TAWIRI APPLICATION FOR EXTENSION/RENEWAL OF RESEARCH CLEARANCE

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1. Personal particulars of the researcher
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   (e) Highest qualification: MSc (scheduled to defend PhD in Oct. 2024)

2. Title of the research project:

   Balancing Pastoralist Livelihoods and Wildlife Management in Ngorongoro

3. Study/protected area(s) of the study
   Ngorongoro Conservation Area (NCA)

4. Objectives of the research

The main goal with this research project is to explore and develop a sustainable model for human-lion coexistence in a pastoralist landscape, to evaluate its impact on people's perception and tolerance, and to monitor the impact of this model on the lion population itself. The latter is done by maintaining the long-term lion demography study, with the addition of genetic survey to assess genetic status, contemporary dispersal patterns, and to verify gene-flow and thereby current population connectivity.

Based on our observations, lions have been particularly challenged under current coexistence model and have disappeared from large sections of their former range in NCA, largely driven by direct human-lion conflicts. Thus, coexistence requires strategies that reduce the costs incurred by lions, and that increase tolerance towards them. The source for human-wildlife conflicts is rarely the wildlife itself, but the diverging interests of various stakeholder groups. Therefore, building relations and fostering participation and dialogue between stakeholders will be an important part of the coexistence model we develop.

The research objectives of this project are to 1) maintain the long-term demography study of the Ngorongoro lions, 2) measure the extent, drivers, and impact of human-lion conflicts on lion ecology and pastoralists livelihoods, 3) evaluate the 3-year trial of an alternative incentive-based model, Conservation Incentive Payment (CIP) in NCA, that concluded September 2023, and whether impacted community attitudes towards lions, conservation, and engagement in conservation planning, and 4) assess feasibility of CIPs as a viable tool for promoting human-lion coexistence in the NCA and in other pastoralist and/or coexistence landscapes across Tanzania.

We share and deliberate our findings and recommendations with the key stakeholders, including the local authorities and the resident communities, so as to jointly develop a sustainable model for a long-term human-wildlife coexistence in the NCA. An ultimate impact, if successful, will be a landscape with increased tolerance for large carnivores, leading to reduced risks and stressors for lions in the multiuse landscape, increasing survival and dispersal opportunities, that may restore genetic connectivity between the Ngorongoro Crater lions the larger lion population across the greater Serengeti ecosystem.

Further, we aim to share our findings in scientific publications, under themes of conservation ecology, genetics, and socio-ecology, thus adding to the broader discourse on studies of multiuse landscapes and their contribution to conserving naturally functioning ecosystems.

More specifically, our research questions are:

A. Landscape use by humans and animals and their interaction patterns in the NCA.
    i. What are the contextual and spatiotemporal patterns of lion-livestock-human interactions?
    ii. How can lion abundance and population trends be reliably and feasibly monitored in human-dominated areas?
    iii. Which landscape and/or anthropogenic variables facilitate or impede lions' connectivity across the landscape?
B. Landscape genetics for revealing space use and interactions.
    i. What are the demographic trends of lions in the area? Is conflict affecting the social structure in the population, and if so, is the effect uniformly distributed?
    ii. What is the impact of human-wildlife conflict on gene flow and long-term genetic health of the lion population?
C. Evaluating a CIP program's impact to foster coexistence. The CIP program that we developed together with key stakeholders and piloted between Oct. 2020 and Sept 2023 in two wards in NCA.
    i. How to structure a CIP program that builds on and fosters participation?
    ii. Is lion presence a feasible proxy for communities' conservation service?
    iii. What benefit sharing system impacts most on communities' coexistence tolerance?

iv. Has the CIP pilot impacted community attitudes towards lions, conservation, and engagement in conservation planning?
v. Has the CIP pilot impacted lions' movement and behaviour patterns? Is there any detectable response to any changes in safety levels?

D. Monitoring and evaluating impact from mitigation efforts and outreach activities on communities and on the lion population.
i. Changes in peoples' attitudes and perceptions towards wildlife, and lions in particular?
ii. Changes in peoples' actions that influence conservation outcomes?
iii. Changes in lions behaviour pattern use of the landscape, activity pattern What impact does our conflict mitigation strategies have on direct conflict patterns by lions
iv. What impact does our conflict mitigation strategies have on and the lion population; in numbers, range, and ultimately in dispersal and gene-flow?

Disseminating findings in scientific publications authored by team members.

5. Data collection methods/ tools:

- Direct observation and individual recognition of lions for the continued long-term demography study. Data collection is regular and frequent. Data describes trends over time in lion numbers, density, population structure, survival, reproduction. Adding data on search effort (vehicle tracklog) we will attempt to estimate lion densities across our study area in NCA, using a spatially explicit capture-recapture (SECR) model, as described in Elliot & Gopalaswamy (2017 [1]).
- Deployment of GPS collars on lions in multiuse area for close monitoring and conflict mitigation (GPS collar up to eight (8) lions simultaneously in NCA's multiuse area). The collar model we use (Vertex Lite, by Vectronic) features a remote drop-off function, so that collars drop off automatically after a pre-set period, or on command, avoiding the need to immobilize animal again for collar removal.
- Analyse location data from collars with integrated step-selection analyses (iSSA, Avgar et al. 2016 [2]) to assess habitat selection, comparing between areas of different conservation strategies, and behaviours by kill-sites of domestic versus natural play.
- Monitoring lion presence, verified through lion visual observations and/or signs of lions across study area, including use of camera traps and call-ups (often the only option in areas inaccessible to vehicles, and where lions are elusive).
- CIP pilot evaluation. This study will be conducted together with TAWIRI registered PhD student Mr. Adam Pekor, who in 2017 led the feasibility study during the CIP

[1] Elliot, N.B. and Gopalaswamy, A.M., 2017. Toward accurate and precise estimates of lion density. Conservation Biology, 31(4), pp.934-943.
[2] Avgar, T., Potts, J.R., Lewis, M.A. and Boyce, M.S., 2016. Integrated step selection analysis: bridging the gap between resource selection and animal movement. Methods in Ecology and Evolution, 7(5), pp.619-630.

model development phase. In late 2023 we conducted a household survey after the conclusion of the 3-year CIP trial. Evaluation of this survey and comparing results with the 2019 NCA/TAWIRI/LPZ survey (serving as a baseline), we will be able to assess the impacts of the CIP program compared to before the trial began, and relative to KopeLion's other conservation interventions (group ii) and relative to no lion conservation interventions at all (group iii), to help determine whether CIPs are a viable tool for promoting human-lion coexistence in the NCA, and its potential for other coexistence landscapes in Tanzania.

- CIP pilot evaluation II) to evaluate whether the CIP program has impacted lions' movement and behaviour patterns, we will analyse and compare lion habitat use and activity patterns between (a) within CIP program, (b) outside CIP but within KopeLion's area, and (c) outside KopeLion's area of operations. We will analyse: (i) spatial and accelerometer data collected between 2012 to 2024 from 25 satellite-collared lions (16 males, 10 females) in the NCA over a combined total of 536 months (2.5 – 73 months per individual); and (ii) records of lion presence data (visual observations or their tracks, scat, or hair). From this data, lions' behavioural responses will be analysed by (i) comparing lion's fine-scale habitat selection (using iSSA), (ii) evaluating the collars' accelerometer values for circadian activity patterns and levels and movements using daily net-squared displacement (NSD) and movement speeds (Bastille-Rousseau, et al. 2016 [3]), and (iii) lion presence in the multiuse area, using number of lion observations per distance walked by the field team. From these data, we aim to discern whether the CIP program has impacted lion movement and behavioural responses, which could indicate perceived safety in the landscape (Wong and Candolin, 2015 [4]).
- Continued opportunistic collection of lion samples that contain DNA (hair, faeces and tissue) for future opportunities of genetic analyses (including DNA extraction, genotyping, output interpretation). Collaborating laboratory not yet identified,

6. Extension period requested: 36 months

7. Justification for extension of research:

The core of this research project is a long-term demography study of a lion population. Further, it is exploring a sustainable model for long-term human-lion coexistence, including a 3-year trial of incentive-based system (Conservation Incentive Payment, CIP) for HWC mitigation (Oct. 2020 to Sept. 2023). With the trial now concluded, we plan evaluate the conservation impact from such CIP model.

[3] Bastille-Rousseau, G., Potts, J.R., Yackulic, C.B., Frair, J.L., Ellington, E.H. and Blake, S., 2016. Flexible characterization of animal movement pattern using net squared displacement and a latent state model. Movement ecology, 4(1), pp.1-12.

[4] Wong, B.B. and Candolin, U., 2015. Behavioral responses to changing environments. Behavioral Ecology, 26(3), pp.665-673.

8. Name and address of local contact:

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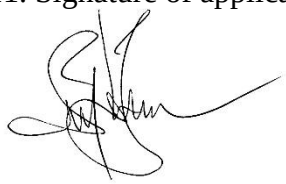
10. Name (s) of other applicant(s)

Name	Title	Position	Institution	Nationality
Camilla Sandström	Prof.	Collaborator	Umea Univ., SWEDEN	Swedish
Bernard Kissui	Dr.	Collaborator	School for Field Studies	Tanzanian
George Lohay	Dr.	Collaborator	Grumeti Fund	Tanzanian
Dennis Peshut	Mr.	Research assistant	KopeLion Inc.	Tanzanian
Roimen Lelya Olekisai	Mr.	Field assistant	KopeLion Inc.	Tanzanian
Ndolok Kilitya	Mr.	Field assistant	KopeLion Inc.	Tanzanian

11. Signature of applicant



Date: 29th July 2024