MPIG

LINCOLN PARK ZOO

17th Annual

Midwest Primate Interest Group Conference

October 22-23, 2021

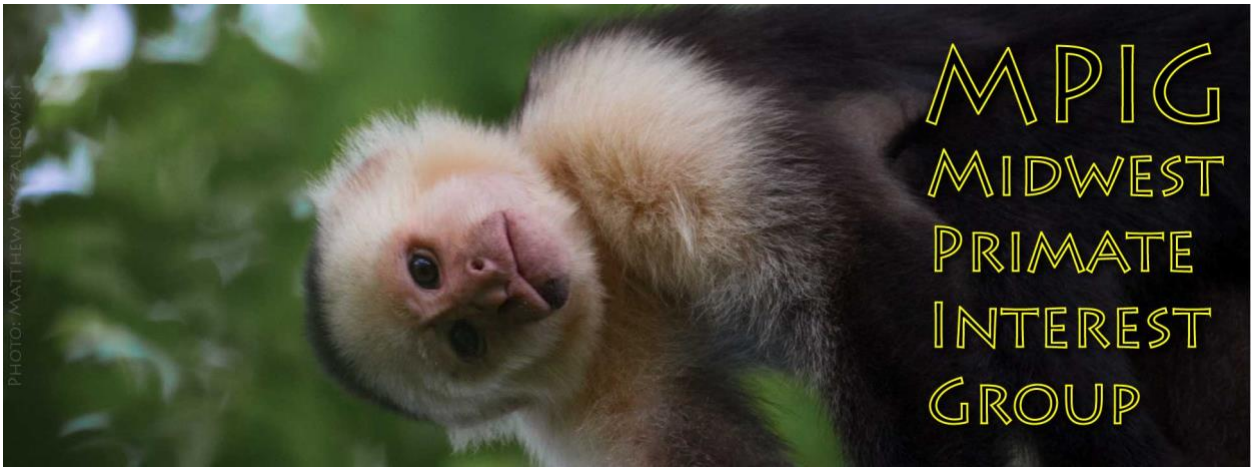
Lincoln Park Zoo

Chicago, IL

Hosted by the Lester E. Fisher Center for the Study and Conservation of Apes

Welcome to Lincoln Park Zoo!

On behalf of the MPIG executive committee and the Lester E. Fisher Center organizing committee, we are pleased to welcome you to the 2021 MPIG conference hosted by the Lester E. Fisher Center for the Study and Conservation of Apes at Lincoln Park Zoo in Chicago, IL.



Due to the ongoing COVID pandemic, in addition to vaccination, we will be requiring masks inside at all times and operating at half capacity. Please social distance from others when possible.

SCHEDULE OF EVENTS

All talks will take place in the Ann Milligan Gray Room inside the Laflin Administrative building at 2001 N Clark St. Chicago, IL 60614

Friday, October 22nd

Registration	**5:00 - 5:45pm** **Laflin Reception Desk**
Welcome by MPIG President Dr. Katie Amato and Lester E. Fisher Center Director Steve Ross	**5:45 - 6:00pm** **Ann Milligan Gray Room**
Distinguished Primatologist Award and Presentation – Dr. John Mitani	**6:00 - 7:00pm** **Ann Milligan Gray Room**
Social hour	**7:00 – 8:00pm** **Ann Milligan Gray Room**

Saturday, October 23rd

Registration and Poster Drop Off	**8:00 - 8:45am** **Laflin Reception Desk**
Breakfast	**8:00 am** **Ann Milligan Gray Room**
Morning Podium Session	**9:00 – 11:45am** **Ann Milligan Gray Room**
Lunch (on your own)	**11:45 - 1:30pm**
Afternoon Podium Session	**1:30 - 3:45pm** **Ann Milligan Gray Room**
Explore Zoo Grounds/ Break (on your own)	**4:00-4:30pm**
Poster Session and Reception	**4:30-6:30pm** **Regenstein Center for African Apes**

Podium Sessions (9:00 – 11:45am, 1:30 – 4:00pm)

8:45-9:00am	**Opening Remarks – Dr. Katherine Amato**
9:00am-9:15am	**1. Evaluating the Effects of a High Fat, Low Fiber Diet on the Composition and Biodiversity of Gut Microbiota in Wild Olive Baboons** Madelyn Moy[1], Laura Diakiw[2], Katherine R. Amato[1] *[1]Department of Anthropology, Northwestern University, Evanston, IL* *[2] Olderkesi Wildlife Conservancy, Kenya*
9:15-9:30am	**2. A 25-year Retrospective Review of Mortality in Chimpanzees (*Pan troglodytes*) in Accredited U.S. Zoos: A management and welfare perspective** Priyanka B. Joshi[1], Stephen R. Ross[1], Karen Terio[2], Kathryn C. Gamble[3] *[1]Lester E. Fisher Center for the Study and Conservation of Apes, Lincoln Park Zoo, Chicago, IL* *[2]Veterinary Diagnostic Laboratory, University of Illinois at Urbana-Champaign, Urbana, IL* *[3]Department of Animal Care, Lincoln Park Zoo, Chicago, IL*
9:30-9:45am	**3. Blood vessel genes are upregulated in male gelada monkey (*Theropithecus gelada*) chest skin** Patricia M. DeLacey[1], Thore J. Bergman[1,2], Jacinta C. Beehner[1,3], Noah Snyder-Mackler[4,5] *[1]Department of Psychology, University of Michigan, Ann Arbor, MI* *[2]Department of Ecology & Evolution, University of Michigan, Ann Arbor, MI* *[3]Department of Anthropology, University of Michigan, Ann Arbor, MI* *[4]Center for Evolution and Medicine, Arizona State University, Tempe, AZ* *[5]School of Life Sciences, Arizona State University, Tempe, AZ*
9:45-10:00am	**4. Context and personality-dependent information use in wild vervet monkeys (*Chlorocebus pygerythrus*)** Christina Nord[1], Tyler Bonnell[1], Matthew Hasenjager[2], Delaney Roth[1], Madison Clarke[1], Peter Henzi[1], and Louise Barrett[1] *[1]Department of Psychology, University of Lethbridge, Lethbridge, AB* *[2]National Institute for Mathematical and Biological Synthesis, University of Tennessee, Knoxville, TN*
10:15 – 10:45am	**BREAK**

10:45 – 11:00am	**5. Inferring welfare of five species of zoo-housed primates based on preferred distance from visitors** Alexandria Cairo-Evans[1] Natasha K. Wierzal[2], Jason D. Wark[2], Katherine A. Cronin[1,2] *[1]University of Chicago, Chicago, IL* *[2]Animal Welfare Science Program, Lincoln Park Zoo, Chicago, IL*
11:00 – 11:15am	**6. Ecologically consistent and socially variable ranging dynamics of western lowland gorillas (*Gorilla gorilla gorilla*) in Ndoki Forest** Kathryn Judson[1], Crickette Sanz[1], Thierry Fabrice Ebombi[2], Jean Marie Massamba[2], Prospère Teberd[2], Gaston Abea[2], Gaeton Mbebouti[2], Espoir Magema[2], Colleen Stephens[1], David Morgan[3] *[1]Department of Anthropology, Washington University, Saint Louis, MO* *[2]Wildlife Conservation Society, Congo Program, Brazzaville, Republic of Congo* *[3]Fisher Center for the Study and Conservation of Apes, Lincoln Park Zoo,, Chicago, IL*
11:15 – 11:30am	**7. Viral surveillance in sanctuary chimpanzees (*Pan troglodytes*) in Africa** Emily Dunay[1], Leah A. Owens[1], Christopher D. Dunn[1], Joshua Rukundo[2], Megan F. Cole [3], Melissa Emery Thompson[3], Alexandra G. Rosati[4], Tony L. Goldberg[1] *[1]Department of Pathobiological Sciences, School of Veterinary Medicine, University of Wisconsin-Madison, Madison, WI* *[2]Ngamba Island Chimpanzee Sanctuary / Chimpanzee Trust, Entebbe, Uganda* *[3]Department of Anthropology, University of New Mexico, Albuquerque, NM* *[4]Department of Psychology, and Department of Anthropology, University of Michigan, Ann Arbor, MI*
11:30 – 11:45am	**8. Factors shaping the gut microbiomes of Eulemur rubriventer** Tabor Whitney[1], Laura O. Diakiw[2], Diana M. Christie[3], Nelson Ting[3], Katherine R. Amato[1], Andrea Baden[4], Stacey Tecot[5] *[1]Department of Anthropology, Northwestern University, Evanston, IL* *[2]Department of Anthropology, University of Wyoming, Laramie, WY* *[3]Department of Anthropology, University of Oregon, Eugene, OR* *[4]Department of Anthropology, CUNY, New York, NY* *[5]Department of Anthropology, University of Arizona, Tuscan, AZ*
11:45-12:00pm	**9. Flexible Subgrouping and Spacing: Crowned Lemur and Sanford's Lemur Groups in a Continuous Forest Versus a Forest Fragment** Benjamin Z. Freed[1], Nathanael Bartosch[1] *[1]Department of Language & Cultural Studies, Anthropology, and Sociology, Eastern Kentucky University, Richmond, KY*

12:00 – 1:30pm	**LUNCH (ON YOUR OWN)**
1:30-1:45 pm	**10. Leveraging Touchscreen Technology to Assess Primate Attentional Biases and Welfare** Jesse G. Leinwand[1], Lydia M. Hopper[1,2], Mason Fidino[3], Priyanka Joshi[1], Stephen R. Ross[1] *[1]Lester E. Fisher Center for the Study and Conservation of Apes, Lincoln Park Zoo, Chicago, IL* *[2]Department of Molecular and Comparative Pathobiology, Johns Hopkins University School of Medicine, Baltimore, MD* *[3] Urban Wildlife Institute, Lincoln Park Zoo, Chicago, IL*
1:45-2:00 pm	**11. Preliminary observations of urine-trail marking and latrine behavior in northern sportive lemurs (*Lepilemur septentrionalis*) at Montagne des Français, Madagascar.** Mary P. Dismore[1], Karen B. Strier[2], E.E. Louis Jr.[3,4] *[1]School of Environmental Sustainability, Loyola University Chicago, Chicago, IL* *[2]Department of Anthropology, University of Wisconsin Madison, Madison, WI* *[3]Center for Conservation and Research, Omaha's Henry Doorly Zoo & Aquarium, Omaha, NE* *[4]Madagascar Biodiversity Partnership, Madagascar*
2:00-2:15pm	**12. How is Western lowland gorilla (*Gorilla gorilla gorilla*) behavior and physiology impacted by 360degree visitor viewing access?** Maire O'Malley[1,2], Jocelyn M. Woods[1,3], Jocelyn Byrant[1], Lance J. Miller[1] *[1]Animal Welfare Research, Chicago Zoological Society, Brookfield, IL* *[2]The Dian Fossey Gorilla Fund International, Atlanta, GA* *[3]Department of Animal and Dairy Sciences, University of Wisconsin-Madison, Madison, WI*
2:15-2:30pm	**13. Viruses and life history trade-offs in wild chimpanzees** Tony Goldberg[1] *[1]Department of Pathobiological Sciences, School of Veterinary Medicine, University of Wisconsin-Madison, Madison, WI*
2:30-3:00pm	**BREAK**

3:00-3:15pm	**14. Use of Thermal Imaging to Measure Behavioral Thermoregulation of Western Chimpanzees (*Pan troglodytes verus*) in a Savanna-Mosaic Woodland Environment** McKensey R. Miller[1], Jill D. Pruetz[2] *[1] Department of Anthropology, University of Michigan, Ann Arbor, MI* *[2] Department of Anthropology, Texas State University, San Marcos, TX*
3:15-3:30pm	**15. Parasitome sequencing: high-throughput molecular parasitology for the study of primates** Leah A. Owens[1], Sagan C. Friant[2], Tony L. Goldberg[1] *[1]Pathobiological Sciences, School of Veterinary Medicine, University of Wisconsin-Madison, Madison, WI* *[2]Department of Anthropology, The Pennsylvania State University, University Park, PA*
3:30-3:45pm	**16. Foraging itineraries and diel nutritional variation: Why do brown lemurs (*Eulemur fulvus)* prefer some foods in the daytime and others at night?** Irwin, Mitchell T[1,2], Gherardi, Chloé N[3], Rahalinarivo, Vololonirina[4], Raharison, Jean-Luc[2], Ramorasata, Bruno[2], Ranaivoarisoa, Jean-Freddy[4], Randrianasy, Jeannot[4] *[1]Department of Anthropology, Northern Illinois University, DeKalb, IL* *[2]ONG SADABE, Antananarivo, Madagascar* *[3]Department of Biological Sciences, Northern Illinois University, DeKalb, IL* *[4]Mention Anthropobiologie et Développement Durable, University of Antananarivo, Antananarivo, Madagascar*
3:45-4:30pm	**EXPLORE ZOO ON OWN**
4:30-6:30pm	**POSTER SESSION AND RECEPTION (REGENSTEIN CENTER FOR AFRICAN APES)**

Poster Session (4:30-6:30PM)

1. Polyspecific Association Overlapping Feature Stack Framework in Studies: Primates in Focus

Dobson, Kaelyn[1], Pruetz, Jill[1]

[1]Department of Anthropology, Texas State University, San Marcos, TX

2. Examination of a parallel laser apparatus to measure growth and flanges of wild Bornean orangutans (*Pongo pygmaeus wurmbii*)

Ella R. Brown[2,4], Timothy G. Laman[5], Erin E. Kane[1,2], Faye S. Harwell[1,2], Tri Wahyu Susanto[2,6], Cheryl D. Knott[1,2,3]

[1]Department of Anthropology, Boston University, Boston, MA
[2]Gunung Palung Orangutan Conservation Program, West Kalimantan, Indonesia
[3]Department of Biology, Boston University, Boston, MA,
[4]Department of Anthropology, University of Michigan, Ann Arbor, MI
[5]Museum of Comparative Zoology, Harvard University, Cambridge, MA
[6]Biology Faculty, Universitas Nasional, Jakarta, Indonesia

3. Reconstructing an Eocene primate paleo biome with insights from the extinct tillodont, *Esthonyx*

Carson E. Black [1], Kimberley A. Nichols [2]

[1] Department of Anthropology, Texas State University, San Marcos, TX
[2] Department of Anthropology, Colorado State University, Fort Collins, CO

4. Preliminary technical validation of T3, a potential non-invasive measure of energy balance, in lemurs

Casey M. Farmer[1, 2], Savannah Lo[3], Anne Crowley[1], Laurence R. Gesquiere[3], Elaine E. Guevara[1, 4]

[1]Department of Evolutionary Anthropology, Duke University, Durham, NC
[2]Department of Anthropology, Northern Illinois University, DeKalb, IL
[3]Department of Biology, Duke University, Durham, NC
[4]Department of Anthropology, University of North Carolina at Wilmington, Wilmington, NC

5. Genetic Signatures of Biochemical Plant-Primate Interactions: ESR1 as a Case Study

Elliot Heye[1], Christopher Tubbs[2], Stephanie A. Poindexter[3], Alicia M. Rich[1]

[1]Department of Biology and Earth Science, Otterbein University, Westerville OH
[2]Reproductive Sciences Division, San Diego Zoo Wildlife Alliance, Escondido, CA
[3]Department of Anthropology, University at Buffalo, Buffalo, NY

6. The potential benefits of cognitive, non-food-based enrichment compared to traditional food enrichment in capuchins (*Sapajus apella*)

Katherine Keck[1], Eleanor Jordan[1], Amanda M Seed[1], Hannah M. Buchanan-Smith[2]

[1]School of Psychology and Neuroscience, University of St Andrews, Scotland, UK
[2]Psychology, Faculty of Natural Sciences, University of Stirling, Scotland, UK

7. Evaluating duration of visual contact and the success of laboratory-housed adult male macaque (*Macaca spp.*) pairs

Lace E. Lively[1]

[1]*Southwest National Primate Research Center, Texas Biomedical Research Institute, San Antonio, TX*

8. Inter-tissue isotopic offsets in three sympatric primates from Kibale National Park, Uganda: Implications for dietary reconstructions

Maire A. Malone[1], John D. Kingston[1]
[1]*Department of Anthropology, University of Michigan, Ann Arbor, MI*

9. Comparing Lab and Field Methods and Ethanol and Methanol on the Extraction of Cortisol from Mountain Gorilla (*Gorilla berengei berengei*) Fecal Samples

Georgia Mies[1], Josephine Schmidt[1], McKensey R. Miller[1], Ella R. Brown[1], Winnie Eckardt[2], Rose Umuhoza[2], Tara S. Stoinski[3], Stacy Rosenbaum[1]
[1] *Department of Anthropology, University of Michigan, Ann Arbor, MI*
[2] *Karisoke Research Center, Musanze, Rwanda*
[3] *The Dian Fossey Gorilla Fund International, Atlanta, GA*

10. Dominance rank correlates with use of a groom-soliciting vocalization in white-faced capuchins

Melissa C. Painter[1], Savannah E. Rascon[2], Thore J. Bergman[1,2]
[1]*Department of Psychology, University of Michigan, Ann Arbor, MI*
[2]*Department of Ecology and Evolutionary Biology, University of Michigan, Ann Arbor, MI*

11. Comparison of Testosterone and DHEA Hormone Levels in Wild Male Mountain Gorillas (*Gorilla beringei beringei*)

Josephine Schmidt[1], Georgia Mies[1], McKensey R. Miller[1], Winnie Eckardt[2], Rose Umuhoza[2], Tara S. Stoinski[3], Stacy Rosenbaum[1], Ella R. Brown[1]
[1] *Department of Anthropology, University of Michigan, Ann Arbor, MI*
[2] *Karisoke Research Center, Musanze, Rwanda*
[3] *The Dian Fossey Gorilla Fund International, Atlanta, GA*

12. Healthy Children, Healthy Chimps: Reducing respiratory disease transmission from humans to chimpanzees in Uganda.

Taylor E. Weary[1,2], Tony L. Goldberg[1,2]
[1]*Department of Pathobiological Sciences, University of Wisconsin School of Veterinary Medicine, Madison, WI*
[2]*Kibale EcoHealth Project, Uganda*

13. Validation of Novel Ultra-Wide Band Technology to Monitor Captive Animal Movement

Jocelyn M. Woods[1], Sarah J.J. Adcock[1]
[1] *Department of Animal and Dairy Sciences, University of Wisconsin-Madison*

14. Chemical niche divergence in sympatric lemurs: understanding species' food selection

Chloé N.M. Gherardi[1], Jean-Luc Raharison[2], Bruno Ramorasata[3], Vololonirina Rahalinarivo[3], Jean-Freddy Ranaivoarisoa[3], Jeannot Randrianasy[3], Jessica M. Rothman[4,5], Karen E. Samonds[1,2] Mitchell T. Irwin[2,6]
[1]Department of Biological Sciences, Northern Illinois University, DeKalb, IL
[2]ONG SADABE, Antananarivo, Madagascar
[3]Anthropobiology and Sustainable Development, University of Antananarivo, Antananarivo, Madagascar
[4]Department of Anthropology, Hunter College, New York, NY
[5]Graduate Center, CUNY, New York, NY
[6]Department of Anthropology, Northern Illinois University, DeKalb, IL

15. Larger group size is associated with faster weaning in wild geladas (*Theropithecus gelada*)

Sofia Carrera[1], Alice Baniel[2], Jacob Feder[2], Jacinta Beehner[1,3], Amy Lu[2]
[1] Department of Psychology, University of Michigan, Ann Arbor, MI, USA 48109
[2] Department of Anthropology, Stony Brook University, Stony Brook, NY, USA 11794
[3] Department of Anthropology, University of Michigan, Ann Arbor, MI, USA

All events will be taking place in:
1) Laflin Administrative Building- #21 on map
AND
2) Regenstein Center for African Apes - #14 on map

Information

Searle Visitor Center Guest and member services, visitor information, stroller and wheelchair rental, lost & found, accessibility services, nursing rooms, public safety, and first aid. 🚻 $ ✚ HA

Member Center Join the zoo, renew membership, purchase a gift membership, ADOPT an animal, purchase animal enrichment, or make a donation. Want free parking? Become a member today!

Animals

1. Regenstein **African Journey** *Giraffes, Rhinos, Pygmy Hippos.*
2. Walter Family **Arctic Tundra** *Polar Bears.*
3. Robert and Mayari Pritzker **Penguin Cove** *African Penguins.*
4. McCormick **Bird House** *Birds from around the world.*
5. Regenstein **Birds of Prey Exhibit** *Vultures, Eagles, Owls, Storks.*
6. Regenstein **Macaque Forest** *Snow Monkeys.* HA
7. Pritzker Family **Children's Zoo** *Black bears, Otters, Wolves, Turtles.* HA
8. Kovler **Seal Pool** *Seals.*
9. Regenstein **Small Mammal-Reptile House** *Snakes, Lizards, Bats, Sloths, Monkeys.* HA
10. Hope B. McCormick **Swan Pond** *Swans, Ducks.*
11. **Waterfowl Lagoon** *Flamingos, Swan Geese.*
12. Helen Brach **Primate House** *Monkeys, Lemurs, Gibbons.*
13. Regenstein **Center for African Apes** *Chimpanzees, Gorillas.*
14. **Camel & Zebra** *Zebras, Kangaroos, Tahrins, Camels.*
15. **Farm-in-the-Zoo** *Cows, Goats, Pigs, Ponies, Chickens, Rabbits.* HA

Dining and Snacks

A. **Safari Café** Enjoy hot dogs, nachos, ice cream, and Dippin' Dots. 🍴 *Open seasonally.*

B. **Eadie Levy's Landmark Café** Grab a classic Chicago-style hot dog, iced slushy, or beer. 🍴 *Open seasonally.*

C. **Bird's Eye Bar & Grill** Enjoy burgers, beer, and backyard barbecue fare at this rooftop cafe. 🍴 HA *Open seasonally.*

D. **Park Place Café** Choose from Mexican, Italian, grilled grub, sandwiches, and ice cream at this indoor food court. Nursing rooms in lower level. *Open year-round.* 🍴 HA $

E. **The Patio at Café Brauer** Relax with full-service dining, cocktails, and a skyline view. 🍴 *Open seasonally.*

F. **Ice Cream Shoppe** Savor hand-dipped ice cream, banana splits, and sundaes. 🍴 *Open seasonally.*

Shopping

Gift Shop Choose from a wild selection of Lincoln Park Zoo mementos, apparel, plush animals, and gifts. *Open year-round.*

Things to Do

J. Lionel **Train Adventure** *Ticket purchase required. Open seasonally.*

K. AT&T **Endangered Species Carousel** *Ticket purchase required. Open seasonally.*

L. **Nature Boardwalk** Stroll through an urban haven for native plants, birds, frogs, fish, turtles, butterflies, and dragonflies.

M. Peoples Gas **Education Pavilion** One of Chicago's most popular spots for skyline photos.

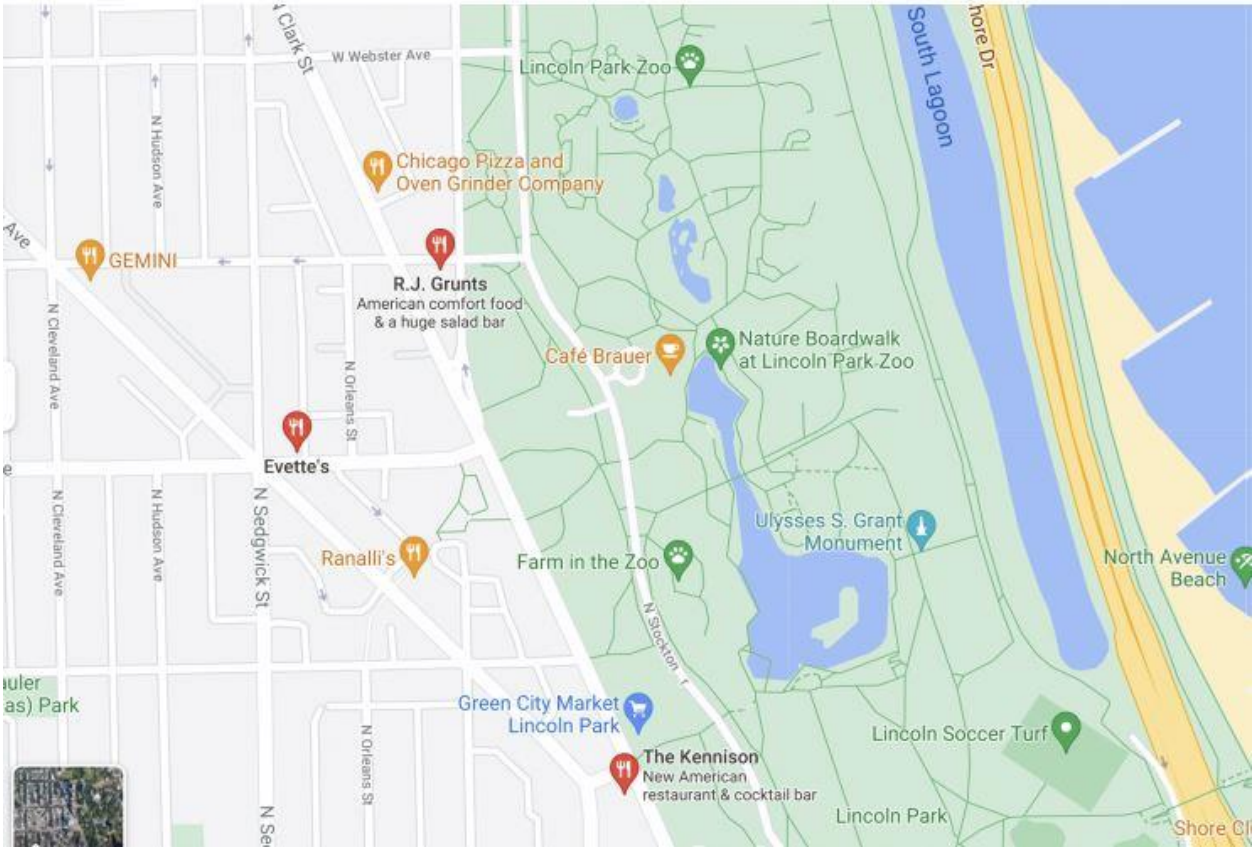
N. **Main Barn** Activities for children encourage their first connections to nature. HA

O. Malott Family **Penguin Encounter** Meet African penguins inside their exhibit. $60 per person ($50 for members). *Tickets and same-day registration available at Searle Visitor Center. Open April 1–October 31.*

Please note: Kovler Lion House is temporarily closed for renovation, but when the historic landmark reopens, it will feature new, state-of-the-art habitats for lions and more. Learn more at lpzoo.org/pride.


Foreman Pavilion
20
Waterfowl Lagoon
12
South Lawn
Regenstein Center for African Apes
14
BRAUER GATE
Lockers
P
BUS DROP-OFF
Closes at 3 p.m.
Laflin Administrative Building
21
The Patio at Café Brauer
E
F
Hoofstock
15
Carlson Cottage
Nature Boardwalk
L
SOUTH GATE
FARM GATE
Peoples Gas Pavilion

Nearby Restaurants



DISTINGUISHED PRIMATOLOGIST LECTURE ABSTRACT

My life among the apes

John C. Mitani[1]
[1]Department of Anthropology, University of Michigan, Ann Arbor, MI, USA, 48109

I have been extraordinarily lucky throughout my career as a primatologist and have been given incredible opportunities to conduct fieldwork investigating the behavior of our closest living relatives, the apes. This includes studies of gibbons (*Hylobates muelleri and Hylobates agilis*) and orangutans (*Pongo pygmaeus*) in Indonesia, bonobos (*Pan paniscus*) in the Democratic Republic of the Congo, gorillas (*Gorilla berengei*) in Rwanda, and chimpanzees (*Pan troglodytes*) in Tanzania and Uganda. In this talk, I review some findings derived from this research. My current and ongoing work involves a 26-year-long study of a remarkable chimpanzee group that has recently fissioned at Ngogo in Kibale National Park, Uganda. I discuss the history of our research at Ngogo and summarize some of our recent observations of chimpanzees there. I conclude by offering some advice to the next generation of field primatologists.

PODIUM ABSTRACTS

1. Evaluating the Effects of a High Fat, Low Fiber Diet on the Composition and Biodiversity of Gut Microbiota in Wild Olive Baboons

Madelyn Moy[1], Laura Diakiw[2], Katherine R. Amato[1]
[1]*Department of Anthropology, Northwestern University*
[2] *Olderkesi Wildlife Conservancy*

Host diet has proven to influence the composition and function of the GM, which subsequently affects host nutrition and health via interactions with metabolism, the immune system, and brain. Studies of humans have demonstrated marked differences in populations that consume low fat, high fiber diets (LFHF) versus high fat, low fiber diets (HFLF). Recent speculation suggests that the human GM may be more plastic in response to diet compared to the GMs of other primates. However, there are fewer studies of the non-human primate GM, and many human studies of diet are geographically confounded in that populations consuming distinct diets also inhabit distinct environments and engage in different lifestyle practices. To begin to improve our understanding of non-human primate GM responses to diet in a comparative context, we investigated if the GM of a wild, non-human primate changes in response to an industrialized, HFLF diet. We collected fecal samples from seven social groups of wild baboons in Rwanda's Alkagera National Park consuming three diets: a wild diet (LFHF), a diet with limited garbage input (partial HFLF), and a diet with unlimited garbage input (HFLF). Our data indicate significant differences in GM composition across the three diet groups. Interestingly, while baboons consuming an unlimited garbage diet had lower GM diversity than baboons consuming a wild diet, baboons consuming a limited garbage diet did not. This pattern suggests there is a

diet threshold past which the GM shifts and that low amounts of HFLF foods may not negatively affect the GM. Moving forward, we plan to compare these data to data from other wild primate species consuming similar diets, as well as from humans.

2. A 25-year Retrospective Review of Mortality in Chimpanzees (*Pan troglodytes*) in Accredited U.S. Zoos: A management and welfare perspective

Priyanka B. Joshi[1], Stephen R. Ross[1], Karen Terio[2], Kathryn C. Gamble[3]

[1] Lester E. Fisher Center for the Study and Conservation of Apes, Lincoln Park Zoo, Chicago, IL

[2] Veterinary Diagnostic Laboratory, University of Illinois at Urbana-Champaign, Urbana, IL

[3] Department of Animal Care, Lincoln Park Zoo, Chicago, IL

Understanding causes of death allows adjustment to health management strategies for animals in managed care. From the 224 documented chimpanzee (*Pan troglodytes*) deaths occurring from 1995 to 2019 in 42 accredited U.S. zoos, post-mortem records and necropsy reports were analyzed for the primary cause of death. Thirty-seven cases of stillbirth and neonate deaths were assessed (16.5%), but focus was otherwise placed on remaining cases in which the death occurred in individuals aged greater than one month (n=177). The most common cause of death was degenerative (49.7%) and of those, the majority (76.1%) were associated with cardiopulmonary issues, a known leading cause of death for this species. The second primary cause was infection and inflammation (26.0%) although the true etiology of these varied widely between individuals. The 26 deaths associated with trauma (14.7%) were attributed in almost half of those cases (46.2%) as associated with conspecific aggression. Other trauma-related deaths were associated with exhibit design, including drowning, although no reported drownings in accredited zoos in over a decade with the replacement of most water moats. Understanding causes of mortality and the interrelation with management can benefit managed populations of chimpanzees

3. Blood vessel genes are upregulated in male gelada monkey (*Theropithecus gelada*) chest skin

Patricia M. DeLacey[1], Thore J. Bergman[1,2], Jacinta C. Beehner[1,3], Noah Snyder-Mackler[4,5]

[1]Department of Psychology, University of Michigan, Ann Arbor, MI.

[2]Department of Ecology & Evolution, University of Michigan, Ann Arbor, MI

[3]Department of Anthropology, University of Michigan, Ann Arbor, MI

[4]Center for Evolution and Medicine, Arizona State University, Tempe, AZ

[5]School of Life Sciences, Arizona State University, Tempe, AZ

Many animals use color to communicate their health and status to conspecifics. When the intensity of color is associated with higher reproductive fitness for the bearer, colorful sexually selected signals can evolve. Although vibrant coloration is rare in mammals, the “bleeding heart” of the gelada monkey (*Theropithecus gelada*) is one notable exception. The most striking feature of geladas is a brilliant, flame-red patch of skin on the chest and neck. In males, chest patch color changes according to status, with dominant males exhibiting the brightest patches. Male geladas’ chest patches are hypothesized to be a sexually selected signal, serving as a signal of current strength and condition to ward off would-be rival males. In contrast, female geladas’ chest patches are hypothesized to vary with reproductive cycles rather than dominance status.

To understand the costs that may underlie signal production, we must identify the physiological mechanisms driving variation in signal intensity. Here we assess potential mechanisms driving chest color sex differences gelada monkeys. We conducted RNA sequencing on 4mm chest skin biopsies collected from 21 male and 17 female geladas in the Simien Mountains National Park, Ethiopia in 2017 and 2019 while animals were anesthetized for blood collection. Although we expected estrogen and androgen related genes to be upregulated in males, we found no differences in sex hormone related gene expression between the sexes. However, we found that genes related to blood vessels and circulation were upregulated in males, indicating that blood flow drives changes in redness. Therefore, we further hypothesize that increased blood flow to chest skin may act as a signal production cost for male geladas in the below-freezing temperatures of the Simien Mountains.

4. Context and personality-dependent information use in wild vervet monkeys (*Chlorocebus pygerythrus*)

Christina Nord[1], Tyler Bonnell[1], Matthew Hasenjager[2], Delaney Roth[1], Madison Clarke[1], Peter Henzi[1], and Louise Barrett[1]

[1]Department of Psychology, University of Lethbridge, Lethbridge, AB

[2]National Institute for Mathematical and Biological Synthesis, University of Tennessee, Knoxville, Tennessee

Social learning is often concerned with whether or not individual attributes, such as age, sex, and personality, influence information use. Here, we presented three troops of wild, non-provisioned vervet monkeys (approximately 140 individuals) *(Chlorocebus pygerythrus)* with two social learning tasks and determined the extent to which age, sex, dominance ranking, and personality influenced whether animals used personal or social information to solve the task. Using network-based diffusion analysis, I found that approximately 25% of learning events were transmitted via social learning, and 75% via individual learning, for both tasks. In the first, easier-to-solve task, more neophilic animals relied on personal information to solve the task. However, in the second, more-difficult-to-solve task, more neophilic animals relied heavily on social information to solve it. I discuss these findings in light of our previous findings that neophilia is socially facilitated, and how the two tasks differed in their social facilitation affordances. Finally, I explain how these findings stress the importance of considering context, i.e., proximate environmental contingencies, in social transmission.

5. Inferring welfare of five species of zoo-housed primates based on preferred distance from visitors

Alexandria Cairo-Evans[1] Natasha K. Wierzal[2], Jason D. Wark[2], Katherine A. Cronin[1,2]

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An animal's welfare is directly related to their mental state, which can be shaped by experiences within the environment throughout their life. For zoo-housed animals, visitors to the zoo are a large part of that environment and a fluctuating variable within it. This study examines the impact of visitors at Lincoln Park Zoo in Chicago, Illinois, on the welfare of five species of zoo-housed primates, including eastern black-and-white colobus monkeys (*Colobus guereza*, n = 5), Allen's swamp monkeys (*Allenopithecus nigroviridis*, n = 2), *DeBrazza's monkeys (Cercopithecus neglectus, n = 4), Bolivian gray titi monkeys (Callicebus donacophilus*, n = 4), and crowned lemurs (*Eulemur coronatus*, n = 3). Data were collected using the ZooMonitor app, with trained observers recording spatial coordinates for each individual animal over periods of 12 to 32 months. This study examines the relationship between proximity to visitor viewing glass and the number of visitors present at a given point in time. Distance from visitor viewing glass is treated as an indication of comfort in the presence of zoo visitors. Linear mixed model regressions were conducted, with crowd size as a fixed effect predictor variable and both species and individual as predictor variables for random effects. Analyses reveal a statistically significant but small decrease in primate distance from visitor viewing glass when visitors were present at each habitat and as the number of visitors increased. Thus, results suggested that primates were either indifferent to, or attracted to, visitors, and results provide no evidence that guests contributed to a negative welfare state.

6. Ecologically consistent and socially variable ranging dynamics of western lowland gorillas (*Gorilla gorilla gorilla*) in Ndoki Forest

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Ranging dynamics are physical and behavioral representations of space use decisions in response to various socioecological factors. Western lowland gorillas (*Gorilla gorilla gorilla*) are a model species to explore socioecological effects on space use given the natural variation in ecological and social factors found within the species. In this study, we investigated western lowland gorilla ranging dynamics based on longitudinal data from multiple habituated groups in northern Republic of Congo. We evaluated the influences of resource seasonality and social factors on variation in the home range size, extent of spatial clustering, and amount of intergroup overlap among multiple gorilla groups. Our study found small, stable home ranges, indicating that large home ranges may not be as universal as previously supposed. There were higher concentrations of activity within defined core areas compared to the rest of the home range, indicating an importance of these regions within the landscape. Although certain aspects of ranging were linked to local ecological factors, the largest source of variation in intergroup space use was group specific, with intergroup home range overlap demonstrating some of the strongest signals for group specific variation in space use. Our findings highlight the importance

of intergroup interactions on space use and prompt further research on the role of social dynamics in ranging strategies.

7. Viral surveillance in sanctuary chimpanzees (*Pan troglodytes*) in Africa

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Infectious disease is a major concern in both wild and captive primate populations. Chimpanzee sanctuaries in Africa provide necessary care and housing for thousands of wild-born, orphaned apes who have been confiscated from the bush-meat trade. As chimpanzees in these sanctuaries typically semi-free-range in forest enclosures and live in normal social groups, they present a valuable context to study wild-born primates experiencing naturalistic diets and activity levels, but where blood sampling during routine health checks are possible. To understand patterns of susceptibility to infections in these populations, we are using metagenomic next-generation sequencing to examine plasma samples from sanctuary chimpanzee (*Pan troglodytes*) populations across Africa. Thus far, we have results from two sanctuaries in which we have identified viruses from six viral families (*Anelloviridae, Flaviviridae, Genomoviridae, Parvoviridae, Picobirnaviridae,* and *Picornaviridae*). The majority (13/21) of viruses identified are in the family *Anelloviridae* and represent the genera *Alphatorquevirus* (Torque teno virus) and *Betatorquevirus* (Torque teno mini virus). The only virus identified that has been associated with disease in captive or wild chimpanzees is a Rhinovirus C (*Picornaviridae*) in which one individual was infected subsequent to an outbreak of respiratory illness in that population. Our results thus far show a lack of persistent pathogenic viremia beyond clinical disease stage and suggest that the risks of acquisition of exotic pathogens by apes in such settings may be low. This work further complements studies of pathogens in wild-living apes where such blood samples cannot be routinely obtained.

8. Factors shaping the gut microbiomes of Eulemur rubriventer

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The gut microbiome consists of microbial communities that reside in the gastro-intestinal tract of living organisms. Variation in this system has been linked to health outcomes in humans and animals by affecting digestion, immune system development, and pathogen invasion. However, we still lack a complete understanding of the factors that shape gut microbiome variation, particularly in wild primates. The central objective of this research is to determine which factors are predicting inter-individual variation in the gut microbiome of red-bellied lemurs (*Eulemur rubriventer*). We sequenced the 16S rRNA hypervariable V-4 region to characterize the gut microbiome from 26 genotyped individuals across eleven pair-bonded social groups residing in Ranomafana National Park. This research estimates to what degree genetic relatedness, social group membership, diet, sex, and geographical distance drive inter-individual variation in the microbial communities residing in red-bellied lemurs. Other than sex, all factors play a significant role in predicting gut microbiome composition. However, our model has high levels of variance inflation inhibiting our ability to determine which factors are more predictive of gut microbial composition. This is one of few studies that analyzes environmental, genetic, and biological factors' impact on variation in the gut microbiome. Our results provide evidence that there is a need for more research that considers various sources of influence on gut microbial variation. For endangered species as a whole, understanding how such factors shape variation is critical in recognizing the consequences this variation has on host nutrition, health, and its overall effect on host ecology and conservation.

9. Flexible Subgrouping and Spacing: Crowned Lemur and Sanford's Lemur Groups in a Continuous Forest Versus a Forest Fragment

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Primates in highly anthropogenic habitats often show remarkable behavioral flexibility. In this study we compared crowned lemur (*Eulemur coronatus*) and Sanford's lemur (*Eulemur sanfordi*) social spacing and grouping between groups in a small forest fragment near humans with those from previous work in a large, continuous forest away from humans. Quantitative behavioral observations of lemurs were collected in June-July 2016 and 2017 (n=380 hours) in Analabe Gallery Forest in northern Madagascar. These data were then compared with those that were collected in Mt. d'Ambre National Park, Madagascar in 1989-1991. Crowned lemurs in both locations live in multimale/multifemale groups of 3-9 individuals that subgroup daily. While Sanford's lemurs in both locations also live in multimale/multifemale groups of 3-9 individuals, Analabe's Sanford's groups were less spatially cohesive, as measured by percent of observation days in which subgrouping occurred (29%), and in average nearest neighbor distance. The flexibility observed in both species' social organization may reflect seasonal limits in food availability, or perhaps relate to the small habitat size and effects of human presence. At a minimum, behavioral flexibility in social organization may help these primates live in a wider range of habitats than previously thought.

10. Leveraging Touchscreen Technology to Assess Primate Attentional Biases and Welfare

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As touchscreen computers have become more practical and affordable, they are increasingly used in zoos to study animal cognition and welfare. At Lincoln Park Zoo, we have conducted voluntary touchscreen research with chimpanzees (*Pan troglodytes*), gorillas (*Gorilla gorilla gorilla*), and Japanese macaques (*Macaca fuscata*) in a group setting and on public display for a number of years. Using touchscreens, stimuli can be presented in a controlled, repeatable manner and animals' responses can be precisely measured. Accordingly, animals' response latencies to stimuli allow us to make inferences about their interpretation of those stimuli and potentially their emotional responses to them (i.e., their cognitive biases). Whereas assessing primate biases has often required extensive training, the "dot-probe" paradigm does not require training and instead presents primates with two stimuli for a fraction of a second before the stimuli disappear and a dot replaces one of the stimuli. The difference in the primates' latency to touch this dot when it replaces one stimulus type compared to another is indicative of an attentional bias (i.e., quicker response times suggest the animal's attention is captured more by one category of images over others). Here, we demonstrate that the paradigm is sensitive enough to detect apes' differential responses to different categories of stimuli, such as familiar and unfamiliar human faces as well as different colors, at both the species and individual level, but flexible enough to answer a variety of welfare-related questions using a limitless supply of stimuli.

11. Preliminary observations of urine-trail marking and latrine behavior in northern sportive lemurs (*Lepilemur septentrionalis*) at Montagne des Français, Madagascar.

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Latrine use and urine-marking are rare among haplorrhine primates, however strepsirhines regularly utilize these behaviors for olfactory communication. It is hypothesized that lemurs rely on scent marking via urine and latrine use to communicate about resource defense, territorial boundaries, reproductive state, and social bonds. Latrine sites and urine-marking have been observed for several species within the nocturnal and folivorous genus, Lepilemur. Here we describe the first systematic observations of the Critically Endangered northern sportive lemur

(NSL; *Lepilemur septentrionalis*) utilizing urine-marking and latrine behavior at Montagne des Français, Madagascar. Behavioral data were collected on nine individual lemurs over two field seasons in 2016 and 2017, using ad libitum and instantaneous scan samples. We observed 17 instances of urine-marking by all six female NSLs in our study. Females urine-marked by descending in trees to < 1 m above ground where they urinated against the tree trunk in both mating and nonmating seasons. This behavior was not observed for any of the three males in our study, despite similar per capita sampling time. We also observed one small latrine within a female's home range, with ~6 fecal deposits at the base of a tree. We propose that female NSLs, which lack anogenital scent glands and maintain exclusive territories, may utilize urine-marking and latrine behavior for demarcation of territory and/or mate communication.

12. How is Western lowland gorilla (*Gorilla gorilla gorilla*) behavior and physiology impacted by 360degree visitor viewing access?

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The current study explored the impact of 360° visitor viewing access on the welfare of Western lowland gorillas (*Gorilla gorilla gorilla*) (N=7). Data were collected for three weeks for baseline measures (360° visitor viewing access) and then for another three weeks with restricted viewing (walkway was restricted by ~75%). Data collection included both observations to examine both behavioral states and events as well as daily fecal collection from known individuals to examine glucocorticoid and dehydroepiandrosterone (DHEA) metabolites. Behavioral and physiological data were analyzed using Wilcoxon signed ranked tests to compare baseline to treatment. Results suggest that the restricted viewing significantly reduced solitary grooming events ($z=-2.197$, $p<0.05$), fecal glucocorticoid metabolites ($z=-2.201$, $p<0.05$), and the ratio of glucocorticoid metabolites to DHEA metabolites ($z=-2.201$, $p<0.05$). All other state and event behaviors, including possible behavioral welfare indicators, were not affected by the restricted viewing. The results suggest that 360° visitor access may impact animal welfare, but further research is required as some possible indicators of animal welfare were not impacted by the treatment.

13. Viruses and life history trade-offs in wild chimpanzees

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Life history theory predicts trade-offs among energetic expenditures for competing physiological processes, such as growth, reproduction and somatic maintenance. Viruses are obligate, intracellular molecular parasites and may therefore be especially sensitive to the physiological states of their hosts and thus particularly useful for investigating life history

tradeoffs. However, our current understanding of viruses in wild primates is strongly biased towards those that cause highly pathogenic, acute infections. This talk describes a series of studies of viromes of the Ngogo and Kanyawara chimpanzee communities of Kibale National Park, Uganda. Unbiased metagenomic methods were used to characterize fecal viromes, identifying nearly 50 viruses, most of which are poorly known. Overall viral loads were markedly increased in individuals when they were clinically ill. Viral richness (number of viruses) increased with age in males but not in females. Viral richness was also higher in females during early lactation, an especially costly reproductive stage, than when those same females were cycling or pregnant. Kanyawara chimpanzees shed more viruses and at higher loads than Ngogo chimpanzees, perhaps reflecting greater food availability at Ngogo. Finally, among viruses, three previously unknown viruses accounted for the majority of the trends described above. These results indicate that particular members of the primate virome may be sensitive biomarkers of host physiology and thus useful as indicators of life history tradeoffs.

14. Use of Thermal Imaging to Measure Behavioral Thermoregulation of Western Chimpanzees (*Pan troglodytes verus*) in a Savanna-Mosaic Woodland Environment

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As regions continue to warm, it is becoming increasingly important to understand non-human primates' ability to adapt to changing environmental conditions. However, physiological measurements can be difficult to obtain from primates, especially when invasive methods are not feasible. Recently, new technologies have become available that can provide insight into the behavioral and physiological mechanisms animals utilize to maintain homeostasis. Thermal imaging is a non-invasive technology that can be used to measure surface body temperature of individuals. We use thermal imaging, microclimate environmental conditions, and behavioral data to measure how chimpanzees' surface hair temperature is affected by behavioral thermoregulation in the Fongoli chimpanzee (*Pan troglodytes verus*) group in Senegal. Data collection included all day follows of adult males, n=12, with focal points at 10-minute intervals. 1438 focal points were collected, 1027 of these focal points include thermal images measuring surface body temperature. Our results demonstrate that while surface body temperature is largely determined by environmental temperature, habitat selection, behavior, and even individual differences play a small, albeit important, role in the maintenance of homeostasis. Therefore, surface temperature can be used to show how specific behavioral adaptations can alter the thermal load animals experience and eventually respond to using more energetically expensive physiological adjustments.

15. Parasitome sequencing: high-throughput molecular parasitology for the study of primates

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Current parasitological methods used in primatology, including morphological identification, coproculture, and molecular detection of specific organisms, are very useful but have important limitations. Recently, there has been much interest in leveraging the power of next-generation DNA sequencing for primate parasitology. Although this approach has been adopted in microbiome studies, there are several long-standing issues that constitute a critical barrier to progress in the development of parasite metagenomic sequencing. To address these issues, we are developing a novel parasite sequencing pipeline that uses a new amplification approach and unique molecular noise-reduction techniques. *In silico*, we show that our 'Parasitome' method amplified 97.1% of parasites as compared to an average of 69.4% (range: 24.8% - 91.3%) for published methods (*n*=12). *In vitro*, we found that our method most accurately reflected the composition of a mock community of parasites (evenness=0.93), compared to published protocols (mean evenness=0.88, range: 0.62 – 0.92, *n*=9). Furthermore, our method identified more organisms in primate fecal samples (mean richness=5.00, stdev=1.51) than standard microscopic analyses (mean richness=3.33, stdev=1.22). Finally, we applied this pipeline to samples collected from western chimpanzees (*Pan troglodytes verus*) and found that 35.71% of individuals were positive for *Blastocystis* spp., 37.50% for *Troglodytella abrassarti*, and 7.14% for *Oesophogostamum stephanostomum* (*n*=14), which was concordant with results from microscopy. Moving forward, our pipeline will enable the collection of large, comprehensive parasite data sets that will be instrumental to the future of primatology research.

16. Foraging itineraries and diel nutritional variation: Why do brown lemurs (*Eulemur fulvus)* prefer some foods in the daytime and others at night?

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Most primates, including lemurs, tend to be categorized as folivores or frugivores, but few species are fully dedicated to one food type. For those that mix food types, seasonality in diet composition has been a central focus of research (e.g., increased reliance on leaves as a lean season fallback food), but less attention has been paid to the differential use of food types across the diel (24-hour) cycle – and these studies have focused on diurnal primates. Cathemeral species (like *Eulemur* spp.) have more flexibility due to their daytime and nighttime activity.

We studied the diet of the mainly-frugivorous brown lemurs (*Eulemur fulvus*) from July 2016 – July 2017 and found that leaves (12% of feeding time) and flowers (6% of feeding time) were disproportionately eaten in the lean season, and preferentially consumed at night during those months. Preference varied strongly across plant species, however, with select leaf species consumed preferentially during the day.
To determine if temporal nutritional variation contributed to preference for non-fruit foods at night, we quantified the macronutrient profile of four highly-consumed leaf species at 2-hour intervals across a 24-hour cycle. We quantified ash, available protein, fat, water soluble carbohydrates, fiber and total non-structural carbohydrates (TNC). No leaves showed significant temporal variation. We conclude that diel feeding was driven by (1) some kind of nutritional variation we did not detect, or (2) other factors, including sensitivity to predators (some of the leaf species were found on the ground or near open areas), interspecific competition, thermoregulation or sensory factors. Future studies should also examine diel variation in the other foods: for example, lemurs may be prioritizing fruit during daylight hours.

POSTER ABSTRACTS

1. Polyspecific Association Overlapping Feature Stack Framework in Studies: Primates in Focus

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Knowledge of polyspecific associations, their instigation, establishment, continuity through ecological features and reoccurrence can greatly expand the current understanding of primate behavioral ecology. Polyspecific associations occur when at least one species is in a relation with another in either a mutualistic, commensal, amensal, negative, or parasitic interaction for given time. Expanding our knowledge of polyspecific interactions can provide a better foundation for developing protocols in response to the current conservation crisis many species face. Impacts on one species within a system may cause changes for multiple species and natural cycles beyond what is currently known. Detailed knowledge of polyspecific interactions and associations is increasingly required in an anthropogenically-altered natural world. Establishing a standard framework of ecological and behavioral features used to classify species interacting in polyspecific associations can increase the detailed ecology and shared characters of a known multi-species association, provide a foundational structural framework in which to identify unknown multi-species relationships, and build upon previously known interactions. A developed framework using a layering method of features can aid in our knowledge of

polyspecific associations' complexity as well as the importance of understanding the interdependence of species in an ecosystem.

2. Examination of a parallel laser apparatus to measure growth and flanges of wild Bornean orangutans (*Pongo pygmaeus wurmbii*)

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Laser photogrammetry allows for remote measurements of wild animals, using projected lasers with a known separation as a reference ruler within a photo. We constructed a novel laser photogrammetry device from commercially-available parts, and used it to measure the forearm lengths and flange widths of 16 wild Bornean orangutans (*Pongo pygmaeus wurmbii)* in Gunung Palung National Park, Indonesia. Our objectives were to validate our method, report preliminary measurements and growth, and discuss issues encountered. We measured forearm lengths in three different ways to see which was most consistent, and re-checked the laser width with calibration photos after each session. We estimated error with repeatability, accuracy, and inter-observer reliability measures, tracked the forearm growth of three immature females, and examined the ratio of flange size to forearm length. The longest forearm measure was the most repeatable (CV = 1.64%), and was similar to flange repeatability (3.50%). Accuracy measurements of a known object were high (error = 0.25%), and inter-observer error low (3.74%). Laser spacing increased with distance, but we corrected for this using calibration photos. Females grew at -1.37mm/month over the course of one month to 1.07mm/month over the course of five. For adult males, flange width and forearm length did not increase in tandem. We transparently discuss the issues we encountered, and hope this accessible method can help expand the use of laser photogrammetry. Preliminary measurements are promising for future studies about orangutan growth and male bimaturism. We suggest using six months as an interval for growth measurements, and making improvements to the apparatus and method to ensure the lasers remain parallel.

3. Reconstructing an Eocene primate paleo biome with insights from the extinct tillodont, *Esthonyx*

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Tillodonts are an order of extinct mammals that lack diversity across all genera and are known from the earliest Paleocene to the middle Eocene of Asia and North America. *Esthonyx* tends to be the most common of all the genera and was the first to migrate to North America from Asia around 56 Ma. Fossils of this obscure early mammal are recovered in Bighorn Basin, Wyoming in association with the earliest fossil primates, the Plesiadapiformes; it would not have been competing with the primates directly for resources, so the environment must have been rich enough to sustain the large-bodied quadruped. *Esthonyx* is also recovered with water-dwelling Eocene taxa, which would suggest that Plesiadapiformes were living in trees in swampland zones. Despite being an evolutionary dead end, *Esthonyx* provides insights to the ecology and environment in which early primates lived through comparisons of meter level, paleosol maturity, hydromorphic condition, and taxon to reconstruct an Eocene primate paleo biome. Here, we test whether the frequency of *Esthonyx* is higher in hydromorphic or non-hydromorphic paleosols, and also if *Esthonyx* occurs more frequently with Euprimates or Plesiadapiformes. The results of this study support sympatry between the Tillodont, *Esthonyx* and the modern and extinct orders of primates. Further research is necessary due to the limited sample size reported here. Relationships of the same time appear to exist in previous report from the Willwood Formation of similar stratigraphic levels and paleosol maturity.

4. Preliminary technical validation of T3, a potential non-invasive measure of energy balance, in lemurs

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Energetic state is crucial for animal survival and fitness; however, non-invasive measurements of energetic state in wild population remain limited. Recently, fecal triiodothyronine (T3) has proven to accurately reflect energetic condition in a variety of wild mammals, including primates like baboons. Here, we sought to validate a commercial T3 radioimmunoassay in Coquerel's sifakas (*Propithecus coquereli*). We collected 72 samples from six females at the Duke Lemur Center from December 2020 to March 2021. Samples were immediately frozen at -80C and a subset of samples were subdivided, with one aliquot stored in 95% ethanol at room temperature. We freeze dried samples, extracted T3 using 70% ethanol, and determined T3 concentrations via radioimmunoassay. We found that T3 can be reliably measured in sifaka feces that were frozen or stored in 95% ethanol for up to six weeks. Ethanol extraction efficiency of T3 from feces was 81.44% ± 1.2%, parallelism between serial dilutions of fecal extracts and assay standards was observed (ANCOVA, $F(1,7) = 2.354$, $p = 0.1688$), and assay accuracy was good (112% ± 7.2). Interassay and intra-assay reliability were high (coefficient of variation < 10%). Biological validation using activity and foraging data from a larger sample size of individuals is currently underway. These preliminary results offer promise for utilizing this method for non-invasive study of strepsirrhine energetics.

5. Genetic Signatures of Biochemical Plant-Primate Interactions: ESR1 as a Case Study

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Plants secrete chemical defenses that co-opt vertebrate estrogen receptors (ER) and alter development, fertility, and behavior. Two genes - ESR1 and ESR2 code for ERα, and ERβ, respectively. While relatively conserved, minor mutations across ESR1's ~472,929-base-pair sequence may alter susceptibility to chemical disruption. Other studies make compelling cases for phytoestrogens' broad impacts on primates, including signs of selection on ESR2 across Platyrrhines. Building on this, we compared all primate ESR1 sequences published on GenBank (N=30: 3 strepsirrhines, 27 haplorrhines [12 hominoids, 9 cercopithecoids, and 5 platyrrhines]). Using the top transcript variants, we translated protein-coding nucleotide sequences into amino acid sequences in Geneious Prime v2021.2. After MAFFT-based-alignment, we manually inspected/corrected sequences. To visualize phylogenetic patterns, we reconstructed Bayesian (*MrBayes*) and Maximum Likelihood (*RAxML*) trees. We used the *pis* function in the R package *ips* to identify the most informative sites. To measure the strength of selection, we calculated the ratio of non-synonymous substitution to the rate of synonymous substitution (dN/dS or ω). Then, by comparing data from the Database of Single Nucleotide Polymorphisms (dbSNP), we located the positively selected sites that matched human SNPs linked to endocrine phenotypes or developmental differences. Our results shine a new light on ERα's critical role as a physio-environmental mediator throughout primate evolution. These data will also guide our developing projects, including *in silico* ligand-binding, *in vitro* receptor activation, and *in vivo* gene expression patterns.

6. The potential benefits of cognitive, non-food-based enrichment compared to traditional food enrichment in capuchins (*Sapajus apella*)

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In the wild, non-human primates engage with a variety of objects, many of which do not provide food or other visible reward. However, in captivity most enrichment given to animals is food-based or the enrichment tasks result in a food reward when successfully completed. Food-based enrichment may elicit a higher amount of aggression due to competition over a resource. Non-food-based enrichment may provide monkeys with the opportunity to engage in natural behaviours without inciting aggression and instead promote more prosocial behavior. In this study we compared the behavior of brown capuchin monkeys (*Sapajus apella*) across three conditions, a control and two different forms of enrichment. We studied the two capuchin

troops housed at the Living Links to Human Evolution Research Centre at the RZSS Edinburgh Zoo across three observational conditions matched for time of day and duration: a control condition (no enrichment objects), a cognitive enrichment condition (objects and no food) and a food enrichment condition (objects and food) over the course of three days in a week. Each group received a total of two sessions for each condition. In each condition, we video recorded the group for 30 minutes during the enrichment (if applicable) and then a further 30 minutes after the enrichment objects were removed. The sessions were coded using *ad libitum* sampling of prosocial and aggression events as well as occurrences of potentially stress related behaviours. We found that in sessions with non-food-based cognitive enrichment, there were significantly more time spent engaging in prosocial behavior and in food-based sessions there were significantly higher rates of aggression, supporting our hypothesis.

7. Evaluating duration of visual contact and the success of laboratory-housed adult male macaque (*Macaca spp*.) pairs

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While the benefits of pair housing have been well documented, less is known about improving adult male macaque pair success. Identifying ideal time periods for visual contact is important to improve pair success, reduce risk of injury, and reduce the use of single housing in laboratory-housed adult male macaques. In this retrospective study, 75 unfamiliar adult (*M*=5.9 years, *SD*=1.55) male macaque (51 *M. mulatta*; 24 *M. fascicularis*) pairs were examined to determine whether duration of visual contact improved success rate. Pair success was defined by 2 weeks in full tactile contact without injury requiring clinical treatment or care. A logistic regression analysis was conducted to investigate the relationship between pair success and time in visual contact for pairs formed between July 2018 to June 2021 in which a significant relationship was found, $X^2(11, N=75) = 20.54$, p=.038. Higher success rates were found when pairs were provided 0-1 (69%) or 8+ (71%) days in visual contact; compared to 2-4 (22%) and 5-7 (50%) days. Pairs that showed affiliative behaviors were more likely to move to tactile contact in 0-1 days, while those that exhibited agonistic behaviors were maintained in visual contact for longer. These results indicate that when agonism is present in visual contact, waiting more than a week to provide tactile contact may improve success for unfamiliar adult male macaque pairs.

8. Inter-tissue isotopic offsets in three sympatric primates from Kibale National Park, Uganda: Implications for dietary reconstructions

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Stable isotopic analysis of enamel apatite is commonly used to reconstruct diets of fossil taxa. Enamel, dentine, and bone bioapatite have come to be considered isotopically equivalent, but

recent studies in humans and pigs have documented an offset of several per mil (‰) between $\delta^{13}C$ values from these tissues of the same individuals. These tissues form at different points during development and exhibit variable turnover rates, and therefore cannot represent equivalent time periods if sampled from adult individuals. Sampling these co-forming tissues from deceased juvenile individuals may represent the only way to determine the comparability of these three apatite sources. Here we document $\delta^{13}C$ offsets between bone, enamel, and dentine apatites of adult and juvenile members of three sympatric primates from Kibale National Park, Uganda (*Pan troglodytes schweinfurthii, Cercopithecus ascanius,* and *Piliocolobus rufomitratus*). We test whether juvenile members of each species show a different pattern of apatite offsets than the adults of their species, based on greater temporal overlap between the formation of these tissues in immature individuals. Apatite samples were powdered and pretreated according to established protocols for each tissue and isotopically analyzed. When data from the three primates are viewed together, the $\delta^{13}C$ apatite offsets between bone and enamel, bone and dentine, and enamel and dentine vary by over 3.0 per mil, with the juvenile individuals of each taxon showing strikingly different patterns of offset variation than the adults of their group. These results are examined in the contexts of differences in dietary regime, developmental pace, and tissue turnover rate in these three sympatric primates. Also discussed are implications for future studies seeking to use disparate apatite sources interchangeably in dietary reconstructions.

9. Comparing Lab and Field Methods and Ethanol and Methanol on the Extraction of Cortisol from Mountain Gorilla (*Gorilla berengei berengei*) Fecal Samples

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Fecal hormone extraction methods differ between the field and lab due to equipment and supply constraints. Here, we test two different methods of fecal cortisol metabolite extraction, along with two different extraction solutions (methanol and ethanol), using wild mountain gorilla (*Gorilla berengei berengei*) fecal samples collected in 2004 at the Dian Fossey Gorilla Fund's Karisoke Research Center in Volcanoes National Park, Rwanda. The laboratory method relied on shaking and centrifuging, while the field method used a microhomogenizer and filter paper. We extracted 14 fecal samples using the field and lab methods with both methanol and ethanol, then assayed the samples using an ISWE cortisol minikit (Arbor Assays, Ann Arbor MI). Previous experiments have shown that methanol performs better as an extraction solution than ethanol in geladas (*Theropithecus gelada*)[1]. We expect to see similar results in mountain gorillas. We anticipate that our results will confirm the extraction solution most appropriate for fecal hormone extraction in wild mountain gorillas, and that quantification of any differences in extraction efficiency of the field and lab methods will allow us to appropriately correct for this potential confounding factor when switching between methods is necessary.

10. Dominance rank correlates with use of a groom-soliciting vocalization in white-faced capuchins

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Communicative signals used in close proximity to conspecifics often function to facilitate social interactions. In white-faced capuchins (*Cebus imitator*), a vocal signal and a suite of gestural signals are associated with soliciting group members for an important primate social interaction - grooming. Here, we explore usage rates of the "peep" vocalization and groom soliciting gestures for 19 individuals in a group of white-faced capuchins at Taboga Forest Reserve in Guanacaste, Costa Rica. As white-faced capuchins have been shown to preferentially groom higher-ranking individuals, we predicted that lower-ranking individuals would have a greater need to solicit grooming and would therefore use both signal types at higher rates. We calculated peep rates and groom soliciting gesture rates for each individual from 238 hours of focal observations conducted between August 2018 and July 2021. We determined dominance ranks by calculating David's scores for each individual based on aggressive and submissive behaviors recorded during focal observations. A partial Spearman's correlation, controlling for age and sex class, revealed that peep rates correlated with dominance rank, such that lower-ranking individuals used the vocalization at the higher rates. Groom soliciting gesture rates, however, did not vary by dominance rank, nor did peep rates and groom soliciting gesture rates correlate with one another. These results suggest that, rather than serving as redundant signals to solicit grooming, the peep vocalization and groom soliciting gestures may communicate different information or be used in different social contexts. Detailed analyses of the context and sequencing of peep vocalizations and groom soliciting gestures are planned to further explore potential functions.

11. Comparison of Testosterone and DHEA Hormone Levels in Wild Male Mountain Gorillas (*Gorilla beringei beringei*)

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Testosterone (T) and dehydroepiandrosterone (DHEA) are two hormones integral to the process of male sexual development. For human males, DHEA increases during pre-puberty, as the zona reticularis of the adrenal cortex forms. This process is called *adrenarche*, and is followed by an increase in T during puberty. There is limited information about how the process of adrenarche compares across great apes, meaning there is still much to be learned about how male developmental patterns differ by species. As a first step in the investigation of DHEA changes with age, we analyze fecal samples of wild male mountain gorillas (*Gorilla beringei beringei*)

ages 3-15, collected at the Dian Fossey Gorilla Fund's Karisoke Research Center in Volcanoes National Park, Rwanda. Our goal is to determine if the ELISA hormonal assays in use with this gorilla population are able to detect differences between T and DHEA fecal metabolites, which are not structurally identical to the native hormones they are derived from. Because both hormones are adrenal androgens, the potential for cross-reactivity is high, and thus may prevent characterization of adrenarche using this method. Here, we run the same fecal samples on commercially available T and DHEA assays, and compare the results. We expect that DHEA will increase in mountain gorillas during pre-puberty (around age 4), and for T to increase during puberty (around age 8). If so, these methods are sensitive enough to characterize changes in T and DHEA separately, and can be used to investigate the process of adrenarche in a wild great ape population.

12. Healthy Children, Healthy Chimps: Reducing respiratory disease transmission from humans to chimpanzees in Uganda.

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Reverse zoonotic respiratory diseases threaten wild chimpanzees across Sub-Saharan Africa. In the Kanyawara chimpanzee (*Pan troglodytes schweinfurthii*) community in Kibale National Park, Uganda, respiratory disease has caused 59% of deaths over the past 30 years, with mortality rates of up to 10% during outbreaks. Our studies of the Kanyawara and nearby Ngogo communities have identified the causative agents as "common cold" pediatric human pathogens. We hypothesize that these pathogens circulate in children living near chimpanzee habitats, and that adults in those villages become asymptomatically infected and can carry the pathogens into the forest and infect chimpanzees. Our objectives are to characterize respiratory pathogens in local children, forest workers, and chimpanzees using comprehensive molecular diagnostics and metagenomic DNA sequencing, and to examine the reverse zoonotic transmission risk that varies with pathogen type, season, environment, and the individual characteristics of humans and chimpanzees. We began sample and data collection from people and chimpanzees (1,900 swabs from 302 human study participants and over 700 fecal samples from 141 chimpanzees to date) prior to the onset of COVID-19, and our efforts have continued to the present. Initial data show that children exhibit high frequencies and severities of symptoms while adults are largely asymptomatic and that COVID-19 lockdown significantly decreased symptoms frequencies in children. Reverse zoonotic respiratory disease is a major threat to all wild apes, and SARS-CoV-2 has been a "game changer" in this regard. No other study has established prospective matched cohorts to identify where, when and how respiratory pathogens move from people to chimpanzees. Our data will lead to evidence-based actions to reduce transmission to the approximately 1,500 chimpanzees of Kibale National Park and, by extension, to apes across Sub-Saharan Africa.

13. Validation of Novel Ultra-Wide Band Technology to Monitor Captive Animal Movement

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Automated tracking is increasingly used to monitor the health, behavior, and welfare of captive animals in laboratories, farms, zoos, and sanctuaries. Spatial data obtained from radio frequency technologies can provide information about an animals' space use, location, and proximity to other individuals. Ultra-Wide Band is a newer radio frequency technology that has been successfully used to track individuals in farm and laboratory settings. We sought to validate the stationary location estimates obtained from a commercially available Ultra-Wide Band animal tracking system (TrackLab, Noldus Information Technology, Netherlands). The research took place at an indoor sheep facility. Stationary posts were positioned in a 1 m x 1 m grid throughout the barn (28.96 m x 11.81 m). The precise location of each post was recorded using a laser tape measurer. These measurements were used as control points for comparison to the system's recorded coordinates. The tracking tags were then placed on the stationary posts and location data were recorded for approximately one minute. At each post location, the tags were placed at two different heights to determine whether height affected reliability. Analyses to determine accuracy for each point at both heights are ongoing. The validation of this technology will inform studies specifically focusing on the behavior, health, and welfare of sheep but has far-reaching implications for future research on captive animals.

14. Chemical niche divergence in sympatric lemurs: understanding species' food selection

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The integration of nutritional ecology into primatology has provided considerable insight into the feeding strategies of primates, and the ecological factors limiting populations - critical knowledge in a world of rapidly changing habitats. The eastern rainforest of Madagascar is home to one of the world's most diverse primate communities, however, the ecological mechanisms by which these species can coexist are not well understood. We quantified the nutritional chemistry of the foods eaten by six sympatric lemurs (*Avahi laniger*, *Lepilemur mustelinus*, *Eulemur fulvus*, *Eulemur rubriventer*, *Hapalemur griseus*, and *Propithecus diadema*) to assess their niche separation. We also examined and compared the nutritional chemistry of foods and non-foods (foods not eaten by any of these lemurs) to gain insight into the food selection rules guiding these species' feeding behaviors. High dietary diversity in plant species

consumed was found with very little overlap – only 55 out of 213 foods tested being shared by at least two lemur species. Overall, both plant secondary metabolites (PSMs) and macronutrients appeared to drive food selection. Leaf selection depended on diet type and adaptations of different species: the frugivorous *Eulemur* species selected high-protein leaves, likely to balance their low-protein fruit foods, while two of the folivores (*A. laniger* and *P. diadema*) seemed to tolerate low-protein leaves. *A. laniger* and *P. diadema* tolerated high levels of tannins in their diet, while as *L. mustelinus* and *H. griseus* avoided them, confirming previous studies on the influence of PSMs on food selection. 33 of 53 non-foods collected were also found to contain tannins. Understanding the nutritional requirements and divergent dietary strategies of primates are essential for developing more effective conservation efforts, like reforestation and restoration projects.

15. Larger group size is associated with faster weaning in wild geladas (*Theropithecus gelada*)

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Weaning is a classic example of parent-offspring conflict; extended nursing provides benefits to infants but comes at a cost to mothers' future reproduction. Mothers with greater resource access (i.e., high-ranking, parous females) may wean infants faster, but mothers exposed to environmental risks may also speed up weaning to shift energy to future reproduction. In wild geladas (*Theropithecus gelada*), infanticide due to male takeovers is the leading cause of infant mortality. Gelada mothers accelerate weaning following takeovers. However, takeovers are more likely in larger groups, suggesting that group size itself may be an additional prompt for females to wean infants faster. Here, we examined the effects of maternal parity, dominance rank, and group size on the timing of weaning outside of takeovers. We used a Cox proportional hazards model (N=61) to determine how these factors predict the likelihood of weaning in a population of wild geladas from the Simien Mountains National Park, Ethiopia. As expected, first-time mothers were more likely to wean their infants at older ages ($p < 0.01$, $z = -2.8$); however, there was no effect of maternal rank. Females in larger units were more likely to wean their infants earlier ($p < 0.01$, $z = 2.6$). Accelerated weaning in large groups is unlikely related to resource availability as group size has no effect on adult interbirth intervals. Thus, our results indicate that simply belonging to a large unit can signal a risk to females, producing a more rapid weaning schedule for them.