NORTHEASTERN EVOLUTIONARY PRIMATOLOGISTS
2ND CONFERENCE
NOVEMBER 4-5, 2016, HUNTER COLLEGE

LOCATION

Hunter College, West Building, Lexington and 68th Street

- Enter through the Visitor's Center (corner of Lexington Ave & 68th St.)
  - Faculty lounge, 8th floor (take elevator)
  - Glass Cafe, 3rd floor (just before sky-walk; take elevator from 8, take elevator/escalator from 1)
  - Room 714, 7th floor (take elevator or escalator)

REGISTRATION

Faculty Lounge, 8th floor

Friday, November 4, 2016	**05:00-06:00 pm**
Saturday, November 5, 2016	**07:30-08:25 pm**

- We will provide name tags for participants, but neither a printed program nor writing pads, pens, or bags. The outside funding and the registration fees are used to pay for food and venue costs. Please bring your own writing pad, pen, and anything else you will need during the conference.
- Registration on-site is possible ($30 students and $60 faculty), but because of logistical reasons this will not include lunch, just coffee-tea breaks and snacks.

PODIUM PRESENTATIONS

The talks are scheduled for 15 minutes with 12 minutes for the presentation itself and 3 minutes for Q&A. Please upload your talk to the presentation computer Saturday during registration or lunch.

POSTER PRESENTATIONS

Posters should have a portrait orientation with a maximum size of 48 inches (height) x 36 inches (width). Please remain within these limits due to space constraints.

FOOD AND DRINKS

The conference fee includes coffee-tea breaks and lunch on Saturday as well as the Friday and Saturday evening reception snacks. On Friday night and Saturday afternoon/evening we will have cash bars.

GENERAL MEETING

At a General Meeting on Saturday we suggest to discuss the following: (i) abstract submission and acceptance process, (ii) invited speaker and podium presentations, (iii) finances, (iv) NEEP officers, (v) timing and venue for next event, and (vi) anything else?

ACKNOWLEDGEMENTS

This event is financially supported by Hunter College, The City University of New York (School of Arts and Sciences; Department of Anthropology) and NYCEP (The New York Consortium in Evolutionary Primatology). Books and certificates for student prizes were provided by Wiley Publishing (American Journal of Primatology, American Journal of Physical Anthropology, Evolutionary Anthropology) and Springer Publishing.

CONFERENCE ORGANIZATION

Andrea Baden, Carola Borries, Rachel Jacobs, Andreas Koenig, and Megan Petersdorf with help from Nicole Hill, Kelsey Pugh, and Kristen Ramirez. We also thank all the many volunteers helping during the conference.

PROGRAM COMMITTEE

Carola Borries, Marina Cords, Lauren Halenar, Andreas Koenig, Herman Pontzer, Ryan Raaum, Michael Steiper

Student Prize Committee

Elena Cunningham, Nathaniel Dominy, Eduardo Fernandez-Duque, Lauren Halenar, Eleni Nikitopoulos, Ryne Palombit, Herman Pontzer

PROGRAM

FRIDAY, NOVEMBER 4, 2016

Location: Hunter College, West Building, Lexington and 68th Street

Faculty Lounge, 8th floor

05:00-06:00 pm **Registration**

Glass Café, 3rd floor

06:00-06:10 pm **Welcome**

06:10-07:00 pm **Invited speaker**
'Look how you've grown!': Integrative perspectives on primate growth and development
Christopher Schmitt, Department of Anthropology, Boston University

07:00-09:00 pm **Reception: Snacks; Cash Bar**

SATURDAY, NOVEMBER 5, 2016

Location: Hunter College, West Building, Lexington and 68th Street

Faculty Lounge, 8th floor

07:30-08:25 am **Registration**

Room 714, 7th floor

08:25-08:30 am **Welcome**

Session 1: Diet, nutrition, and seed dispersal. Chair: Erin Vogel; Rutgers University

08:30-08:45 am **Orangutans, fruit, and the geometric framework - fruit and non-fruit choice in wild *Pongo pygmaeus wurmbii***
Andrea DiGiorgio and Cheryl Knott; Boston University

08:45-09:00 am **The macronutrient niche of olive baboons in Kibale National Park, Uganda**
Caley Johnson[1,2], David Raubenheimer[3], Jessica Rothman[2,4]; [1]Graduate Center of CUNY; [2]NYCEP; [3]University of Sydney; [4]Hunter College of CUNY

09:00-09:15 am **Importance of non-natural food resources in the nutritional strategies of female blue monkeys (*Cercopithecus mitis*)**
Maressa Takahashi[1,2], Jessica Rothman[2,3], and Marina Cords[1,2]; [1]Department of Ecology, Evolution, and Environmental Biology, Columbia University; [2]New York Consortium in Evolutionary Primatology, New York; [3]Department of Anthropology, Hunter College

09:15-09:30 am **Starch in foods of forest-living olive baboons (*Papio anubis*)**
Camille Stewart[1], Caley Johnson[2,3], Jessica Rothman[1,2,3]; [1]Hunter College CUNY; [2]Graduate Center of CUNY; [3]NYCEP

09:30-09:45 am **The acidic mammalian chitinase gene (CHIA) in primate and bat insectivores: Evidence of convergence?**
Mareike Janiak; Department of Anthropology, Rutgers University

09:45-10:00 am **Seed dispersal effectiveness in two populations of Bornean orangutans (*Pongo pygmaeus wurmbii*)**
Andrea Blackburn[1], Shauhin E. Alavi[2], Prima Lady[3], Rivandi[4], Erin R. Vogel[2], and Cheryl D. Knott[5]; [1]Department of Anthropology, Boston University; [2]Department of Anthropology, Rutgers University; [3]Department of Biology, Universitas Nasional, Indonesia, [4]Department of Biology, University of Tanjungpura, Indonesia, [5]Department of Anthropology, Boston University

10:00-10:30 am **Coffee-Tea Break**

Session 2: Social strategies and vocalization. Chair: Eduardo Fernandez-Duque; Yale University

10:30-10:45 am **Hormonal correlates of maturation in wild owl monkeys: implications for explanations of dispersal**
Margaret Corley[1], Claudia Valeggia[2], and Eduardo Fernandez-Duque[2]; [1]University of Pennsylvania; [2]Yale University

10:45-11:00 am **Social strategies and their relationship with baseline fecal glucocorticoids in juvenile blue monkeys**
Nicole A Thompson[1], Marina Cords[1], and Michael Heistermann[2]; [1]Columbia University, NYCEP; [2]German Primate Center

11:00-11:15 am **Effects of anthropogenic disturbance on behavior and physiology of female chacma baboons in the Cape Peninsula of South Africa**
Shahrina Chowdhury and Larissa Swedell; City University of New York, Graduate Center

11:15-11:30 am **Social behavior of mother-offspring dyads in wild *Pongo pygmaeus wurmbii***
Amy Scott and Cheryl Knott; Boston University

11:30-11:45 am **Blue monkey (*Cercopithecus mitis*) grunt vocalizations do not differ by context or caller**
Holly Fuong and Marina Cords; Columbia University, NYCEP

11:45 am-12:00 pm **Female counterstrategies to male takeovers in hamadryas baboons**
Alexis L. Amann[1,2], Mathew Pines[2], and Larissa Swedell[1,2]; [1]NYCEP/ CUNY Graduate Center and Queens College; [2]Filoha Hamadryas Project

Faculty Lounge, 8th floor
12:00-01:00 pm **Lunch Break**

Room 714, 7th floor
Session 3: Speciation and morphology. Chair: Chris Gilbert; Hunter College

01:00-01:15 pm **Using ecological niche modeling to assess distribution and taxonomic diversity in the genus *Papio***
Amanda Fuchs[1], Christopher C. Gilbert[1], and Jason M. Kamilar[2]; [1]Hunter College, CUNY; [2]University of Massachussetts, Amherst

01:15-01:30 pm **Ecological or allopatric speciation under past climate conditions? An investigation into the lemurs of Northwestern Madagascar**
Jen Tinsman; Columbia University, AMNH

01:30-01:45 pm **Impact of behavioral traits on diversification rates in primates**
Alejandro Laserna[1] and James P. Herrera[2]; [1]Queens College; [2]Department of Mammalogy and Division of Vertebrate Paleontology, American Museum of Natural History

01:45-02:00 pm **Phylogenetic signal in primate morphology**
Gina Agostini and Jason M. Kamilar; University of Massachusetts Amherst

02:00-02:15 pm **The relationship between bi-iliac breadth and birth canal area**
Jennifer Eyre[1], Christie Oreste[2], and Scott A. Williams[1]; [1]New York University, CSHO, NYCEP; [2]Edward R. Murrow High School

02:15 -02:30 pm **Sexual dimorphism and testis volume across *Papio*: where do Kinda baboons fit in?**
Megan Petersdorf[1], James P. Higham[1], Jane E. Phillips-Conroy[2], Clifford J. Jolly[1], and Jeffrey Rogers[3]; [1]New York University NYCEP; [2]Washington University School of Medicine; [3]Baylor College of Medicine-Human Genome Sequencing Center

02:30-02:45 pm **Coffee-Tea Break**

02:45-03:45 pm **General Meeting**

Faculty Lounge, 8th floor
04:00-06:00 pm **Poster Session: Snacks; Cash Bar**
Announcements: Student Prize winners, NEEP Logo Contest winner

POSTER PRESENTATIONS (ALPHABETICAL BY FIRST AUTHOR)

1. **Nutrient limitation and orangutan facilitated nutrient recycling in a peat swamp habitat**
   Shauhin Alavi[1], Sri Suci Utami Atmoko[2], Mardianto Djinu[3], Erin R Vogel[1]
   [1]Rutgers University and The Center for Human Evolutionary Studies; [2]Universitas Nasional Jakarta; [3]Universitas Palangka Raya
2. **Cranial diversity in Asian Colobinae and the origins of the pileatus group**
   Julia Arenson
   The Graduate Center, CUNY; NYCEP

3. **Diversity, Disease, Ecology, Behavior: Treasures of the YPM *Pan troglodytes* skeletal collection**
   Gary P. Aronsen and Megan Kirkham
   Yale University
4. **Whole genome sequencing of a gibbon parent-sibling quartet to examine mutation rate variation**
   Dean Bobo[1], Onta Lin[2], Lucia Carbone[3], Omer Gokcumen[2], Krishna Veeramah[1]
   [1]Stony Brook University; [2]University of Buffalo; [3]Oregon Health & Science University
5. **Assessing the impacts of human activities on sifakas (*Propithecus verreauxi*) at Beza Mahafaly Special Reserve**
   Chloe Chen-Kraus[1], Hanitriniaina K. Ihariliva[2], Richard R. Lawler[3], Joelisoa Ratsirarson[2], Jeannin Ranaivonasy[2], Alison F. Richard[1], David P. Watts[1]
   [1]Yale University; [2]University of Antananarivo; [3]James Madison University
6. **The effects of captive environments on sub-adult gorilla behavior**
   Sydney Chertoff and Sue Margulis
   Canisius College
7. **Some strepsirrhines prefer alcohol**
   Nathaniel Dominy and Samuel R. Gochman
   Dartmouth College
8. **Modelling female kin reunion in hamadryas baboons**
   Marcy Ekanyake-Weber[1] and Larissa Swedell[2]
   [1]Stony Brook University; [2]Queens College CUNY
9. **Using new and improved measures of protein digestibility to better understand colobine monkey nutrition**
   Katarina Evans[1,2] and Jessica Rothman[2,3]
   [1]Graduate Center CUNY; [2]NYCEP; [3]Hunter College CUNY
10. **Testing repeatability for laser photogrammetric measurement of body size variation in wild male olive baboons (*Papio anubis*)**
    Melanie R. Fenton[1], James E. Fenton, and Ryne A. Palombit[1]
    [1]Rutgers University
11. **Seasonal nutritional ecology of the black and gold howler monkey (*Alouatta caraya*) in Argentina**
    Vanina Fernandez[1] and Jessica Rothman[2]
    [1]Grupo de Genetica y Ecologia en Conservacion y Biodiversidad, Division Mastozoologia, Museo Argentino de Ciencias Naturales "Bernardino Rivadavia"; [2]Department of Anthropology, Hunter College and NYCEP
12. **Membership change and female hierarchy in a group of silvery lutungs (*Trachypithecus cristatus*) at the Bronx Zoo**
    Richard Flamio Jr.[1], Emily Casper[1], Colleen McCann[2], and Reiko Matsuda Goodwin
    [1]Fordham University; [2]Wildlife Conservation Society
13. **Male influxes in blue monkeys: More variation than we thought**
    Lu Gao[1] and Marina Cords[1,2]
    [1]Columbia University; [2]NYCEP
14. **A closer look at fossil euprimate and plesiadapiform encephalization quotients**
    Christopher C. Gilbert
    Hunter College, CUNY
15. **The effects of age and sex on long-term spatial memory**
    Maria D. Gonzalez, Malvin Janal, Rachelle Wolk, and Elena Cunningham
    New York University College of Dentistry
16. **Response diversity in lemurs of Madagascar promotes ecosystem resilience**
    James Herrera
    American Museum of Natural History
17. **Novel and highly polymorphic color vision in wild indriids**
    Rachel Jacobs[1], Tammie S. MacFie[2], Amanda N. Spriggs[3], Andrea L. Baden[4], Toni Lyn Morelli[5], Mitchell T. Irwin[6], Richard R. Lawler[7], Jennifer Pastorini[8], Mireya Mayor[9], Runhua Lei[10], Ryan Culligan[10], Melissa T.R. Hawkins[10], Peter M. Kappeler[11], Patricia C. Wright[12], Edward E. Louis Jr. [10], Nicholas I. Mundy[13], and Brenda J. Bradley[1]
    [1]The George Washington University; [2]University of Cambridge; [3]University at Albany – SUNY; [4]Hunter College; [5]University of Massachusetts Amherst; [6]Northern Illinois University; [7]James Madison University; [8]Universitaet Zurich; [9]Centre ValBio Research Station; [10]Omaha's Henry Doorly Zoo and Aquarium; [11]German Primate Center; [12]Stony Brook University; [13]University of Cambridge
18. **Evolutionary conservation at voltage-gated sodium channels is correlated with gene expression in primate brains**
    Wei Jiang, Erich Horeth, and Krishna Veeramah
    Stony Brook University
19. **The effects of human visitors on the behavior of captive ruffed lemurs**
    Abigail Johnson
    Hunter College

20. **Nutritional chemistry and benefits of fallback foods utilized by the Tana River mangabeys, *Cercocebus galeritus*, Kenya**
Stanislaus Kivai[1,2], Erin Vogel[1], Ryne Palombit[1], Charles Maingi[2], and Jessica Rothman[3]
[1]Rutgers University; [2]Institute of Primate Research, Kenya; [3]Hunter College, CUNY
21. **Testing time: Fifteen years of forest fragmentation in southeastern Madagascar**
Katherine Kling[1], Z. A. Andriandrasana[2], A. Dehgan[3], P. C. Wright[1]
[1]Stony Brook University; [2]University of Antananarivo; [3]Conservation X Labs
22. **Human activity and perceived predation risk in a habituated primate prey species: *Cercopithecus albogularis schwarzi***
Laura LaBarge[1,2], Andrew T. L. Allan[2,3], Susan W Margulis[1,4], Carol M. Berman[1], and Russell A. Hill[2,3]
[1]University at Buffalo; [2]The Primate and Predator Project, Lajuma Research Centre; [3]Durham University; [4]Canisius College; Carol M. Berman (University at Buffalo)
23. **The relationship between canine eruption sequences and canine size in female guenons (tribe Cercopithecini) and other cercopithecids**
Reiko Matsuda Goodwin and Warren Pardi
Fordham University
24. **Tarsier phylogenetic inference using museum skin samples**
Laura Matthews
New York University
25. **Self-directed behavior as an indicator of social stress in wild orangutans**
Caitlin A. O'Connell and Cheryl D. Knott
Boston University
26. **Effects of sociality on glucocorticoid production in the male rhesus macaque**
Rachel Petersen[1], Michael Heistermann[2], James Higham[1]
[1]New York University, NYCEP; [2]German Primate Center
27. **Expert *versus* novice understanding of a cooperative task with chimpanzees**
Luke Quarles and Malini Suchak
Canisius College
28. **New sivaladapid from the Lower Siwaliks of India**
Kathleen Rust[1], Christopher C. Gilbert[1,2], Biren A. Patel[3], N. Premjit Singh[4], Christopher J. Campisan[5], John G. Fleagle[6], and Rajeev Patnaik[4]
[1]Hunter College, Department of Anthropology; [2]Graduate Center CUNY, NYCEP; [3]Department of Cell and Neurobiology, Keck School of Medicine, University of Southern California; [4]Department of Geology, Panjab University, Chandigarh; [5]School of Human Evolution and Social Change, Arizona State University, Institute of Human Origins, Arizona State University, [6]Department of Anatomical Sciences, Stony Brook University
29. **The relationship between mtDNA substitution parameters and BMR in primates**
Jerred K. Schafer and Adam D. Gordon
University at Albany-SUNY
30. **Assessing the reliability of genomic and pedigree data of free-ranging rhesus macaques**
D. Seok[1], M. J. Montague[1], N. Snyder-Mackler[2], S. Madlon-Kay[1], J. E. Horvath[3], M. L. Platt[1]
[1]University of Pennsylvania; [2]Duke University; [3]North Carolina Museum of Natural Sciences
31. **Quantifying countershading in *Eulemur* using eigencoats**
Amanda N. Spriggs[1], Brenda J. Bradley[2], Jason M. Kamilar[3], and Adam D. Gordon[4]
[1]University at Albany – SUNY; [2]The Center for the Advanced Study of Human Paleobiology (CASHP), Department of Anthropology, The George Washington University; [3]Department of Anthropology, University of Massachusetts Amherst; Graduate Program in Organismic and Evolutionary Biology, University of Massachusetts Amherst; [4]Department of Anthropology, University at Albany – SUNY
32. **Grandmother effects in wild chimpanzees**
Maggie Stanton, Helen Gaynor, and Carson Murray
The George Washington University
33. **U-opioid receptor role in grooming behavior of free-ranging rhesus macaques**
Isabelle Tersio[1], Michael Montague[1], Noah Snyder-Mackler[2], Darsol Seok[1], Seth Madlon-Kay[1], Lauren Brent[3], and Michael Louis Platt[1]
[1]University of Pennsylvania; [2]Duke University; [3]University of Exeter
34. **Testing ruffed lemurs (*Varecia* spp.) color vision at Duke Lemur Center using SMARTA**
Raymond Vagell[1], Vance J. Vagell[2], Rachel L. Jacobs[3], Jim Gordon[1], and Andrea L. Baden[4]
[1]Animal Behavior & Conservation Program, Hunter College CUNY; [2]Queens; [3]Center for the Advanced Study of Human Paleobiology, Department of Anthropology, The George Washington University; [4]Department of Anthropology, Hunter College CUNY, The Graduate Center CUNY and NYCEP

35. **Observing breeding behaviors in *Symphalangus syndactylus* (Siamang) in captivity**
Gina Vaira[1], Joseph Gaspard[2], and Summer Arrigo-Nelson[3]
[1]Indiana University of Pennsylvania; [2]Pittsburgh Zoo and PPG Aquarium; [3]California University of Pennsylvania
36. **Males in uniform: intra-individual pelage color variation is associated with social style in male macaques**
Andrew Van Horn[1,2], Amanda N. Spriggs[2,3], Ben Wilhelm[4], Jason M. Kamilar[5], and Brenda J. Bradley[6]
[1]Anthropology Dept., Temple University; [2]Center for the Advanced Study of Human Paleobiology, GWU; [3]State University of New York at Albany; [4]State University of New York at Cobleskill; [5]University of Massachusetts, Amherst; [6]The George Washington University
37. **How can camera trapping improve your research program?**
Jane Widness
Yale University
38. **Long-term spatial memory in *Eulemurs* and effects of learning schedules**
Rachelle Wolk, Malvin Janal, Maria Gonzale, and Elena Cunningham
Department of Basic Sciences NYU College of Dentistry
39. **Recent evolution of the salivary mucin MUC7 in primates**
Duo Xu[1], Pavlos Pavlidis[2], Supaporn Thamadilok[1], Emilie Redwood[1], Sara Fox[1], Ran Blekhman[3], Stefan Ruhl[1], Omer Gokcumen[1]
[1]SUNY Buffalo; [2]Foundation of Research and Technology–Hellas; [3]University of Minnesota
40. **The value of understanding intraspecific relationships in comparative analyses**
Lu Yao[1], Hongjie Li[2], Corrie S. Moreau[3], Ripan S. Malhi[2], and Robert D. Martin[3]
[1]AMNH; [2]University of Illinois at Urbana-Champaign; [3]The Field Museum

Abstracts of

Podium Presentations

Phylogenetic signal in primate morphology

Gina Agostini and Jason M. Kamilar
University of Massachusetts Amherst

One expectation of Brownian evolution is that random changes will accumulate in phenotypic traits as a product of time. Therefore, recently diverged species should be similar to one another and distantly related species should be different – a pattern referred to as phylogenetic signal. This project uses a broad analysis of primate morphology to test whether phylogenetic signal varies across traits from different anatomical regions and the degree to which it is affected by allometry. Phylogenetic signal was calculated for 191 traits across 11 anatomical categories that represent the skeletal, dental, nervous, sensory, and reproductive systems. We found that phylogenetic signal for raw data is generally high, though there is substantial variation (Blomberg's K values = 0.14 to 4.55). However, phylogenetic signal was markedly reduced when we controlled for body mass (Blomberg's K = 0.01 to 0.45). We also found significant differences in phylogenetic signal across anatomical regions, both before and after controlling for mass (p-value < 0.001 for both datasets). Interestingly, the significance for raw data is largely driven by high craniofacial K values, while for body-mass controlled data the pelvic and vertebral traits possess the highest K values while craniofacial traits possess the lowest. These results suggest that phylogenetic signal is impacted by allometry, but also by the anatomical region from which a trait arises, perhaps due to integrative or plastic effects. This has important implication for understanding primate trait evolution and reconstructing phylogenies based on morphological data.

Female counterstrategies to male takeovers in hamadryas baboons

Alexis L. Amann[1,2], Mathew Pines[2], and Larissa Swedell[1,2]
[1]NYCEP/ CUNY Graduate Center and Queens College; [2]Filoha Hamadryas Project

The evolutionary consequences of sexual selection and sexual conflict are epitomized in the hamadryas baboon, a species characterized by strong sexual dimorphism and intense male-male competition. Hamadryas males coerce individual females into reproductively exclusive one-male units via aggressive takeovers, and infants involved in such takeovers are five times more likely to be killed (or otherwise die) after takeovers compared to other times. Here we examine female reproductive state before and after takeovers as a means to further elucidate the determinants of takeovers and their impact on female reproduction. Our data set consists of 151 takeovers over a period of seven years in a population of wild hamadryas baboons at Filoha, Ethiopia. Results show that, in contrast to their polygynandrous relatives, hamadryas males show no bias with regard to female reproductive state at the time of the takeover, but that they are more likely to take over nulliparous females compared to females that have had one or more offspring. In addition, these results reinforce previous findings demonstrating the high likelihood of infant loss after takeovers and suggest that females may use an additional strategy of pregnancy termination as a means to curtail investment in offspring that are very likely to die anyway. These results suggest that hamadryas males target females with high future reproductive value, possibly as an extension of their tendency to form their first OMUs with pre-reproductive females, and that hamadryas females employ counterstrategies to help mitigate the effects of sexual coercion and infanticide on their own fitness.

Seed dispersal effectiveness in two populations of Bornean orangutans (*Pongo pygmaeus wurmbii*)

Andrea Blackburn[1], Shauhin E. Alavi[2], Prima Lady[3], Rivandi[4], Erin R. Vogel[2], and Cheryl D. Knott[5]
[1]Department of Anthropology, Boston University; [2]Department of Anthropology, Rutgers University; [3]Department of Biology, Universitas Nasional, Indonesia, [4]Department of Biology, University of Tanjungpura, Indonesia, [5]Department of Anthropology, Boston University

Orangutans consume large quantities of ripe fruit and disperse intact seeds over wide areas. However, few studies have quantified seed dispersal in orangutans (Galdikas 1982; Nielsen et al. 2012). We hypothesized that orangutans are effective seed dispersers. This was tested by identifying, measuring and counting seeds in orangutan feces and recording fecal coordinates to determine seed spatial distribution patterns. Orangutan feces were collected opportunistically from March - September 2015 at the Tuanan Research Station (n=97) and from July - August 2016 at the Cabang Panti Research Station in Gunung Palung National Park, Indonesia (n=98). The feces were sieved, seeds were counted, and seed morphotypes were identified in at least 96% of fecal samples. Flanged males, unflanged males, adult females, and juveniles independent enough from their mother to allow for fecal collection, were all observed dispersing seeds. Four fruit genera were dispersed at Cabang Panti and nine fruit genera were dispersed at Tuanan. At Cabang Panti, the largest intact seed size recorded was 2.29cm in length and the smallest seeds dispersed were less than 1mm Ficus seeds. At Tuanan, 31% of fecal samples had 2 or more genera, 42% had 1 genera, and 26% had no seeds. We used descriptive GIS to describe the spatial distribution of the dispersed seeds. We concluded that orangutans have an important role in fruit tree recruitment. They disperse intact seeds of varying sizes and disperse several different genera of seeds. Future research will measure seed dispersal distances and orangutan gut-passage rates to establish the orangutan seed shadow.

Effects of anthropogenic disturbance on behavior and physiology of female chacma baboons in the Cape Peninsula of South Africa

Shahrina Chowdhury and Larissa Swedell
City University of New York, Graduate Center

Habitat loss and human disturbance are significant threats to wildlife populations and can cause chronic stress, with detrimental effects on long-term health and fitness. Here we investigate endocrine and behavioral responses of female chacma baboons (*Papio hamadryas ursinus*) in the Cape Peninsula, South Africa to anthropogenic disturbance in the form of conflict with humans and deforestation in their natural habitat within Table Mountain National Park. Living in close proximity to humans, the baboons often raid suburban areas and agricultural land, and get herded by 'baboon monitors' – people employed to chase baboons from private property. We analyzed the effects of anthropogenic disturbance on fecal glucocorticoid (GC) levels and behavioral measures in three troops of baboons: JT (20 individuals total, 6 females) spent the most time in urban areas, MT2 (40 individuals, 11 females) was mostly in the forest, and MT1 (70 individuals, 16 females) spent time both in the forest and urban areas. In two troops, we found that GC levels correlated negatively with time spent ranging in the forest (MT1: $r = -0.672$, $p = 0.002$; JT: $r = -0.635$, $p = 0.006$) and positively with time spent ranging in suburban areas (MT1: 0.477, $p = 0.045$, JT: $r = 0.614$, $p = 0.009$). We also investigated behavioral measures to understand how social relationships may be affected as a result of anthropogenic stressors. Baboons may adjust their social relationships as a means of coping with physiological stress.

Hormonal correlates of maturation in wild owl monkeys: implications for explanations of dispersal

Margaret Corley[1], Claudia Valeggia[2], and Eduardo Fernandez-Duque[2]
[1]University of Pennsylvania; [2]Yale University

Natal dispersal is a life history event with important implications for the evolution of social behavior, and a variety of hypotheses have been proposed to explain dispersal patterns. We assessed whether Azara's owl monkeys (*Aotus azarae*) reached sexual maturity before dispersing, as predicted by the mating competition avoidance hypothesis, or after dispersing, as predicted by the inbreeding avoidance hypothesis. To do this, we examined reproductive hormone profiles obtained from fecal extracts of predispersed juveniles (5 females, 6 males), subadults (6 females, 2 males), dispersed solitaries (4 females, 1 male), and adults (5 males, 5 females) in a wild population of monogamous, bisexually dispersing owl monkeys in Formosa, Argentina. ELISAs were used to obtain profiles of estrogen and progesterone conjugates (E1G and PdG) in females and levels of testosterone (T) in both sexes. Subadult females showed peaks in PdG indicative of ovulation, suggesting they reached sexual maturity prior to dispersing. Juveniles of both sexes had relatively low T levels (46% and 33% of adults' mean T levels for male and female juveniles, respectively). While subadult females had T levels similar to those of adult females (287+53 ng T/g feces), subadult males' mean T levels were similar to those of juveniles and substantially lower than adult males' (103+0.7 versus 206+32 ng T/g feces, respectively). All solitaries had mean T levels similar to or even higher than adults (mean=490+183 ng T/g feces). These data suggest mating competition may play an important role in regulating owl monkey dispersal.

Orangutans, fruit, and the geometric framework - fruit and non-fruit choice in wild *Pongo pygmaeus wurmbii*

Andrea DiGiorgio and Cheryl Knott
Boston University

Recent evidence suggests that the foraging strategies of Bornean orangutans (*Pongo pygmaeus wurmbii*) cannot be characterized within the optimal foraging framework alone, and that the geometric framework of nutrition may also apply to this species. As we evaluate the role of geometric theory with optimal foraging theory in the diet selection of orangutans, one criticism of the geometric framework is that we cannot be

certain that an animal is seeking other food types and not merely eating what they encounter after leaving depleted fruit and while searching for another fruit. To demonstrate that orangutans are indeed selecting non-fruit foods and not only seeking fruit, we expect to see two behaviors: (1) orangutans leaving available fruit crops for non-fruit foods, and (2) orangutans selecting non-fruit foods when fruit is available and nearby. We use data from 51 full-day focal animal follows (611 feeding bouts, 15 focal animals) collected in Gunung Palung National Park, Borneo, from May 2015 – Jan 2016. We find that when orangutans do leave available fruit (n=95) it is significantly more often for non-fruit foods (80/95 occurrences, Exact Binomial, p = 3.4e-12). We characterize the nutrient content of fruits that orangutans leave available most often. We also present descriptive GPS data demonstrating that orangutans often leave or even pass by fruit crops to consume other food types. Together, these data suggest that geometric models, in addition to optimal foraging models, may be appropriate to characterize the feeding behavior of wild Bornean orangutans.

The relationship between bi-iliac breadth and birth canal area

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Modern humans have a difficult time giving birth because the neonate's head is as large as the mother's birth canal. Why hasn't selection favored a more capacious birth canal to make birth less dangerous? This conundrum is termed the "obstetrical dilemma". Several hypotheses have been proposed, such as that a wider pelvis increases the cost of locomotion, or that a wider pelvis is antagonistic to effective thermoregulation in hot climates. These hypotheses rely upon the relationship between hip width and the dimensions of the birth canal. While it has been shown that hip width corresponds to the transverse dimensions of the birth canal, it is not clear whether narrow hips lead to an overall constricted birth canal and thus a harder time giving birth. This project tests the relationship between hip width (bi-iliac breadth) and the capacity of the birth canal at the inlet, midplane and outlet. Three-dimensional laser scans of pelves from the Point Hope Collection and the Medical Collection at the American Museum of Natural History were processed and measured to determine if there is a correlation between bi-iliac breadth and birth canal size. It was found that bi-iliac breadth and inlet area are correlated (R2=0.90, p=0.001) and bi-iliac breadth and midplane area are correlated (R2=0.45, p=0.0009) but that bi-iliac breadth and outlet area are not correlated (R2=0.023, p=0.61). This could be because the outlet is the plane farthest from the iliac blades and also because the outlet has few bony constraints.

Using ecological niche modeling to assess distribution and taxonomic diversity in the genus *Papio*

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In this study, we use ecological niche modeling to investigate how niches vary across *Papio* species in an attempt to understand the climatic variables that have influenced their distribution and taxonomic diversity. Locality data for six *Papio* species and climate information from WorldClim was used to generate niche models using Maxent software. If niche models have good predictive power, *Papio* species distributions should be highly correlated with climatic variables. If niche models have poor predictive power, *Papio* species distribution will not be highly correlated with climatic variables, perhaps supporting the hypothesis that they are ecological generalists. Our models performed reasonably to extremely well depending on the species, suggesting climatic variables influence the distribution of extant baboon species. Models for both *P. papio* and *P. kindae* performed best, while the model for *P. hamadryas* performed the worst, possibly due to the recent divergence of the species and/or its ability to inhabit more varied climates. We also examined the degree of niche overlap among all possible pairs of taxa. Most species pairs exhibited significantly different niches, challenging the common idea that they are ecological generalists. Additionally, the results of a Mantel test suggest that there is no significant correlation between niche overlap and estimated divergence dates for *Papio* species. In total, the results of these models further support a parapatric speciation scenario for the genus *Papio*. Furthermore, these results suggest that fluctuations in climate may have significantly influenced the distribution and complex evolutionary history of *Papio* species.

Blue monkey (*Cercopithecus mitis*) grunt vocalizations do not differ by context or caller

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Distinguishing individuality in vocalizations is important to the study of animal vocal communication. Before testing whether animals can differentiate callers or call types, one should first establish that calls are individually distinctive. There has been a recent shift towards quantitatively categorizing vocalizations that were previously qualitatively assessed. We examined whether blue monkey (*Cercopithecus mitis*) grunt vocalizations differed based on the context of the call and by caller identity. We measured multiple acoustic features of 54 grunts collected from 18 adult females living in the same social group in the Kakamega Forest, Kenya. We found no effect of call context when we controlled for caller identity. Separately, we found that a few individuals emitted grunts that differed significantly in various acoustic features from many other callers. Using discriminant function analyses, however, we could correctly assign only 18% of grunts by individual and 21% of grunts by matriline. Unlike similar studies in other cercopithecines, we found no evidence for context-related grunt vocalizations and only limited evidence that grunts are individually or matrilineally distinguishable. Future directions will include examining more acoustic features of grunts and individual caller variation in other vocalizations.

The acidic mammalian chitinase gene (CHIA) in primate and bat insectivores: Evidence of convergence?

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Many bats and many primate species rely on insects as a source of food. However, the chitinous exoskeletons of insects are difficult to break down, requiring specialized digestive adaptations. Insectivorous bats, for example, produce the digestive enzyme acidic mammalian chitinase in the stomach to digest insect exoskeletons. This enzyme is encoded by the gene CHIA. Investigating this gene offers a non-invasive alternative for studying digestive enzyme adaptations in primate insectivores. Preliminary work has shown that the CHIA gene is conserved and apparently functional in insect-eating New World primates (*Callithrix, Saguinus, Callicebus, Sapajus, Saimiri*), as well as some Old World monkeys (*Macaca, Papio*). Preliminary analyses suggested possible amino acid convergence between insectivorous New World monkeys and insectivorous bats (*Eptesicus fuscus, Myotis lucifugus*). To build on this research I sequenced the CHIA gene in two closely related bats with different diets, the insectivore *Macrotus californicus* and the sanguivore *Desmodus rotundus*, as well as in an Old World monkey with high annual insect consumption, the patas monkey (*Erythrocebus patas*). Comparing the CHIA nucleotide and CHIA amino acid sequences across a bigger sample of insect-eating and non-insect eating bats and primates will give us a more complete understanding of the extent of convergence between insectivores.

The macronutrient niche of olive baboons in Kibale National Park, Uganda

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Adequate nutrition is an important factor determining health, longevity, and reproductive output. The intake of nutrients by consumers is the product of consumer biology engaging with qualitative and quantitative variation in food availability, an interaction often modelled as a "nutritional niche". We attempt to operationalize the nutritional niche of baboons using the right-angled mixture triangle (RMT), in a manner similar to the Hutchinsonian niche. Using the RMT, we construct the 3-dimensional niche based on the macronutrients that contribute to metabolizable energy (protein, digestible carbohydrates, and fat) of foods ("food composition niche"), and dietary intakes of adult female olive baboons. We collected these data from nutrient analyses of 512 foods, and 320 full-day focal follows in Kibale National Park, Uganda, between 2013-2014. We found that the protein and carbohydrate space occupied by foods was extensive, with 90% and 94% of possible space occupied. Dietary intakes encompassed the lower range of protein (3-53%) and the upper range of carbohydrate food space (23-92%). As fat was low in foods, the food composition niche occupied the lower 58% of lipid space, and diet intakes occupied this entire range. The total 3-D area of the RMT occupied by baboon foods was 42%, while 26% was occupied by dietary intakes. While we know baboons are ecological generalists and therefore are one of the most widespread primate species, more comparative data on nutritional niches across taxa are needed to contextualize the extent of their generalism, and their ability to partition space with other species.

Impact of behavioral traits on diversification rates in primates

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Diversification rates can be affected by certain traits, such as key innovations which allow organisms to exploit open niches. Primates have flexible behaviors in response to the environment, possibly reflecting adaptations. Changes in these traits may affect diversification rates. While research has been done on the evolution of molecular and morphological characters, little is known about behavioral evolution. Previous studies have attempted to use behavioral characters to test for phylogenetic signal, finding evidence of homoplasy. Traits exhibiting homoplasy may be adaptive, and therefore may effect diversification rates. We tested if nine behavioral traits were related to diversification using state dependent speciation and extinction analyses (n=80-110 species per trait). Dispersal showed no effect on speciation rates (likelihood ratio test, $p>0.05$); net diversification rates were near zero for lineages in which male and female dispersal was common or uncommon. Allomothering showed a positive effect on speciation - species that have allomothering had higher speciation rates (0.93 species My-1) than those that did not (0.22 species My-1). Mating system also showed a positive effect on speciation. This may be explained by potentially higher genetic diversity in primates that mate promiscuously than in species that mate monogamously, which may lead to more chances for evolution to take place. While dispersal patterns had no effect on diversification, infant care and mating systems did, indicating that these traits may be adaptive. Further research is needed to understand the proximal links between traits and fitness that may lead to effects on diversification rates.

Sexual dimorphism and testis volume across *Papio*: where do Kinda baboons fit in?

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Male-male competition can take many forms and has led to a diversity of traits in primates. Direct male-male competition selects for traits such as large body size and high-crowned, projecting canine teeth that assist males in fights over reproductive opportunities with females. Indirect male-male competition includes post-copulatory sperm competition, which results from polyandry and is directly correlated with relative testis volume. Even among closely-related taxa, there is variation in traits associated with direct and indirect male-male competition. We explored this variation among four species of *Papio* to determine how the little-known Kinda baboon compares to other baboon taxa. We measured body mass, canine basal area, and testicular volume in a large sample of wild-caught hamadryas, yellow, olive, and Kinda baboons. Compared to other baboons, Kinda exhibit significantly less sexual dimorphism in body mass and canine size, and relatively larger testes. This suggests that Kinda baboons are subject to less direct contest competition and more sperm competition than other baboon species. This study provides further evidence for the Kinda's distinctiveness, while highlighting that the genus *Papio* exhibits more variation in competition dynamics than previously believed.

'Look how you've grown!': Integrative perspectives on primate growth and development

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Characterizing growth and development is essential to understanding the evolutionary history of any organism. Developmental perspectives do not only inform the path to adult phenotypes, but also the unique developmental modes that occur throughout an organism's life history, each subject to their own selective pressures. Such studies, however, are often neglected in favor of analyses of adult phenotypes in isolation from the processes that shaped them. In my work, I use developmental perspectives to inform evolutionary analyses using traditionally disparate methods that span the breadth of our discipline, including aspects of behavioral ecology, morphometrics and paleontology, and quantitative genetics and genomics. In my work with captive vervets, for example, I've used growth phenotypes to find novel genomic markers implicated in adult-onset obesity. My fieldwork has used growth patterns to uncover previously unknown life history variation among vervets, suggesting a suite of ecogeographic and sexually selected differences between populations. Finally, my collaborative work with the Hlusko lab has used quantitative genetics, paleontology, and neontology to tracing the evolution of the postcanine dentition and potential dietary modes in Catarrhines. This work underscores the importance of incorporating growth and development – and reaching across disciplinary boundaries to do so – for illuminating novel, exciting pathways and perspectives into the evolution of both human and nonhuman primate growth, health, and diversification.

Social behavior of mother-offspring dyads in wild *Pongo pygmaeus wurmbii*

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Due to the semi-solitary social organization of orangutans, little is known about the interactions between males and mother-offspring dyads. Orangutan socioecology and life history predict a lack of male care and a vulnerability to infanticide. Promiscuous and post-conceptive mating by females increase paternity confusion, an anti-infanticide strategy. We hypothesize, if males present an infanticide risk then mother-offspring dyads will avoid encountering males and will enter closer proximity in the presence of males. Data were collected in Gunung Palung National Park, Borneo, Indonesia, from 1994-2016. We found that mothers with offspring under 6 years encounter males significantly less often that mothers with dependent offspring over 6 years and adult females without offspring (Ï‡2 = 90.183, df=2, $p < 0.001$). This may be due to a combination of male avoidance by mothers with young offspring and an increase in male-female interactions as females resume cycling. Additionally, the distance between a mother and her dependent offspring is significantly shorter in the presence of males than when the mother-offspring dyad is alone or in the presence of a non-related female (R2= 0.788, n = 360, $p<0.001$). This suggests that the presence of males is threatening to mother-offspring dyads. We also performed hot spot analysis in ArcGIS to illustrate changes in the ranging behavior of females with young infants. These data, along with female mating behavior, suggest that infanticide is a selective pressure shaping female orangutan mating and mothering behavior. Funders include the National Geographic Society, the Leaky Foundation, and the National Science Foundation (No.DGE-1247312).

Starch in foods of forest-living olive baboons (*Papio anubis*)

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Increased consumption of starchy foods by early hominins has often been implicated as a driving force in the evolution of increased brain size and tool use to access such foods. Specifically, the dietary switch from herbaceous and woody vegetation to underground storage organs and grass-derived foods by hominins as they transitioned from forest to savanna in the Plio-Pleistocene. Here we present evidence of starch concentrations in foods selected by baboons in a forest. With this we can begin to examine the nutritional switches primates may undergo when moving from a forest to a savanna, much like early hominins. We analyzed the total starch content of staple foods (n=85) in the diet of olive baboons in Kibale National Park, Uganda using the Megazyme assay for determination of total starch in foods not containing high levels of resistant starch, D-glucose and/or maltodextrins. The %starch in foods ranged from <1%-15%, with the least in *Marantacloa* sp. piths and highest in *Marantacloa* sp. corms. Gums had the least starch (<1%) and tubers had the highest (14%). Overall, compared to the starch content of savanna-foods in diets of extant primates, foods selected by baboons in a forest had little starch. Even foods such as corms and seeds which are expected to have higher amounts of starch, did not. These data support the hypothesis that savanna-living baboons have increased access to starchy foods compared with omnivorous baboons living in closed-habitats, and the incorporation of such foods may have been an impetus for the hominin adaptive suite.

Importance of non-natural food resources in the nutritional strategies of female blue monkeys (*Cercopithecus mitis*)

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Generalist feeding primates like blue monkeys forage flexibly from a large menu of possible food items. Flexibility may allow variable diet composition or even variable nutritional strategies (e.g. prioritizing or balancing certain nutrients) to reach a particular nutritional target. We explore such flexibility by comparing the nutritional ecology of three blue monkey groups whose home ranges included different amounts of human-modified and near-natural habitat. How environmental variation corresponds to changes in nutritional strategies is not well known. Even

less known is the relative importance of non-natural foods (found mainly in human-modified habitat) to overall nutritional intake. We predicted that regardless of home range habitat composition, individuals in different groups would feed flexibly to reach similar nutrient targets, though the diet composition or nutritional strategy might vary. We analyzed data from 24 adult females from 3 groups and >300 food items. Diet composition (e.g. ca. 57 ± 26% fruit) was similar across groups, converging on a nutrient balancing strategy of non-protein energy to protein in an approximate 3:1 kcal ratio. Three non-natural foods ranked among the highest in caloric contribution for each group. However, the relative importance of all non-natural food varied by group (23, 38, and 62% of a group's caloric intake). Results confirm our prediction that blue monkeys are flexible feeders that converge on a nutritional strategy regardless of home range composition. They also use non-natural foods to meet dietary needs. We conclude our study by exploring how fruit/plant phenology may affect use of non-natural food resources.

Social strategies and their relationship with baseline fecal glucocorticoids in juvenile blue monkeys

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In gregarious animals, affiliative ties can serve several functions. One broad function is to decrease allostatic load, often by protecting individuals from, or alleviating their experience of, social and environmental stressors. For juvenile animals that are growing physically and navigating a new social group, ties can help protect individuals from starvation and social competition from older and larger individuals. Using data collected over 8 consecutive months on 41 juvenile blue monkeys from 3 social groups, we measured the quality of ties (using a dyadic sociality index), their quantity, and the activity budgets of subjects to assess their relationship with allostatic load, as measured by baseline fecal glucocorticoid metabolites (FGCMs). Social ties and activity budgets varied by sex and age in a manner expected for female philopatric primates. Tie quality, quantity, and time spent grooming and playing showed repeatable inter-individual differences across seasons, whereas time spent in other activities did not, suggesting juveniles have social personalities. Unexpectedly, more time spent grooming corresponded with higher baseline FGCMs, regardless of subjects' age or sex. Also unexpectedly, FGCMs increased with fruit availability. Tie quality, quantity, rates of aggression given or received, and time spent in other activities did not relate to FGCMs. Time spent grooming in one period did not predict FGCMs in the following period, nor vice versa. Although the causal relationship between grooming and FGCMs is uncertain, these results raise interesting questions that may challenge common notions about what that relationship is.

Ecological or allopatric speciation under past climate conditions? An investigation into the lemurs of Northwestern Madagascar

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Most of the world's biodiversity occurs in the tropics, but the processes that generate this abundance of species are still poorly understood. Isolation in refugia, or remnant pockets of forest during glaciation in the Pleistocene, has been proposed as a major geographic driver of diversification, but evidence for this is often based on snapshots of modern species distributions instead of past ones. This study used Maxent to project the ecological niches of lemurs onto past climate conditions for the Last Glacial Maximum (LGM; ~21kya), the mid-Holocene (~6kya), and modern day in northwestern Madagascar, where several putative refugia occurred. Past models and were compared with putative refugia proposed by Wilme et al. (2006) and modern species distributions. Four pairs of sister species, such as *Eulemur flavifrons* and E. macaco, would have had large areas of geographic overlap in the past, despite occupying separate ranges today and separate refugia as identified with modern distributions. However, background tests for niche similarity indicated exhibited significantly diverged ecological niches during the LGM. Climatic conditions may have played a larger role than previously thought in reducing gene flow between populations previously thought to be in allopatric refugia during the LGM. This approach to studying historical causes of speciation is applicable to other primates and could help determine the importance of past climatic conditions in shaping the present distribution of biodiversity.

Abstracts of

Posters

Nutrient limitation and orangutan facilitated nutrient recycling in a peat swamp habitat

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The ecological role of primates and their effects on forest dynamics have been largely limited to seed dispersal studies, with little attention paid to the other services that primates provide. Some soil nutrients are critically limiting in tropical forests, and large animals are thought to be disproportionately important for the translocation of soil nutrients. We present data on nutrient limitation in a Bornean peat swamp, and orangutans' role in facilitating nutrient recycling. Data were collected at the Tuanan Research Station in Central Kalimantan, Indonesia from 2014-2015. Nutrient limitation was quantified with nutrient addition experiments using root in-growth cores. Nitrogen, phosphorous, and potassium were the experimental treatments and were compared to control cores. After one year, the change in below ground (fine root) biomass for each treatment was measured. Orangutan fecal samples were collected opportunistically during full-day focal follows, and soil samples were collected prior to nutrient addition experiments. Only phosphorous cores were significantly different from control cores in fine root biomass ($p < 0.0001$), with a 7-fold mean increase due to phosphorous addition. Mean total phosphorous per fecal sample was 2.85 times greater than mean total phosphorous per soil sample. These data suggest that phosphorous is limiting at Tuanan, and that orangutan feces is comparatively rich in phosphorous relative to the native soil. Orangutans are among the largest animal species at Tuanan, and are at a relatively high density. Orangutans are therefore potentially important regulators of soil phosphorous within peat swamps, and thus provide important ecosystem services to these habitats.

Cranial diversity in Asian Colobinae and the origins of the pileatus group

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The langurs (Subfamily Colobinae, Tribe Presbytini) of Southeast Asia have undergone many phylogenetic revisions. In particular, some molecular data suggest the pileatus-group langurs (*Trachypithecus pileatus* and *T. geei*) are the result of ancient hybridization between *Semnopithecus* and *Trachypithecus* species. The addition of morphological data may help clarify this issue. Previous studies have noted the overall cranial similarity of the pileatus-group langurs to both putative parent genera. Another way to evaluate generic affiliation is with allometric trends in cranial shape, which tend to be conserved among species within a genus. This project tests whether the pileatus-group langurs conform to the allometric relationships of *Semnopithecus* or *Trachypithecus*. Forty-five 3D cranial landmarks were collected using a Microscribe-3DX on 293 adults from 18 species representing 7 genera of Asian Colobinae. Specimens were optimally superimposed with a generalized Procrustes analysis and subjected to a principal components analysis. The first principal component (PC1) explained 29.4% of the total variance; shape changes associated with PC1 approximate allometric changes common to catarrhine primates. PC1 was plotted against the natural log of the centroid size (reduced major axis regression; overall $R2=0.375$, $p<0.0001$). The odd-nosed colobines did not conform to a single trend in shape, but did follow unique trends. *Semnopithecus* and *Trachypithecus* appear to share an allometric trend; however, the pileatus-group langurs were separate and had lower PC1 scores for their size. This analysis highlights the distinct aspects of pileatus-group cranial morphology relative to the putative parent genera and perhaps supports a unique evolutionary origin for these species instead.

Diversity, disease, ecology, behavior: Treasures of the YPM *Pan troglodytes* skeletal collection

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Museum collections are critical resources for testing comparative anatomy, developmental biology and life history hypotheses. Skeletal collection review illuminates spatiotemporal-, species-, population- and individual-level variation, and informs us of environmental, social and epidemiological history. For endangered species such as primates, such collections are now nearly impossible to replicate. Here, we review the Yale Peabody Museum *Pan troglodytes* skeletal collection. Although the majority of the collection is from Central Africa's Atlantic Coast, multiple subspecies are present in the collection. Multiple age and sex classes are present, with craniodental and postcranial elements available for each age class. All material was assessed for developmental, disease, trauma, and socioecological indicators. Multiple indicators of metabolic stress are present, likely associated with nutritional and/or epidemiological factors. Instances of trauma and injury, ranging from antemortem to perimortem events, are described. For some individuals, these injuries are likely associated with intraspecific and intrasexual competition and violence, whereas others are suggestive of infanticide attempts. Other injuries are associated with interspecific violence, and are of value for forensic examination. Our evaluation of the YPM collection provides a baseline for future research and testable hypotheses for alternate techniques, such as isotopic analyses of calculus and noninvasive genetic testing. Museum collections continue to provide new insights into taxonomic and individual variation and environmental cues, and ultimately allow for comparisons between modern and historic environmental and behavioral variables.

Whole genome sequencing of a gibbon parent-sibling quartet to examine mutation rate variation

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Understanding the evolution of the human germ line mutation rate (μ) is vital for numerous aspects of medical, population and evolutionary genetics. Traditionally, μ is estimated using a phylogenetic approach in which genetic divergence between two species is calculated and calibrated using some external estimate of the species split time to give the substitution rate per year (k). More recently, direct pedigree estimates of μ from whole genome sequencing of parent-child trios in humans, infer estimates that are approximately half of that inferred using k. This discrepancy may be explained by the 'hominid slowdown' where μ is thought to have decreased per unit time during the transition from small primates to larger primates. However, the recent observation of a positive correlation of μ with paternal age in humans challenges this hypothesis. Gibbons, being phylogenetically between old world monkeys and great apes are key to testing the robustness of the hominid slowdown explanation. Here, we generated high-throughput sequencing data (>20x) of a family quartet of *Nomascus gabriellae* (yellow-cheeked gibbon). Without a reference genome for this species, reads were mapped to *Nomascus leucogenys* (nomLeu3), which is approximately 2 million years diverged. With such divergence, many spurious mutations are identified and the number of candidate *de novo* mutations (CDMs) is excessive. To address this, we use several methods to masks low-quality genomic regions and infer inheritance states in the quartet to inform a custom variant caller developed to identify a reasonable number of CDMs that can be sent on for further sequencing.

Assessing the impacts of human activities on sifakas (*Propithecus verreauxi*) at Beza Mahafaly Special Reserve

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Beza Mahafaly Special Reserve (BMSR) has been an important site of lemur research and community-based conservation for over three decades. In 2015, BMSR was officially expanded to encompass 4,600 ha of forest, including both core conservation areas and multiple-use zones. These recent changes provide an ideal setup to expand lemur research outside Parcel 1 (an 80 ha core zone where monitoring efforts are concentrated) and assess differences in sifaka biology across areas with distinct degrees of human impact. To begin this project, we set up line transects across the expanded reserve and habituated sifaka groups in new core and sustainable use zones. Although forests outside Parcel 1 face significant human impact (most notably: livestock grazing and cutting of trees), we found sifaka groups inhabiting all of the zones surveyed. Our preliminary data also suggest that the abundance of sifakas across the reserve cannot be explained by measures of disturbance or protection status alone. Finally, pilot behavioral data comparing sifakas in Parcel 1 to those in areas of higher human impact indicate differences in behavior are quite subtle and require more refined behavioral sampling protocols. Moving forward, we will collect systematic evidence of the impact of human activity and measures of sifaka behavior, distribution, demography, and physiological health. This integrated approach will help elucidate the determinants of sifaka population health, and will inform future management policies. This work will also provide the benchmark for a larger-scale survey and model of sifaka distribution and connectivity across the Mahafaly region.

The effects of captive environments on sub-adult gorilla behavior

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Canisius College

The behaviors of juvenile Western lowland gorillas, ages two and four, and their father, 28, were observed when the gorillas were in their holding area compared to their naturalistic exhibit. Previous studies have indicated that infant gorillas will increase their levels of object examination and solitary play in a naturalistic environment, but increase their exploration of other conspecifics while in holding (Hoff, Fothman, & Maple, 1994). The purpose of this study was to further explore these finding by comparing the behaviors of two different-aged juvenile gorillas in order to determine if they showed similar patterns, and if there were individual or age-specific differences in their behaviors. Each focal subject was observed 18 times for 20 minutes per session over an eight week period when the gorillas were in holding. Data were also collected when the gorillas were on exhibit across the same eight week period. Results suggested that Amari, age four, increased her interaction level with others while in holding and increased her levels of object play and self-directed behavior while in her natural exhibit. In contrast, Nyah, age two, showed less interest in soliciting grooms while in holding, but increased play solicits, levels of social play, and object play while in holding. These descriptive results suggest that there are distinct differences between behaviors in holding areas and on exhibit, but these patterns can differ across individuals. Differences may be a result of the age differences however there is not enough data to confirm this.

Some strepsirrhines prefer alcohol

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Recent reports suggest that dietary ethanol, or alcohol, is a supplemental source of calories for some primates. For example, slow lorises (*Nycticebus coucang*) consume fermented nectars with a mean alcohol concentration of 0.6% (range: 0.0–3.8%). A similar behavior is hypothesized for aye-ayes (*Daubentonia madagascariensis*) based on a single point mutation (A294V) in the gene that encodes alcohol dehydrogenase class IV (ADH4), the first enzyme to catabolize alcohol during digestion. The mutation increases catalytic efficiency 40-fold and may confer a selective advantage to aye-ayes that consume the nectar of *Ravenala madagascariensis*. It is uncertain, however, whether alcohol exists in this nectar or whether alcohol is preferred or merely tolerated by nectarivorous primates. Here we report the results of a multiple-choice food preference experiment with two aye-ayes and a slow loris. We conducted observer-blind trials with randomized, serial dilutions of ethanol (0–5%) in a standard array of nectar-simulating sucrose solutions. We found that both species can discriminate varying concentrations of alcohol; and further, that both species prefer the highest available concentrations. These results bolster the hypothesized adaptive function of the A294V mutation in ADH4, and a connection with fermented foods, both in aye-ayes and the last common ancestor of African apes and humans.

Modelling female kin reunion in hamadryas baboons

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In species with female dispersal, it is assumed that females live with unrelated individuals and thus have few opportunities to benefit from kin interaction. This problem is particularly acute for hamadryas baboons, *Papio hamadryas hamadryas*, which have arguably the most male-dominated social system among primates. Males target individual females to aggressively take over from other males and add to their own one male unit, separating female kin in the process. Recent genetic research, however, suggests that adult females are often closely related within units. Early field reports also suggested that female hamadryas baboons often are transferred into units containing their kin. We created an agent-based model of hamadryas baboon demography and social dynamics to investigate whether female influence could replicate the relatedness pattern better than strictly male-controlled dispersal. We used data from the Filoha and Erer Gota field sites in Ethiopia to reconstruct life history and dispersal. The simulation tracked the complete lineage of each individual to generate detailed kin relationships. We ran simulations where females had no influence on unit dispersal and where there was female preference to join kin. We compared the resulting relatedness of adult female dyads within and across units. Our findings lend support to the hypothesis that females could be increasing the relatedness of the unit by influencing dispersal. We now plan to use our models of hamadryas baboon dispersal and lineage to investigate differences in male lifetime reproductive success in *Papio*.

Using new and improved measures of protein digestibility to better understand colobine monkey nutrition

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Primates require approximately 10-12% protein for maintenance and reproduction. Low dietary protein has been predicted to be limiting for population abundance. The ratio of protein to fiber in mature leaves reliably predicts colobine biomass at several sites within Kibale National Park, Uganda. Mature leaves in Kibale contain high levels of protein, which is well above the estimated protein needs, so it is unclear why protein would be limiting to colobine abundance. Previous studies examined crude protein but it is not biologically relevant because it does not account for the presence of tannins, as well as the presence of nitrogen in many other non-protein compounds. To account for these factors, we used an in vitro assay to estimate how much nitrogen is available for digestion in leaves that are a predominant food source (n=33 spp.) of *Colobus guereza* and *Procolobus rufomitratus* in Kibale. This assay also uses polyethylene glycol, a chemical which binds tannins in foods, to estimate their impact on digestibility. Young leaves had high levels of digestible protein (24.9% CP, s=4.8%; 16.7% digestible protein, s=6.2%), whereas mature leaves had lower levels of digestible protein (18.9% CP, s=4.9; 9.9% digestible protein, s=5.4%). Tannins are rare in the trees of Kibale and we found that they did not have a significant effect on protein digestibility. Our results suggest that protein is not limiting for Kibale monkeys and other nutritional factors may contribute to the relationship between diet and colobine abundance.

Testing repeatability for laser photogrammetric measurement of body size variation in wild male olive baboons (*Papio anubis*)

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The marked sexual dimorphism of baboons has often been attributed to the fitness benefits of large body size in male-male competition over mates. Testing this hypothesis requires reliable methods for measuring body size accurately in the field. Recently, researchers have developed non-invasive methods for acquiring these data without the need to capture free-ranging subjects. The aim of this preliminary study was to test the utility of parallel laser photogrammetry for assessing variation in body size estimates based on linear measurements of photographs. We measured body length of 20 adult males (4 photos each) in a wild group and calculated a measure of repeatability between different photos of the same male. In our dataset, 54.5% of the variability in body length came from differences among males rather than differences within individual males. This comparatively low value indicates there may be several sources of error in our method that resulted in high within individual variation. Potential sources of error include: 1) identification of the anatomical landmarks for measurement is hampered by the relatively large capes of dense hair of males and by any significant motion of individuals at the time the image was captured; 2) Adobe® Photoshop may not be the best software for measurements at this scale; 3) the use of two lasers may be less accurate than a single split laser. These preliminary results suggest that despite past successes of parallel laser photogrammetry, it is still crucial to validate such methods before using them in data collection.

Seasonal nutritional ecology of the black and gold howler monkey (*Alouatta caraya*) in Argentina

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There are different feeding patterns in primates that reflect the wide variation in the macronutrient composition of their foods. We applied the Geometric Framework to explore seasonal strategies used in the food selection of howler monkeys (*Alouatta caraya*) inhabiting the southern limit of its distribution in Argentina. We collected 482 observational hours (June-December 2010, two groups) including 48 full day focal follows (2 males and 5 females). We analyzed the nutritional composition of 146 samples of food eaten from 27 species and 7 food parts, and estimated daily nutrient intake. Average monthly energy intake was 1011.22 ± 149.26 KJg-1mbm-1 (CV = 14.76%) of which 842.57 ± 117.66 KJg-1mbm-1 corresponded to non-protein energy (NPE) (CV = 13.96%) and 168.66 ± 35.13 KJg-1mbm-1 available protein

(CV = 20.83%) an intake equivalent to 9.92 ± 2.1 gmbm-1 of daily protein. However, these values were highly variable among months (CV Energy = 50.32%, CV NPE= 53.24 %, CV P = 62.99%), individuals, and groups, and there were two nutritional rails of NPE:P intake. In October and November, months of high-fruit intake (>80%, dry matter basis), NPE:P was 11.44 ± 0.71 and protein represents 21.34 ± 2.11% of total energy consumed. By contrast, in periods of less fruit intake (< 62%, dry matter basis) the NPE balance was 4.0 ± 0.81 and protein represents 8.26 ± 0.43% of total energy consumed. Understanding nutritional strategies of howlers could help us to understand how howlers are capable of coping with marginal environments across their distribution.

Membership change and female hierarchy in a group of silvery lutungs (*Trachypithecus cristatus*) at the Bronx Zoo

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Age-inverse hierarchy has been observed in several folivorous primates in the wild, but ranks are often unstable. Past studies on the wild silvery lutung (*Trachypithecus cristatus*), a folivorous primate, reported that the species lacks dominance hierarchy while one captive study conducted in Sri Lanka found there was a clear female dominance hierarchy with the suggestion of an age-inverse hierarchy. We examined female hierarchy before and after a membership change in a *T. cristatus* group at the Bronx Zoo. In March 2015, the group contained three males and seven females. By June 2016, two males have been removed and a subadult female was replaced by an older female. We observed agonistic behaviors in adult females for 60 hours each before and after the change. In both March 2015 and June 2016, we used ad lib sampling methods, because agonistic interactions infrequently occurred. We expected age-inverse hierarchy in 2016 due to increased age differences. We obtained Normalized David's Scores (NDS) (Dij) and modified Landau's indices to find steepness and linearity of hierarchies using R (3.3.0). Triangle transitivity was also tested. Spearman's rank correlation was performed on age-NDS relationships. 35 and 47 agonistic interactions occurred in pre- and post-group change, respectively. We found that hierarchy was non-linear in both years and transitivity decreased, however, steepness (stp = 0.546, p = 0.03) increased in 2016 probably because of the increase in age differences. Contrary to our hypothesis, age-inverse hierarchy was not found post-group change. These results are preliminary due to brief observations.

Male influxes in blue monkeys: More variation than we thought

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Blue monkey groups include multiple females and a single resident male most of the time. However, during the breeding season, the number of adult males within a group is more dynamic. In some breeding seasons, new males enter the group but are transitory, staying for only a short period; in others, multiple males stay for extended periods, and one of them may eventually take over the group from the previous resident male. Prior studies of our Kakamega, Kenya study population showed that these two types of breeding seasons, "influx" and "non-influx" were distinct, with non-overlapping criteria. We explored whether similar differentiation occurs in a more recent, eight-year dataset from eight blue monkey groups. We found clearly intermediate cases in terms of the total number of males, the average number of males per day, and the percentage of days with multiple males. These intermediate cases occurred exclusively in two large groups. Large groups also showed more variation in male number than smaller groups, which were more frequently uni-male. The relationship between sexually active females and the number of males in a group per day was much looser than previously demonstrated: across breeding seasons, the proportion of breeding season days with multiple sexually active females did not predict the proportion of days with multiple males. These results suggest that there is more continuous variation in male residence patterns than previously documented, and that factors other than female estrus synchrony drive variable male group membership.

A closer look at fossil euprimate and plesiadapiform encephalization quotients

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Recent studies illuminating the neuroanatomy of fossil plesiadapiforms and early euprimates have been a welcome addition to the literature. Within these analyses, encephalization quotients (EQs) are often calculated and compared across taxa. On the basis of overlapping EQs between plesiadapiform and early euprimate specimens, it has been suggested that, despite numerous changes in brain shape and sensory input, there is little evidence for an increase in brain size during early primate evolution and the origin of euprimates. In this study, I reexamine these data, noting that EQs calculated from an all-mammal regression line are negatively allometric across plesiadapiforms and early fossil euprimates. Therefore, larger animals will have smaller EQs in part due to their larger size, resulting in an overlap between large euprimate specimens and small plesiadapiforms in calculated EQ values. Among specimens for which data are available, when plesiadapiforms and early fossil euprimates of similar estimated body size are compared (i.e., taking a narrow allometric approach), it is clear that fossil euprimates always have larger EQ values compared to their similar-sized plesiadapiform counterparts. This result is true no matter whether cranial or dental body mass estimates are used to calculate EQ values. Thus, the available data suggest that there was indeed a shift to increased brain size during early primate evolution and that the origin of euprimates included a change in brain size as well as brain shape and sensory input.

The effects of age and sex on long-term spatial memory

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We investigated the influence of age, sex and dominance on performance in a learning task in a strepsirrhine primate, *Eulemur mongoz*. *E. mongoz* live in small family groups and are characterized by female dominance. We collected data from five groups at the Lemur Conservation Foundation in Florida. Lemurs were tested in social groups of two or three individuals. Six or nine containers, one third of which were baited with cantaloupe were placed in consistent locations for five learning trials and six test trials in the lemurs' habitual enclosures. We collected data on agonistic interactions and the order in which the lemurs investigated the containers, opened the containers, and ate the cantaloupe. We analyzed the number of unique visits of each individual to baited and empty to containers until all the baited containers were visited. The expected ratio of visits to baited and empty containers is 0.5. During the test trials, the ratio for adult males was 0.96, for adult females it was 0.84, and for offspring it was 2.25. Adult females were dominant to all other members of the group. Although they initially visited fewer baited sites than adult males or offspring, they ate the most cantaloupe because they displaced other individuals. The study found that lemurs can remember the location of baited containers and there is a difference in learning across different ages, where younger lemurs are more capable of remembering baited locations. The results also suggest an interaction of social and cognitive factors in an experimental foraging task.

Response diversity in lemurs of Madagascar promotes ecosystem resilience

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Habitat loss and climate change are affecting the environments in which species function. Response diversity – the diversity of responses to environmental change among species that contribute to ecosystem functioning – promotes ecosystem resilience because the composition of communities changes as the environment changes but overall function is preserved. Response diversity is evidenced statistically by an interaction between the species identity and the environmental gradient on abundance. I surveyed 31 transects in five localities in southeast Madagascar to measure lemur abundance, elevation, tree species richness, tree diversity, lemur food tree abundance, forest structure, and human disturbance history. I tested for an interaction between species identity and each environmental factor, while controlling for the phylogenetic relatedness of species and spatial effects. I found that 13 species co-occur in the region, but only 5-10 species co-occur on each transect. Variation in lemur abundances was explained by interactions between species identity and each of the environmental variables, suggesting different species react individualistically as the environment varies. The greatest response diversity was observed in relation to elevation and tree diversity. The abundance of six species increased with increasing elevation, while five species decreased. The abundance of seven species increased with increasing tree diversity, while four species decreased. These results illustrate that communities composed of species with different responses to environmental gradients increase the resilience of ecosystems in the face of environmental change, and future conservation policies should also focus on response diversity in addition to species diversity.

Novel and highly polymorphic color vision in wild indriids

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Polymorphic trichromacy occurs in most diurnal New World monkeys and some day-active lemur species. Many other day-active lemurs appear to be strictly dichromatic, and these differences in color vision might be influenced by subtle variation in activity patterns. We provide a comprehensive analysis of color vision in the lemur family Indriidae, which includes species with variable activity patterns. We sequenced the X-linked opsin gene for 151 individuals representing 10 species (the most strictly diurnal *Indri indri*, and all nine species of generally diurnal *Propithecus*) from 15 sites across Madagascar. Although previous research has found the closely-related nocturnal *Avahi* to be strictly dichromatic, at least eight species of diurnal indriids have polymorphic trichromacy. The four largest-bodied, rainforest-living species (*I. indri* and three *Propithecus* spp.) have alleles that have not been previously found in lemurs. *I. indri* exhibits the most allelic variation, with three alleles confirmed, including two novel alleles not known to occur in other lemur species. Given that *I. indri* is considered to be the most strictly diurnal lemur species, there may be stronger selection favoring trichromacy in this taxon. Furthermore, the novel color vision variation we identified is so far restricted to the largest-bodied, diurnal lemur species. Since most large-bodied diurnal lemurs have recently gone extinct, color vision in lemurs may have been more variable in the past.

Evolutionary conservation at voltage-gated sodium channels is correlated with gene expression in primate brains

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SCN1A, the gene encoding voltage-gated sodium channel alpha-subunit type I (Nav1.1), is highly expressed in the brain and is a commonly mutated in association with severe childhood epilepsy. Given its clear importance to human brain function, we examined whether the evolutionary pressure for this gene varied amongst primates by contrasting humans with other apes and macaques for both human-disease causing and putatively neutral SCN1A mutations using large databases of whole genomes and exomes. We found evidence of increased levels of nonsynonymous polymorphism in the human SCN1A gene, consistent with stronger negative selection pressure in nonhuman primates. An interesting pattern was that observable non-disease associated polymorphisms were almost exclusively localized to the cytoplasmic loop and extracellular sections of the protein in nonhuman primates, while those in humans were also distributed on the transmembrane helices. We then expanded our survey to the other nine members of the SCN Î±-subunit gene family, which are expressed at different levels throughout the body. Interestingly we observed that the most conserved genes were those expressed in the central nervous system, namely SCN1A, SCN2A and SCN8A. We are currently examining the mutation topology in the other SCN genes, where we predict that conservation in the intramembrane portion but not other areas of the gene will be correlated with increased brain expression levels. We are also exploring whether the most conserved gene in our survey, SCN8A, demonstrates notable differences in methylation patterns for humans compared to other primate homologues.

The effects of human visitors on the behavior of captive ruffed lemurs

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The purpose of this study is to observe the potential effects of visitors on the duration of agonistic and affiliative behaviors as well as active and inactive behaviors in captive ruffed lemurs. Two stable social pairs of ruffed lemurs, *Varecia rubra* and *Varecia variegata* were studied for two months at the Duke Lemur Center in order to determine if human visitors affect their behavior. Observations focused on particular behaviors that were categorized as either active, inactive, affiliative or agonistic in nature. The observed behaviors included sitting, resting/sleeping, greeting, grooming self, grooming others, playing, huddling, fighting, vocalizations, traveling, eating, and scent marking. The behavior of the lemurs was observed before the presence of a tour group, during and after. There were only private tours, the visitors are specifically brought to an exhibit at a set time. The study intends to illustrate a directional relationship between the presence of humans and lemur behavior. With this tour structure, changes in behavior can more easily be attributed to the presence of visitors, rather than the presence of visitors being a result of a change in behavior. Previous studies couldn't address the issue of causality because the visitors weren't in controlled groups. It was hypothesized that there would be an overall rise in active behaviors during the visitor condition, and more specifically a rise in agonistic behaviors. The ruffed lemurs exhibited an increase in active behaviors during the tour, and as a result a decrease in inactive behavior. There was little effect on time spent on affiliative or agonistic behaviors.

Nutritional chemistry and benefits of fallback foods utilized by the Tana River mangabeys, *Cercocebus galeritus*, Kenya

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The foods that primates rely upon during periods when preferred items are scarce, often referred to as fallback foods, are typically characterized by pronounced mechanical or chemical defenses. The consumption of these fallback foods is potentially critical for maintaining energetic homeostasis, particularly for juveniles, which are generally less efficient foragers than adults. The diet of the Tana River mangabey includes five plant species that are difficult to exploit because constituent food items are large in size and/or difficult to process. These foods include fruits and seeds from *Hyphaene compressa* and *Borassus aethiopum, Oncoba spinosa, Saba comorensis,* and *Diaspyros mesipiliformes*. What nutritional benefits do immature mangabeys derive from these foods when they manage to overcome the mechanical defenses they present? To answer this question, we examined the levels of macronutrients in these foods and their contribution to diets of juveniles. We collected food samples from a population inhabiting the Tana River Primate National Reserve, Kenya, and performed nutritional analyses (fat, fiber, nonstructural carbohydrates, protein). We found that the percent fat content was significantly higher in *Oncoba spinosa* (9.0 ±2.0%) compare to other foods (KW=6.1, p=0.002). Protein varied across the five species (KW=10.4 p= 0.04) from 5.21 ± 0.23 in *H. compressa* to 12.7 ±3.35 in *S. comorensis*. We conclude that although these food items are difficult to process, they provide juvenile mangabeys with both fat and protein during periods of resource scarcity, and thereby help individuals offset temporal seasonal energetic constraints.

Testing time: Fifteen years of forest fragmentation in southeastern Madagascar

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Fragmentation of primate habitats is a dynamic process and one of immense importance for both understanding primate behavioral flexibility and in best guiding conservation efforts. While fragmentation is well-explored within forested landscapes, its effects are difficult to generalize, particularly as fragmentation studies are often not conducted within a long-term context. To address the deficit in long-term fragmentation research, a study of 8 forest fragments in 4 villages in southeastern Madagascar, east of Ranomafana National Park (RNP), was conducted in June-August, 2016 to replicate a study of the same sites in 1999-2001. A total of 62 500-m transect surveys, split evenly between diurnal and nocturnal, were conducted to determine occupancy of the fragments by the thirteen lemur species native to RNP, in addition to conducting botanical plots, and systematically noting incidences of human disturbance. Fragment size decreased by 43.5 +/- 53.97% on average, representative of widely varying historical fragment contexts. Small-bodied *Microcebus murinus* was the most commonly sighted primate while the largest-bodied species in the region, *Propithecus edwardsi* and *Varecia v. variegata*, were not observed during the study period, indicating differential response across species to fragmentation. This study reveals the importance of long-term efforts within fragmented regions to capture compositional changes across time and space and to best advise the allocation of scarce resources toward conservation efforts.

Human activity and perceived predation risk in a habituated primate prey species: *Cercopithecus albogularis schwarzi*

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Wild primates are typically habituated to human observers before observation to avoid influencing their behavior. As a result of habituation, study groups in proximity to humans may have a lower actual risk from predation. However, whether they perceive a decreased risk is unclear. In this study we examined whether behavioral changes indicative of fear and/or an awareness of predation risk across the landscape were related to the presence of human activity at an African research station. To do this we collected behavioral and GPS data on two troops of wild habituated samango monkey (*Cercopithecus albogularis schwarzi*) through areas of both regular and low human activity in the Soutpansberg Mountains of South Africa. We hypothesized that proximity to areas high in human activity would result in a decrease in the rate of vigilance bouts and vertical habitat usage. Our model suggested that glance rates were mainly governed by vertical habitat usage, habitat type, and the distance to the nearest human habitat while remaining constant across age-sex classes, time of day, and troops. However, we did not find evidence that distance was related to the odds that a troop would use the ground vs. heightened forest layers. As few areas in the world exist without human activity, elucidating how potential changes in perceived risk may influence prey behavior is important for understanding behavioral plasticity in wild populations and for predicting the responses of wildlife to different types of human disturbance.

The relationship between canine eruption sequences and canine size in female guenons (tribe Cercopithecini) and other cercopithecids
Reiko Matsuda Goodwin and Warren Pardi
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We studied the degree of polymorphic eruption sequences of permanent teeth in extant juvenile guenons (tribe Cercopithecini) and compared the results with published data for other cercopithecids obtained from the literature. Using a five-point system to score the teeth of 203 jaws belonging to >20 species of four guenon genera excluding *Erythrocebus*, we tabulated pairwise matrices. Micro-computed tomography (μ-CT)-scanning resolved some deciduous/permanent teeth ambiguities. We then examined whether interspecific variations in female canine eruption sequences relate to variations in canine height (CHT), canine mesiodistal diameter (MD) canine bucco-lingual width (BL), canine size dimorphism (CSD), and body weight (BW), which were obtained from the literature. Sequences in *Cercopithecus* were: M1I1[I2M2]PM4PM3[CM3]/M1I1[I2M2][P4=P3]CM3 (male) and M1I1I2M2[PM4=PM3C]M3/M1I1I2M2[C=PM3=PM4]M3 (female). *Miopithecus* and *Chlorocebus* show similar sequences with some variations. Small sample size precluded us from determining *Allenopithecus* sequences. Our samples (except *Allenopithecus*) have tendencies for the backward premolar sequence (not in *Miopithecus*), delayed eruption of /C in males, and canines erupt before premolars in females (not in *Miopithecus*). In Cercopithecids, we found three types of female canine eruption sequence (FCES): canines erupt before M2 (Type 1), canines erupt after M2, but before premolars (Type 2), after premolars (Type 3). Multinomial logit analysis and linear regression analysis conducted using R (3.3.1) showed that type is best predicted by the greatest mesiodistal diameter of female maxillary canines ($R^2=0.2696$, $F(2, 22)=4.06$, $p=0.032$), then by CHT and CSD, but not by BW. Eruption sequences for unstudied mangabey taxa are needed to substantiate our findings.

Tarsier phylogenetic inference using museum skin samples
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Tarsiers are a unique lineage of primates that have the potential to inform investigations on early primate evolution as the sister group to anthropoids. We have a clear understanding of the phylogenetic placement of tarsiers relative to other major primate groups, we have little understanding of the genetic diversity or species level relationships amongst extant tarsier species which include three genera: *Carlito*, *Cephalopachus*, and *Tarsius*. While tarsiers are sometimes included in primate-wide phylogenies, these studies generally only include a handful of samples and only tarsier mitochondrial loci. High-quality genetic samples of tarsiers are hard to obtain, and it is even more difficult to obtain high-quality samples across the full tarsier range that extends from the Philippines, Borneo, Sulawesi, and to the southern tip of Sumatra. Museum samples provide a great alternative to recently collected blood or tissue samples. Museum samples have already been collected across the breadth of the tarsier range and they do not disrupt living tarsier populations, many of which are vulnerable or worse according to the IUCN Red List. I attempted DNA extraction on 28 museum skin samples from the American Museum of Natural History, the Field Museum of Natural History, and the National Museum of Natural History. DNA extracts ranged from 0.159-4.56 ng/μL of DNA. I am attempting to sequence thousands of nuclear loci from each sample using hyRAD sequencing to infer the first multilocus nuclear phylogeny including all three tarsier clades.

Self-directed behavior as an indicator of social stress in wild orangutans
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Orangutans are considered semi-solitary and highly constrained by poor fruit availability in their Southeast Asian habitat compared to that of the African apes. With high levels of sexual coercion/mating resistance and very little social interaction described, orangutan studies give the impression of general social aversion. As such, we hypothesized that meeting conspecifics would elicit psychosocial stress. Self-directed behavior has been identified as a behavioral marker of anxiety in non-human primates. During day-long focal follows of wild orangutans in Gunung Palung National Park, all instances of yawning, self-scratching, and self-grooming were recorded during 10-minute intervals of unobstructed orangutan viewing. Orangutans had higher rates of self-directed behavior when they were social (within 50 meters of an independently ranging conspecific) than when they were alone [$t(485.3)=-3.65$, $p<0.05$]. Generalized linear mixed models were used to predict rates of self-directed behavior based on the focal orangutan's age-sex class and the age-sex class of their social partner. This revealed that adolescent females had a significant increase in rate of self-directed behavior when social ($p=0.047$) and that socializing with a flanged male significantly increased the rate of SDB ($p<0.05$). We describe the contexts in which orangutans display elevated rates of self-directed behavior and the implications of these findings for social development. We also discuss the potential utility of self-directed behavior as a metric for characterizing dyadic relationships in a socially cryptic species that is revealing itself to have far greater social nuance than previously thought.

Effects of sociality on glucocorticoid production in the male rhesus macaque.
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The quality of an individual's social environment is known to play an important role in determining the health of both human and non-human primates. While the links between sociality and measures of fitness are well established, the physiological mechanisms mediating these links remain unclear. In this study, we explore the role of glucocorticoids (GCs), a class of steroid hormones associated with the regulation of metabolic function and the immune system, as mediators of the relationship between sociality and health in the male rhesus macaque. Chronically elevated GC production is associated with inflammation and immunosuppression and is likely to mediate long-term impacts of sociality on fitness. Behavioral data and fecal samples were collected from 20 reproductively mature males living within the same social group on Cayo Santiago from January to April 2015. We predicted that males who spent less time in proximity and grooming with adult females would exhibit higher fecal GCs. The majority of the models showed no significant effect of proximity and grooming with adult females on GC concentrations. These results improve our understanding of the selective benefits associated with social behavior in primates, as well as provide insight into the health consequences of variation in human sociality.

Expert *versus* novice understanding of a cooperative task with chimpanzees
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Canisius College
In any social group, individuals will have varying levels of expertise on any given task. I observed a group of chimpanzees participating in a cooperation task in which two individuals had to pull at separate bars on an apparatus simultaneously in order to receive a reward. The group consisted of four experts who had previous experience with the apparatus and eleven novices who had no previous experience. All bar pulling (purposeful and extraneous) was recorded. There was no difference in the overall success of novices versus experts, however both groups did not develop equal understanding of the task. Specifically, the novices engaged in significantly more uncoordinated pulling than the experts. Results were also compared with a group composed entirely of novices, where all individuals appeared to develop understanding of the task. Overall, our findings suggest that experts

can help facilitate the success of novices in the group, but may hinder their understanding of the task.

New sivaladapid from the Lower Siwaliks of India

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In 2014, renewed fossil prospecting of Lower Siwalik deposits near Ramnagar, India recovered a partial right mandible of a sivaladapid primate at the newly discovered fossil locality of Sunetar (14 Ma – 11 Ma). While Lower and Middle Siwalik sites on the Potwar Plateau in Pakistan and Haritalyangar in India, respectively, have produced Sivaladapis and Indraloris fossils, the recently recovered specimen is only one of two sivaladapid fossils known from the Ramnagar region. The specimen (VPL/RSP1) preserves the corpus with roots of P4 and M1-M3 dentition, all of which are extremely worn. Comparative and phylogenetic analyses indicate that VPL/RSP1 is significantly different in morphology compared to previously described sivaladapid taxa, thus warranting a new genus and species. Results of a 40-character phylogenetic analysis including 26 adapoid taxa most often places VPL/RSP1 at the base of a Sivaladapine clade. The parsimony analysis revealed a number of interesting findings; for example, some previously identified sivaladapid taxa (i.e., *Lushius*) do not fall within the broader family-level Sivaladapidae. Results also show a more distant relationship between both Guangxilemur species, suggesting the creation of a new genus name for *G. singsilai*. Traditionally, investigations of Sivaladapid phylogeny have been wrought with paraphyletic relationships and little resolution, thus initial findings of the current analysis further encourage future examination. In order to clarify sivaladapid relationships and the origin of Sivaladapidae, future research should examine sivaladapids within a broader context by including additional characters and basal adapoid taxa.

The relationship between mtDNA substitution parameters and BMR in primates

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Understanding the relationship between genotype and phenotype is a central question in evolutionary anthropology and biology, especially with respect to the effects of brain and body size on basal metabolic rate. Various hypotheses have been put forth testing these effects; however, few of these have tested the effects of DNA substitution parameters. Considering the role of the mitochondrion in metabolism, evolutionary changes in mitochondrial DNA (mtDNA) seem likely to have an important role in influencing basal metabolic rate. This study tests the hypothesis that mtDNA substitution parameters such as dN (the rate of non-synonymous substitutions), dS (the rate of synonymous substitutions) and GC content have a causal role in determining primate basal metabolic rates. We used phylogenetic path analysis models to test causal relationships between the mtDNA substitution parameters and body mass, brain mass, and basal metabolic rate in primates using published data from both strepsirrhines and haplorhines (n=21). Results from nine alternative phylogenetic path models yielded three significant models (C-statistic = 6.353, 12.866, 14.176; CIC = 57.686, 64.200, 56.176). Two of these models included significant relationships between dN, dS, GC content and basal metabolic rate while all models indicated significant relationships between body mass, brain mass and basal metabolic rate. These results suggest that, though body mass and brain mass may still be the main objects of phenotypic selection, the changes observed in the mtDNA substitution parameters are important responses to this selection and influence the changes observed in primate basal metabolic rates.

Assessing the reliability of genomic and pedigree data of free-ranging rhesus macaques

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Individual variation in social behavior arises from a combination of experience, environmental factors and genetic predispositions, but the extent to which genetic variation is associated with social behavior remains poorly understood. Many attempts to detect genetic associations in non-human primates relied on particular exonic polymorphisms or targeted gene sequencing approaches, but gene regulation and gene-protein interactions occur in incredibly complicated ways. Thus targeted gene approaches are limited in their ability to explain the genetic underpinnings of complex social behaviors. To approach this problem, we generated whole genome sequence (WGS) data for 217 rhesus macaques (*Macaca mulatta*) from the free-ranging population on Cayo Santiago, which has an extensive set of ethological and pedigree data. First, we identified over 19 million genome-wide single nucleotide polymorphisms (SNPs). In order to assess the accuracy of our sequence data, we also collected genotypes from a SNP array of 271 polymorphisms for a subset of our sample (N=141). Our WGS data had a >90% concordance rate with the SNP array without controlling for genotype quality, and it exceeded 95% after controlling for and excluding lower quality variants. Next, we assessed the reliability of the population pedigree data, which were previously derived from behavioral and microsatellite data. We integrated a maximum likelihood estimation of relatedness with our WGS data and identified a number of first-order pedigree discrepancies. This initial investigation of a single primate population using WGS data opens avenues for future analyses of variant associations with specific suites of behaviors.

Quantifying countershading in *Eulemur* using eigencoats

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Countershading has been identified as an important anti-predator adaptation, especially within Primates. Smaller-bodied primates that adopt a pronograde posture and locomotion are more likely to be countershaded compared to larger-bodied primates that move and feed using an orthograde posture. Many *Eulemur* individuals have countershaded pelage, although the degree of countershading and difference in countershading between sexes varies among *Eulemur* species. Here we use the eigencoats algorithm, a variation of eigenfaces, to quantify countershading on the dorsal and ventral surfaces of the entire pelage for 39 adult male and female *Eulemur* (n=78 surfaces). An eigencoat analysis takes entire coat variation into consideration by transforming color-corrected digital photographs of preserved primate skins into column vectors of pixel data, then performing a principal component analysis on the covariance matrix of these vectors. The first principal component accounted for 60% of the total variance and captured variation relating to darker or lighter pelage coloration across an entire dorsal or ventral surface, with a clear division between darker dorsal and lighter ventral surfaces. Degree of countershading was quantified by calculating the Euclidean distance of principal component scores between dorsal and ventral surfaces of each specimen. Male *E. albifrons* had the highest countershading values (0.23, 0.21, and 0.19), while dorsal and ventral surfaces of male *E. macaco* had had the lowest countershading values with little difference in color pattern between dorsal and ventral surfaces (0.032, 0.04, 0.02, and 0.03). This type of analysis can be generalized to other questions regarding pelage pattern variation in primates.

Grandmother effects in wild chimpanzees

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The existence of prolonged post-reproductive lifespans, which are particularly pronounced in human females, remains an evolutionary puzzle. Adaptive explanations for this phenomenon include the "grandmother" hypothesis, which argues that grandmothers receive greater inclusive fitness benefits by investing in their grandoffspring compared to continuing to reproduce themselves. Grandmother effects have been reported in taxa both with and without post-reproductive lifespans; however these effects have never been investigated in chimpanzees, one of human's closest relatives. Chimpanzee females typically disperse before reproducing; however ~50% of females born in the Kasekela community of Gombe National Park, Tanzania remain in their natal community, providing the unique opportunity for maternal grandmothers to interact with their grandoffspring. In this study, we used 35+ years of behavioral and demographic data to test for evidence of grandmother effects in wild eastern chimpanzees (*Pan troglodytes schweinfurthii*). We found that direct interactions, such as grooming and playing, between grandmothers and their grandoffspring were extremely rare and grandmother presence in the community was not related to grandoffspring

survival (Î²=-0.212, HR=0.809, p=0.760) or length of their adult daughter's interbirth interval (Î²=1.32, HR=3.73, p=0.470). These results indicate that given the opportunity, chimpanzee grandmothers do not directly invest in the production or survival of grandoffspring.

U-opioid receptor role in grooming behavior of free-ranging rhesus macaques

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Across mammals, the opioid system plays a putative role in the development of social bonds. In humans, the Î¼-opioid receptor (MOR) potentially mediates reward, addictive behavior, aggression and sociability, but functional differences exist in the population. A single nucleotide polymorphism (SNP) in the MOR gene (OPRM1 A118G) causes a greater affinity for endogenous opioid neuropeptides. In rhesus macaques, OPRM1 exhibits ~98% homology to the human gene, and a nonsynonymous SNP (C77G) similarly increases Î²-endorphin affinity. One allele was previously implicated in increased frequency of bonding and attachment behaviors in free-ranging and captive rhesus macaques, yet the polymorphism's impact on other social behaviors, like grooming, is poorly understood. Our study population of rhesus macaques on Cayo Santiago island (Puerto Rico) represents a large, semi-naturalistic sample with extensive behavioral and pedigree data. We generated whole genome sequences for 217 individuals, as well as data using a SNP chip array for 141 of these individuals. We observed genotype frequencies and allele frequencies of 53/53/70, 0.452C, and 0.548G for the WGS data and the SNP chip data, respectively. We then used dyadic observations of grooming data (grooming received + grooming provided) collected over five years to build a simple network model where the probability of grooming interactions depended on the OPRM1 C77G variant. The estimate of the variant effect was close to zero, suggesting that OPRM1 C77G has an impact that is small or variable enough that we cannot reliably detect it with our current sample size in terms of grooming rate or grooming interactions within the social networks of Cayo Santiago rhesus macaques, even after controlling for age and sex.

Testing ruffed lemurs (*Varecia* spp.) color vision at Duke Lemur Center using SMARTA

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In primate populations with polymorphic color vision there are both dichromatic (red-green colorblind) and trichromatic individuals. This results from allelic variation of a single x-linked opsin gene allele. The link between genotype and phenotype is well-established in haplorhines but is not well-studied in lemurs. We developed the subject-mediated automatic remote testing apparatus (SMARTA) to investigate the color vision genotype-phenotype link in ruffed lemurs (*Varecia* spp.). SMARTA is an innovative novel apparatus for behavioral touchscreen discrimination tasks. It aims to reduce biases, increase inter-rater reliability, and to accurately test the color discrimination abilities of inferred dichromatic and trichromatic individuals. SMARTA is controlled remotely via a smartphone app, has a motorized conveyer that automatically dispenses food rewards, automatically logs data online, and is relatively inexpensive to build. Preliminary results show no evidence that time needed for SMARTA skill acquisition is influenced by age and sex.

Observing breeding behaviors in *Symphalangus syndactylus* (Siamang) in captivity

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Despite their endangered status, little research exists on breeding behaviors of the siamang (*Symphalangus syndactylus*), in the wild or in captivity. The purpose of this study was to monitor a breeding pair of zoo-housed siamangs, at the Pittsburgh Zoo and PPG Aquarium, to determine if siamangs exhibit specific mating patterns/behaviors and/or a visibly discernable estrus cycle. We observed a recently sexually mature male/female pair over a span of 6 weeks. The pair was video recorded two days a week, continuously for one hour, either in the morning or late afternoon, in their indoor exhibit. These videos were used to construct an ethogram and activity budget for each individual, which was compared using nonparametric statistics. Then, an additional nine hours of video was collected, which was used to descriptively assess mating/breeding behaviors. The activity budget comparison revealed the siamangs spent most of their time brachiating while indoors, and while there was no visual indicator of an estrus cycle in our female, it appears that male attentiveness to the female (e.g., playful chasing and remaining in close proximity) may foreshadow mating attempts. Additionally, it was determined that copulation in captive siamangs mirrors that in the wild, with males approaching females to copulate dorso-ventrally and participating in suspensory copulation. Further study is needed to determine if these behaviors persist as the pair becomes older and more sexually experienced. We hope that this study improves our basic understanding of captive siamang mating behaviors, and contributes to the success of future siamang breeding efforts.

Males in uniform: intra-individual pelage color variation is associated with social style in male macaques

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Sexual dichromatism–differences in coloration between the sexes–is associated with sexual selection in many animal species. As with many potentially dimorphic traits, male coat color is expected to vary with intrasexual competition, while female color is expected to vary in response to environmental variables. Although macaque species are not obviously dichromatic, pelage color may still be an indicator of male quality, and thus subject to sexual selection. Social behavior in macaques has been classified using social "styles," which reflect the rigidity of dominance hierarchies and the strength of inter-individual competition for resources and mates. In order to determine if there is a relationship between social style and variation in uniformity of pelage color, we compared average intra-individual color variation for males and females of eight macaque species with different social styles. We took high-resolution photographs of the dorsal surface of each specimen. We then counted the number of unique colors–unique combinations of RGB values–in the dorsal torso pelage of each individual. Using phylogenetic ANOVA, we found a significant difference in color counts between social styles in males ($F = 33.270$, $p = 0.005$), but not in females ($F = 9.074$, $p = 0.061$). We further analyzed the relationship between color counts and ecological variables (average annual rainfall, average temperature and latitude) using phylogenetic generalized least squares. We found no significant correlation between ecological variables and color counts. Our findings suggest that socio-sexual factors exert adaptive pressure on male pelage color uniformity independent of environmental conditions.

How can camera trapping improve your research program?

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In the last decade, there has been a tenfold increase in publications reporting data on primates from camera traps. Although camera traps have been used to study primate behavior and ecology in animals ranging from <100g (*Microcebus*) to >150kg (*Gorilla*), not all research questions are appropriately addressed with this method. For example, camera traps can document the presence of unhabituated or cryptic animals and record rare behaviors, like tool use, but density or abundance estimates are often biased by camera placement. There are also ecological, technical, and logistical concerns associated with using camera traps, such as destruction by animals, improper device operation, and theft. Camera trapping can have value by itself, but can also be integrated with direct observations to gather data on animals unlikely to be camera trapped, e.g. arboreal species, and those unlikely to be seen directly, e.g. nocturnal species. Camera trapping programs can produce vast amounts of data; this has advantages but also presents challenges. Options for data management and processing include freely available software, such as TRAPPER or camtrapR, and citizen scientist platforms, like Zooniverse. Benefits of working with citizen scientists include educational outreach and stimulating interest in your research. However, the goals of the project must be clear from the start, and a plan must be in place to provide support personnel. Once the data have been analyzed for your target species or behaviors, the videos or images can be made available for other scientists or projects through outlets like the Camera Trap Data Network.

Long-term spatial memory in *Eulemurs* and effects of learning schedules

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We examined long-term memory in Eulemurs and the impact of distributed learning schedules on their ability to recall the location of food sources. Recent experimental work indicated that Eulemurs could not recall the location of a single baited site after 12 massed exposures and a 1-week delay. We conducted our study at the Lemur Conservation Foundation in Florida. Our analysis focused on 1) determining if the Eulemurs demonstrated memory, and 2) if learning schedules produced a significant difference in retention. We tested two distributed schedules that differed in the spacing of the first five trials (Learning Trials): one included 1-2 hour delays and the other included 1-day delays. We placed containers, 1/3 baited, in consistent locations. A sniff of a container was considered as a visit. A two-way split plot ANOVA showed no significant difference between distributed schedules. A t-test analysis of container visits was not significant for the Learning Trials, but supported the memory hypothesis for delays of 1, 2, 4, 7, and 14 days. Their visits indicated an achievement of 2/3 of perfect scores. The Eulemurs opened 100% of baited containers and 11% of empty containers, indicating that they relied on olfaction at close range. These experiments 1) demonstrate the first time a lemur species has shown evidence of spatial memory for multiple locations for a one-week delay, 2) shows the effectiveness of a distributed over a massed schedule for long-term memory and 3) indicates that lemurs rely on memory and olfaction to locate food.

Recent evolution of the salivary mucin MUC7 in primates

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Genomic structural variants constitute the majority of variable base pairs in primate genomes and affect gene function in multiple ways. While whole gene duplications and deletions are relatively well-studied, the biology of subexonic (i.e., within coding exon sequences), copy number variation remains elusive. The salivary MUC7 gene provides an opportunity for studying such variation, as it harbors copy number variable subexonic repeat sequences that encode for densely O-glycosylated domains (PTS-repeats) with microbe-binding properties. To understand the evolution of this gene, we analyzed mammalian and primate genomes within a comparative framework. Our analyses revealed that (i) MUC7 has emerged in the placental mammal ancestor and rapidly gained multiple sites for O-glycosylation; (ii) MUC7 has retained its extracellular activity in saliva in placental mammals; (iii) the anti-fungal domain of the protein was remodified under positive selection in the primate lineage; and (iv) MUC7 PTS-repeats have evolved recurrently and under adaptive constraints. Our results establish MUC7 as a major player in salivary adaptation, likely as a response to diverse pathogenic exposure in primates. On a broader scale, our study highlights variable subexonic repeats as a primary source for modular evolutionary innovation that lead to rapid functional adaptation.

The value of understanding intraspecific relationships in comparative analyses

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Phylogenetic comparative methods are often used when comparing multiple species in order to take phylogenetic non-independence into account. Some species are more closely related to each other than to others, so it is crucial to control for different degrees of relatedness. However, such methods are rarely used when analyzing data within species. We demonstrate that a grounded understanding of intraspecific relationships not only allows for taking phylogenetic relatedness into account in intraspecific comparative analyses but also provides crucial context for interpreting resulting patterns. We reconstructed an intraspecific mitogenome phylogeny for 135 long-tailed macaques and analyzed body size of specimens from islands and the mainland in Southeast Asia using both raw and phylogenetically corrected data. In our analyses, *M. fascicularis* does not generally display dwarfing in body size on islands, although populations on Borneo and Sumatra have smaller body sizes than those living on the mainland or on islands of lesser size. Small body sizes of long-tailed macaques on Borneo may be driven by low soil quality on that island, and our phylogeny indicates that colonization of Sumatra by some Bornean lineages may have led to small-bodied populations on that island as well. Additionally, the phylogeny elucidates the origins of insular populations from the mainland, paving the way for proper comparison of specific insular and mainland populations. We stress the importance of controlling for phylogenetic relatedness in intraspecific comparisons for a full understanding of the results of comparative analyses.