IPS - Research Grant Application

Please complete the following application in the space provided. The application, including references and any supplementary materials, should not exceed the space provided. Font should be no less than 12pt. Please direct any questions regarding your application or this award to Dr. Joanna Setchell (joanna.setchell@durham.ac.uk).

Application Due: March 1st

Name

Last: Burke First: Ryan Middle Initial: J

Project

Title of Proposed Project: **Are Gelada monkeys keystone species? A broad-scale analysis of the population status of Ethiopia's herbivorous primate and consequences for ecosystem processes**

Contact Information

Address: **Merton College, Merton St., Oxford UK, OX1 4JD**

Email: **ryan.burke@merton.ox.ac.uk**

Provide a 200 word summary of your proposal:

The gelada monkey (*Theropithecus gelada*) is the only gramnivorous primate in the world. As this once widespread terrestrial primate represents the majority of the native large herbivore biomass throughout the Ethiopian Highlands, an investigation into their impact on ecosystem processes is needed. We will conduct the first broad-scale census of *T. gelada* throughout their central range, and evaluate their potential role as keystone species in the Afroalpine ecosystem. Evaluation will include an assessment of their impact on plant community diversity and structure, water infiltration capacity and nutrient cycling. The results of this study will be crucial for an updated conservation status assessment of this endemic species, and will provide much needed ecological information for the development of conservation and restoration strategies in the increasingly degraded Ethiopian Highlands.

1. Describe the rationale and significance of this request and how it relates to theory and/or primatology. (1 page maximum)

Gelada monkeys (*Theropithecus gelada*) are an iconic endemic species of the Ethiopian highlands, and have been the subject of intensive and long-term research spanning topics from sociobiology to feeding ecology (Iwamoto & Dunbar 1983; Dunbar 1977). The intensity of this study is not very surprising considering the high numbers they can achieve (up to 800 individuals), and the unique nature of the plateaus, gorges and escarpments they inhabit (Crook 1966; Dunbar 1992). It is well known that the genus *Theropithecus* was once widespread and highly abundant in areas throughout eastern and southern Africa (Jolly 1972). Today, populations are increasingly marginalized to areas near the cliffs due to a rapidly growing human population and associated subsistence activities of cultivation and pastoralism (Iwamoto 1993; Dunbar 1998). Indeed, the human population of Ethiopia has quadrupled in the last century to 70 million, and is predicted to quadruple again in the next 90 years (UNDESA 2013).

Large mammals have been widely recognized to play key roles in ecosystem functioning (McNaughton et al 1997). Through habitat engineering and interactions with diverse constituents of the faunal and floral communities, animal control of physiochemical processes and energy flow reverberates through the ecosystem (Jones et al 1994). Those species defined as keystones exhibit disproportionately large control over the structure and functioning of ecosystems relative to their abundance (Power et al 1996). For example, many herbivores can have ecosystem-level consequences through herbivory, seed dispersal, digging and trampling, and depositing feces (Delibes-Mateos et al 2006). These activities can affect a number of in situ processes, including primary production, plant community composition, and system stability (Tilman 1988; Day & Detling 1990; Polis et al 1997), which regulate ecosystem services for the long-term sustainability of human inhabitants of a landscape. The loss of keystones can have dramatic consequences on the structure and function of ecosystems (Power et al 1996; Davidson 2006). However, it has not yet been possible to identify thresholds of species abundance beyond which ecosystem function is severely diminished. More fundamentally, some ecosystems have not been studied in enough detail to even identify which species play keystone roles.

Recent research on *T. gelada* population size has focused on localized regions in protected areas (e.g. Simien Mountains National Park; Beehner et al 2007) and has been limited to DNA-based methods, which suggest high habitat fragmentation and metapopulation isolation (Atickem, unpublished data). A large-scale biogeographic census of *T. gelada* is thus a glaring research priority considering their equal flagship status among Ethiopia's endemic mammals and their probable importance to ecosystem processes as the region's most abundant large herbivore.

All herbivores return Nitrogen (N) through feces and urine, enhancing N cycling (Day and Detling 1991). Grazing and browsing behavior enhance compensatory regrowth of plant species if soil nutrients allow, which in turn depends on the system's ability to prevent leaching and exportation (McNaughton 1983; Pastor et al 1997). The balance between high sediment and nutrient runoff as opposed to water infiltration in a system is a minute one, dependent on the proportion of annual and perennial vegetation (Gordon 2006). Less palatable grasses will experience lower loss rates of N than palatable grasses (McNaughton et al 1997). Thus, in certain rangelands, long-term repeated grazing of palatable grasses can result in increased functional heterogeneity with patches of preferably-grazed, high-quality lawns embedded within a matrix of rarely-grazed taller grasses (Fynn 2011). However, intense grazing such as that practiced by livestock herders in semi-arid systems globally often reduces this heterogeneity such that reduced vegetation cover decreases litterfall and organic matter accumulation, and thus infiltration and nutrient accumulation (Pastor et al 1997). Spatial heterogeneity in habitat use and intensity by grassland animal communities then could result in strikingly different ecological processes across different environments, with communities comprising primarily native fauna predicted to enhance ecological functioning due to their long-term co-adaptation with their environment (Kotliar 2000).

2. What are your hypotheses and predictions? (1/2 page maximum)

The primary goals of this study are twofold: firstly, to provide a current and accurate population estimate throughout the central range of the northern highlands. A population estimate will determine whether numbers are being maintained, in decline, or in recovery, and are a critical first step for natural resource and conservation policies. Secondly, my goal is to determine the effect of *T. gelada* on ecosystem processes, focusing on landscape patterns in plant communities, soil condition and nutrient cycling. In areas of "stable" and abundant *T. gelada* presence like Menz-Guassa however, preliminary evidence suggests that *T. gelada* herds have a positive influence on plant community diversity, soil moisture, and nutrient cycling (Burke, unpublished data). We will evaluate this possibility more directly by sampling on a larger spatial scale.

I hypothesize that *T. gelada* plays a keystone role in the ecological processes of the Afroalpine region. I will test this hypothesis by evaluating the plant structure and composition, the soil structure and infiltration potential, and the nutrient cycling between areas where they are present versus absent. I predict that (1) areas with *T. gelada* will have higher plant community diversity and functional heterogeneity than areas where they are absent; (2) areas with *T. gelada* will have higher soil moisture than areas where they are absent; and (3) areas with *T. gelada* will have higher concentrations of soil nutrients and higher potential N-mineralization rates than areas where they are absent. Positive results for these predictions will suggest that *T. gelada* grazing and trampling behavior promotes compensatory regrowth of some plant species within a matrix of non-preferred species (prediction 1), *T. gelada* mediated plant communities encourage greater water infiltration (prediction 2), and the combination of nutrient input and reduced soil erosion through the latter two predicted impacts of *T. gelada* presence enhances nutrient retention and cycling (prediction 3).

3. What methods, data and statistics will be used to answer your question(s)? Please be specific. (1/2 page maximum)

From May 1st to July 15th, we will conduct direct count censuses of potential T. gelada habitat. I will work with the two co-PIs (Anagaw Atickem and Peter Fashing), three experts from the Guassa and Simien Gelada Research Projects, and 5 scouts/assistants from the local Menz-Guassa Conservation Council and Addis Ababa University (AA's assistant). We derived a simple model predicting T. gelada suitable habitat from a Digital Elevation Model (DEM) and broad vegetation zones. For 320 existing T. gelada presence locations, 99% were located in the predicted suitable habitat. As T. gelada are reliably found along cliff edges early in the morning, observers will be spread out along this natural "transect" and perform direct counts during the hours of 0700-1100.

Each observer, trained in soil sampling and rapid botanical surveys, will sample one a priori randomly selected 20 x 20 m plot in each habitat types. Sampling will occur every afternoon in that observer's census region and involve: vegetation diversity and cover, site characteristics such as stone cover and topography, soil moisture using a WET-sensor, and samples of above-ground biomass and surface soils.

In order to extrapolate results to the region as a whole, I will use UAV-based aerial photography. A UAV and camera system will be flown in a systematic manner over the entire day's sampling area. A photogrammetric post-processing workflow will allow the creation of Digital Terrain Models (DTMs) and ortho-image mosaics. The resulting fine-scale mosaics and DTMs will be used to regress the plot vegetation and nutrient data to the larger spatial extent.

I will transport samples to Oxford for spectrophotometry analysis. For the vegetation samples, I will determine the 15N:14N ratios (standardized relative to air, d15N) as well as N, Carbon (C), and Phosphorous (P) concentrations. In addition to soil texture, I will determine soil C and N concentrations, d15N, and potential net N mineralization will be determined for each soil sample. Measuring potential N mineralization as an index of soil N supply will allow me to test whether high N availability can be explained by greater rates of supply and whether biotic uptake of N has likely been reduced. Response variables will be compared between sites of T. gelada presence and absence using ANOVA analysis.

4. Please provide a timeline for this project.

February-March 2014: Continued intensive local-scale pilot research at Menz-Guassa. This includes rapid botanical surveys and plant and soil plots in areas along a gradient of T. gelada habitat use, small mammal sampling, and refining of aerial photography methodology for fine-scale habitat classification.

May-July 2014: Conduct T. gelada census, vegetation and soil sampling in the Central Range from Menz-Guassa to North Wollo. Conduct censuses in the morning and plot sampling in the afternoon. Spend 2-3 days traveling between the 5 main base camps.

August-September 2014: Conduct spectrophotometry lab work at the University of Oxford.

October-December 2014: Complete analysis of data and write up results for publication and IPS Report.

5. Budget – Please provide detailed information for all expenditures not to exceed $1500.00. Do you have additional funds for this project? If so, please list funding sources and amounts.

Item	Funding Requested from IPS	Obtained Funding	Totals in $USD
TRAVEL			
Flight (between London, UK and Addis Ababa, Ethiopia)	**900***		900
excess baggage: London-Addis Ababa	**600***		600
Vehicle rental, including driver and diesel ($80 USD/day x 15 days x 3 cars)		3600**	3600
Visa		20**	20
LIVING EXPENSES			
in Addis Ababa: Food ($15 USD/day x 3 days)		45**	45
Lodging ($10 USD/day x 3 days)		30**	30
in the field: Meals ($10 USD/day x 5 people x 68 days)		3400**	3400
Tents (2-man tent x 3)		200**	200
Sleeping bag and pad ($100 USD x6)		600**	600
OTHER COSTS ASSOCIATED WITH RESEARCH			
Ethiopian Research Permit		1000**	1000
Field Scout/Assistant per diem ($6 USD/day x 4 people x 68 days)		1632**	1632
Botanical Technician ($20 USD/day x 4 days))		80**	80
SUPPLIES AND EQUIPMENT			
Used Garmin 62S GPS ($100 USD x5)		500***	500
GoalZero Sherpa 100 Solar battery packs ($200x2)		400***	400
Nikon Binoculars ($100 x 4)		400***	400
Petzl Tikka Plus LED Headlamp ($25 USD x 3)		75***	75
Fixed Wing UAV aircraft Sirius I		1500***	1500
Batteries (AAA, AA, both x 48)		200***	200
WET sensor ($60 USD x 12)		720***	720
Gardening supplies for soil and plant sampling ($30 x 12)		360***	360
Flagging tape ($2/roll x 20 rolls)		40***	40
6 field notebooks		56***	56
OTHER COSTS			
Analysis of samples (N=300 x $10 USD/sample)		3000***	3000
Communication (phone cards, emails, mail)		50***	50
Miscellaneous (e.g. photocopies, computer time)		100***	100
Total	**$1,500**	$18,008	$19,508

*** Funding requested from IPS**

** Funding obtained from Commonwealth Scholarship

*** Funding obtained from National Science and Engineering Research Council of Canada.

Many of the costs for my project can be covered by my Commonwealth and NSERC research grants. I am currently waiting on results from National Geographic YEG (past first of two rounds), Primate Conservation Inc, Primate Society of Great Britain, American Society of Mammologists and Sigma Xi. Co-PIs have submitted grants to Conservation International and St Louis Zoo. We will be applying to other small grants as well, including Mohammed bin Zayed among others.

(Optional Section)
Conservation through Community Involvement (CCI)

If you plan to include CCI in your program you may be eligible for an additional award of $500 to support these initiatives. Please describe your CCI plan below, addressing how these funds will be used and how this will impact conservation in your region. For more information on CCI and suggested CCI practices, please see the Guidelines for Conservation through Community Involvement posted in the publications section of the IPS website. (1/2 page maximum)

6. Literature cited

AAshenafi ZT. 2001. Common property resource management of an Afro-alpine habitat supporting a population of the critically endangered Ethiopian Wolf Canis simensis. PhD Dissertation, University of Kent, Canterbury, UK.

Beehner JC, Gebre B, Bergman TJ, McCann C. 2007. Population estimate for geladas (Theropithecus gelada) living in and around the Simien Mountains National Park, Ethiopia. SINET Ethiopian Journal of Science 30:149-154.

Buckland ST, Anderson DC, Burnham KP & Laake JL. 1993. Distance Sampling: Estimating Abundance of Biological Populations. Chapman and Hall, London, UK.

Craine JM, Ballantyne F, Peel M, Zambatis N, Morrow C & Stock WD. 2009. Grazing and landscape controls on nitrogen availability across 330 South African savanna sites. Austral Ecology, 34:731-740.

Day TA & JK Detling. 1990. Grassland patch dynamics and herbivore grazing preference following urine deposition. Ecology 71:180–188.

Delibes-Mateos M, Delibes M, Ferreras P, and R. Villafuerte. 2006. Key Role of European Rabbits in the Conservation of the Western Mediterranean Basin Hotspot. Conservation Biology 22:1106-1117.

Dunbar RIM. 1977. Feeding ecology of gelada baboons: a preliminary report Primate Ecology (Ed. by T. H. Clutton-Brock) pp. 251-273. Academic Press, London.

Dunbar RIM. 1998. Impact of global warming on the distribution and survival of the gelada baboon: a modeling approach. Global Change Biology 4:293-304

Ethiopian Wolf Conservation Programme. 2011. Strategic Planning for Ethiopian Wolf Conservation. Canid Specialist Group, IUCN/Species Survival Commission.

Fashing PJ & Nguyen N. 2009. Gelada feeding ecology in a tall grass ecosystem: influence of body size on diet. American Journal of Primatology 71:60.

Fynn RW & Bonyongo MC 2011. Functional conservation areas and the future of Africa's wildlife. African Journal of Ecology, 49:175-188.

Iwamoto, T. (1993). The ecology of Theropithecus gelada. In: Theropithecus: The Rise and Fall of a Primate Genus. Cambridge, (Jablonski, N.G. ed.) Cambridge University Press, pp. 441–452.

Jones CG, Lawton JH, and M Shachack. 1994. Organisms as ecosystem engineers. Oikos 69:373–386.

Kotliar NB. 2000. Application of the new keystone-species concept to prairie dogs: how well does it work? Conservation Biology 14:1715-1721.

Linder W. 2009. Digital Photogrammetry: A practical course. Springer.

Marino, J. 2003. Threatened Ethiopian wolves persist in isolated Afroalpine enclaves. Oryx 37: 62-71.

McNaughton SJ, Banyikwa FF, McNaughton MM. 1997. Promotion of the cycling of diet-enhancing nutrients by African grazers. Science 278:1798–1800.

Tilman, D. 1988. Plant strategies and the dynamics and structure of plant communities. Princeton University Press, Princeton, New Jersey, USA.

United Nations Department of Economic and Social Affairs, Population Division. (2013). World Population Prospects: The 2012 Revision. Key Findings and Advance Tables. Working Paper No. ESA/P/WP.227, New York.

7. CV (principal investigator)

EDUCATION

2013-Present	DPhil Zoology	University of Oxford
2011-2013	MSc Biological Anthropology	University of Toronto
2009	BSc Environmental Science	University of Ottawa

AWARDS AND SCHOLARSHIPS

2013-2016	NSERC Alexander Graham Bell Canada Graduate Scholarship (CGS-D) $105,000 – Declined to take up PGS-D; $62,000
2013-2016	Commonwealth Scholarship and Fellowship Plan
2012	Ontario Graduate Scholarship (OGS) Fellowship ($15,000/year)
2011	NSERC Alexander Graham Bell Canada Graduate Scholarship (CGS M) $17,500 / year
2010	NSERC Alexander Graham Bell Canada Graduate Scholarship (CGS M) - $17,500 / year - Declined
2010	Ontario Graduate Scholarship (OGS) $15,000 / year - Declined
2008	Research Internship – German Academic Exchange Service $3,000
2005-2009	Admission Scholarship – University of Ottawa $2,500 / year
2005-2009	Registrar's Special Scholarship – University of Ottawa $1,500 / year
2005-2009	Dean's Honour List – University of Ottawa

PEER-REVIEWED PUBLICATIONS

Burke, R.J. and Lehman, S.M. (In Press). Edge effects on morphometrics and body mass in two sympatric species of mouse lemurs in Madagascar. Folia Primatologica.

Valenta, K., Burke, R.J., Styler, S.A., Jackson, D., Melin, A.D., and Lehman, S.M. 2013. Colour and odour drive fruit selection and seed dispersal by mouse lemurs. Scientific Reports. 7: 31-36.

Burke, R.J., Fitzsimmons, J. M. and J.T. Kerr. (2011). A mobility index for Canadian butterfly species based on naturalists' knowledge. Biodiversity and Conservation. 20, 2273-2295. DOI: 10.1007/s10531-011-0088-y.

Fashing, P.J., Nguyen, N.T., Barry, T.S., Burke, R.J., Goodale, C.B., Jones, S.Z., Kerby, J.T., Lee, L.M., Nurmi, N.O. and V. Venkataraman. (2010). Death among geladas (Theropithecus gelada): A broader perspective on mummified infants and primate thanatology. American Journal of Primatology, 71, 1-5. DOI: 10.1002/ajp.20902

POSTERS AND PRESENTATIONS

Burke, R.J. and Lehman, S.M (2013) Edge effects and competitive exclusion: A case of two sympatric species of mouse lemurs in northwestern Madagascar. International Biogeography Society 6th Biennial Meeting – 9-13 January 2013, Miami, USA. Poster Presentation. Frontiers of Biogeography Vol. 4, suppl. 1. International Biogeography Society, 230 pp.

Burke, R.B. and Javidpour J. (2009) Dietary overlap between native scyphomedusae Aurelia aurita and invasive ctenophore Mnemiopsis leidyi in the Kiel Bight, Western Baltic Sea. International Conference on Aquatic Invasive Species, Apr. 19-23, 2009, Montréal, Quebec. Poster Accepted for Presentation.

FIELD AND RESEARCH EXPERIENCE

- Principal Investigator, M.Sc. Research, Ankarafantsika National Park, Madagascar
- Guassa Gelada Research Project, Guassa, Ethiopia (May 2010-June 2011)
- Honours Thesis Research, Ottawa, Canada (May-Dec 2009)
- Global Change Monitoring of Canadian Butterflies, Ontario/Quebec, Canada (May-Dec 2009)
- Field/Research Assistant, Canada Global Change Transect (University of Ottawa)
- Field and Laboratory Techniques in Environmental Sciences, Deep River, Canada (Aug 2009)
- Habitat Amount and Configuration Effects on Bees, Ontario/Quebec, Canada (May-Jul 2009) - Field/Research Assistant, University of Ottawa

Send this application AS ONE PDF DOCUMENT to: Dr. Joanna Setchell (joanna.setchell@durham.ac.uk)