and easy to assemble) predator-proof kraal aimed at both the communal and commercial farming sectors. Mobile predator-proof kraals currently on the market are expensive and cumbersome to move, and/or are not suitable for rugged terrain or windy conditions. As such, farmers leave herds out overnight or resort to making their own rudimentary structures, which are often vulnerable to predation.

Ultimately an improved and more affordable kraal design will promote human-predator coexistence, enabling many South Africans to farm alongside predators, with a more positive mindset. A freely available blueprint would allow livestock farmers and conservation organisations the opportunity to facilitate their own construction of an extra tool for their depredation mitigation toolbox. Although the aim of the CLT focuses on the continual survival of leopards, this solution ultimately advances multi-species conservation. Reduced livestock losses will protect predators, biodiversity and critical ecosystems, and improve food and income security.

1.3. Specific Objectives

The specific objectives of this competition are to:

i) Provide participants across a wide range of disciplines the opportunity to provide an innovative solution to a community problem that impacts both food and income security and predator conservation, by facilitating the design of the "Mobi-kraal" – an affordable, durable and mobile predator-proof kraal;

ii) Allow the winning team an opportunity to assist with development and/or field testing of their design;

iii) Make the design for a tested Mobi-kraal publicly available to provide the livestock farming community with a potentially affordable, manageable solution to depredation by multiple predator species.

2. Competition Framework

2.1. Scope

The CLT Conservation Kraal Challenge will be launched as a national ideas competition, where eligible participants or teams may register and enter one digital design for a Mobi-kraal, as per the parameters outlined in Section 4 of this Guide. The competition does not require the building and/or testing of the design by the participants as part of their entry for judgement - if a participant wishes to do so, this will be at their own cost and will not be considered part of their submission. The winning design will receive a cash prize of up to R50 000 and a one-week trip within the Western Cape (including local travel and accommodation allowance) to the value of R20 000, to grant the winning individual or team members the opportunity to join the journey from concept to creation. The winning design will be rigorously tested in field, the cost of which will be subsidised by the CLT. Once a working design has been successfully tested, the blueprint will be made publicly available for livestock farmers across the world to incorporate into or inspire their predator mitigation toolboxes.

2.2. Timeline

Applications open:	1 February 2024
Applications close:	30 June 2024
Judging period:	1 to 30 July 2024
Winners announced:	10 August 2024
Winning concept testing:	January to December 2025

2.3. Eligibility requirements

This competition is open to those meeting the following requirements:

- All participants and team members must be South African citizens, or a permanent residents of South Africa;
- All participants must be 18 years or older at the time of entry;
- Participants may enter as individuals or as teams of no more than 5 people;
- Participants may not be part of more than one team or individual competition entry;
- The competition is open to participants across multiple disciplines, however it is recommended that participants have some degree of engineering, agricultural and/or conservation experience;

- Teams may be made up of multidisciplinary expertise and varying degrees of qualification, including students, professionals and amateurs;
- Anyone employed by, affiliated with or closely related to (i.e. spouse, parent, child, sibling, grandparent, and "step" child) the CLT or member of the judging panel will not be eligible to compete or assist participants.

2.4. Submission requirements

All entries submitted for consideration in this competition must fall within the conditions outlined in the Submission Details in Section 4. Additionally, submissions will not be considered if the following minimum requirements are not met:

- All individuals and teams must read through and agree to the Conservation Kraal Challenge Terms and Conditions during the entry submission process;
- Only one design may be submitted by each registered participant/team. The identities of each member of a team must be provided on registration. Note that personal and contact information will not be used outside of the stipulated competition framework;
- All entries must be submitted digitally via the Entry Portal as specified in Section 4;
- Designs submitted for entry must be original, and may not infringe on existing design copyrights, intellectual property rights or patents.

2.5. Judging process

An independent judging panel consisting of industry professionals (from engineering, conservation and agricultural fields) is assigned for this competition. To ensure fair judgement and anonymity, submissions will be received only by the CLT competition organisers and the identity of the participants will be replaced with assigned number codes before submission to the judging panel. Any entries that do not meet the eligibility and submission requirements listed in 2.3 and 2.4 will not be submitted to the judging panel for scoring.

Each judge will score each submission independently, based on as the merit-based scoring matrix in Section 3. Scores will thereafter be totalled for each entry. Should there be a tie or discrepancy of scores, the full judging panel will make a merit-based decision after discussion. All scoring and rationale will be documented.

2.6. Winner selection and awards

Winning designs will be based solely on scoring. Participants may request a summary of their own results, but the decision made by the judging panel will be considered final.
The second and third highest-scoring designs will be designated as such and awarded with CLT merchandise prizes. The individual or team that submitted the design with the highest overall score will be designated the winner of the competition and will be granted a total cash prize of up to R50 000 (per individual or team as entered, not per team member), as well as a one week trip within the Western Cape (travel and accommodation) to the value of R20 000 during which the winning individual or team will be invited to consult on the development of replicate prototypes of the winning design, which will be tested for efficacy on working livestock farms. Once a working design has been rigorously tested and proven effective, the blueprint will be made publicly available on mobikraal.org for livestock farmers across the world to incorporate into or inspire their predator mitigation toolboxes.

3. Competition Design Criteria

At the core, the submitted design must represent for your own vision of the Mobi-kraal - a mobile kraal that provides livestock with at least overnight protection against predators. Additional information and links to resources on predator behaviour, predator-livestock interactions and current kraal designs can be found in Appendices A-C.

All submissions must be made as per the required documents and submission processes stipulated in Section 4.

3.1. Mandatory requirements

The mobile kraal design must meet the following specifications to be considered eligible for minimum scoring:

- Must be an enclosure with at least one entrance (which must be able to open and close securely)
- Must be suitable for containing sheep and/or cattle
- Must be designed to exclude predators (e.g. leopard, jackal, caracal, brown hyena) and therefore have sufficient height, be difficult to climb over or under, be able to support weight/strength of an animal, etc.
- Must be light and small enough to transport by Code B vehicle (or tractor) with attached trailer on 4x4 tracks/farm roads
- Should be suitable for two people (adults) to assemble and disassemble

- Should be designed for the option of use on rugged, uneven terrain
- Must be designed to withstand strong winds and extreme temperature conditions (frost, snow, high heat, UV)
- Must not cause intentional harm to predators.

3.2. Recommended specifications

Higher scores will be awarded if the mobile kraal design entry makes provision for the following specifications:

- Affordable/cost-effective for both subsistence and commercial farmers
- Adaptable and suitable for containing up to 200 sheep*, or 50-60 cattle, having regard for animal welfare
- Scalable/modular
- Reduced visibility through the sides for both livestock and predators
- Blends in with natural environments
- Any additional features that may aid in the deterrence of predators, but subject always to the Mandatory Requirement that the design must not cause intentional harm to predators.

*This is the average flock size in the Western Cape.

3.3. Scoring matrix

Scores will be awarded to submitted designs based on eight elements (mobility, predator exclusion, durability, suitability for livestock, dimensions, materials, landscape suitability, aesthetic) and specific considerations within each. Additional points may be awarded for desirable features or considerations not specifically listed, such as the use of recycled or sustainably-sourced materials, remote or automatic features, etc.

Judges will score how well the design addresses each consideration on a rating scale of 0 (Design does not address requirement/s) to 5 points (Requirement/s are met with specific considerations suitably addressed or exceeded).

Scores will be awarded for the following specific considerations:

Element	Specific considerations
Mobility	Able to be moved within one day
	Can be assembled and disassembled by a maximum of three people
	Light enough for carrying and moving over 4x4/farm/tractor roads
	Requires only common or basic tools for assembly/disassembly

	Additional mobility considerations
Predator exclusion	Suitably and safely excludes predators
	Tall and/or angled enough to prevent and/or deter jump-overs
	Difficult to climb
	Difficult to burrow under
	Inside not visible to predators
	Additional predator exclusion considerations
Durability	Wind factor considered
	Able to withstand extreme heat and cold
	Able to withstand weight of predator
	Able to withstand livestock trampling
	Additional durability considerations
Suitability for livestock	Tall and strong enough to contain livestock
	Water and/or feed provision considered
	Environment which does not harm livestock
	Additional livestock suitability considerations
Dimensions	Packs small enough to fit onto Code B vehicle and/or attached trailer when disassembled
	Large enough to comfortably house a maximum of 200 sheep plus water
	Scalable/modular
	Additional dimensional considerations
Materials	Cost effective
	Easily available
	Durable
	Additional material considerations
Landscape suitability	Can be assembled on rugged/hard terrain
	Can be assembled on a slope
	Additional landscape suitability considerations
Aesthetic	Blends in natural environments
	Does not deter visitors
	Additional aesthetic considerations

4. Submission Details

4.1. Registration and application

Any individual or team wishing to submit an entry must submit their entry through the online Entry Portal ("Enter the Competition") between 1 February and 30 June 2024. The application portal will not be accessible after 23h59 on 30 June 2024. Only fully completed entries submitted through the online entry portal will be considered a valid entry.

Registration and competition entry are free of charge. Conservation Kraal Challenge documentation to support application preparation is available for download at mobikraal.org. It is advised that entrants read all competition documents carefully, and Entry Questions and designs are prepared offline prior to competition entry.

Team registration must be completed as one registration (i.e. each team member is not required to register individually) by a designated "Team Leader". In the case of an individual entry, the individual is synonymous with the designated "Team Leader". During the online submission process, you will be required to complete the Individual/Team Registration electronically (details can be found in the Entry Questions document) and to agree to the Conservation Kraal Challenge Terms and Conditions on behalf of all team members.

Each team must upload one PDF document including images of your design, any relevant illustrations, working drawings, schematics, and custom part/detail drawings where relevant. Include dimensions or annotations in the images where appropriate. This document may not be larger than 50 MB in total.

Teams must complete all questions pertaining to their design within the online Entry Portal to qualify as an official entry.

Please note that the following general rules apply for the application:

- Applications are to be completed in English. Submissions will not be penalised for grammar or spelling where intention or meaning is clear.
- All measurements or dimensions are to be provided in metric scale.
- Any cost estimates or references are to be provided in South African Rands (ZAR).

Any problems experienced with the entry processes may be directed to mobikraal@capeleopard.org.za.

Appendix A: Short summary of predator-livestock interactions in South Africa

Sheep, goats and cattle are the main livestock farmed within South Africa, with some game farming, and the majority of losses to depredation are animals younger than weaning age (Kerley et al., 2018). With a general decreasing trend in income and employment in the livestock sector over the last decade (Kerley et al., 2018), loss of livestock to depredation can result in significant financial implications for farmers.

While the most recent estimates suggest that up to 13% of small livestock may be lost due to depredation across much of South Africa (Van Niekerk, 2010; Kerley et al., 2018), the overall extent of livestock depredation is not accurately determined due to reporting and identification bias, lack of carcasses for evidence and irregular sample sizes (Kerley et al., 2018). Individual farms and/or locations may also experience higher depredation rates where natural prey are scarce and/or individual predators have developed habitual livestock predation.

The most common livestock predation experienced in South Africa is by black-backed jackal and caracal, particularly in small-stock farming areas (Van Niekerk, 2010; Kerley et al., 2018). Leopard and lion are also considered to play an important role in livestock predation in a number of areas (Kerley et al., 2018).

Several mitigation methods exist for livestock depredation, but the choice made by farmers to employ these is largely driven by cost, benefit and available manpower (Ogada et al., 2003; Kerley et al., 2018), particularly in the case of communal farmers. Herders are by far the most effective option but also the most expensive (Kerley et al., 2018), and good quality livestock guardian dogs are expensive and require feeding, monitoring and veterinary care (Owino, 2015; Kerley et al., 2018). Electric fencing has proved effective in excluding predators such as jackal (Kerley et al., 2018), but is costly in terms of initial installation and requires a reliable power source and regular maintenance. Kraaling livestock at night is effective against most predation (Ogada et al., 2003; Woodroffe et al., 2007; Owino, 2015; Lichtenfeld et al., 2015; Manoa, 2016; Kerley et al., 2018; Van Eeden et al., 2018) but requires the land space, effective materials and legal ability to construct permanent structures. Use of permanent kraals may also lead to excessive trampling in the surrounding area. Often multiple kraals are required where livestock are moved across large expanses and/or between camps for grazing. Evidence shows that if affordable mitigation options are not known or available to farmers, lethal methods are more likely to be used (Kerley et al., 2018).

Appendix B: Use of kraals for mitigating depredation, current products and designs

i. Kraals for depredation mitigation

Kraaling of livestock has long been common practice in South Africa due to predator presence (Beinart, 1998). Reviews of mitigation methods show that apart from active livestock guarding (either by herders and/or livestock guardian dogs), predator-proof livestock enclosures (kraals) are one of the most effective protection measures against livestock depredation (Ogada et al., 2003; Woodroffe et al., 2007; Lichtenfeld et al., 2015; Owino, 2015; Manoa, 2016; Kerley et al., 2018; Van Eeden et al., 2018).

The efficacy of a predator-proof kraal is dependent on several factors however (Woodroffe et al., 2007; Owino, 2015; Weise et al., 2018). These include the size of the kraal, number of livestock, number of entrances, materials used and predator species. Research shows that there is a significant correlation between higher in-kraal predation rates and the number of gates/entrances in said kraal (Woodroffe et al., 2007; Owino, 2015), although this is data is mostly based on traditional thorn bush kraal design.

For construction of stationary/fixed kraals, there are several materials that have proven effective in excluding predators. Traditional thorn bush kraals are common and cost-effective but are most effective when either of increased thickness and height (Woodroffe et al., 2007; Owino, 2015), or when fortified (Weise et al., 2018). Wire-mesh or chain-link fencing is also commonly used (Owino, 2015), but are not as effective against climbing predators (e.g. caracal, leopard) as thorn bush walls (Ogada et al., 2003) unless the fence is appropriately angled at the top or the kraal is fully enclosed. Jackal have been effectively excluded with 1.2m wire mesh fencing (Beinart, 1998). Fencing material also needs to be able to remain upright both under the weight of a predator and against the force of potentially panicked livestock (Owino, 2015), particularly cattle which have been killed in stampedes in response to predator presence (Ogada et al., 2003).

ii. Fixed/permanent predator-proof kraal designs in use

Fixed or permanent predator-proof kraals have been used effectively in both communal and commercial farming. While these may not be practical for small-scale farmers in rugged or mountainous regions, the basic principles may provide insight into the specific features that assist with predator exclusion.

Some make use of woven logs and branches (e.g. Pride in Our Prides), or reinforcement of traditional thorn kraals with poles and tall steel mesh (e.g. Born

Free). The most common material is sturdy posts and tall (2m or more) chain-link fencing combined with barbed or high-tensile wire (e.g. Kenya Wildlife Trust, Anne K Taylor Fund, Namibian Lion Trust). This can also be combined with material to reduce visibility, such as shade cloth (e.g. Conservation Travel Foundation). It is important to note that the majority of these projects arose from areas predominantly experiencing depredation by lions. Leopard and caracal have been known to cross seemingly predator-proof fencing (even electrified), due to their agility and ability to climb, jump and burrow. Tall fencing with the top angled outward seems to be effective against snow leopard in Asia (Snow Leopard Trust).

iii. Mobile predator-proof kraal designs in use

Some mobile kraal designs have proven effective throughout African countries, although again it is worth noting that the majority of these were developed in response to depredation by lion. Most make use of plastic sheeting or shade cloth to break visibility between predators and livestock (e.g. Wildlife Conservation Research Unit, Sustainable Wildlife Management (SWM) Programme, Victoria Falls Wildlife Trust, Conservation Travel Foundation) which has significantly reduced loss of cattle to predators. African Wildlife Foundation has also successfully used metal kraal panels fitted with chain-link fencing to protect cattle against lion, and these bomas can be moved in 15 minutes. It is unclear how these designs may stand up to consistently strong winds and other predators.

iv. Existing commercial mobile kraal designs

Internationally, there are a number of similarly designed portable cattle corral systems available mostly on the American commercial market. Examples include the Heeler, Rawhide, Wrangler, Diamond W, Titan West OK and WW Express portable corrals. Although relatively heavy (ranging from 2000 to 4500kg), most of these have integrated trailers (usually incorporated into a mobile loading ramp) and can be set up and disassembled by one person. They are available in different size and function options and are modular, mobile and durable, but the majority are developed merely as temporary holding/sorting pens and are not suitable for predator exclusion. Commercial prices range from the equivalent to R200 000 – R400 000 depending on size and features (where 1 USD = 18.02 ZAR at the time of publishing).

While independently developed designs have been constructed for conservation projects, personal or local agricultural use out of necessity, very few options for mobile kraals are readily available to communal or commercial farmers in South Africa. Portable fencing parts (e.g. fence panels) can be readily acquired, but in terms of ready-made systems only options such as the Tal-tec portable kraal unit with trailer and Algar mobile kraal unit are available, retailing at between R120 000 and R150 000. Custom units can be commissioned (e.g. Arwald Trailers custom

mobile kraal), or a "homemade" system of similar design can be attempted (described as costing R50 000 if made from salvaged parts). While these systems may be similar in convenience to and cheaper than the American versions, none are adequately predator-proof without modification. Portable electric fencing is also available, but is aimed at livestock and grazing management rather than predator-proofing.

Appendix C: References and recommended reading

i. References

Amin, R., Wilkinson, A., Williams, K. S., Martins, Q. E., & Hayward, J. (2022). Assessing the status of leopard in the Cape Fold Mountains using a Bayesian spatial capture–recapture model in Just Another Gibbs Sampler. African Journal of Ecology, 60(3), 299–307. https://doi.org/10.1111/aje.12944

Beinart, W. (1998). The Night of the Jackal: Sheep, Pastures and Predators in the Cape. Past & Present, 158, 172–206. http://www.jstor.org/stable/651225

Drouilly, M., Nattrass, N., O'Riain, M. J. (2023). Small-livestock farmers' perceived effectiveness of predation control methods and the correlates of reported illegal poison use in the South African Karoo. Ambio, 52, 1635–1649 https://doi.org/10.1007/s13280-023-01892-7

Kerley, G.I.H., Wilson, S.L. & Balfour, D. (Eds) 2018. Livestock Predation and its Management in South Africa: A Scientific Assessment. Centre for African Conservation Ecology, Nelson Mandela University, Port Elizabeth.

Kissui, B. M. (2008). Livestock predation by lions, leopards, spotted hyenas, and their vulnerability to retaliatory killing in the Maasai steppe, Tanzania. Animal Conservation, 11(5), 422–432. https://doi.org/10.1111/j.1469-1795.2008.00199.x

LeFlore, E. G., Fuller, T. K., Tomeletso, M., & Stein, A. B. (2019). Livestock depredation by large carnivores in northern Botswana. Global Ecology and Conservation, 18. https://doi.org/10.1016/j.gecco.2019.e00592

Lichtenfeld, L. L., Trout, C., & Kisimir, E. L. (2015). Evidence-based conservation: predator-proof bomas protect livestock and lions. Biodiversity and Conservation, 24(3), 483–491. https://doi.org/10.1007/s10531-014-0828-x

Manoa, D. O. (2016). Human-wildlife conflict mitigation and community well-being: Evidence from predator-proof bomas. World Scientific News, 55, 101–113.

Mann, G. K. H., Wilkinson, A., Hayward, J., Drouilly, M., O'Riain, M. J., & Parker, D. M. (2019). The effects of aridity on land use, biodiversity and dietary breadth in leopards. Mammalian Biology, 98, 43–51. https://doi.org/10.1016/j.mambio.2019.07.003

Martins, Q., & Harris, S. (2013). Movement, activity and hunting behaviour of leopards in the Cederberg mountains, South Africa. African Journal of Ecology, 51, 571-579.

McManus, J. S., Dickman, A. J., Gaynor, D., Smuts, B. H., MacDonald, D. W. (2015). Dead or alive? Comparing costs and benefits of lethal and non-lethal human-wildlife conflict mitigation on livestock farms. Oryx, 49(4), 687–695. https://doi.org/10.1017/S0030605313001610

Ogada, M. O., Woodroffe, R., Oguge, N. O., & Frank, L. G. (2003). Limiting Depredation by African Carnivores: The Role of Livestock Husbandry. Conservation Biology, 17(6), 1521–1530. http://www.jstor.org/stable/3588900

Owino, M. D. (2015). Assessment of Predator-Proof Bomas as an Evidence-Based Conservation Tool in Loitokitok Sub-Country, Kenya [Master of Environmental Planning & Management]. University of Nairobi.

Seoraj-Pillai, N.; Pillay, N. (2017). A Meta-Analysis of Human–Wildlife Conflict: South African and Global Perspectives. Sustainability, 9(1), 34. https://doi.org/10.3390/su9010034

Swanepoel, L. H., Lindsey, P., Somers, M. J., van Hoven, W., & Dalerum, F. (2014). The relative importance of trophy harvest and retaliatory killing of large carnivores: South African leopards as a case study. South African Journal of Wildlife Research, 44(2), 115–134. https://hdl.handle.net/10520/EJC178581

Thorn, M., Green, M., Scott, D., Marnewick, K. (2013a). Characteristics and determinants of human-carnivore conflict in South African farmland. Biodiversity Conservation, 22, 1715–1730. https://doi.org/10.1007/s10531-013-0508-2

Thorn, M., Green, M., Marnewick, K., Scott, D. (2013b). Determinants of attitudes to carnivores: Implications for mitigating human–carnivore conflict on South African farmland. Oryx, 49(2), 270-277. https://doi.org/10.1017/S0030605313000744

Van Eeden, L. M., Eklund, A., Miller, J. R. B., López-Bao, J. V., Chapron, G., Cejtin, M. R., Crowther, M. S., Dickman, C. R., Frank, J., Krofel, M., Macdonald, D. W., McManus, J., Meyer, T. K., Middleton, A. D., Newsome, T. M., Ripple, W. J., Ritchie, E. G., Schmitz, O. J., Stoner, K. J., … Treves, A. (2018). Carnivore conservation needs evidence-based livestock protection. PLoS Biology, 16(9). https://doi.org/10.1371/journal.pbio.2005577

Van Niekerk, H. N. (2010). The cost of predation on small livestock in South Africa by medium-sized predators [MSc Agriculture]. University of the Free State.

Weise, F. J., Hayward, M. W., Casillas Aguirre, R., Tomeletso, M., Gadimang, P., Somers, M. J., & Stein, A. B. (2018). Size, shape and maintenance matter: A critical appraisal of a global carnivore conflict mitigation strategy – Livestock protection kraals in northern Botswana. Biological Conservation, 225, 88–97. https://doi.org/10.1016/j.biocon.2018.06.023

Woodroffe, R., Frank, L. G., Lindsey, P. A., Ole Ranah, S. M. K., & Romañach, S. (2007). Livestock husbandry as a tool for carnivore conservation in Africa's community rangelands: A case-control study. Biodiversity and Conservation, 16(4), 1245–1260. https://doi.org/10.1007/s10531-006-9124-8

ii. Recommended reading

It is recommended the following documents be read to increase understanding of the relevant subject matter and inform design:

a) Species information sheets

- Black-backed jackal
- Brown hyena
- Caracal
- Leopard
- Lion
- Spotted hyena

b) Predation management information/guides

- Centre for African Conservation Ecology (2018): Livestock Predation and its Management in South Africa: A Scientific Assessment
- Cheetah Conservation Botswana (2008): The Predator-Safe Livestock Guide
- Predation Management Forum (2016): Predation Management Manual: The farmer's one-stop guide to identifying and managing predators