

73. CHIMPANZEES' (*PAN TROGLODYTES*) RESPONSE TO INEQUITY IN AN EXPERIMENTAL EXCHANGE PARADIGM

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During the evolution of cooperation, it may have become worthwhile for individuals to compare their own payoffs to those of others, in an effort to increase relative fitness. Humans do so, frequently rejecting payoffs that are perceived as unfair (even if they are advantageous). If a sense of fairness did evolve to promote cooperation, some nonhuman animals may exhibit inequity aversion as well. Here we examined the response of twenty adult chimpanzees from three social conditions to an inequitable distribution of rewards during experimental exchange with a human experimenter. Pairs alternated exchanging in situations in which 1) both received the same reward, 2) one received a superior reward, 3) one received a superior reward without exchange (e.g. no work), and 4) both observed a superior reward which was not given to the partner. As with previous work on capuchins, chimpanzees were less likely to complete an exchange when their partner received a higher-value food item than they ($F_{3,6} = 838.053$, $p < 0.001$), yet this response decreased over time if no other chimpanzee received the better reward ($F_{2,69} = 16.83$, $p < 0.005$). There was significant variation in responses in the different social conditions ($F_{6,14} = 8.714$, $p < 0.001$), indicating an ability by chimpanzees to alter their responses. An ability to modulate behavior may be a key difference between monkeys, apes, and humans.

74. PROMISCUOUS OR SELECTIVE? A PAIR CHOICE TEST IN FEMALE LONG-TAILED MACAQUES (*MACACA FASCICULARIS*)

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Sexual behavior in primates is likely a compromise between male and female strategies. To determine whether females, free from male coercion, mate promiscuously or selectively relative to ovulation, we conducted a pair choice test where female long-tailed macaques had control over access to males. Six females and four males were tested for 240 days. Females were presented with a different pair of males twice a day. The males within a pair alternated in a fixed order and each male was presented daily. Females could freely enter a male's chamber and were allowed two entries per male-pair. Entry and subsequent copulation with a male was defined as a choice with mating. The females' mating pattern was related to the menstrual cycle and timing of ovulation as determined from fecal progesterone profiles. Females chose and mated promiscuously in all phases of their menstrual cycle. There was no difference between menstrual phases in the number of mates (Chi-squared = 0.78, $p = 0.68$). The highest ranking male was not generally preferred to other males, but three out of six females initially avoided the lowest ranking male (Binomial test, $p = 0.004$). The adaptive significance of female promiscuity in long-tailed macaques is conjectural. Promiscuity might allow sperm competition and/or cryptic female choice. Furthermore, the

chance of infanticide by males and /or genomic incompatibility between mating partners might be reduced.

75. SOCIAL LEARNING IN COTTON-TOP TAMARINS (*SAGUINUS OEDIPUS*): COSTS AND BENEFITS OF FOLLOWING THE LEADER

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In cooperatively breeding Callitrichids, social cues assist acquisition of novel motor tasks and food aversions. However, attention to social cues may have costs. We tested which stages of novel task acquisition are enhanced by social interactions. Sixteen paired captive cotton-top tamarins were presented with a novel foraging task. Tamarins learned the location of two hidden food rewards from among ten spatially and visually differentiated foraging sites. Individual Learners ($n = 8$) had eight trials without social input and then were trained to become demonstrators. Social Learners ($n = 8$) had 6 trials with their trained mate present and 2 trials with mate absent. Individual Learners took longer to first open a forage site (Mann-Whitney U-test, $p = 0.012$) and to first demonstrate correct responses, defined as visiting both correct forage sites before visiting incorrect sites (Mann-Whitney U-test, $p = 0.003$). However, the two groups did not differ on number of trials to first receive a food reward (Mann-Whitney U-test, $p = 0.083$). All Social Learners first opened forage sites and seven made correct responses on days when tested with their mate present. Only two Social Learners first received food rewards on days with their mate present, despite a lack of competition or monopolization of rewards by their mates. Social interactions facilitated some aspects of task acquisition, but independent exploration was needed to succeed at the task. Supported by USPHS Grant MH 29775.

76. NEW PERSPECTIVES IN MESOAMERICAN PRIMATOLOGY: CONSERVATION, BEHAVIOR AND ECOLOGY

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Extending from southern (tropical) Mexico to the Colombian border of Panama, Mesoamerica is the third most biologically diverse region in the world. The region covers only 0.5 percent of the world's land surface but harbors 7-10% of the world's biological diversity. Primate species and their populations stand out among the rich mammalian fauna of the region and they are represented by three species of howler monkeys (*Alouatta palliata*, *A. pigra* and *A. coibensis*), three subspecies of spider monkeys (*Ateles geoffroyi vellerosus*, *A.g. yucatanensis*, *A.g. panamensis*), one species of capuchin monkey (*Cebus capucinus*), two subspecies of squirrel monkeys (*Saimiri oerstedii oerstedii*, *S.o. citrinellus*), one species of tamarin (*Saguinus geoffroyi*) and one species of owl monkey (*Aotus lemurinus*). The purpose of this symposium is to present a comprehensive overview of recent advances in primate field research in Mesoamerica. The overall goal of each contribution is

to identify how our current knowledge of primate behavior and ecology has moved beyond more traditional approaches by incorporating new theoretical perspectives. A major focus of the symposium is to identify geographical regions and species for which we continue to lack sufficient information, action plans for future research, and a long-term commitment to conservation. In spite of many decades of research in specific localities in the region, much is still unknown about population trends and current distribution of populations and about the basic ecology and behavior of the species present. Two major areas of research will be the focus of the symposium: population and conservation and ecology and behavior.

77. DO POPULATION PARAMETERS OF TWO SYMPATRIC MONKEY SPECIES (*ALOUATTA PALLIATA* AND *ATELES GEOFFROYI*) REFLECT FRUIT PRODUCTION ESTIMATES? THE EVIDENCE FROM BARRO COLORADO ISLAND, REPUBLIC OF PANAMA

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To conserve tropical mammals, it is important to understand the range of population fluctuations that normally occur over the long term so that periodic shifts in numbers can be taken into account in the planning of reserve size. Some data suggest population fluctuations may be tied, at least in part, to phenological production patterns of important plant resources, these in turn often influenced by climatic events. Here I compare 14 years of data on fruit production patterns on Barro Colorado Island, Republic of Panama with data on population estimates for two sympatric primate species—howler monkeys (*Alouatta palliata*), obligate folivores that also consume considerable fruit and spider monkeys (*Ateles geoffroyi*), a strongly frugivorous species. Though differing in dietary focus, the two monkey species appeared to show little detectable response to fruit production patterns in terms of their respective population dynamics over the 14-yr study period. Supported by NSF grants #85-12634 and #90-20058 and funds from the California Agricultural Experiment Station; collection of fruit trap data supported by the Environmental Science Program (ESP), Smithsonian Institution.

78. DISTRIBUTION OF THE BLACK HOWLER MONKEY (*ALOUATTA PIGRA*) IN MESOAMERICA: A GIS ANALYSIS

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This study reassesses the distribution of black howler monkeys (*Alouatta pigra*) in Mesoamerica originally proposed by Horwich and Johnson (1986). Their proposed distribution was based on sightings, local informants, and the presence of suitable habitat. Current methods for investigating primate distributions have greatly improved beyond the methods utilized in that study. Geographic Information Systems (GIS) is shown to be a powerful tool in the

assessment of geographic distributions of primates. This study synthesizes population data of black howlers and utilizes GIS to provide an updated evaluation of known populations and the overall distribution of this endemic species. Population data from ten sites in southern Mexico, Belize and Guatemala were entered and compared for density, demographics, and geographical attributes. The most current elevation, vegetation and satellite imagery were analyzed to provide an updated map of the likely distribution of *A. pigra*. It is evident that this species prefers medium-tall evergreen and semideciduous forest, elevations below 600 m above sea level, and that densities are higher in forest fragments than in continuous forest. This new evaluation shows that the earlier distribution assessment overestimated the boundaries of this species' range. These new data provide us with more precise locations in which to investigate the presence or absence of *A. pigra*. These areas may reveal more populations of this species and also provide sites for translocation and rehabilitation.

79. DEMOGRAPHIC FEATURES OF *ALOUATTA PIGRA* POPULATIONS IN EXTENSIVE AND FRAGMENTED FORESTS.

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In southern Mexico tropical rain forest destruction and fragmentation by human activity has altered the original distribution of primate populations and little is known about where populations are currently found and about their demographic parameters. In this paper we report data on demographic parameters for populations of *Alouatta pigra* found in eight extensive forest sites and in three fragmented landscapes in southern Mexico and Guatemala. Populations were surveyed at these sites between 2000 and 2003 using auditory triangulations and direct visual counts. In extensive forests, population means for troop size ranged from 4.07 to 8.80 individuals, for adult sex ratios from 1.08 to 1.67, for secondary sex ratios from 0.68 to 2.00 and for female to immature ratios from 0.44 to 1.61. Estimated population density at these sites ranged from 1.8 to 44.0 ind/km². The percentage of one-male troops varied from 10.0 to 71.4%. In fragmented landscapes, population means for troop size varied between 5.19 and 8.00 individuals, for adult sex ratios between 1.39 and 1.78, for secondary sex ratio ranged from 1.43 to 5.00 and for female to immature ratios ranged from 0.89 to 1.48. Population density estimates at these sites varied from 101.9 to 246.7 ind/km². The percentage of unimale troops ranged from 33.3 to 61.1%. Data are discussed in relation to land-management practices and its impact on persistence of primate populations, suggesting that although howlers can survive in forest fragments, they may not do well in the long-term.

80. SPIDER MONKEY (*ATELES GEOFFROYI*) CONSERVATION IN EL SALVADOR IN RELATION TO HUMAN COMMUNITIES

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El Salvador is the smallest country in Central America with a high human population density. The country has suffered much environmental destruction due to deforestation, natural phenomena, and a civil war for over 12 years that ended in 1991. The war has decimated the wildlife and increased the scale of human poverty, especially in the rural areas. In surveying spider monkey populations of the country - the only non-human primate species present in El Salvador - we have found areas containing spider monkeys, four of which are in Usulután, a Department in the southeast zone. This is a very important site for wildlife conservation that contains remnants of forest and important mangrove forests on which much wildlife depends on, including the monkeys. In recent years, interest in conservation activities have increased in this area of the country and some governmental and non-governmental organizations are currently developing projects with the help and participation of the people of the communities near to these forests and marine ecosystems. We have focused on Chaguantique, El Tercio, Normandía, and Nancuchiname communities for awareness programs for school children and all the members of the communities to try and develop a plan for community co-management of these areas. We are working with the Ministry of Natural Resources, local area cooperatives and NGOs who are working in these communities.

81. PRIMATE POPULATIONS IN THE PROTECTED FORESTS OF MAYAN ARCHAEOLOGICAL SITES IN SOUTHERN MEXICO

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Habitat destruction and fragmentation, resulting from human activity, affects the viability of existing primate populations throughout Mesoamerica. While national parks and ecological reserves protect native habitat and biodiversity, protected forests surrounding Mayan archeological sites may also be important foci of conservation for populations of several primate species in the region. Between 2000 and 2003 we surveyed the forests surrounding 13 Mayan sites for presence of primate populations. Primate populations were discovered in 92% of the sites surveyed. In the northernmost Mayan site in Mesoamerica (Comalcalco) we discovered a population of *Alouatta palliata*. South of Comalcalco, 82% of the sites the forests harbored populations of *A. pigra* and in 54% of *Ateles geoffroyi*. In 45% of the sites we found both *A. pigra* and *A. geoffroyi*. The cumulative area of native habitat protected by a large constellation of Mayan sites adds importantly to the total area of legally protected tropical rain forests in southern Mexico and to the conservation of populations of the three northernmost primate species in the Neotropics.

82. POPULATION STRUCTURE OF BLACK HOWLERS (*ALOUATTA PIGRA*) IN SOUTHERN BELIZE

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This paper describes the population structure of black howler (*Alouatta pigra*) monkeys in Monkey River, Belize near the southern boundary of the species range. The population is recovering from a major hurricane in 2001. *A. pigra* has recently been upgraded to Endangered in the IUCN Redbook, due to increased forest loss and an increase in available information. Further documentation of this species, especially as it recovers from severe habitat alteration, is crucial to conservation efforts. The purpose of this paper is to describe and explore the relationship between population density and group size and composition. Data are based on intensive monitoring of social groups (4 - 8) within a 52-hectare study area for 11 months between May 1999 - May 2001 and for 30 months continuously from Oct 2001 - April 2004. Population density was high (102 individuals/km²) before the storm, and ranged from 60 to 40 individuals/km² in the 52-hectare area in the 30 months after the storm. Group size appears to be positively correlated with population density possibly because small groups represent newly forming groups in areas where density permits new group formation. These results are consistent with population data for *A. pigra* from other sites in Belize and Mexico. Population density estimates before and after the hurricane, suggest that the population has not yet stabilized and may continue to fall.

83. A METAPOPULATION APPROACH TO CONSERVATION OF HOWLER MONKEYS IN HIGHLY ALTERED LANDSCAPES IN MEXICO: INCREASE PATCH SIZE OR SET UP INTER-PATCH CONNECTIVITY?

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As a result of tropical forest loss and fragmentation, the abundance of howler monkeys (*Alouatta palliata*) have diminished 90% in the vicinity of Los Tuxtlas, Mexico. The remaining population consists of groups inhabiting in archipelagos of forest patches. Metapopulation theory predicts a high persistence as more habitat patches are occupied and dispersal is possible among populations. We studied howler monkeys inhabiting a landscape of 4,965 ha, where only 11% of the original habitat exists and is fragmented in 92 patches (range size: 0.3-75 ha). From 2001-2003 we censused groups and estimated the metapopulation persistence probability using the population viability program RAMAS Metapop, ecological network theory, and spatial explicit models. In particular, we evaluated the importance of three-habitat area change and three connectivity levels. A total of 77 individuals inhabit 20% of the total patches. When we simulated the total number of individuals expected in the next 30 years, we found that habitat area change had a higher impact on the metapopulation viability than connectivity level. In contrast, when we simulated the patch incidence, we found that connectivity was crucial to allow movements of individuals among patches. In conclusion, from

the perspective of metapopulation viability more habitat (>30% of the total landscape), bigger patches (>10 ha) and lower patch isolation (<200 m) is needed to support the existing population. Supported by ASP Small Grant Program, and Primate Conservation, Inc.

84. MEXICAN PRIMATES IN THE YUCATAN PENINSULA: PRIORITY AREA FOR CONSERVATION IN MESOAMERICA

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We conducted primate population surveys (Jan 2000 - April 2002) in some of the best-preserved areas of the Yucatan peninsula. Using GIS we identified 93,942.39 km² (63.9% of total area for the peninsula) as potential habitat for the three primate species occurring in Mexico (*Alouatta pigra*, *Alouatta palliata mexicana* and *Ateles geoffroyi yucatanensis*). Primates were encountered in 66 of 78 sites surveyed. Of these, 24 sites harbored *A. pigra*, 15 harbored *A. geoffroyi yucatanensis* and both species co-occurred in 24 sites. We found 70 social units of *A. g. yucatanensis*, six in Yucatan, 40 in Quintana Roo, and 24 in Campeche. We found 149 troops of *A. pigra*, one in Yucatan, 39 in Quintana Roo, and 109 in Campeche. All four *A. p. mexicana* troops were found in Campeche. An important corollary is the new report of two sites in Campeche where *A. pigra* and *A. palliata mexicana* coexist sympatrically. Finally, even though the Yucatan peninsula is considered one of the most important Mexican forested areas to promote effective conservation management for primates, we found early evidence of negative impact on habitat disturbance as a consequence of tourism in some sites in the north of the Yucatan peninsula, as well as heavy alterations along the coast of Quintana Roo. Supported by Primate Conservation Inc. and Conservation Committee, ASP.

85. TAXONOMIC STATUS OF ATELES GEOFFROYI IN NORTHERN HONDURAS

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The taxonomic status of the black-handed spider monkey, *Ateles geoffroyi*, in Central America has in the past presented several difficulties. Most researchers consider that *A. geoffroyi* can be divided into several subspecies, which differ in pelage characteristics. In Honduras, it has been suggested that the subspecies represented is *A. g. vellerosus*, but this has been based on a reported sighting in northeast Honduras and descriptions of specimens mainly collected throughout parts of Mexico. Here I present and compare photographic evidence of pelage characteristics from a population of spider monkeys residing in one of the largest National Parks in Honduras, Parque Nacional Pico Bonito, north of a major isolating cordillera. Based on comparisons of the monkeys living in northern Honduras to those from other regions of Central America, it appears that this population may be of a

previously undescribed subspecies. Supported by the Australian National University and Primate Conservation, Inc.

86. CONSPECIFIC VOCAL SIGNALS MODERATE URINARY CORTISOL EXCRETION IN ISOLATED MARMOSETS (*CALLITHRIX KUHLII*)

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For many species, the presence of a significant social partner can lessen the behavioral and physiological responses to stressful stimuli. This study examined whether a single individually specific signal (vocalizations) could attenuate the physiological stress response in isolated marmosets. Utilizing a repeated measures design, isolated marmosets ($n = 10$) were exposed to three distinct conditions: vocalizations from a pairmate, vocalizations from an unfamiliar opposite sex individual, or no auditory stimuli. Subsequent levels of urinary cortisol were monitored as a physiological indicator of stress. To provide a baseline for later comparison, urinary cortisol levels were monitored in undisturbed marmoset pairs. Analysis revealed a significant interaction between condition and length of separation on levels of urinary cortisol ($F(9,72) = 6.393$, $p < .001$). Undisturbed marmosets had significantly lower levels of urinary cortisol than isolated marmosets exposed to no auditory stimuli ($p < .001$), familiar vocalizations ($p < .001$) or unfamiliar vocalizations ($p < .011$). Exposure to a familiar pairmate's vocalization resulted in significantly lower levels of urinary cortisol than exposure to no auditory stimuli ($p < .031$) or unfamiliar marmoset vocalizations ($p < .040$). The results presented here provide the first evidence that a single, individually specific communication signal can decrease the magnitude of a physiological stress response in a manner analogous to the physical presence of a social partner.

87. INFANT-CARRYING BY NON-MOTHERS IN WILD WHITE-FACED CAPUCHIN MONKEYS (*CEBUS CAPUCINUS*): DO INFANTS HAVE PREFERENTIAL TRANSPORTATION PARTNERS?

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This paper explores patterns of infant carrying in white-faced capuchin monkeys (*Cebus capucinus*) in northwestern Costa Rica over an 11-month period. Data were collected on two habituated groups of capuchins using a variety of sampling techniques, and all group members were recognized individually. Most primates are completely dependent on their mothers for transportation during the first few weeks, and often months, of life; capuchins are especially altricial at birth, and develop more slowly when compared to other New and Old World monkey species. In this study of *C. capucinus*, the first 2 months of life were marked by a period of locomotor dependency on the infant's mother. Once an infant was continually crawling off of its mother at 8-10 weeks of age, its social world expanded and was marked by an increasingly

complex set of social interactions. When infants were independent and away from their mothers for extended periods of time, non-mother adults and juveniles often carried them. Infants were both the recipients of 'ride invite' behaviors, as well as the instigators of getting transportation assistance. I will discuss individual variation in partner preferences from the infant's perspective, and explore reasons for such variation: relationship of the infant's mother to the preferred non-mother carrying partner, temperament differences and dominance status of the non-mother carriers, and kinship.

88. SEX-DIFFERENTIAL REARING EFFECTS ON THE SOCIAL BEHAVIOR OF CAPTIVE JUVENILE COMMON CHIMPANZEES (*PAN TROGLODYTES*) AT THE PRIMATE FOUNDATION OF ARIZONA (PFA)

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Many studies have reported differences in post-rearing social behavior among differently reared animals, but not all have been able to control for the potentially confounding effect of different post-rearing housing situations. The social behavior of 17 juvenile chimpanzees born, reared, and then similarly housed at PFA were compared to examine if rearing differences had an effect on social behavior during the juvenile period. A total of 642 hours of observations were collected on the 17 animals in this study by reliable (85% inter-observer reliability) researchers between 1983 and 1993. Long-term mother-reared animals were defined as those housed with their mothers until at least 2.8 years of age; short-term mother-reared/hand-reared animals were separated from their mothers at 1.3 years or sooner. All subjects were housed in the main colony during data collection in their juvenile periods. Four indices of social behavior were calculated from the available data: social repertoire; frequency of social behavior; affiliation score; and frequency of abnormal behaviors. Differences in these 4 indices were tested among the 4 sex/rearing groups using a 2-way ANOVA. There were no significant differences among groups for any of the indices of social behavior, nor was there an interaction effect of sex and rearing ($\alpha = .05$).

89. FACE AND SEX SKIN COLORS VARIABLY CORRELATE WITH AGE, BODY AND FAT MEASURES IN FREE-RANGING ADULT FEMALE RHESUS MACAQUES (*MACACA MULATTA*)

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Female rhesus macaques (*Macaca mulatta*) exhibit individual differences in face and sex skin colors. To understand whether these differences convey information to which conspecifics might attend, the present study sought to

evaluate whether relationships exist between: (1) face color (FC) and sex skin color (SSC) and (2) coloration and predictors of fertility, including age and morphometric measures. We adapted the RGB Method to quantify color channels (red, green, blue and luminosity). Subjects were 22 adult female rhesus macaques free-ranging on Cayo Santiago. Single measures for each subject were collected during the 2003 annual trapping period (January-March). Our analyses showed that while FC and SSC overlapped in range, they were not correlated with each other. FC and SSC differed in all channels but red, (G: $t=2.156$, $df=28.897$, $p=0.040$; B: $t=2.992$, $df=41$, $p=0.005$; L: $t=2.246$, $df=29.311$, $p=0.032$). While FC was positively correlated with age ($r=.422$, $p=0.050$), SSC and age were inversely correlated (B: $r=-.437$, $p=0.048$). FC was correlated with height/weight ratios (R: $r=.435$, $p=.043$; B: $r=.595$, $p=.003$), various bone lengths and abdominal fat (B: $r=.506$, $p=.016$; L: $r=-.632$, $p=0.037$). While SSC was also related to abdominal fatness (G: $r=-.470$, $p=0.032$; B: $r=.506$, $p=0.016$; L: $r=-.632$, $p=0.037$), SSC was unrelated to body measures. We propose that color might advertise female residual reproductive value and that FC and SSC could reveal similar or different aspects of quality. Our results lead us to predict an association between individual differences in coloration and fitness outcome.

90. EARLY SOCIAL BEHAVIOR OF INFANT RHESUS MONKEYS (*M. MULATTA*) PRODUCED BY ASSISTED REPRODUCTIVE TECHNOLOGIES (ART)

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Assisted Reproductive Technologies used in infertility clinics include conception by intracytoplasmic sperm injection (ICSI) or in vitro fertilization (IVF). In primate research, either technique can be used with embryo splitting (ES) to produce identical twin offspring. Primate offspring have been produced by all three techniques, but health and behavioral safety issues have not been addressed. We assessed the first 30 days of social behavior by 6 ICSI, 4 IVF and 5 ES 1-2 month old nursery-reared rhesus macaques, and four 1-2 month old infants produced by artificial insemination (AI). Behavioral observations were taken during daily playroom sessions. MANOVAs revealed statistically significant between-group differences ($p<.05$) in the total frequency of social behaviors, frequency of non-contact behaviors, frequency and duration of reciprocated behaviors, frequency and duration of withdrawal behavior, and frequency and duration of aggressive behavior. Artificial insemination infants displayed the extremes of the categories that had significant differences, showing more social behaviors, reciprocating more behaviors, having more non-contact behaviors, and withdrawing and aggressing more. ES infants were at the other extreme, having the least amount of each behavior in which AI infants had the most. The results of this initial small sample study suggest that there are early social differences between young infant rhesus monkeys produced by embryo splitting and those produce by artificial insemination. Supported by NIH grants HD12913-21, RR00166, HD02274.

91. PRELIMINARY EVIDENCE OF AN ASSOCIATION BETWEEN MORPHOLOGICAL ASYMMETRY AND DECREASED AFFILIATIVE BEHAVIOR IN ADOLESCENT CYNOMOLGUS MONKEYS (*MACACA FASCICULARIS*)

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Morphological asymmetry is thought to be a marker of atypical developmental events and asymmetry is associated with reduced fitness in some species. We hypothesized that asymmetric individuals would show reduced affiliative tendencies when compared to relatively more symmetric individuals. We examined the relationship between frequencies and durations of social behavior and the degree of asymmetry in the ulna and femur in twenty-four socially-housed adolescent male cynomolgus macaques (*Macaca fascicularis*). Measurements of the ulna and femur were made using an anthropometer and the degree of asymmetry was calculated using the following formula: $\text{asymmetry} = |(\text{right-left})/(\text{right+left})|$. Social behavior was recorded during six to eight 10-min focal observations across 6 weeks. Relationships between asymmetry and social behavior were examined by calculating Pearson or Spearman correlation coefficients. Overall, multiple measures of affiliative behavior showed trends for more symmetrical subjects to be more sociable. Subjects with greater symmetry in long bones were more likely to be involved in a mount (Spearman $Rho = 0.47$, $p = 0.02$, $n = 24$) and demonstrated trends to spend more time grooming a cagemate (Pearson's $r=0.39$, $p=0.07$, $n=24$) and to lipsmack more frequently (Pearson's $r=0.41$, $p=0.08$, $n=22$). These results provide preliminary evidence that morphological asymmetry may serve as a marker for individual differences in social behavior in nonhuman primates. Supported by NIH grant #AA013995.

92. PRIMATES, PRAIRIE VOLES, AND THE PHYSIOLOGY OF LOVE AND FEAR

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All mammalian species must perform some basic types of social behavior—mothers must care for their infants, at least to the extent of lactation; and males and females must interact in order to mate. However, many mammals, and most primates, develop a much more complex array of social relationships and attachments. There appear to be many commonalities between the physiological bases of these different types of behaviors, often involving competing emotions of fear and attraction. Hormones involved in these behaviors include not only steroids such as estrogens, progestogens, and corticosteroids, but also peptides such as oxytocin and vasopressin. I will give a short history of this field of research in primates, with additional information derived from my own research, including fecal monitoring studies of wild golden lion tamarins (*Leontopithecus rosalia*), neurobiological studies of rhesus macaques (*Macaca mulatta*), and comparative data from another social mammal, the prairie vole (*Microtus ochrogaster*). In particular, I will

concentrate on hormonal and neurobiological underpinnings of two social behaviors, parental care and pair-bonding. For research support I thank NIH PO1 HD38490 and NRSA F32 HD08702, NSF, the Burroughs-Wellcome Fund, ASP, Sigma Xi, NAAR, and IRUL #322.

93. THE CHANGING PARADIGM OF PUBLISHING AND ITS IMPACT ON LIBRARIES: WHERE DO WE GO FROM HERE?

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Scholarly communication is in the throes of a major revolution. What was once a manageable system involving researchers, scholarly societies and associations, small commercial publishers, and libraries has now become a US\$7 billion global industry. Science, technology and medicine (STM) publishing is big business. Since the early 70's STM publishers recognized the inelasticity of the STM market and began consolidating ownership and control. Mergers, acquisitions and takeovers in the publishing industry over the last few decades have resulted in a small number of very large publishing concerns in the commercial market. As a result journal prices have risen dramatically. According to Library Journal, April 15, 2003, "over a 15-year period ending in 2001, journal prices rose 215%." Add to the mix the accelerated use of technology to provide access to information, the shift from purchasing print subscriptions to licensing digital collections, copyright and fair use, and the need for stable archiving solutions. As a result we are seeing a fundamental change in how we provide, purchase, access and use information. Many of our long-standing beliefs and assumptions about the scholarly communications process are up for debate. Over the last several years' libraries, universities, scholars, and others have begun to look for alternatives to commercial publishing. Current initiatives include the Public Library of Science (PLoS), the Scholarly Publishing & Academic Resource Coalition (SPARC), and BioMed Central.

94. BEHAVIORAL AND PHYSIOLOGICAL CONSEQUENCES OF FEEDING ROUTINES IN *CEBUS APELLA*

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The behavioral and physiological effects of predictable and unpredictable feeding schedules were measured in a group of brown capuchins (*Cebus apella*, n = 6). Animals were fed on a predictable schedule for 6 weeks followed by 6 weeks on an unpredictable schedule (varied by early, on-time, or late feeds). We hypothesized that meal unpredictability would alter behavior and cortisol levels. Behavior was sampled via instantaneous scan sampling 1 hr pre-feed and 1 hr post-feed for both schedules. Morning fecal samples from all

individuals were collected three times a week for the duration of the study and analyzed for cortisol. Behavioral data were analyzed using a 2-factor MANOVA, with feeding schedule (predictable, early, on-time, or late) and time (pre- or post-feed) as factors. Feeding schedule had a significant effect on social activity; significantly more time was spent in social activity on early and predictable days than late days ($p < 0.05$). In post-feed versus pre-feed periods there was a significant decrease in time spent in social activity and proximity and an increase in agonistic behavior ($p < 0.05$). Specifically, post-feed agonistic behavior was significantly greater for on-time and late feed days of the unpredictable schedule ($p < 0.05$). Cortisol levels were significantly higher during the unpredictable versus the predictable phase (Wilcoxon, $Z = -2.20$, $p < 0.05$). Our results suggest that predictable feeding schedules may be most beneficial to the well being of captive capuchins.

95. ENCLOSURE USE BY AGED SQUIRREL MONKEYS (*SAIMIRI SCIUREUS*)

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A group (3.2) of squirrel monkeys (*Saimiri sciureus*) was translocated from an indoor exhibit at Lincoln Park Zoo, IL, to an outdoor enclosure at Miami Metrozoo. All are nonreproductive and aged (18-31 yrs). Scan sampling data were collected, as part of a larger study, to document how these monkeys used the naturalistic enclosure. We analyzed 2830 samples, 566 samples per individual. Use areas were scored on a grid system and substrates classed as static or dynamic. The monkeys were scored most often among the largest and highest branches in the tallest tree in the enclosure (17.7%). Males were scored more often in the highest parts of the trees (10% of scores) in comparison to females (8% of scores), a pattern consistent with the behavior of their wild conspecifics. None were ever scored on the ground, despite the water source being there and the insect foraging opportunities. Static substrates were preferred (64.3%). Dynamic substrates, like rope walkways, were used primarily during locomotion (33.8%) from one static location to another. Moving feeding sites did not change the use pattern of substrate type, only the paths they took to and from the food. The oldest animals were scored least often on moving substrates (16%). Advanced age may lessen agility and flexibility, explaining the use patterns.

96. CAGE LEVEL HAS LITTLE EFFECT ON BEHAVIOR OF MACAQUES (*M. FASCICULARIS*, *M. NEMESTRINA*, AND *M. MULATTA*)

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Monkeys are commonly housed in two-tiered caging, which is more economical than single-level cages. Some animal welfare advocates maintain that inhabitants of lower-level cages experience compromised welfare, and

experiments may be impacted if behavior and/or physiology vary by cage level. While testing the temperament of 318 monkeys, we assessed time spent in front third of cage (Front) and engagement in five activities: scratching, grooming, eating, manipulating objects, and locomotor stereotypy, a possible indicator of compromised well-being. An observer not known to the monkeys in any other capacity made observations from the middle of the room (Phase 1, 4 min) followed by observations while standing directly in front of each subject's cage (Phase 2, 4 min). Each monkey was tested twice. We used repeated measures GLM on the Test 2 data to investigate effects of the independent variables Phase, Tier, Species, Sex, Age, and Time in Colony. There was a Tier effect only for Front ($p < .01$; time in front third of cage greater for monkeys in top cages). Front was also affected by Phase, Species, Sex, and Time in Colony (each $p < .0005$). Frequency of engagement in the five activities did not differ by Tier but did differ by Phase, Species, Sex, Age, and/or Time in Colony. Cage level exerted less impact on the measured behaviors than the other independent variables. NIH RR00166.

97. ONSET OF INITIAL SOCIALIZATION AMONG NURSERY-REARED RHESUS MACAQUES (*MACACA MULATTA*) AND LATER EXPRESSION OF ABNORMAL BEHAVIOR

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The socialization of nursery-reared macaques typically involves initial social exposure at approximately one month of age. However, in a biomedical environment, the onset of socialization may be delayed for a variety of reasons. This ongoing study examined the prediction that these delays are associated with broadened expression of abnormal behaviors among immature, socially-housed rhesus macaques. In order to control for the types of research procedures experienced and the reason for delayed socialization, all subjects were drawn from one research project that imposed restrictions on early socialization. Subjects included 14 (6:8) six-month-olds first socialized at 2 - 6 mo., 24 (15:9) 18-month-olds socialized at 3 - 7 mo., and 14 (6:8) 30-month-olds socialized at 9 - 18 mo. Three five-minute surveys were conducted on each subject, noting the presence of 16 abnormal behaviors. Associations between age at socialization and frequency of abnormal behavior within each cohort were determined by simple regression procedures. Among the 6- and 30-mo. cohorts, no relationship was detected between age at socialization and number of abnormal behaviors. However, among the 18-month-old subjects, onset of socialization was positively related to breadth of the abnormal behavior repertoire ($F[1,22]=7.15, p < 0.05$). Initial results suggest that decisions regarding early socialization need to strike a careful balance between the rationale for delayed socialization and the promotion of normal development. Continued research will permit an examination of a wider range in subject ages and initial socialization ages.