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Conference Organizer: Dr. Paul A. Garber

Abstracts of MPIG Poster and Podium Presentations

1. Morphometric comparisons of scapulae: data from three Callitrichid species. Zachary Bledsoe and Luci Kohn, Southern Illinois University Edwardsville, Edwardsville, IL 62036.

[POSTER]

Skeletal distinctions among closely related taxa have largely been based on cranial morphology, and studies examining skeletal distinctions using postcranial dimensions are limited. The scapula is unique in that it is a bridge between the axial and appendicular skeleton. Therefore, any locomotor differences between taxa should be represented in the scapula. This study examines scapular morphology in 180 adult skeletons representing *Saguinus oedipus*, *Saguinus fuscicollis*, and *Callithrix jacchus*. The species are closely related, but their locomotor habits are different. Three-dimensional coordinates of 11 landmarks were recorded using a Patriot (Polhemus) 3D digitizer. Data were analyzed by traditional and geometric morphometrics methods. Lengths describing functional regions of the scapula were analyzed for species differences. Traditional methods showed that significant differences across species were due largely to the greater size of *Saguinus oedipus*. Geometric morphometrics methods are necessary to distinguish shape differences across taxa.

2. Genetic variation for life history and morphology in the Cayo Santiago female rhesus macaques (*Macaca mulatta*). G.E. Blomquist. Department of Anthropology, University of Notre Dame.

[POSTER]

For populations to be affected by selection and drift there must be genetic variation in traits. Several explanations predict how the standing level of additive genetic variation should be patterned according to a trait's relationship with fitness. In populations close to an evolutionary equilibrium, traits tightly associated with fitness are predicted to have low genetic variance, because of the "erosion of variance" by selection. Other explanations focus on the genetic and developmental processes that generate genetic and residual variance in traits—either through differences in mutational input or interdependencies among traits.

I tested these predictions by calculating the heritability and coefficients of additive genetic and residual variation for 6 life history traits (including fitness) and 15 skeletal measurements using long-term demographic records and the skeletal collection of female macaques from Cayo Santiago. REML methods, allowing maximum use of pedigree information, were implemented in the program DFREML. Only sexually mature females were included in the analysis ($n = 98$ to 883). The association between each trait and fitness was estimated by the parametric correlation between them.

In contrast to expectations of the "erosion of variance" view, fitness and life history traits closely correlated with it have modest heritabilities at Cayo Santiago. Additionally, the patterning of coefficients of variation offers support to models stressing the incorporation of residual variance, due to functional interdependence, by traits closely associated with fitness.

While these results do not match equilibrium expectations, they are not unusual when compared to similar investigations of genetic variation in other mammalian species. Current levels of genetic variation in the traits studied imply the potential for rapid evolutionary change in this primate population.

Research supported by the University of Illinois Graduate College. Cayo Santiago and the Caribbean Primate Research Center are NSF, NIH, and University of Puerto Rico funded facilities. Paternity data, used under agreement in this research, was gathered by John Berard, Fred Bercovitch, Matt Kessler, Michael Krawczak, Peter Nurnberg, and Jorg Schmidtke.

3. Aggression and Affiliation in Wild White-Faced Capuchins (*Cebus capucinus*). Jordan Brinkman, Vanderbilt University

[POSTER]

Within group competition has been accepted as the prominent hypothesis to explain social behavior (Wrangham, 1980). If this paradigm were correct one would expect aggressive and agonistic behaviors to occur at higher rates than affiliative behaviors. However, Sussman and colleagues (2005) hypothesize that sociality in primates evolved because of the collective benefits, not costs, received from group living. If collective advantages promoted the evolution of group living, then one would assume affiliative behaviors occur at high rates and with a higher frequency than agonistic behaviors. In a brief study at La Suerte Biological Research Station in Costa Rica, I collected data on the frequency and rate of agonistic and affiliative behaviors in two groups of white-faced capuchin monkeys (*Cebus capucinus*). Data were collected using focal animal instantaneous sampling at two-minute intervals and all occurrence sampling of both affiliative and agonistic behaviors over 17.5 hours of observation. Affiliative interactions were defined as proximity, grooming, nongrooming affiliative contact, sexual behavior, and coalitions. Agonism was defined as facial and vocal threats, lunging, chasing, hitting, biting, and wrestling. Active social interactions comprised an average 5.5% of the capuchin activity budget for both groups. Affiliative behaviors accounted for 74% of the social interactions while agonistic behaviors accounted for only 26%. Affiliative behaviors occurred at a higher rate than agonistic behaviors (4.4 vs. 1.5 events/hr). I have shown that agonism occurs at low rates in *Cebus capucinus* which demonstrates that competition is not as significant as assumed in the evolution of primate sociality.

4. Notes on the behavior and conservation status of two endemic primates (*Oreonax flavicauda* and *Callicebus oenanthe*) of the Andean foothills, Alto Mayo, northern Peru.

Anneke DeLuycker, Department of Anthropology, Washington University, St. Louis.

[POSTER]

There have been few long-term field studies of primates in the foothills of Andean Peru, and little is known concerning the biology of its three geographically rare and endemic species (*Oreonax flavicauda*, *Callicebus oenanthe*, and *Aotus miconax*). All three species are highly endangered and persist in increasingly isolated, threatened cloud forests and premontane forests in scattered areas of the Departments of San Martín and Amazonas, in northern Peru. Two of these species were studied in detail: the yellow-tailed woolly monkey (*O. flavicauda*), from June until August 2004, and the Río Mayo titi monkey (*C. oenanthe*) from October 2004 until September 2005. No long-term research has been conducted on *O. flavicauda* in more than 20 years. Three sightings of *O. flavicauda* showed an average group size of 17-20 individuals—higher than previous sightings by Mariela Leo Luna in the early 1980s, who observed average

group size of 9 individuals. The difficulty we encountered in finding groups in the study area suggests that yellow tailed woolly monkeys have a large home range. In the first field study on the behavioral ecology of *C. oenanthe*, I was able to record detailed information on identified individuals followed at close range. Pelage coloration differences were seen among individuals of different groups in *C. oenanthe*, which may indicate color morphs or possible subspecies. General activity budget of *C. oenanthe* is detailed. The conservation status and implications are described for both species, with discussions on their rarity, isolation, and human-induced threats. Suggestions for conservation action are given.

5. Crowned Lemur (*Eulemur coronatus*) Social Organization Without Pair Bonds.

Benjamin Z. Freed, Department of Anthropology, Emory University.

[Podium]

Although several researchers have hypothesized that some prosimians organize themselves socially around one-male/one-female units or pair-bonds, few researchers have found such units within multi-male/multi-female prosimian societies that routinely subgroup. Based on surveys in northern Madagascar, one-male/one-female units were rarely seen among crowned lemur (*Eulemur coronatus*) populations in different habitats. In a year-round behavioral study in the Mt. d'Ambre, Madagascar rain forest, I found no evidence of such units within two crowned lemur study groups that formed subgroups daily. Neither sex excluded one another from mating, nor was one sex dominant. Using Monte-Carlo analysis, I found no evidence of one-male/one-female units among subgroup partner and nearest neighbor preferences. Although subgroup partner and nearest neighbor preferences did exist, individuals often preferred more than one other group member in subgroups or as nearest neighbors. As a result, one-male/one-female units or pair-bonds do not explain much of how these multi-male/multi-female primates organize themselves socially.

6. Ecology of pathogen transmission among humans, non-human primates, and livestock in western Uganda . Tony Goldberg, Tom Gillespie, Innocent Rwego, Colin Chapman.

**Department of Pathobiology, College of Veterinary Medicine, University of Illinois,
Department of Anthropology, University of Illinois**

[Podium]

Infectious diseases transmitted among humans, non-human primates, and domestic animals represent an emerging threat to human health, animal health, and primate conservation. The Kibale EcoHealth Project endeavors to improve our understanding of what factors determine interspecific infectious disease transmission risks in and near Kibale National Park, a mid-elevation forested park near the foothills of the Rwenzori Mountains in western Uganda. Project data indicate that forest fragmentation has led to increased prevalence of a broad variety of directly transmitted and water-borne pathogens in non-human primates inhabiting forest fragments (e.g. strongyle and rhabditoid nematodes, protozoa of the genera *Giardia* and *Cryptosporidium*, and various species of pathogenic enterobacteria). Epidemiological surveys of domestic animals living near forest fragments implicate cattle, goats and sheep as reservoirs and conduits of infection between people and primates. Molecular analyses of bacteria isolated from humans living near forest boundaries or employed in primate-directed eco-tourism indicate that specific human behaviors that increase ecological overlap between people and primates also accelerate microbial transmission rates. Patterns of antibiotic resistance in these same bacteria show that human-livestock-primate microbial transmission risk is spatially structured, with forest

fragmentation being a key factor accelerating transmission. Spatially explicit analyses suggest that the link between biodiversity loss and human-primate disease transmission is mediated by human behavior, primate behavior, and hydrology. A fine-scale understanding of the mechanisms by which anthropogenic changes to primate habitats alter interspecific infectious disease transmission risks between people and non-human primates will be essential for the formation of improved conservation and public health strategies that would benefit human health on both a local and global scale.

7. Behavioral effects of the death of a silverback on a bachelor and mixed-sex group.

Elena Hoellein^{1,2}, Kristen Lukas^{1,2}, Tara Stoinski³ and Chris Kuhar⁴

**¹Cleveland Metroparks Zoo, Cleveland, OH, ²Case Western Reserve University, Cleveland, OH, ³Zoo Atlanta, Atlanta, GA, ⁴Disney's Animal Kingdom, Lake Buena Vista, FL
[POSTER]**

Western lowland gorillas (*Gorilla gorilla gorilla*) in the wild are usually found in small social groups containing one silverback, several adult females, and their young. When a leading silverback dies in the wild, the remaining group members may persist as an all-female group, disband, or be taken over by another adult male. Captive gorilla groups can be modeled after wild groups in composition in the form of family or all-male groups. The current study examines the response of a multi-male group to the death of a dominant silverback at the Pittsburgh Zoo and the response of a bachelor group to the death of a silverback at Cleveland Metroparks Zoo. The silverback that died in Pittsburgh was dominant as opposed to the one that died in Cleveland. In the Pittsburgh group, we found no increase in aggression and a decrease in social proximity between group members. We also found that time spent feeding decreased and self-directed behaviors increased after the death. In the Cleveland group, social agonistic behaviors decreased and undesirable behaviors increased. Furthermore, feeding increased and self-directed behaviors decreased. This research supports the idea that the dominant silverback of a group exerts a control role, which is lost upon death (Hoff, 1982). This may explain why there was a greater disruption to the Pittsburgh group following death. These results provide more insight into how captive gorillas respond to the loss of a silverback and may inform future management strategies for minimizing disruption to social groups following animal deaths.

**8. Costs of Reproduction in Sexually Promiscuous Primates: Sex Differences in Seasonal Mortality Patterns among Free-Ranging Rhesus Macaques. C.L. HOFFMAN¹, A.V. RUIZ-LAMBIDES², E. DAVILA³, M.S. GERALD³, D. MAESTRIPIERI¹. ¹Animal Behavior Research Group, University of Chicago, Chicago, Ill., ²Sebana Seca, Caribbean Primate Research Center, Sebana Seca, Puerto Rico, ³Cayo Santiago, Caribbean Primate Research Center, Punta Santiago, Puerto Rico
[POSTER]**

Rhesus macaques are highly social and sexually promiscuous primates which exhibit seasonal reproduction both in the wild and in captivity. In the free-ranging rhesus macaque population on the island of Cayo Santiago, Puerto Rico, reproductive effort for males is mostly accounted for by male-male competition and mate attraction during Spring and Summer, while reproductive effort for females is associated with lactation in Fall and Winter. In this study, we examined the hypothesis that adult males and females may exhibit differences in seasonal patterns of mortality in relation to seasonal differences in the timing of their reproductive effort. This is because immune function may be compromised in periods of time requiring high energy investment and

because males may be at higher risk of infection in the mating season due to frequent aggression and injuries. Mortality data for 521 males and 452 females older than 4 years of age over a 44-year period were obtained from the long-term colony records of the Caribbean Primate Research Center. Consistent with our predictions, we found that females are more likely than males to die during the birth season ($t=2.12$, $p=0.04$), whereas males are more likely than females to die during the mating season ($t=-4.84$, $p<0.001$). Furthermore, annual peaks in mortality for males and females closely tracked year-to-year fluctuations in the onset of the birth season, with female and male deaths occurring, on average, 154 and 196 days after the birth season onset, respectively. These findings are consistent with similar data from wild ungulates and highlight strong differences in the costs of reproduction for males and females even in food-provisioned primate populations living in predator-free environments.

9. Brain ontogeny in infant baboons (*Papio hamadryas*).. P. Jelinek², P. Kochunov², M. Davis², J. Rogers³, S. Leigh¹. ¹University of Illinois ²Research Imaging Center, University of Texas Center for Health Sciences San Antonio, ³Southwest Foundation for Biomedical Research.

[POSTER]

Different ontogenetic pathways in primate brain development may have profound implications for understanding primate life history and cognition. Advances in magnetic resonance imaging (MRI) technology resolve numerous limitations of traditional data on brain size ontogeny and life history, enabling unprecedented insights into the dynamics of brain ontogeny.

This study investigates brain growth patterns in captive baboons (*Papio hamadryas*) using MRI, testing the hypothesis that brain growth occurs primarily in the first year of life. To test this hypothesis, we obtained longitudinal MRI data using a 3T scanner from five infant baboons (16 observations obtained under strict IACUC-approved protocols). Total brain volume and gray/white matter volumetric changes were measured. Ages span 12 days to 32 weeks.

Results indicate that total baboon brain volume increases from 85 cm³ to 130 cm³ by 32 weeks (82% average female adult size, 69% adult male size). Myelination occurs rapidly, comprising approximately 5% of total brain volume by 2 weeks, 25% by 32 weeks. The brain growth curve is characterized by rapid non-linear acceleration of growth in the first weeks of life.

These results support the hypothesis that baboons reach adult brain size quickly, and further suggest that adult neural architecture is achieved at a rapid pace. MRI findings are compatible with field observations associating rapid cognitive development with complex physical and social environments. The implications of these patterns for primate cognitive and life history evolution are discussed.

Supported by National Institutes of Health P51 RR13986, Pilot Study Program Southwest National Primate Research Center.

10. Predictors of within-species ecological variability in primates Jason M. Kamilar. Department of Anthropology, Washington University.

[PODIUM]

With the increasing amount of quantitative data from several populations of a species, biologists have recently used within-species variation as a powerful test of adaptation. In primates, many species have been well-studied at various sites, yet we have little knowledge of the factors responsible for among-site variability. The objective of this project was to test several hypotheses explaining the amount of within-species geographic variability in primate social

organization, diet, and activity budget. Data for over 250 primate populations from 37 species were collected from the literature. Multivariate techniques were employed to calculate the amount of within-species variation in each of the three behavioral datasets for each species. Phylogenetic independent contrasts were calculated from species' data and were used in generalized linear multiple regressions for hypothesis testing. The results showed that primate species living in varied environmental conditions and in large social groups displayed the highest levels of within-species variability in social organization and diet. In addition, species that typically live in habitats with high levels of rain seasonality displayed the highest amounts of within-species activity budget variation. These results stress the importance of environmental and demographic factors influencing primate behavioral and ecological variability and have important ramifications for primate socioecology

11. A GIS Analysis on How Human Influence Can Impact Ring-tailed Lemur Population Estimates: A Preliminary Model. Elizabeth (Lisa) Ann Kelley [POSTER]

Sussman et al (in press) have recently conducted a study using ground-truthing and GIS to estimate "best case scenario" population sizes for ring-tailed lemurs. The numbers they obtained for the remaining wild population were 933,162 in 1985 and 751,251 for 2000. As an expansion of their research, I have created a preliminary model to assess how many of these ring-tailed lemurs actually live within "best-case scenario" conditions. The assumption of this model is that anthropogenic activity is the agent most responsible for disrupting these "best-case scenario" conditions. The variables incorporated in this model range from immigration and roads to the maintenance of sacred forests and national reserves. Each of these variables are represented in maps that have been first reclassified and second adjoined to Sussman et al.'s original forest canopy density (FCD) maps, the foundation from which they were able to obtain their estimates. To calculate the percentages of negative, neutral, and positive impact by anthropogenic activity within 1 km² areas, I have also used the same formula Sussman and colleagues used to obtain their density estimates. Results indicate that only about 18.7% of the potential ring-tailed lemur population is either neutrally or positively impacted by human activity. In addition, it is evident that the areas least densely populated by ring-tailed lemurs are also the areas most cared for by humans. Last, this analysis supports the current belief that the sacred forests of south and southeast Madagascar are very likely the most stable habitats for the long-term survivability of this species.

12. Neotropical wet and dry forests: a look at adaptability in primates. Lana Kerker. University of Missouri, St. Louis. [POSTER]

Mantled Howler Monkeys (*Alouatta palliata*) are able to live in a variety of forest habitats ranging from wet to dry tropical forests. Wet forests tend to be larger in stature and have as much as twice the tree species as their dry forest counterparts. Since mantled howler monkeys live a completely arboreal lifestyle, they use adaptations such as grasping hands and feet and a fully prehensile tail to secure their position on substrates of various sizes and to obtain food from terminal branches. I studied substrate use in mantled howler monkeys on Ometepe Island, Nicaragua in 2004; a dry tropical forest and at La Suerte in Costa Rica in 2005; a wet tropical forest. My data show a significant difference in substrate size use in these two forests. In the wet forest, the howler monkeys used small substrates 38.2% of the time compared to 13.8% in

the dry forest. They used large substrates more frequently in the dry forest (33.1%) than in the wet forest (4.5%). Medium substrates were used approximately half of the time at both sites. It is important to look at substrate use in primates to obtain a better understanding of their evolutionary adaptations to living in trees.

13. Subgroup Variation in Morphological Traits in Rhesus Macaques. Luci Kohn and Zachary Bledsoe, Department of Biological Sciences, Southern Illinois University Edwardsville, Edwardsville, IL 62026

[POSTER]

Studies of Primate social groups within a population usually assume the subgroups are essentially unbiased samples of the overall population. They assume that each social group contributes equally to overall genetic variation, and the environment influences social groups similarly. This study tested this assumption by examining skeletal variation in rhesus macaques (*Macaca mulatta*) from the Caribbean Primate Research Center colony on Cayo Santiago, Puerto Rico. Fifty postcranial dimensions were measured on 285 rhesus macaques from 7 social groups. Included individuals were of known parentage. We tested whether subgroups differ phenotypically and genetically in their mean morphology. Significant differences between social groups were found. Genetic drift or migration may be expected to influence a mosaic of traits, causing differences between social groups. These results suggest that social groups may not always be representative of an overall population.

14. Alternative Mating Strategies In Black And Gold Howler Monkeys. M. Kowalewski^{1,2}, P. A. Garber¹ and G. E. Zunino², ¹Dept. of Anthropology - University of Illinois UC, 109 Davenport Hall - 607 S Mathews Ave, Urbana, IL, 61801, USA, ²Estación Biológica de Usos Múltiples, Corrientes-Museo Argentino de Cs. Naturales, Argentina.

[PODIUM]

In several primate species, adult males peacefully co-reside in the same social group and females are reported to mate with multiple adult males. Under these conditions, individual males and females may rely on a range of social strategies to increase reproductive opportunities. We investigated the mating behavior of *Alouatta caraya* on Isla Brasilera (27° 20' S-58° 40' W) in Argentina. Two groups were followed 5-days a month from sunrise to sunset from April 2003 to November 2004. We observed 216 copulations for 8 females (32% were extra-group copulations [EGC] and 62% intra-group copulations [IGC]), and 210 copulations involving 7 males (31% EGC, 69% IGC). Courtship, measured as the exchange of grooming before and after copulations was more frequent during IGC than EGC for males and females (G-test, $p < 0.01$). EGC occurred most frequently outside of visual contact of a females' group (G-test, $p < 0.01$), but were interrupted if observed by a resident adult male. In contrast, IGC were never interrupted by resident males. Female howlers copulated with multiple males before, during and after conception (3.4 ± 0.9 males/month during ovulation, 1.5 ± 0.7 males/month during gestation, and 1.6 ± 0.5 males/month during lactation). Social tolerance and affiliative behavior among resident males may promote cooperative group defense. Promiscuity in females may have several functions including mate choice, sperm depletion, extragroup male recruitment, paternal uncertainty and infanticide avoidance.

15. Genetic Structure Of Two Populations Of *Alouatta caraya* In Continuous And Fragmented Habitats. M. Kowalewski^{1,2} and L. I. Oklander² ¹Dept. of Anthropology - University of Illinois UC, 109 Davenport Hall - 607 S Mathews Ave, , Urbana, IL, 61801, USA, ²Estación Biológica de Usos Múltiples, Corrientes-Museo Argentino de Cs. Naturales, Argentina.

[POSTER]

Demographic factors such as group size, group density, and male and female dispersal patterns can significantly affect the genetic structure of a primate population. In addition, habitat fragmentation may isolate populations and limit dispersal opportunities. We studied 7 groups of black and gold howlers inhabiting continuous forest (CF) on Isla Brasilera (27° 20' S, 58° 40' W) and 10 groups of black and gold howlers inhabiting a fragmented forest (FF) in Corrientes (27° 30' S, 58° 41' W) in northern Argentina. On the island, several groups have overlapping ranges whereas in FF each group was restricted to a forest fragment. We analyzed the genetic variability of these groups using seven polymorphic microsatellites: 3 for *A. caraya* (AC14, AC17, AC45), and 4 described for *Homo sapiens* (TGMS1, TGMS2, D5S117, D8S165). Our results indicate that neither population deviated from H-W equilibrium. However, *F_{st}* (inbreeding coefficient) values between-groups in the FF were consistent with a recent genetic differentiation between groups (Analysis of Molecular Variance: *F_{st}*=0.08805, *p*=0.000). In contrast *F_{st}* values between-groups in the CF showed no differentiation between groups (AMOVA: *F_{st}* 0.00771, *p*>0.05). These results suggest that habitat fragmentation may serve to decrease the ability of howlers to disperse between groups. Isolation can lead to inbreeding depression unless gene flow is restored by developing of biological corridors.

16. A Preliminary Study Of Troop Leadership During Travel In Black And Gold Howler Monkeys. M. Kowalewski^{1,2}, V. Fernandez², G. Zunino². ¹Dept. of Anthropology-University of Illinois at Urbana-Champaign, ²Estación Biológica Corrientes-Museo Argentino de Cs. Naturales, Argentina

[POSTER]

Sex-biased behaviors are common in non-human primates. They involve differential resource and risk allocations as functions of their anticipated reproductive output. Greater direct female investment in reproduction implies that females should influence travel decisions affecting foraging efficiency more than males. We explored evidence of sex-biased differences in both travel progression and the initiation of group movement in *Alouatta caraya*. Data were compared across three activities, feeding, resting, and encounters with neighboring groups. Group leadership was defined by the sex of the individual initiating and ending progression. Two groups of *A. caraya* were followed 5 days a month from May to November 2004 on Isla Brasilera (27° 20' S and 58° 40' W) in northern Argentina. We recorded 319 displacements and registered who was leading the progression and the number of changes in leadership during feeding, resting and intergroup-encounters. Considering all behavioral contexts together, there were no significant differences in the sex that led movement ($\chi^2=0.2, df=1, p>0.05$). Females led movement to feeding sites and resting sites more often than did males, and males led movement to intergroup encounters more often than females ($G=17.2, df=2, p<0.05$). There were no significant differences between the number of false starts and the sex of the initiator ($G=0.48, df=1, p>0.05$). Females may benefit from leading movement to feeding sites if this

enables them to increase access to food resources. Males played an important role in leading the group during inter-encounter groups that related to territorial and group cooperative defense. Additional relationships between troop leadership and howler behavioral ecology are discussed. Funded by The Leakey Foundation, The Wenner- Gren Foundation, American Association of Primatologists, University of Illinois and Ideawild Inc.

17. Modeling Pathogen Transmission in Balinese Macaques: the LNK Model

Kelly E. Lane*, **Gerhard Neiderweiser[§]**, **Ryan Kennedy[§]**, **Hope Hollocher***, and **Agustin Fuentes⁺**. **Departments of Biology ***, **Computer Science[§]**, and **Anthropology⁺**. **University of Notre Dame, Notre Dame, IN, 46556.**

[PODIUM]

Recently several zoonotic diseases have emerged on the Asian landscape, and primates are implicated as both pathogen hosts and reservoirs. Simultaneously, human alteration of habitats has increased. However, few studies have examined the relationship between pathogens, changes in existing landscapes, and primate populations. We are interested in how human manipulation of landscapes impacts macaque social and genetic structure and how these changes might influence pathogen ecologies among primates on Bali, Indonesia. To understand the interplay between these factors, we have developed a model based on GIS data of the landscape of Bali, preliminary macaque genetic data supporting female philopatry and male dispersal, and variable input of several aspects of pathogen life history and disease transmission, and applied it across several populations of long-tailed macaques (*Macaca fascicularis*) on the island of Bali. Our goal is to dissect how anthropogenic ecosystem level changes are effecting macaque populations on a genetic level, how this, in turn, impacts pathogen populations, and how simulation of these population dynamics across time and geography will predict and elucidate barriers to gene flow as well as disease corridors, both of which are crucial to understanding disease transmission.

18. Locomotor Differences between Male and Female Coquerel's Sifakas (*Propithecus verreauxi coquereli*) in a Captive Environment. Jaime LaVelle

University of Missouri-St. Louis, Advisor: Dr. Donna Hart

[POSTER]

Research was conducted to determine whether there are differences in the amount and type of locomotion between male and female Coquerel's sifakas (*Propithecus verreauxi coquereli*) living in a captive environment. Sifakas have evolved morphologically as specialized vertical clingers and leapers, a type of locomotion requiring sophisticated coordination that enables them to take full advantage of their environment. While vertical clinging and leaping is the foremost type of locomotion in the wild, this study identified thirteen other types of locomotion in captivity. The study consisted of twenty hours of data collection using a continuous all-occurrence sampling technique on selected aspects of locomotion. The sample group consisted of two individuals, a male and female housed together at the St. Louis Zoo. To determine sex-based differences between male and female sifaka locomotion, the following data were collected for each individual: 1) continuous locomotor movements, 2) distance preferences, 3) total distance traveled and 4) relative frequencies of fourteen different types of locomotion. Data from this study indicated that there are sex-based differences in amount and type of locomotion between

male and female Coquerel's sifakas in a captive environment. Data indicated that in all four aspects of locomotion studied, the male was more active than the female.

19. Activity Cycles and Social Interactions of Wild White-Faced Capuchins (*Cebus capucinus*). Jaime LaVelle, University of Missouri-St. Louis, Advisor: Dr. Donna Hart [POSTER]

Research was conducted at the La Suerte Biological Field Station in Costa Rica, where I studied the activity cycles and social interactions of wild white-faced capuchin monkeys (*Cebus capucinus*). The sample consisted of one habituated group of approximately fifteen individuals. Twenty hours of data were collected for all age and sex sub-groupings. To determine activity cycles, data were collected using a five-minute focal animal instantaneous scan sampling technique. Activities were classified as resting, feeding, moving, and traveling. Social interactions were recorded using a focal animal all-occurrence sampling method when the focal animal was within eight centimeters or in body contact with another individual. The type of interaction, the focal animal as agent versus recipient of an action, and with whom the focal animal interacted were recorded. Three main conclusions emerged from the study: 1) the activity cycles of adults and juveniles were similar, 2) the highest frequencies of all activities took place below the emergent tree canopy but above the tree trunk, 3) the highest percentage of social interactions at a distance of 8 cm were between adults, while infants and adults had the highest frequencies of contact interactions.

20. The Use and Preference of Structural Enrichment of Captive Callitrichid Primates. Nadia Lopez and Susan M. Ford. Department of Anthropology, Southern Illinois University, Carbondale, Illinois. [PODIUM]

Zoos play an increasingly important role in the management, breeding, and survival of endangered species, including many primates. The goal of enrichment is to promote the physical and psychological well-being of captive animals (Shepherdson, 1998). Increasing the complexity of a captive environment, such as providing structural, food, social, and object enrichment, has been shown to elicit more markers of increased well-being. For this study, structural enrichment usage and preferences were observed in two species of callitrichid primates (n=7), cotton-top tamarins (*Saguinus oedipus*) and callimicos (*Callimico goeldii*), at Lincoln Park Zoo during a three week period, using 2-minute scan sampling. The hypothesis that animals show preferences for some types of enrichment over others was supported, as was the hypothesis that the two species would differ in their preferences. The results show that although both groups preferred branches over any other structure, cages and platforms were also highly used. Preference in structure height was very apparent, with callimicos favoring heights at an intermediate level (1.2-3.0 m), while cotton-tops preferred higher supports (4.6m+). Other behaviors such as foraging (1.1-2.9%) and locomotor (7.2-10.7%) were substantially less frequent in comparison to data from populations in the wild, although some of the results were similar to those seen in other groups of captive callitrichids. No stereotypic (repetitive, abnormal) behaviors were observed during the length of the study. Since little is known about both "natural" and stereotypic behaviors in callitrichids, further exploration in this area is needed to better understand animal behavior and ensure their well-being in captivity.

**21. Parental behavior following delayed reproductive success in a pair of white-cheeked gibbons (*Hylobates leucogenys*). Kristen E. Lukas¹, Grace Fuller^{1,2}, Anita Yantz³, Bonnie A. Jacobs³, and Andrew Henderson³ ¹Cleveland Metroparks Zoo, Cleveland, Ohio, ²Case Western Reserve University, Cleveland, Ohio, ³Lincoln Park Zoo, Chicago, Illinois
[POSTER]**

Concern over a lack of breeding success in a pair of white-cheeked gibbons (*Hylobates leucogenys*) prompted a study of gibbon behavior and physiology at the Lincoln Park Zoo initiated in 1998 (Lukas et al., 2002). The results showed that the female exhibited normal estrus cycles. Behavioral data indicated that social interaction occurred at species-typical levels between the pair but also suggested that housing changes might encourage closer social proximity. The female became pregnant several months after the pair was moved to an exclusively indoor exhibit, and an infant male was born on September 2, 2001. The present study examines 420 hours of group behavioral data collected over the first 36 months of the infant's life. Here we compare the social proximity and behavioral activity budgets of each adult both to their pre-pregnancy values (Lukas et al., 2002) and as they change over 36 months following the birth. We also examine the social proximity of each adult to the infant to assess the relative contributions of each to its care. We assess the effects of the birth on sex differences in behavior originally reported between the two adults (Lukas et al., 2002). Finally, we evaluate how patterns of exhibit use change as a result of giving the pair access to holding facilities following the birth and the implications of these results

**22. Censuses in the transition zone of mantled and black howlers (*Alouatta palliata* and *Alouatta pigra*) in Tabasco, Mexico. LeAndra G. Luecke¹, Alejandro Estrada², and Rodolfo Martínez Mota³. ¹ Department of Anthropology, Washington University, St. Louis, MO, ² Estación de Biología Los Tuxtlas Instituto de Biología, UNAM Apdo. Pos. 176, San Andrés Tuxtla, Veracruz, México 95700, ³ Depto. Biodiversidad y Ecología Animal, Instituto Ecología, Xalapa, Veracruz, México
[POSTER]**

Surveys of parapatric howler monkey species were conducted in the Pantános de Centla Biosphere Reserve in 2005 and 2006. The reserve covers more than 300,000 ha of wetland habitat in the Usumacinta River basin, which makes up a large portion of the state of Tabasco in southeastern Mexico. There are several rivers flowing northward here into the Gulf of Mexico; the largest and most important of these is the Usumacinta system. This river system marks the primary boundary and limiting factor on the east-west distribution of black howlers (*Alouatta pigra*) and Mexican mantled howlers (*Alouatta palliata mexicana*) (Smith, 1970; Hall, 1981; Horwich & Johnson, 1986; Luecke, 2004). This is the first report on the populations of both species in the reserve. A combination of ground, river, and triangulation surveys were conducted in fragmented mangrove forest, flooded forest, and private ranch land within and near the northern portion of the reserve. An estimated four groups of Mexican mantled howlers reside in the red mangrove surrounding a small lake and one group was found in remnant forest on a private ranch to the east of the river. Seven groups of black howlers were found in red and mixed association mangrove and flooded *pucteal* forest within the reserve to the east of the river system. A description of these populations and comparisons between them and with conspecific populations in other habitats is discussed, as well as intended future work on the howlers within the transition zone in Tabasco.

23. Parental behavior following delayed reproductive success in a pair of white-cheeked gibbons (*Hylobates leucogenys*). Kristen E. Lukas¹, Grace Fuller^{1,2}, Anita Yantz³, Bonnie A. Jacobs³, and Andrew Henderson³ ¹Cleveland Metroparks Zoo, Cleveland, Ohio, ²Case Western Reserve University, Cleveland, Ohio, ³Lincoln Park Zoo, Chicago, Illinois [POSTER]

Concern over a lack of breeding success in a pair of white-cheeked gibbons (*Hylobates leucogenys*) prompted a study of gibbon behavior and physiology at the Lincoln Park Zoo initiated in 1998 (Lukas et al., 2002). The results showed that the female exhibited normal estrus cycles. Behavioral data indicated that social interaction occurred at species-typical levels between the pair but also suggested that housing changes might encourage closer social proximity. The female became pregnant several months after the pair was moved to an exclusively indoor exhibit, and an infant male was born on September 2, 2001. The present study examines 420 hours of group behavioral data collected over the first 36 months of the infant's life. Here we compare the social proximity and behavioral activity budgets of each adult both to their pre-pregnancy values (Lukas et al., 2002) and as they change over 36 months following the birth. We also examine the social proximity of each adult to the infant to assess the relative contributions of each to its care. We assess the effects of the birth on sex differences in behavior originally reported between the two adults (Lukas et al., 2002). Finally, we evaluate how patterns of exhibit use change as a result of giving the pair access to holding facilities following the birth and the implications of these results

24. Of kites and capuchins: Interspecific associations between a small raptor (*Harpagus bidentatus bidentatus*) and brown capuchins (*Cebus apella apella*) at Brownsberg, Suriname. Katherine C. MacKinnon, Saint Louis University [PODIUM]

There are many anecdotal accounts of foraging associations between capuchins (Genus *Cebus*) and small raptors, but a review of the literature reveals scant published reports for *C. apella apella* and *Harpagus b. bidentatus*. There are a few articles documenting associations between *C. capucinus* and *H. bidentatus fasciatus*, but nothing since the 1980s. I report here on associative behaviors between brown capuchins (*C. a. apella*) and double-toothed kites (*H. b. bidentatus*) at Brownsberg Nature Park, Suriname. I observed these associations on 1 day in July, 2004, 4 days in June, 2005 and 12 days in June, 2006. These data were recorded opportunistically while fieldwork on other projects was underway during the summer months of these 3 years. The majority of my observations of kites with brown capuchins took place in the low under-story of primary rain forest. This concurs with published reports on the foraging behavior of this small raptor (Skutch 1965; Fontaine, 1980; Boinski and Scott, 1988; Schulze, et al., 2000). Kites and capuchins were categorized as "in association" if I could see them simultaneously (e.g., Fontaine, 1980). Most of the observations were characterized by the two species occurring in such close proximity (i.e., <10m between one of the kites and one of the capuchins), and in the low to medium strata of the forest (ground to 20m) that binoculars were at times unnecessary for viewing their behaviors. Associations lasted anywhere from several minutes to up to 5 hours. When following the capuchins, kites hunted from the perch, often sitting for many minutes watching the monkeys and scanning for disturbed prey to capture. Data on successful prey capture by the kites while foraging in association with the capuchins was recorded opportunistically (*ad libitum*), although it was extremely difficult to categorize prey items beyond general type (e.g., large insect). When possible, sex and age class of the raptors was determined based on size and color variations in plumage. On several occasions an adult pair

was observed with the capuchin group. This foraging association may be an example of a facultative mutualism—an association that is not essential for the survival of either species, but a phenomenon that occurs when individuals of each species are present. Other ecological reasons for such a relationship, including potential costs and benefits, will be discussed.

25. Intergenerational transmission of maternal behavior in rhesus macaques and its underlying mechanisms. Dario Maestriperi. Animal Behavior Research Group, The University of Chicago, Chicago, IL.

[PODIUM]

This study investigated the intergenerational transmission of parenting style of rhesus macaques (*Macaca mulatta*) and its underlying mechanisms. Thirteen rhesus macaque females that were crossfostered at birth were followed longitudinally until they gave birth for the first time. Their maternal behavior was compared to the behavior of both their foster and their biological mothers. Crossfostered females were similar to their foster mothers in their rates of maternal rejection and to their biological mothers in their rate of contact-making with their infants. Females who were exposed to higher rates of maternal rejection in early infancy had lower cerebrospinal fluid (CSF) concentrations of the serotonin metabolite 5-HIAA in the first 3 years of life than females exposed to lower rates of maternal rejection. In adulthood, females with lower CSF 5-HIAA exhibited higher rates of maternal rejection with their own infants. These findings suggest that individual differences in maternal rejection rates are transmitted across generations through experiential mechanisms and that these mechanisms involve experience-induced long-term alterations of the serotonergic system. Other aspects of the parenting style of rhesus macaque females, such as the rate with which they initiate contact with their infants, also appear to be transmitted across generations but through genetic mechanisms.

26. Identifying SNPs in the genome of *Macaca mulatta*: Useful genetic markers for the analysis of degraded DNA. Ripan S. Malhi, Department of Anthropology, University of Illinois Urbana-Champaign

[PODIUM]

The complete sequencing of the *Macaca mulatta* genome is being recognized for its biomedical value as macaques are widely used as models in the study of human disease. However, the information available from the macaque genome will also benefit primatologists in the field who usually collect DNA tissue through non-invasive means. This tissue is usually collected from fecal samples and such samples often exhibit degraded DNA when finally extracted in the laboratory. Traditionally, primatologists have screened short tandem repeat (STR) genetic markers to address questions of kinship, population structure, and/or demographic history. Unfortunately, STRs, especially if ascertained from another species, are difficult to interpret. The problems of “stutter bands” and null alleles in STR analyses are often amplified in degraded DNA samples. Single Nucleotide Polymorphism (SNP) genetic markers, however, are more robust to degradation and less prone to misinterpretation during analysis.

This presentation describes a method used to generate 3.5 million base pairs of sequence data in *M. mulatta* for the purpose of identifying candidate SNPs that can be used to address questions of identity and kinship as well as genetic contributions to phenotypic (including behavioral) traits. The candidate SNPs identified are a shared resource available to the scientific community.

27. Social Behavior in a Captive Community of Young Bachelor Gorillas (*Gorilla gorilla gorilla*). Krista Milich, Department of Anthropology, University of Illinois, Urbana, IL [POSTER]

Gorillas usually live in relatively stable, cohesive groups consisting of one to three silverbacks, multiple adult females, and juveniles. Both sexes may disperse from their natal groups. When females disperse, they join a new group; whereas, when males emigrate, they either lead a solitary life or enter a bachelor group with other males. These dispersal patterns and group configurations present problems for the maintenance of male gorillas in captivity. Housing the excess males by themselves is inefficient and could lead to their desocialization. Forming captive all-male groups permits them to continue interacting in a social setting and provides a solution for how to house extra males. This study examined a group of 3 young male gorillas at the Detroit Zoological Society to determine the types of social interactions that take place within bachelor groups in a captive setting. I recorded an individual's activities and proximity to other males during 10-minute focal observation sessions. Occasionally, additional observations were recorded *ad libitum* to document dominance or sexual interactions. The three gorillas often stayed in close proximity to one another, which supports past field studies of wild bachelor groups. The two youngest males spent significantly more time in proximity to one another than either did to the dominant male. Similarly, the dominant individual spent significantly more time alone than either of the subordinates. Furthermore, the oldest male did the most displacing, chasing, and mounting of other individuals, though aggressive behaviors were not common. The group was relatively cohesive, engaging in affiliative behavior during most of the study period. These findings indicate that housing captive gorillas in multi-male groups is an appropriate solution to the space issue, especially when bachelors enter these groups at a young age. Furthermore, these findings suggest that males living in bachelor groups in the wild will also display high levels of affiliative behavior.

28. Ankle and foot use during the positional behaviors of African hominoids. M.G. Nowak, S.M. Ford. Department of Anthropology, Southern Illinois University. [PODIUM]

While African apes are predominantly quadrupedal knuckle-walkers, the need to negotiate variable terrestrial and arboreal substrates allowed the development of a large positional repertoire as well as a complex anatomy. Studies on positional behavior have revealed differences between bonobos, chimpanzees, and gorillas; however, analysis of locomotion has largely dominated field studies. Here, focused observations on movements of the ankle and foot of captive African apes during both locomotor and postural behaviors are used to further explore differences in joint activity.

Instantaneous focal animal sampling, with the help of digital recording equipment, was used to record the ankle and foot positions of African apes in three zoological parks, with complex substrates during routine behaviors. In total 12 bonobos, 7 chimpanzees, and 6 gorillas were followed, resulting in 216 hours (72 hours per species) of study and 10, 070 usable instantaneous samples. Data was statistically analyzed using *chi-square* tests.

Results indicate that there are differences in ankle and foot movements during both locomotor and postural behaviors. During quadrupedalism, gorillas were observed to use greater frequencies of dorsiflexion and abduction compared to chimpanzees and bonobos. During sitting postures, bonobos and chimpanzees were observed to use greater amounts of dorsiflexion, adduction, and eversion, related to the "sit-in" posture. Gorillas in contrast had a more

perpendicular ankle, related to the “sit-out” posture. These differences may be related to size. Better understanding of specific differences in joint use will aid in the understanding of ankle and foot morphology.

29. Subchondral bone density and joint posture in subfossil malagasy lemurs. POLK, John, SCHWARZ, Jennifer, Dept. of Anthropology, Univ. of Illinois, Urbana, IL 61801. GODFREY, Laurie, Dept. of Anthropology, Univ. of Massachusetts, Amherst, MA. 01003. [POSTER]

This study uses an experimentally validated methodology to infer habitual knee and hip joint posture in a sample of subfossil Malagasy lemurs. More specifically, this study analyzes the spatial patterns of subchondral bone density on femoral condyles in five subfossil lemurs: *Megaladapis*, *Archaeolemur*, *Mesopropithecus*, *Pachylemur* and *Hadropithecus*. Subchondral density was measured using Computed Tomography (CT) scans of a single femur for each of these genera. Amira software was used to reconstruct the three-dimensional structure of the femora from CT slices and to apply color maps to regions of differing bone density. Two-dimensional slices were obtained through the center of the femoral head and through the medial condyles of each specimen. Relative joint angles and the range of joint loading were estimated by measuring the angular position of the center of the region of maximum relative density (RMD) on the condyle. Our results suggest that *Megaladapis* used extremely flexed knee and hip postures which is consistent with previous positional interpretations. The range of the RMD for the remaining taxa suggest that they used moderately extended knee postures and are not well distinguished. However, both *Pachylemur* and *Mesopropithecus* have more subtle density patterns that suggest some use of highly extended postures. The juvenile *Hadropithecus* had lower density and a broader spread of the RMD, suggesting a wider range of habitual knee postures. While it is likely that these species moved in different ways than extant lemurs, further analyses of other mammals are necessary to determine the locomotor behaviors that caused these patterns of bone density.

30. Exudate feeding by *Callimico goeldii*. Leila Porter¹, Paul A. Garber², and Edilio Nascimento. ¹Department of Anthropology, Northern Illinois University, DeKalb, IL, ²Department of Anthropology, University of Illinois, Urbana, IL. [PODIUM]

Exudates provide an important food resource for many callitrichines. Marmosets have specialized incisors for gouging holes for exudate feeding, thus many species feed on exudates regularly. In contrast, the other callitrichines lack dental specializations for gummivory, thus they eat exudates opportunistically. We documented opportunistic gummivory by one group of *Callimico goeldii* studied in northwestern Bolivia from August 2001 – August 2002. Five minute focal animal samples were collected during all day follows, with equal numbers of observations of all group members taken each month. Data on feeding behavior, ranging behavior and habitat use were collected during each sample. In addition, opportunistic feeding data were collected on the same group in July 2005. The group’s diet varied significantly by season ($X^2 > 33.37$, $p < 0.001$, $df = 4$): in the dry season the diet was composed of 19% fruit, 39% fungi, 14% arthropods, 14% exudates, and 1% other, whereas in the wet season the diet was 54% fruit, 26% fungi, 16% arthropods, 3% exudates and 1% other. Consumption of exudates was highest during the dry season month of August, when it was 39% of all feeding records, and lowest from October – January when no exudates were eaten. 93% of all exudate records were

from the pods of *Parkia nitida*. In July, 2005 we also observed the *C. goeldii* group parasitizing the feeding sites of a group of *C. pygmaea* on the trunk of the tree *Didymopanax morototoni*. These data demonstrate that a few plant species may provide *C. goeldii* with an important dry season food source.

31. Hand Manipulation Skills in a One-Arm Gibbon. Jacqueline M. Prime, Southern Illinois University Carbondale
[POSTER]

Previous research focusing on hand manipulation skills in adult gibbons at Lincoln Park Zoo and Toronto Zoo has demonstrated that gibbons are quite capable of using their hands to manipulate objects in a variety of ways, incorporating both independent use of their fingers and thumbs and concurrent use of their digits to handle items. This study presents a comparison between the juvenile male offspring of the Lincoln Park subjects and his adult counterparts in order to gain insights into the development of hand manipulation skills in gibbons and offer some suggestions about the importance of hand manipulation skills for these apes.

The juvenile male offspring of the Lincoln Park subjects provided an interesting point of comparison with the adult subjects for two reasons: [1] because of his young age he provides a comparative model for understanding hand manipulation skills in developing gibbons versus adult gibbons; and [2] as a result of an incident that occurred only a few weeks prior to this study, the juvenile male in the Lincoln Park family unit has only one arm.

Compared with the adult gibbons, the juvenile male appears to be very similar in his use of structural objects within the zoo enclosure; however there appear to be significant differences in the way this individual handled various introduced items within the enclosure. In stark contrast to adult gibbons, the juvenile male rarely used only his thumb to manipulate objects, often employing the finger-and-thumb in conjunction when handling both hard and soft objects. And he exhibited unique adaptations in behaviour to manipulate suspended versus free-moveable objects within the enclosure.

Despite his physical impairment, the juvenile male has adapted quite successfully and does not appear to be restricted in any way. Overall, his hand use is quite similar to adult gibbons, and though he does compensate for his missing arm by extensively using his mouth and legs, he is much more likely to change his positional behaviour in a manner that allows him to access and manipulate objects with the hand that he does have – proving that hand manipulation skills are of great importance to all gibbons

32. One-male harems and female social dynamics in Guinea baboons. Jennifer Radtke, Jessica Mayhew, Cindy L. Carlson, Christy L. Hoffman, and Dario Maestriperi. Animal Behavior Research Group, The University of Chicago, Chicago, IL.
[POSTER]

Little is known about the mating system and social organization of Guinea baboons. This study investigated whether Guinea baboons have a harem-based mating system similar to that of hamadryas and gelada baboons and whether one-male mating units also correspond to social units. Ten adult females in a captive multi-male multi-female group of Guinea baboons were focally observed 2 hours per week for 12 weeks and all observed copulations within the group were recorded. Some males copulated with a single female while others had harems of 2-4 females. All females copulated with a single male except one female that switched harems early in the study. The focal females had higher rates of social interaction with their harem members,

especially their harem male, than with individuals outside the harem. Females appeared to be subordinate to the harem male but little or no physical aggression or herding behavior from the male was observed. Variation in female social interactions within the harem was not accounted for by their sexual interactions with the male or their genetic relatedness with the females. Females, however, appeared to maintain social relationships with their female relatives in other harems. Taken together, the results of this study show that both mating and affiliative interactions in Guinea baboons are concentrated within one-male units and that the social dynamics within and between these units share some similarities as well as differences with those of hamadryas and gelada baboons.

33. Proximity patterns of wild black howler monkeys (*Alouatta pigra*) in Southern Mexico. Nicoletta Righini¹ and Rodolfo Martínez-Mota² ¹Department of Anthropology, University of Illinois at Urbana-Champaign.

²Departamento de Biodiversidad y Ecología Animal. Instituto de Ecología, A.C. Km. 2.5 Carretera antigua a Coatepec No. 351, Congregación El Haya. C.P. 91070, Xalapa, Veracruz, México.

[PODIUM]

The analysis of association patterns offers critical insight into the role of spatial proximity in understanding affiliative and agonistic social interactions in primates. In this study, we analyzed patterns of spatial proximity in three groups and association patterns in four groups of Mexican black howler monkeys (*Alouatta pigra*) in Mexico. To determine spatial proximity, we considered focal animals and their nearest neighbors in two distance categories: contact and less than five meters away (<5 m). To determine association patterns, we considered the frequency of association between two recognized individuals (dyad) using a proximity index. Our results indicate that during feeding, resting and traveling, same-sex individuals were infrequently in close proximity (male-male 3.9%; female-female 29.5%), while males and females were each others nearest neighbor 44.8% of the time. In addition, we were able to detect long-term associations between males and females (dyads) in each group. Male-female dyads were stable during the whole study period (probably including reproductive and non reproductive periods). We suggest that black howlers are selective in their associations, and that proximity patterns among particular males and females offer benefits including protection (for females) or mating advantages (for both males and females).

34. The Acquisition of Social Skills in Juvenile Male Western Lowland Gorillas (*Gorilla gorilla gorilla*). Margaret E. Robinson. Department of Anthropology, Iowa State University, Ames, Iowa.

[POSTER]

In order to function in their social groups as adults, juvenile gorillas need to learn a great deal about the social world around them. This study considers specifically how captive juvenile male gorillas prepare for their future roles as silverbacks. It was hypothesized that they do so through their social interactions with the silverback in their group. Additionally, it was hypothesized that juveniles learn necessary skills through play. It was found that juveniles initiated close proximity to the silverback more often than the silverback initiated close proximity to them. Additionally, juveniles teased the silverback more often than they teased their mother. Thus, it appears that juveniles do create situations in which they can learn social skills from the silverback. The older juvenile in the study spent significantly more time in close proximity to

the silverback than did the younger juvenile and teased the silverback significantly more than the younger, suggesting that juveniles create more social situations with the silverback as they age. Finally, it was found that juveniles spend significantly more time engaged in aggressive forms of play than affiliative forms. This suggests that juveniles use play to refine skills that will aid them when competing with other males once they mature. Though the results support the study's hypotheses, the sample size was small and a longer study with more individuals is necessary. In conclusion, it seems that interactions with the silverback and with peers during play are important to the social development of juvenile male gorillas.

35. Sex Differences in the Activity Budget of Juvenile Spider Monkeys (*Ateles geoffroyi*).

Michelle A. Rodrigues, Department of Anthropology, Iowa State University, Ames, Iowa

[POSTER]

While adult spider monkeys are reported to exhibit sex differences in activity budget, there is a paucity of information on activity patterns and potential sex differences exhibited by juveniles. Adult males are reported to engage in more social behavior and rest, while adult females are reported to spend more time feeding. As part of a study on the sex differences in the social behavior of juvenile spider monkeys, data were collected on the activity budgets of male and female juveniles to determine if differences in activity patterns were present. As spider monkeys exhibit a pattern of female dispersal and greater male sociality, juvenile males were hypothesized to engage in social behavior more often than females. 71 hours of data were collected December 2005-January 2006 and May 2006-August 2006 at El Zota Biological Field Station, Costa Rica, on nine individually recognized focal animals (males; n=4, females; n=5) using two-minute instantaneous sampling. Males tended to spend more time engaged in social behavior than females and less time engaged in rest, but these differences were not significant. Nonetheless, given the small sample size and p-value observed for social behavior ($p=.12$), these results may suggest a trend in which male juveniles engage in more social behavior than juvenile females. Such results would be consistent with the differences reported for adult spider monkeys, but support for this conclusion requires additional study on larger samples.

36. AN INTRODUCTION TO THE LESTER E. FISHER CENTER FOR THE STUDY AND CONSERVATION OF APES. S.R. Ross, E.V. Lonsdorf, S.W. Margulis, T.N. Melber, K.C. Klein, V.M. Vreeman and S.A. Linick.

Lester E. Fisher Center for the Study and Conservation of Apes at Lincoln Park Zoo, Chicago, IL 60614.

[POSTER]

The Lester E. Fisher Center for the Study and Conservation of Apes was established in 2004 with four main goals: increasing the knowledge and understanding of ape biology; improving management of both captive and wild populations of apes; aiding in the conservation of wild ape populations; and educating the public in the behavior, biology, and conservation of apes. To ensure high quality research and increase the understanding of ape biology and conservation, the Fisher Center takes a multidisciplinary approach by combining the expertise of the zoo's scientific staff in areas such as behavior, epidemiology, and population biology with that of colleagues from other institutions. Currently, staff at the Fisher Center conduct research on cognition, behavior, learning, and physiology of our resident ape groups, which include 12 gorillas (*Gorilla gorilla gorilla*), 12 chimpanzees (*Pan troglodytes*) and 4 gibbons (*Hylobates leucogenys*) housed at the Regenstein Center for African Apes and the Helen Brach Primate

House at Lincoln Park Zoo. Internationally, staff focus on conservation issues such as ape health, disease and long-term viability of threatened populations. The Fisher Center also provides opportunities for research conducted by external scientists and has an internship program for undergraduate and post-graduate students that provides training in research methods, ape behavior, and issues in conservation and management. Finally, the Fisher Center aims to increase access to information on apes through database development and management, and through hosting scientific meetings for the research community.

37. LATE PLEISTOCENE MONKEYS IN EUROPE. Ralph Rowlett, Department of Anthropology, University of Missouri, Columbia, MO.

[PODIUM]

The common occurrence of monkeys and apes in Mediterranean Europe going back to the Miocene is well known, while Erik Delson has inventoried the Pleistocene primates in Europe.

Most of the monkeys are the Barbary macaques (*Macaca sylvanus*). In general, more monkeys are found in the earlier Pleistocene than later times; for example, numerous bones of *Macaca sylvanus* are found in the Cromer Forest Bed, complex interstadial deposits from two millions years ago in eastern England. These monkeys persisted into modern times with a precarious foothold in the extreme southwestern Iberian Peninsula. Less well known is that non-human primates are occasionally depicted in the Upper Palaeolithic cave art of southwestern Europe. While most Upper Palaeolithic art, from 30,000 to 9,000 bc features large game mammals, such as reindeer, bison, horse, hart deer, aurochs, rhinoceroses, and ptarmigans, extensively hunted for food, the monkey representations are part of a sub-category of rare art, depicting such creatures as wolves, cave lions, seals, donkeys, snakes, tortoises, various birds, willow parasites, and warble fly larvae. At least 40 monkey images occur in 22 sites, out of hundreds of known sites with Upper Palaeolithic art, with all of these examples concentrated in southwestern France and Spain, mostly in the south toward the Mediterranean littoral. Only five sites, in SW France, occur north of the Pyrenees. Extremely schematic examples that might be confused with representations of humans, snowy owls, and, according to one researcher, horses, are not included in this count.

The Pyrenaean site of Enlène shows humans on the same block with a monkey, so the distinction is clear. All of the recognized monkeys seem tailless and can be identified as Barbary macaques. Half of the representations are shown as quadrupeds and most of the remainder are shown sitting up. The quadrupedal art exemplifies various other activities, including preparation for copulation. A few exhibit male genitalia or lactating female breasts, but most representations are sexually indeterminate. Although Upper Palaeolithic art frequently shows numerous spears thrust into the depicted animals, including humans, none of the clearly monkey engravings manifests spears, so apparently the monkeys were not hunted as food. The vast majority of depictions date from the Magdalenian Tradition, going back 18,000 years, while the middle and late Magdalenian representations north of the Pyrenees evidently demonstrate a re-expansion of the Barbary macaque into western Europe in the waning Pleistocene. Later manifestations of Barbary Macaque bones in Bronze and Iron Age sites might possibly be the descendant remnants of these re-colonizing monkeys.

38. Osteometric analysis in two populations of Japanese macaque (*Macaca fuscata*) inhabiting different forest types. R. Schubert, W.S. McGraw. Dept. of Anthropology, Ohio State University

[POSTER]

The Japanese macaque (*Macaca fuscata*) inhabits a range from southern Japan to the northern tip of Honshu. Macaque habitat transitions from broad-leafed evergreen forests in southern Japan to broad-leafed deciduous forests in northern Japan. These forest types differ in tree species density and diversity, temperature and snow cover. Long-term field studies of habituated macaque populations on Kinkazan (northeastern Japan) and Yakushima (southwestern Japan) islands reveal significant behavioral differences (foraging, ranging, intergroup aggression, etc.) relating to differences in food abundance, seasonality and forest structure. Yakushima and Kinkazan macaques provide an ideal case to examine how patterns of foraging and positional behavior are associated with skeletal morphology.

We collected 38 skeletal measurements on limbs from three collections housed at two Japanese universities. We compared adult male samples from Yakushima (n=24) and Kinkazan (n=9) using 34 morphological indices. We established significant population differences for a number of characteristics. For example, Yakushima macaques exhibit a higher intermembral index, larger supraspinous fossa, greater olecranon length and greater robusticity of the femur and tibia. In contrast, Kinkazan macaques exhibit greater deltoid plane width and a wider intertubercular gap.

Whether these skeletal differences reflect different foraging options, different forest structures or a combination of the two remains unclear. These morphological data will be combined with those on substrate utilization, foraging and positional behavior collected next year. A greater understanding of how living primate behavior impacts skeletal morphology provides insight into Japanese macaque adaptability and allows for greater refinement in how we interpret behavior in fossil species.

39. Return of *Alouatta pigra* to the forests around Nahá, Chiapas, Mexico.

D.S. Shepston. Department of Anthropology, Texas State University-San Marcos.

[POSTER]

By the early 1980s, *Alouatta pigra* became locally extinct due to forest degradation and hunting in the region of Nahá, Chiapas, which is located on the eastern edge of the Selva Lacandona and is owned by the Comunidad Lacandona. Recently, this species was reported by the Lacandon Mayans in Nahá to have returned, even though forests in adjacent areas are being cleared for large-scale agriculture by ejidos. In this study, I determined that *Alouatta pigra* are present in the forest immediately surrounding Nahá, however, the population density is low. Conservation is dependent on the presence of food sources, the practices and attitudes of the local Lacandones, and the extent to which encroachment continues. I examined the potential for the continued survival and growth of populations through an assessment of possible food sources and through interviews with local Lacandones. I found that there are food sources present, including the preferred tree species *Brosimum alicastrum*. In addition, I discovered that the Lacandones in Nahá have locally prohibited the hunting of *Alouatta pigra* and, furthermore, that they have made a community decision to restore their forest. While there is still evidence in the forest of past degradation, it has been shown that *Alouatta pigra* have a better survival rate in fragmented forests than do other species. The continued encroachment by ejidos into the forest around Nahá is the principal constraint to the conservation of *Alouatta pigra* in this region of Mexico.

40. The Maintenance of Social Bonds in Adult Pairs of Captive Cotton-top Tamarins (*Saguinus oedipus*) C. Shibata and S.M. Ford. Southern Illinois University, Department of Anthropology, 3525 Faner Hall, Carbondale, IL, 6290

[POSTER]

Cooperative breeding systems, in which individuals other than the parents take care of the infant, occur in a number of mammalian groups. They are particularly characteristic of the tamarins and marmosets of South America. There is extensive literature on the interactions between adult male tamarins and the offspring; such behaviors include food sharing, grooming, and infant transport. However, little is known regarding the interactions between adult males and the breeding female, including how their bonds are maintained. Data were collected on two captive cotton-top tamarin adult pairs at Central Park Zoo (NY) and Brookfield Zoo (IL) from June through August 2006. Results on allogrooming, scent marking, and food sharing behaviors are based on approximately 180 hours of behavioral observations through focal and *ad libitum* sampling. Preliminary results seem to show although food sharing and scent marking behaviors were rare, allogrooming behaviors were prevalent in both groups.

41. Primate arboreality: using kinematic techniques to explore locomotion in the natural setting. N. J. Stevens¹, J. H. Ratsimbazafy² and K. A. I. Nekaris³, ¹Department of Biomedical Sciences, OUCOM, Ohio University, , Athens, Ohio, 45701, USA, ²Durrell Wildlife Conservation Trust, ³Nocturnal, Primate Research Group, School of Social Sciences and Law, Oxford Brookes University, Oxford, U.K

[POSTER]

Most primates possess a range of behavioral and morphological specializations that have been correlated with the use of arboreal habitats. Typically, research conducted in the wild has addressed questions regarding "how often" individuals engage in different postures or locomotor modes, whereas studies conducted in the laboratory have considered "how" individuals position themselves in order to engage in such behaviors. Here we describe two case studies integrating naturalistic and experimental approaches in the study of primate locomotion. Building upon kinematic hypotheses generated in a laboratory constructed at the Duke University Primate Center, we expand our investigation by using kinematic techniques to examine ecologically-relevant aspects of strepsirhine locomotion in the wild. The first case study, conducted in the Manombo Forest of southeastern Madagascar, examines strategies utilized by *Eulemur* to maintain balance on horizontal and inclined supports. Preliminary results indicate that limb excursion patterns in the wild reflect lab-based predictions regarding limb alignment with the gravity vector. The second case study explores travel velocities in red slender lorises (*Loris tardigradus*) in the Masmullah Proposed Forest Reserve, Sri Lanka. Results indicate the habitual use of surprisingly high velocities, far exceeding expectations based on loris locomotion from the laboratory setting. Such findings suggest that quantification of kinematics in the wild offers new horizons for the understanding of primate locomotor behavior.

42. Mating Interference by Juvenile Chimpanzees. R.M. Stumpf¹, R. Wrangham², C. Boesch³. ¹Department of Anthropology, University of Illinois, Urbana-Champaign, ²Department of Anthropology, Harvard University, ³Department of Primatology, Max Planck Institute for Evolutionary Anthropology.

[POSTER]

Juvenile (and infant) chimpanzees commonly interfere in copulations between adults by approaching the mating pair playfully, aggressively or plaintively. Hypotheses to explain juvenile copulation interference (JCI) include maternal-offspring conflict over the timing of the next birth, incipient male-male competition, learning and play. To address these hypotheses, we studied JCI in Taï National Park, Côte d'Ivoire and the Kanyawara community of Kibale National Park, Uganda. Data came from focal follows and ad lib sampling, and were expressed as the rate of JCI per copulation. The maternal-offspring conflict hypothesis predicts that JCI should peak in juveniles without infant siblings, before weaning. The incipient male-male competition hypothesis predicts that JCI is a predominantly male behavior. The play hypothesis predicts that more JCI will occur during seasons of high play frequency, and among more playful individuals. We found that JCI was associated with an increase in the duration of copulation, mostly involved mothers and offspring, occurred at varying rates per mother and juvenile, was practiced more by juvenile males than females, and that it occurred at a significantly higher rate in Taï than Kanyawara. While none of the hypotheses can be completely rejected, our data suggest that JCI is a low-cost, low-benefit behavior subject to substantial cultural and/or demographic variation.

43. Attempts to determine *Lemur catta* population densities, deforestation rates, and the relationships between the two using satellite imagery and GIS. Robert W. Sussman, Washington University, St. Louis, Saun Sweeney, University of Indiana, and Ingrid Porton, St. Louis Zoo

[WORKSHOP]

We used satellite imagery, ground truthing with GIS, and ecological and demographic data from the field and from the literature in an attempt to determine the rates of deforestation of various habitats within the range of *Lemur catta* and the population density of this species in different habitat types in western and southern Madagascar. We also attempted to determine the effects of deforestation on the ringtailed lemur population over the past 50 years. Finally, we used ethnographic methods in an attempt to understand causes of deforestation in different regions. We found that the ringtailed lemur population differs in different habitats and that this has greatly affected the rate of population decline in the last 50 years. We also found that causes of deforestation vary in different localities. We give preliminary estimates of the total *Lemur catta* population, of population density in different time periods, and in different habitat types.

44. Identifying habitat and estimating habitat loss of the Purple-Faced Langur (*Trachypithecus vetulus*) in the Northern Dry zone of Sri Lanka using remotely sensed images. Rajnish Vandercone, Department of Anthropology Washington University in St Louis.

[POSTER]

The purple faced langur (*Trachypithecus vetulus*) is endemic to the island of Sri Lanka. Currently *T. vetulus* is considered endangered and habitat loss is recognized as the primary

reason for its decline in Sri Lanka (IUCN, 2006). Despite its endangered status, no attempts have been made to characterize its habitat and estimate habitat loss.

LANDSAT images from 1994 and 2001 together with digitized vector maps of Sri Lanka were utilized to identify habitat and estimate habitat loss of *Trachypithecus vetulus*. The habitat utilized by *Trachypithecus vetulus* was characterized based on Normalized Difference Vegetative Index (NDVI) values. The NDVI values of the habitat used by the species ranged between 0.2 and 0.5. The extent of the habitat of *T. vetulus* was 14773 km² and 11383 km² in 1994 and 2001 respectively. During the 8 year period between 1994 and 2001, 3390 km² of habitat was lost at a rate of 484 km² per year. In addition habitat fragmentation was higher in 2001 in comparison to 1994. Thus urgent conservation action is needed to ensure the long term survival of *Trachypithecus vetulus* in Sri Lanka

45. Intended recipients and functional significance of grunt and girney vocalizations during interactions between adult females and mother-infant dyads in rhesus macaques. Jessica C. Whitham*, Melissa S. Gerald†, And Dario Maestriperi*. *Animal Behavior Research Group, The University of Chicago, †Cayo Santiago, Caribbean Primate Research Center, Punta Santiago, Puerto Rico

[POSTER]

A previous study of rhesus macaques suggested that adult females direct grunt and girney vocalizations to mothers to express their intentions to engage in benign infant handling. We investigated the alternative hypotheses that these calls are mostly directed to infants, that they express or induce arousal, and function as attention-getting signals. We focally observed 19 adult female rhesus macaques on Cayo Santiago, Puerto Rico. The rate of occurrence of calls increased dramatically after infants were born in the study group, and most were directed to mother-infant dyads. The caller's visual orientation when infants were physically separated from their mothers indicated that infants were the intended recipients of grunts and girneys in over 90% of the cases. Approaches followed by vocalizations were more likely to lead to the caller grooming the mother, less likely to elicit a submissive response from the mother, and more likely to result in the initiation of infant handling than approaches without calls. Infant handling, however, was not necessarily benign. Vocalizations often were emitted from a distance > 1 m and rarely were followed by approaches or social interactions with mothers or infants. Rather, the female simply sat and observed the infant, sometimes tail-wagging while vocalizing. Although some of our findings support the benign intent hypothesis, our results are more consistent with the hypothesis that grunts and girneys are arousal-related, attention-getting vocalizations with which female monkeys address young infants, the way human females use "baby talk" or "motherese" to address infants.

46. Anatomical variation in knuckle-walking adaptations of the 3rd ray among African apes. Scott A. Williams, Department of Anthropology, University of Illinois at Urbana-Champaign

[PODIUM]

The 3rd manual ray was examined in five taxa of non-human African apes in order to identify morphological variability in features related to knuckle-walking. These data were used to test the hypothesis that knuckle-walking evolved independently in gorillas and chimpanzees and to determine whether it is parsimonious that to conclude that humans descend from a knuckle-

walking ancestor. Further, these results allow for a reevaluation of hypotheses concerning the evolution of bipedalism and the positional behavior characterizing the last common ancestor (LCA) of chimpanzees and humans.

Bivariate and multivariate statistical analyses were utilized to test features traditionally related to knuckle-walking and to assess anatomical variability among African ape taxa. Morphological variability among the African ape 3rd ray suggests that minor anatomical differences between gorillas and chimpanzees are not related to the independent evolution of knuckle-walking. Rather, variation in the anatomy of the 3rd ray among all five taxa implies an adaptive significance. My results indicate that body mass plays a less influential role in the possession of knuckle-walking features than does adaptation to terrestrial or arboreal ecological constraints.

Parsimony dictates that knuckle-walking is a derived behavior for the African great apes, including humans. As such, the LCA of chimpanzees and humans was also a knuckle-walker. This suggests that a significant degree of terrestriality characterized the positional behavioral repertoire of the LCA. Arboreal models for the evolution of bipedalism must be reevaluated in light of this evidence.

47. Gastrointestinal Parasites of the Vervet Monkey (*Chlorocebus* [*Cercopithecus aethiops*] in South Africa, and Their Implications for Conservation. Brandi Wren, Department of Sociology and Anthropology, Purdue University, 700 W. State St., West Lafayette, IN 47907-2059

[PODIUM]

Fifty-one fecal samples from both wild and captive vervet monkeys (*Chlorocebus* [*Cercopithecus*] *aethiops*) at a sanctuary near Tzaneen, Limpopo Province, South Africa, were collected and analyzed to determine which species of gastrointestinal parasites they harbored, and differences in infection rates were examined. Three parasites were found, including two nematodes (*Trichuris trichiura* and one tentatively classified as *Strongyloides* spp.) and one protozoa (*Balantidium coli*). Rates of *B. coli* and *Strongyloides* spp. infection were similar in captive and wild monkeys (*B. coli*: captive 41.9%, wild 35%; *Strongyloides* spp.: captive 77.4%, wild 75%), but only wild individuals were infected with *T. trichiura* (15%). Evidence suggests that the vervets may have been exposed to *B. coli* from a nearby pig farm, and that the wild vervets may have contracted *Trichuris trichiura* from a local waste dump, indicating that humans may pose as much of a threat to vervet health as vice versa. These data suggest that land management practices for the larger surrounding area should be considered when designing protected areas for nonhuman primates, particularly when protected areas may be surrounded by farmland with domesticated animals. Farming practices surrounding protected areas may need to be more strongly regulated to protect the health of some primate species.

48. Do the leaf monkeys of Vietnam vary in the way they process leaves? Wright, B.W.¹, Ulibarri, L.², O'Brien, J.², Covert, H.H.², Nadler, T.³

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[POSTER]

This study examines relationships among the toughness of ingested leaves, chewing rates, and chewing bout lengths among four colobine monkey species at the Endangered Primate Rescue Center (EPRC), Cuc Phuong National Park, Vietnam. The location of this captive rescue and research center permit us to provision the study species with a range of foods found in their natural habitat. The inclusion of *Pygathrix namaeus*, *Pygathrix cinerea*, *Trachypithecus delacouri*, and *Trachypithecus laotum hatinhensis* permit both intra and intergeneric comparisons. By providing the primates with monospecific bundles of leaves we were able to rank the most preferred, moderately preferred, and least preferred foods. Toughness data were collected with a portable tester designed by Lucas et al. (2001). Preferred leaves are the weakest tissues ingested by all four primates, while mid-ranked leaves are the toughest tissues ingested by the four study species. *Pygathrix cinerea* (1305.9 Jm⁻²) processes the toughest mid-ranked leaves on average, followed by *T. delacouri* (1177.5 Jm⁻²), *P. namaeus* (1169.5 Jm⁻²), and *T. l. hatinhensis* (1155.8 Jm⁻²). All four primates exhibit longer feeding bouts when chewing tougher leaves. The skeletally larger primates (body mass estimates are lacking) in each genus (*T. delacouri* and *P. cinerea*) chew leaves more quickly than their congeners, but exhibit shorter chewing bouts. We will be augmenting these findings with data on food chemistry, cranial morphometrics, and additional behavioral data from captivity and the wild. Funded in part by Primate Conservation Inc., Zoological Society of San Diego, and National Geographic Society.

49. Arboreal and terrestrial substrate use by the endangered limestone langurs of Vietnam. Wright KA¹, Stevens NJ², Thanh³, Covert HH⁴, Nadler T^{3 1} Kansas City University School of Medicine and Biosciences, Kansas City, MO

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[POSTER]

Vietnam is home to a unique diversity of primate species, all of which are threatened or critically endangered. Hunting pressure, land use and other anthropogenic factors have contributed to the current distribution of primates within the country. Three of these primates are limestone langurs, two of which are endemic to Vietnam and currently on the verge of extinction; the Cat Ba langur (*Trachypithecus poliocephalus*) and Delacour's langur (*Trachypithecus delacouri*). The third species, the Hantih langur (*Trachypithecus hatinhensis*) is also threatened with extinction. Recent work by Stevens et al (2006a and b) integrating kinematic and naturalistic behavioral data collection methodologies has uncovered variation between Delacour's and Hantih langurs in back and tail posture during quadrupedal locomotion, as well as variation in frequencies of locomotor behaviors. All three langurs are found in limestone karst habitats and are reported to be semi-terrestrial, but it is not known if there are differences in frequencies of use of terrestrial versus arboreal substrates. In this study we examined frequencies of terrestrial and arboreal substrate use in captive Cat Ba, Delacour's and Hantih langurs, as well as semi-wild Delacour's and Hantih langurs at the Endangered Primate Rescue Center in Cuc Phuong National Park, Vietnam. Data were collected from May through July 2006. Our results indicate that the caged Hantih langurs spend twice as much time on the ground (6%) than the caged Delacour's (3%) or Cat Ba (2%) langurs. Terrestrial substrate use by the semi-wild Delacour's and Hantih langurs was rare. These results are discussed in light of what is known about the semi-terrestrial behavior of these three limestone langurs in the wild.

50. Enrichment usage and past life experience in captive lowland gorillas
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[PODIUM]

Environmental enrichment plays an important role in maintaining the psychological well being of captive primates. Better understanding of how different categories of individuals (i.e. rearing history, birthplace etc.) within a particular species utilize enrichment in diverse ways will help researchers better understand primate behavior. This research will also help to understand how non-natural environments affect behavior in comparison to those behaviors seen in the wild. Data were collected on 11 gorillas (4 males, 7 females, with an age range of 3-43) at Brookfield Zoo in Chicago, IL and Fort Worth Zoo in Fort Worth, TX during the summer and fall of 2004. Enrichment was categorized as structural, object, sensory, and food/forage. Observations were taken using instantaneous scans both at the zoos and on videotapes made by the author.

This study broadens the database of information of species- specific enrichment projects. It suggests that enrichment activities for captive gorillas should be tailored to the needs and interests of the individual group members. The data suggest there are legitimate differences between some of the groups of animals studied. Those individuals that were mother reared tended to utilize forage enrichment more than those that were hand reared. Some of the other variables studied warrant more study, such as the one individual studied that resides alone.

Keywords: lowland gorillas, enrichment, psychological well-being