IAPETUS

doctoral training partnership

Room to roam and hotspots of conservation conflicts - Lions, ungulates and people in the matrix

Newcastle University, School of Biology
In partnership with University of Stirling

Supervisory Team	• **Dr Marion Pfeifer**, Newcastle University • **Dr Nils Bunnefeld**, University of Stirling • **Dr Amy Dickman**, Ruaha Carnivore Project, Wildlife Conservation Research Unit, University of Oxford

Key Words	1. **Large carnivores in Africa** 2. **Human-modified tropical landscapes** 3. **Human-wildlife conflict** 4. **Conservation decision-making and actions**

Overview

Agricultural expansion to meet demands for food and livelihood securities in tropical landscapes comes at the expense of biodiversity as natural habitats are cleared to make space for farmland[1]. This conversion is accompanied by the fragmentation of natural habitats into increasingly smaller and increasingly isolated habitat patches[2].

The land separating habitat patches, i.e. the matrix, has the potential to support wildlife by facilitating movement or providing resources[3]. Wildlife-friendly farming can act with habitat 'corridors' and 'stepping stones' to produce heterogeneous landscape mosaics[4] rich in biodiversity. The matrix can also act as an impermeable barrier due to transport networks, dense settlements, and intensely used farmland with little space and resources for wildlife[5].

Species differ in their ability to survive in habitat-matrix landscapes depending on matrix composition, and how big, functional and safe the remaining habitat patches are. Larger species, e.g.

elephants (*Loxodonta africana*), buffalo (*Syncerus caffer*) or lions (*Panthera leo*) require more resources and need larger functional habitats to meet their resource demands. Their movements through the landscapes render them more likely to encounter diverse matrix features[6] and people, increasing the risk of conflicts (e.g. they may kill people or livestock or damage crops essential for people's livelihoods, in turn being killed in prevention or retaliation). As such, dense human population areas and intensely used farmland over large swathes of land may preclude the presence of lions or elephants[7].

This project aims to determine the viability of the matrix for free-roaming lion populations in the 21st century in Eastern Africa. In particular, the project aims to identify the measures that could be taken to halt or reverse the decline of the African lion surviving within the protected area network. Anthropogenic pressures, primarily loss of suitable habitat and prey[8], as well as conflict with people, have led to a severe decline in lion numbers and range over the past century[9]. Lions now remain in only 8% of their historic range. Although protected areas are key to the long-

term survival of lions in rapidly changing African landscapes, much of their remaining range (and that of their prey) lies outside protected areas. Hence, lions require conservation across a wide mosaic of different land uses and habitat types. The debate around this question has become emotional exemplified in 'to fence or not to fence' lions in protected areas debate [10–12].

The PhD will address four key goals, with several underlying objectives:
1. Analyse habitat data across Africa to develop & rank matrix types in their suitability for being occupied/used for roaming by lions
1.1. Use database on extant African lion populations (by [Ruaha Carnivore Project](#)) & extend with data on lion movements and human - lion conflicts across Africa
1.2. Quantify attributes of habitats associated with lions (e.g. protection & management)
2. Estimate potential lion carrying capacity of East African landscapes based on vegetation - prey biomass - lion density relationships
2.1. Compile vegetation - prey biomass relationships[12,13] & use to map prey biomass and lion carrying capacity at landscape scales based on remotely sensed data
2.2. Use database (1.1) to validate and inform models and maps (2.1) & identify functional habitats & movement corridors in East Africa
3. Map hotspots of potential human-lion conflicts in Eastern Africa
3.1. Map hotspots of contact & likely outcomes in case study landscape (Ruaha, Tanzania)
3.2. Identify the governance, economic & socio-ecological variables affecting lions & human-lion conflict in the Ruaha landscape
3.3. Use remote sensing data, population pressure maps & socio-economic data to upscale conflict hotspots to Eastern Africa
4. Map future viable landscapes for the African lion to inform national conservation planning
4.1. Project changes in land use & habitat attributes under climate & human population pressure to map future movement corridors and functional habitats & delineate future human-lion conflict hotspots
4.2. Delineate conservation priority zones on these maps

Methodology

This highly interdisciplinary project will use socio-ecological, socio-economic data and remote sensing data to analyse the viability of heterogeneous landscape mosaics to support free-roaming large carnivores in the 21st century.

The student will implement a review of the scientific and grey literature [7,9,12,14] to compile the best available data on extant African lion populations. Fieldwork involving community surveys will be carried out in central Tanzania, where human-lion conflicts are very high but relatively little researched, working with the Ruaha Carnivore Project (co-ordinated by Dr Amy Dickman, University of Oxford and member of the IUCN Cat Specialist Group & the African Lion Working Group) following standardised protocols.

Quantitative analyses (modelling, simulation, mapping) will be carried out to estimate potential carrying capacity, actual population size and causes underlying discrepancies between both for the target landscape and for Eastern Africa. Climate & land use change modelling will be used to project future changes in the viability of the matrix for lions ('room to roam'). All findings (data, maps, projections) will be shared with TAWIRI and TANAPA to inform national conservation action plans.

Timeline

In the first year, the student will collate information on the status of lion populations in relation to habitat suitability in Africa using literature data on species occupancy & movements with remotely sensed data on habitat attributes & connectivity (Literature review & earth observation data analysis, thesis chapter 1 & publication prep.). The student map functional habitats in Eastern Africa at moderate spatial resolution using MODIS & MERIS data.

In the second year, the student will map functional habitat for the Ruaha landscape at high spatial resolution using SPOT & Sentinel data (through Pfeifer's European Space project) and Landsat (free via USGS Earth Explorer). The student will carry out fieldwork at Ruaha working with the [Ruaha Carnivore Project](#), who are

interlinked with the [Lion Guardians](#), a community orientated conservation model operating in East Africa since 2007. The student will compile information on vegetation & anthropogenic changes and human-lion conflicts across the landscape & analyse their causes through community surveys. The student will collect information on the socio-economic context surveying Tanzania Wildlife Service and NGOs.

In the third year, the student will analyse the data from Ruaha to (a) estimate lion carrying capacity, (b) map lion movement (a small subset of lions is currently collared), actual lion density, & conservation conflicts (thesis chapter 2 & publication preparation). The student will use land use, climate change[15] & population pressure scenarios to map future functional habitat and human-lion conflicts & delineate conservation priority zones (thesis chapter 3 & publication preparation). The student will present findings to the Ruaha Carnivore Project and at the British Ecological Society Annual Conference.

In the fourth year, the student will upscale analysis & mapping to Eastern Africa to determine the current & future viability of the matrix for free-roaming lion populations (thesis chapter 4 & publication preparation). The student will synthesise findings to discuss the implications for conservation & policies aimed at reversing lion decline (thesis chapter 5 & publication preparation). The student will present findings at the International Conference for Conservation Biology & share data with relevant authorities.

Training & Skills

The student will receive training in key skills relevant for conservation and management in changing human-modified tropical landscapes: (i) participatory research to assess socio-ecological changes, (2) remote sensing data & GIS to map ecological variables in dynamic landscapes, (3) spatial modelling to predict changes in ecological traits under climate & land use change, and (4) quantifying mitigation potential through conservation & management.

Novelty: The work is highly interdisciplinary allowing the student to tap into and benefit from

research, practice and teaching of the relevant research groups at Newcastle University (conservation science, ecological resilience, remote sensing), the University of Stirling (human decision-making and the dynamics of socio-ecological processes, game theory for the resolution of conservation conflicts) and the case partner Ruaha Carnivore Project (ecology and conservation of carnivores, resolving human-carnivore conflict). Further support will be provided through Dr Platts (University of York: climate change & human population growth), Mr Nick Deere (University of Kent: carnivore conservation planning) and Prof Craig Packer (University of Minnesota: lions in Africa).

References & Further Reading

1 Foley *et al.* 2005 *Science.* 309, 570 **2** Fahrig. 2003 *Annu. Rev. Ecol. Syst.* 34, 487 **3** Fischer *et al.* 2008 *Front. Ecol. Environ.* 6, 380 **4** Batáry *et al.* 2011 *Proc. R. Soc. B* 278, 1894 **5** Green *et al.* 2005 *Science.* 307, 550 **6** Lyra-Jorge *et al.* 2008 *Biodivers. Conserv.* 17, 1573 **7** Riggio *et al.* 2013 *Biodivers. Conserv.* 22, 17 **8** Schuette *et al.* 2013 *Biol. Conserv.* 157, 148 **9** Bauer et al. 2015 *PNAS* 112**,** 14894 **10** Woodroffe *et al.* 2014 *Science* 344, 46 **11** Pfeifer *et al.* 2014 *Science* 345, 389 **12** Packer *et al.* 2013 *Ecol. Lett.* 16, 635 **13** Loveridge et al. 2009 *Ecography* 32, 953 **14** Bauer et al. 2004 *Oryx* 38, 26 **15** Platts *et al.* 2014 *Afr. J. Ecol.*

Further Information

This project is in competition with others for funding. Success will depend on the quality of applications received, relative to those for competing projects. For further information, or if you are interested in applying, contact Dr Pfeifer at marion.pfeifer@newcastle.ac.uk (cc Dr Bunnefeld at nils.bunnefeld@stir.ac.uk, Dr Dickman at amydickman@gmail.com) In your email include: 1) a two-page covering letter detailing your reasons for applying & why you have selected this project, 2) your CV with contact information for ≥two references, 3) Full transcripts of previous qualifications obtained to date.

Only the best applicants will be asked to submit an application to the University. The application deadline is 22 January 2017. Students are encouraged to contact Dr Pfeifer in advance for consideration.