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: AGOSTINI First: ILARIA Middle Initial:

Project

Title of Proposed Project: "Interaction between food availability and parasitism in Primates: wild black-horned capuchin monkeys (*Sapajus nigritus*) as a model"

Contact Information

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Provide a 200 word summary of your proposal:

Nutrition and parasitism may affect synergically the physiological conditions of animals. Nevertheless, little evidence supports this hypothesis in mammals. The goal of this study is to evaluate the effects of food availability and parasitism, as well as their interaction, on the health status of wild black-horned capuchin monkeys (*Sapajus nigritus*). In Iguazu National Park (Argentina), I am collecting data on 17 identified adult individuals of two capuchin groups during two consecutive winters (2013 and 2014), i.e. the lean seasons. I am collecting fecal samples to determine richness/abundance of gastrointestinal parasites (eggs and larvae). The research protocol includes the experimental manipulation of food availability (food provisioning to one of the two groups, alternatively, each winter) and parasitic infection (supply of anti-helminthic to half of the adults of each group during each winter). To evaluate variations in the physiological conditions of individuals, I will estimate differences in body weight, physical qualitative indices and levels of glucocorticoids of the same individuals between consecutive winters. This study will be the first evaluating experimentally the interaction between nutrition and parasitism in non-human primates and will contribute to clarify the mechanisms through which parasite dynamics affects host dynamics.

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

There is an increasing interest of primate ecologists in identifying the factors that determine the abundance of animal populations, especially with the objective of developing effective management plans for threatened species (Chapman et al. 2005). The nutritional status, predation and parasitism may affect the survivorship and/or the reproduction of the host organism and thus provoke a decline of a population in the short term (Cowlishaw & Dunbar 2000). So far, the importance of diseases have been difficult to quantify in wild non-human primate populations (Chapman et al. 2005), since for most parasites, it is necessary to obtain clinic samples of animals to determine the status of infection. Gastrointestinal parasites represent an exception, since it is possible to diagnose them through a non-invasive analysis of fecal samples. In particular, helminthes and protozoa are the easiest to characterize in non-human primates in the wild. These parasites can affect the survivorship and the reproduction either directly through their pathological effects, or indirectly affecting the physical conditions of the host organism (Coop & Holmes 1996). Nevertheless, when the host has an adequate nutrients intake, parasites usually cause little or no effect over the energetic balance and the host fitness (Gulland 1992; Milton 1996). Since infectious diseases and parasites can generally cause mortality and have population-level effects, the question of interest is: to what extent these effects depend on the interaction with other factors?

When nutrition and parasitism interact, the simultaneous action of a lack of nutrients and a parasitic infection can initiate a process where each intensifies the effect of the other, leading to an increase of nutritional stress, a reduced immunocompetence and a higher intensity of infection. In contrast, a good nutrition can increase the host's ability to overcome the parasitism improving its immunological response, reducing parasites' capacity of initially settling in the host organism and decreasing the probability of re-infection (Gulland 1992; Milton 1996; Chapman et al. 2005). In this way, nutrition and parasitism can operate synergically to affect host's survivorship and reproduction. This synergy has been suggested for howler monkeys (*Alouatta palliata*) and red colobus (*Piliocolobus tephrosceles*), suggesting that different conditions (e.g. levels of food stress or habitat anthropogenic disturbance) may or may not promote the interaction between nutritional status and parasitic infections in an animal population (Milton 1996; Chapman et al. 2006). Nevertheless, such observational studies can only produce an indirect evidence of diseases regulating populations. Experimental studies, like Gulland's (1992) work of on Soay sheep (*Ovis aries*), can really separate the effect of each factor or evaluate possible interactions.

Black-horned capuchin monkeys (*Sapajus nigritus*) are endemic of the Atlantic Forest and in Misiones (NE Argentina), in proximity of its southern geographic boundary, is affected by a marked seasonality in food availability (Di Bitetti 2001). Due to these characteristics, this population constitutes an excellent model for testing hypotheses about the interaction between nutrition and parasitism. The possibility of manipulating food availability in the most critical time of the year (winter) by provisioning monkeys with bananas on platforms (see Janson 1998), plus the opportunity of manipulating the parasitic infection by supplying some anti-helminthic drug to eliminate the most prevalent gastrointestinal parasites, would allow investigating the role of each of these two variables and/or their interaction in determining the physical conditions of wild black-horned capuchins. This study will be the first to experimentally evaluate the interaction between nutrition and parasitism in a non-human primate and will contribute to clarify the mechanisms through which parasite population dynamics affect host population dynamics. Explaining and predicting the transmission, dynamics and distribution of infectious diseases have important implications for public health, wildlife management and biological conservation.

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

Hypothesis: The physical conditions of black-horned capuchins improve with food resource availability and decline with parasite abundance and diversity. It is to be expected that the effects of these two factors are synergic, i.e. the combined effect of both factors upon the physiological conditions of individuals will be greater than expected if the two effects were additive (Pedersen & Greives 2008; Beldomenico & Begon 2010).

Predictions: (A) Individuals will have a higher body weight, higher physical index scores and lower glucocorticoids levels in the winter they are provisioned than in the winter they are not. (B) Experimentally parasite-reduced individuals will have a higher body weight, higher physical index scores and lower glucocorticoids levels than the individuals normally parasitized. (C) There will be an interaction between the two treatments of food provision and anti-helminthic supply: the interaction term "food x anti-helminthic" in an ANOVA-like model will have a significant effect on the response variables (body weight, glucocorticoids level).

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

I carried out the first experimental season during 4 months in winter (May-Aug) 2013, and I will conduct the second experimental season through 4 months in winter 2014 in Iguazu National Park, Argentina. With the help of 3 assistants, I collect fecal samples of 17 adult individuals opportunistically (318 samples obtained in 2013). Approximately 2 g of fecal material is stored in 10% formalin, later processed using a modified Wisconsin Sugar Flotation quantitative method, and analyzed by the veterinarian E. Vanderhoeven under the supervision of Dr. P. Beldomenico (WCS, Argentina). I evaluate the variation in individual physical condition between consecutive winters by using differences in body weight, measured luring a platform balance secured to a tree trunk (repeated measures of 14 individuals obtained during 2013). In addition, differences in qualitative physical index scores and levels of glucocorticoids (measured as part of Dr. Barbara Tiddi's project, GPZ, Goettingen, Germany) between consecutive winters will be considered. The experimental protocol includes the manipulation of food availability (only 1 of the 2 study groups, alternatively, is provisioned with bananas on platforms each winter; see Janson 1998), and manipulation of parasitic infection (each winter half of the adults of each group are supplied with ivermectin + praziquantel, which is administered in a piece of banana (successful supplying in 2013). The experimental design is split-plot with 4 treatments: (1) Control= Parasite-Normal and Food-Normal, (2) Parasite-Reduced and Food-Normal, (3) Parasite-Normal and Food-Provisioned, (4) Parasite-Reduced and Food-Provisioned. To evaluate the effects of food provisioning and anti-helminthic on the variation of body weight and/or glucocorticoids levels in capuchins, I will use a split-plot ANOVA with a temporal block through the two winters, testing specifically for the role of the interaction between food provisioning and anti-helminthic treatment. I will apply generalized linear models to examine the influence of predictive variables and covariables (e.g. food provisioning, anti-helminthic treatment, social rank, female reproductive status) on the response variables .

4. Please provide a timeline for this project.

This project has started in 2012, with a 3-months preliminary study. Then, I carried out the first experimental season in winter 2013. This year I will require at least four months of field experiment, starting from May 2014, six months for fecal samples and data analysis, and two months for reports writing. I will use IPS funding (if granted) to cover partial costs of this second experimental season.

The field work will include following two habituated black-horned capuchin groups, collecting fecal samples and 10-min focal observations (to detect any potential change in activity patterns of individuals due to disease or any other symptoms) of adult individuals. Also, with the help of a veterinarian I will supply anti-helminthic drugs to half of the adult individuals of each study group (selecting those subjects that were not treated in winter 2013). Finally, I will take measurements of body weight of all adult individuals of both study groups to compare with measures obtained in winter 2013.

Activity	**Months (starting from May 2014)**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Winter experiment	X	X	X	X								
Data analysis					X	X	X	X	X	X		
Report writing											X	X

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.

Budget (U$D)

ITEM	DESCRIPTION	other sources*	IPS	TOTAL
TRANSPORTATION				
Ground transportation	National bus transportation for 3 assistants ($280/person)	$ 560.00	$ 280.00	$ 840.00
SUBSISTENCE				
Lodging	monthly fees: $ 350/person/month x 1 person x 4 months (foreigner)] + [$ 140/person/month x 2 people x 4 months (Argentineans)]	$ 1,960.00	$ 560.00	$ 2,520.00
Food	360 person-days @ $14/day	$ 5,040.00	$ -	$ 5,040.00
FIELD WORK				
Field Equipment &Supplies **	1 digital balance (KERN® – EOB 15), 3 pair binoculars, 3 two-way radios + batteries, 3 flashlights, rechargeable batteries and charger, 2 compasses, 3 field watches, 24 field notebooks, 3 units of flagging tapes (2 cartons with 7 rolls in each), 12 marking pens, 3 machetes.	$ 2,969.00	$ 54.00	$ 3,023.00
Assistants/ Consultants	Insurances for 3 field assistants ($ 245); salary for the veterinarian ($ 150/month x 4 months).	$ 245.00	$ 600.00	$ 845.00
Other	Cage and platforms maintenance; banana supply for provisioning platforms; anti-helminthic drug	$ 395.00	$ -	$ 395.00
LABORATORY ANALYSIS				
Lab Supplies	Laboratory fee for the analysis of parasites in the Laboratory of Disease Ecology – UNL, Santa Fe, Argentina ($ 200). Collection tubes for collecting fecal samples (250 units), formalin and distilled water for fecal samples fixation, gloves, spatulas, funnel and mask to manipulate formalin (total = $ 325).	$ 325.00	$ -	$ 325.00
OTHER				
Unexpected		$ 50.00	$ -	$ 50.00
TOTAL		**$ 11,544.00**	**$ 1,494.00**	**$13,038.00**

*National Geographic Society – CRE Scientific Research Grant #9219-12 (total amount awarded in late 2012: U$D 18,377). Currently still available: U$D 8,575 (i.e. U$D 11,544 – U$D 2,969 of field equipment and supplies already purchased, see below).

**Most of the field equipment and supplies were already purchased at the beginning of the first experimental season (winter 2013), thus they are available. However, the PI will purchase 12 new notebook “Rite in the rain” (U$D 4.5 * 12 = U$D 54) for the new field season.

(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

Chapman CA, Gillespie TR & Goldberg TL (2005). Primates and the ecology of their infectious diseases: how will anthropogenic change affect host-parasite interactions? *Evol Anthropol* 14:134-144.

Coop RL & Holmes PH (1996). Nutrition and parasite interaction. *Int J Parasitol* 26:951-962.

Cowlishaw G & Dunbar R (2000). *Primate conservation biology*. Chicago: The University of Chicago Press.

Gulland FMD (1992). The role of nematode parasites in Soay sheep (*Ovis aries* L.) mortality during a population crash. *Parasitol Res* 105:493-503.

Janson CH (1998). Experimental evidence for spatial memory in foraging wild capuchin monkeys, *Cebus apella*. *Anim Behav* 55:1229-1243.

Milton K (1996). Effects of bot fly (*Alouattamyia baeri*) parasitism on a free ranging howler (*Alouatta palliata*) population in Panama. *J Zool Soc London* 239:39-63.

7. CV (principal investigator)

Ilaria Agostini, PhD
Date of birth: August 21, 1976. **Birthplace:** Rome, Italy. **Residence country:** Argentina. **Address:** Bertoni 85 (3370) Iguazú, Misiones, Argentina. **Tel:** +54-3757-423511. **E-mail:** agostini.ilaria@gmail.com
Current position: Researcher of the Argentine National Research Council – CONICET

Education

2009 PhD, Ecology, full honors, University "La Sapienza", Rome (2/5/2009). Advisors: Prof. Luigi Boitani (University "La Sapienza", Rome); Dr. Elisabetta Visalberghi (ISTC-CNR, Rome).

2001 Laurea, Biology, honors *summa cum laude*, University "La Sapienza", Rome (5/24/2001). Advisors: Dr. E. Visalberghi, Prof. L. Boitani.

Research experience

2012- ongoing Experimental study on the interaction between food availability and parasitism on the physiological conditions of black-horned capuchin monkeys (*Sapajus nigritus*) in Iguazu National Park, Argentina.

2010-2011 Survey of brown howler monkeys (*Alouatta guariba)* in Misiones after yellow fever epidemics.

2005-2008 Field researcher – comparative study on two sympatric howler monkey species (*Alouatta guariba* and *A.caraya*), Misiones, Argentina.

2004 Director of field work – project of Fundación Vida Silvestre Argentina: "Jaguars (*Panthera onca*) density estimate", Urugua-í Reserve, Misiones, Argentina.

2002-2003 Field researcher – study on within-group variability in foraging behavior in black-horned capuchin monkeys, Iguazu N. P., Argentina.

1999 Undergraduate student and field assistant - behavioral and ecological studies on wild black-horned capuchins, Prof. C.H. Janson, Iguazu N. P., Argentina.

Fellowships and awards (received as Principal Investigator, last 5 years)

2013 First award - Filippo Bassignani Foundation's prize for doctoral theses, Univ. of Parma, Italy (€ 2,000)

2012 National Geographic Society – CRE (U$D 18,377) – THIS PROJECT

2012 The Banham Zoo (UK£ 500); Primate Action Fund, Conservation International (U$D 4,500)

2010 Mohammed bin Zayed Species Conservation Fund (U$D 5,000); Rowe Wright Primate Fund (U$D 1,202); Conservation Small grant - American Society of Primatologists (U$D 1,000).

Publications (selected)

Agostini I., Holzmann I., Di Bitetti M. S., Oklander L. I., Kowalewski M. M., Beldomenico P. M., Goenaga S., Martínez M., Moreno E. S., Lestani E., Desbiez A. L. J., Miller P. (2014). Building a Species Conservation Strategy for the brown howler monkey (*Alouatta guariba clamitans*) in Argentina in the context of yellow fever outbreaks. *Trop Cons Sci* 7:26-34.

Agostini I, Holzmann I, Di Bitetti MS (2012). Influence of seasonality, group size, and presence of a congener on activity patterns of howler monkeys species. *J Mammal*. 93:645-657

Agostini I, Holzmann I, Di Bitetti MS (2010). Ranging patterns of two syntopic howler monkey species (*Alouatta guariba* and *A. caraya*) in Northeastern Argentina. *Int J Primatol* 31:363-381.

Agostini I, Holzmann I, Di Bitetti MS (2010). Are howler monkey species ecologically equivalent? Trophic niche overlap in syntopic *Alouatta guariba clamitans* and *Alouatta caraya. Am J Primatol* 72:173-186.

Agostini I, Holzmann I, Di Bitetti MS (2008). Infant hybrids in a newly formed mixed-species group of howler monkeys (*Alouatta guariba clamitans* and *Alouatta caraya*) in northeastern Argentina. *Primates*, 49:304-307.

Agostini I & Visalberghi E (2005). Social influences on the acquisition of sex-typical foraging patterns by juveniles in a group of wild tufted capuchin monkeys (*Cebus nigritus*). *Am J Primatol* 65:335-351.

Visalberghi E, Janson CH, Agostini I (2003). Response toward novel foods and novel objects in wild tufted capuchins (*Cebus apella*). *Int J Primatol* 24: 653-675.

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