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: Alavi **First:** Shauhin **Middle Initial:** Edward

Project

Title of Proposed Project:

Orangutans, what do they know and where are they going?

Contact Information

Address:
48S Manor Court
New Brunswick, NJ 08901

Provide a 200 word summary of your proposal:

The complexity of primate cognition and the cognitive mechanisms involved with foraging behavior are unknown. Similarly, whether or not primates have foraging goals and the reasons behind primate foraging decisions are poorly understood. Because animal movements are multidimensional and often autocorrelated, patterns in spatial movement may be consistent with certain cognitive mechanisms, and may be key to understanding the degree of cognitive complexity in primates. The goals of this study are to understand what types spatial and attribute memory might be operating in primates, whether or not foraging behavior is goal directed, and whether protein and energy balance drive foraging goals. Using Bornean orangutans (*Pongo pygmaeus wurmbi*) as a model system, I will examine how primates move between food resources, the nutritive attributes of exploited resources relative to forgone resources, and whether or not an changes in an individual's energetic state result in changes resource choice.

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

It is well documented that foraging strategies are influenced by the distribution and quality of food, that individuals have preferences for certain types of food, and foraging decisions have an economic basis [1:2]. Variation in the availability of food exerts cognitive demands in terms of resource acquisition and navigation, selecting for correspondingly complex cognitive adaptations[3:4]. Because primates are cognitively complex, researchers consider simple random walk models inappropriate for explaining primate behavior, and suggested that primates know detailed information about their food resources[5].

Two types of memory that are important to foraging are attribute memory (e.g. food characteristics) and spatial memory. These types of memory are linked such that food resource quality can be spatially encoded by the forager[6].

Most studies addressing memory and movement have been captive experiments. One study on captive orangutans suggested that orangutan landmark use is consistent with the vector sum model[7], where landmarks in an array are averaged into an absolute directional vector. Unfortunately, captive settings present problems for understanding the ecological correlates of memory, what attribute information might be linked to spatial information, if this information is actually being used to accomplish a foraging goal, or how that information is used to attain that goal. Furthermore, measuring the ecological correlates of memory in the wild has proven to be difficult, and very little conclusive field research on cognitive foraging exists [6:10]. It is difficult to understand how information about food resources is encoded, what information is being encoded, or how that information is used without studying animals in their natural habitat. I aim to be the first to quantify the relationship between diet, movement, and memory in our closest living relatives, the great apes, by studying wild Bornean orangutans (*Pongo pygmaeus wurmbi*).

Bornean orangutans are an ideal model because they do not live in social groups, and can make independent travel and foraging decisions. Orangutans live in variable environments, and are presumably under heavy selection pressure to learn when and where food is available[11]. Habitat switching is documented in orangutans, and it is clear that their behavior is related to the location of feeding trees[12]. There is evidence that their food preference is related to the nutritive value of food [13], and their physiological responses to food variability have been documented[18:19].

Objectives: I want to answer the following questions: **1)** What types of dietary information do orangutans have? **2)** How is this information encoded? **3)** Is this information used to attain foraging goals? **4)** Are these goals related to energetics?

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

There are two main hypotheses for how primates encode spatial information, and each framework allows me to make disparate predictions about orangutan movement patterns. The first is that primates have Euclidean maps, where geometric relationships between landmarks are used to calculate distance and direction[11]. This is only possible if primates are able to store large amounts of spatial and attribute information[8], implying that primates use the information about food, and move in a goal directed fashion[6]. Therefore, under the Euclidian map hypothesis, I predict route optimization with low route fidelity, very autocorrelated movement in the direction of foraging goals, a high persistence in velocity with increases in velocity proportional to the quality of that food resource[7], and discrete changes in turning angles towards the direction of the foraging goal[6]. The location of each goal is independent of other goals. I also predict that the foraging goals will be determined by the physiological demands of the orangutan, and that the nutritive quality of the goal will correlate with the energy and protein balance of the orangutan.

The second hypothesis is that primates have topological maps, where the understanding of spatial relationships is qualitative, route based travel networks are established, and the nodes in the network are major food resources [12]. These nodes are where primates are thought to make foraging decisions[8]. Therefore, under the topological map hypothesis, I predict strict route fidelity, that the location of each node chosen is related to the location of the previous node, with discrete changes in turning angle occurring only at the various nodes in the network. I also predict a lower mean velocity reflecting foraging along routes, and that the nutritive value of each node will correlate with energetic state.

Finally, primates might revert to different movement models as they enter unfamiliar areas; therefore I predict changes in movement behavior towards the edges of their range, where energetic state will not predict foraging behavior, with movement becoming more erratic and less autocorrelated.

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

I will conduct full-day focal follows on orangutans at the Tuanan Research Station (TRP) in Central Kalimantan, Indonesia. Feeding data and GPS coordinates will be collected at two-minute intervals. I will record food species and part, locations, heights, and diameter of feeding trees, along with the height of the orangutan in the tree. Food nutritional values are available at TRP. I will collect urine from morning voids, which will be analyzed for C-peptide and urea concentrations to monitor energetic state. I will also record tree species heights, diameters, and locations of available unused food trees in order to distinguish between random and goal directed movement. Visibility at varying heights will be determined using a line of sight visibility algorithm[17], and the sampling of available unused food trees will be informed by the algorithm and the height of the orangutan. Visibility will be the proxy for detectability, and all unused trees deemed detectable will be compared to utilized trees. I will map all sampled trees and the nutritive attributes of each species will be interpolated to estimate the likely spatial distribution of nutrients at TRP. I will use a Bayesian modeling framework to simulate expectations based on different types of memory at varying spatial scales. Movement data will be compared to each model, and behavioral change point analysis will be used to identify changes in movement behavior [18]. All work and analyses will be completed under the supervision of Dr. Vogel in the Laboratory for Primate Dietary Ecology and Physiology at Rutgers. I collected preliminary data at TRP from June to September of 2013 to assess the feasibility of this study design. 1895 trees were sampled, and preliminary analysis of pilot data is currently underway.

4. Please provide a timeline for this project.

Arrival in Indonesia: May 25, 2014

Start of data collection: June 1, 2014

End of data collection: August 8, 2015

Depart from Indonesia: August 15, 2015

Begin data analysis: August 2015

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.

Per Diem in Jakarta: $30/day for 7 days	$210
Round trip flight Jakarta-Palangkaraya	$240
Round trip travel to Tuanan from Palangkaraya	$160
Misc. field gear (e.g. field backpack, rite in the rain books ect.)	$350
Food in Palangkaraya: $20/day for 5 days	$140
Waterproof field binoculars	$200
Pelican case to protect electronics	$200
Total	$1500

Additional funding is available to me through Dr. Erin Vogel's USAID grant and will cover my travel to and from Indonesia

Round trip flight USA Indonesia	$1700

I have applied for additional funding from the Rutgers Bigel Endowment Award, status is pending

Room and board at Tuanan:	$2000

(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

|[1]Caraco, T.*et al*. (1980). *Anim. Behav.* 28(3), 820–830.|[2]Charnov, E. L. *et al*. (1976). *Theor. Popul. Biol*. **9**(2), 129–136.| [3]Clutton-Brock, T.H. & Harvey, P.H. (1980). *Proc Zool Soc Lond, 190*,309-323|[4]Milton, K. 1988 in Byrne and Whiten. 285-306.|[5]Janson, N. & Byrne, R. (2007) *Anim. Cogn.* **10**, 357-367.| [6]Fagan, W. F., *et al.* (2013). *Ecol. Lett.* **16**(10), 1316-1329.|[7]Cheng, K. (1989). *Journal J. Exp. Psychol.-Anim. Behav. Process.* **15**(4), 366-375.|[8]Boyer, D. *et al*. (2012). *J. R. Soc. Interface.* **9**(70), 842–847.|[9]Di Fiore, A. & Suarez, S. A. (2007). *Anim. Cogn.* **10**(3), 317–329.|[10]Janmaat, K. R. *et al.* (2006). *Animal Behaviour*, **72**(4), 797-807. [11]Knott, C. D. (1998). *Int. J. Primatol. 19*(6), 1061-1079.|[12]Singleton, I., *et al.* (2009). *Oxford University Press, UK*, 205-212.|[13]Leighton, M. (1993). *Int. J. Primatol.* **14**(2), 257-313. |[14]Emery Thompson, M. & Knott, C.D. (2008). *Hormones & Behavior* **53,** 526–535. |[16]Vogel, E.R. *et al.* (2012). *Biol. Lett.* **8**, 333-336. |[17]Liu, L. *et al.* (2010). *Sci China Inf. Sci 53*(11), 2185-2194|[18]Gurarie, E., *et al.* (2009). *Ecol. Lett. 12*(5), 395-408.

7. CV (principal investigator)

Shauhin Alavi
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shauhinalavi@gmail.com

Education

Present: PhD Student – Department of Anthropology
Rutgers, The State University of New Jersey
Graduate Advisor: Dr. Erin Vogel

2010: Bachelors in Anthropology
University of California, Davis

Research Experience

2013	Determining nutrient limitation and nutrient cycling in orangutan habitats (Dissertation pilot under Dr. Erin Vogel)
2012	Democracy or despotism? How do baboons decide? (Assisted Dr. Margaret Crofoot)
2012	Parasite intensity and diversity of Mpala baboons (Independent research: Smithsonian internship under Dr. Margaret Crofoot)
2011	Electroencephalographic measures of sleep in wild frigate birds (Assisted Bryson Voirin)
2010-2011	The impact of seasonal variation on the reproductive behavior and physiology of female spider monkeys *(Ateles geoffroyi)* (Assisted Dr. Christina Campbell and Stephanie Ramirez)
2010	Chinese vs Indian: Behavioral differences between pedigrees among rhesus macaques *(Macaca mulatta)* (Undergraduate research project under Dr. Lynne Isbell)
2010	Model for carrying capacity (Undergraduate research project under Dr. Andrew Marshall)
2010	Internal surrogate study: California National Primate Researc Center (Assisted Casey Hogrefe)
2009-2010	Influence of prenatal iron deficiency on rhesus monkeys (Assisted Dr. Mari Golub and Casey Hogrefe)
2009	Excavation: Roc de Combe Capelle and Abri Peyrony (Assisted Dr. Shannon McPherron)

Teaching Experience

Present	Teaching Assistant	Introduction to Human Evolution
Present	Teaching Assistant	Tuanan Primate Ecology and Conservation Field School

Internships, Fellowships, and Grants

2013	Bigel Endowment Award for Graduate Research	$1,400
2013	Center for Human Evolutionary Studies Small Grant	$1,000
2012	Graduate Student Diversity Fellowship	$21,000
2012	Smithsonian Tropical Research Institute: Internship Award	$2,400

Undergraduate and Post-Baccalaureate Presentations

Alavi, S.A. 2011. Spider monkeys on BCI. The Organization of Tropical Studies – Smithsonian Tropical Research Institute, Barro Colorado Island, Panama

Alavi, S.A. 2011. A different way to think about carrying capacity. Capybara Seminar Series: Smithsonian Tropical Research Institute, Barro Colorado Island, Panama

Alavi, S.A. 2010. Chinese vs Indian: Behavioral differences between pedigrees among rhesus macaques (Macaca mulatta). Anthropology Mini-Symposium. California National Primate Research Center, Davis CA

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