

mals never had adults to learn from. Here I report results from a recent study, documenting changes in the social behavior of the current BCI spider monkeys. Data collected between October of 1997 and December of 1998 show that the social system of the BCI spider monkeys is more cohesive than that of groups studied elsewhere. Subgroup size is larger and females are more frequently observed in the presence of additional adult females and males than on their own. Smaller foraging units are formed, however this occurs only after the group as a whole moves to certain areas of the island in search of a particular food species. In addition, females and their associated offspring do not travel in core areas as reported by previous spider monkey researchers including Milton (1993). All of these differences are potentially related to the increase in the home range of the BCI spider monkey group. During my study the home range was more than 960 hectares, significantly larger than reported from other study sites. I suggest that this large home range size has resulted in a decrease in intragroup feeding competition, which has resulted in a more cohesive social structure.

#### **Biomechanical investigation of African apes and influences of positional behavior.**

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Bone responds to strains, which are engendered through body movements, by adapting its shape to maintain internal stresses below failure level. Using this as a basis, long bone morphology of African apes is investigated with available positional behavior data. Locomotor behaviors are emphasized, rather than postural behaviors, as the former are likely more responsible for adaptations in shaft cross-sectional geometry than the latter. Specifically, cross-sectional geometry of humeral and femoral shafts at 35%, 50%, and 65% lengths is examined across a comprehensive sample of commonly recognized *Gorilla* and *Pan* subspecies, as well as *P. paniscus*.

Hypotheses relating locomotor repertoire to cross-sectional geometry are investigated. Since the arboreal landscape has a higher degree of 3-D complexity relative to the terrestrial landscape, loads engendered during arboreal movement should be more variable in magnitude and orientation relative to those arising during terrestrial movement. Degree of arboreal locomotion, measured as the percentage of locomotor behavior that is arboreal versus terrestrial, correlates negatively with the circularity of the long bone shaft (i.e., the ratio of principal moments of area) at several locations. At a

majority of locations, Theta, the angle between a principal moment of area,  $I_x$ , and a second moment of area,  $I_y$ , is more variable in subspecies exhibiting a higher degree of arboreal locomotion.

This research further clarifies links between morphology and behavior in extant African apes. Because the earliest hominids exhibit ape-like features, a more complete understanding of African ape long bone morphology will assist inferences of early hominid positional adaptations.

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#### **A new theory concerning the adaptive value and evolution of diagonal-sequence gaits in primates and marsupials.**

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Lateral-sequence walking gaits (in which each fore footfall follows the ipsilateral hind footfall) predominate among nonprimate mammals, whereas diagonal-sequence (DS) walks (fore footfall follows contralateral hind footfall) are the norm among primates. No satisfactory explanation of this difference has yet been offered. We conjecture that DS walking allows primates to support themselves with a protracted hind foot, placed on a proven support under the body's center of mass, before putting down a forefoot on a potentially precarious arboreal support. We tested this hypothesis by analyzing over 400 videotaped walking gaits of a wide variety of mammals. Our data corroborate this conjecture and show that DS walks are also prevalent among arboreal marsupials. In both primates and marsupials, this gait pattern is associated with increased loading and duty factors of the specialized grasping hind feet. These apomorphies define a complex of "hindlimb-based" locomotor behavior common to both groups and suggest parallels in their ancestral adaptations. We interpret the grasping hind feet and DS walks of both primates and marsupials as having evolved to facilitate locomotion on thin, flexible branches.

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#### **Parity initially mitigates the effects of aging on bone mineral density (bmd) in the spine of rhesus macaques.**

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This cross-sectional study investigated the relationship between parity, bone mineral density (BMD), and spontaneous osteopenia/osteoporosis in a skeletal population of female rhesus macaques (*Macaca mulatta*) from the free-ranging colony of Cayo Santiago, Puerto Rico. BMD of the last lumbar vertebrae of 119 females between 4.0 and 22.2 years of age at the time of death were measured using dual-energy X-ray absorptiometry (DEXA), and analyzed for evidence of osteopenia/osteoporosis and the effects of parity and age.

Females with low parity have significantly lower mean BMD values than age-matched controls. Forty-three percent of the osteopenic/osteoporotic females in the sample were members of the low-parity group even though it composed only 13% (16/119) of the entire sample. After controlling for age, there is a significant ( $p = 0.0006$ ) increase in BMD with increasing parity, up to a parity of 7 offspring. Thus, high parity initially has a positive effect on BMD in female rhesus monkeys, and appears to mitigate the effects of aging. After controlling for parity, however, age has a negative ( $p = 0.015$ ) effect on BMD beginning several years after the attainment of peak BMD (10 years of age). Thus, the positive effect of parity on BMD is eventually overwhelmed by the aging process. There is also indirect evidence, from natal group membership data, for a genetic component to these observations.

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#### **Within group relatedness and genetic mating systems in white-handed gibbons (*Hylobates lar*).**

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Gibbons have long been termed the "monogamous ape" as the primary social unit has appeared to consist of a pair of adults in a presumably sexually exclusive relationship. Long-term observation of habituated groups of white-handed gibbons (*Hylobates lar*) in the Khao Yai Forest in Thailand, however, has indicated that extra-pair copulations may account for up to 10% or more of the copulations in some females.

Furthermore, polygynous and polyandrous gibbon social groups are not uncommon. In order to clarify the mating system in gibbons, we have determined the genetic relationship of some 60 individuals living in 12 social groups. Noninvasively collected fecal samples were used as the source of nuclear DNA for genotyping. Some samples were preserved in ethanol and others were dried on silica. Successful extractions were carried out in 23% of the ethanol samples and 50% of the silica samples. A total of 52 markers originally identified in humans were examined for variability in *H. lar*, and seven markers exhibiting high variability were typed in all individuals. Paternity assignment was done by exclusion, with assigned fathers sharing an allele with the offspring at all loci and other males excluded by mismatches. These genetic data in conjunction with the observational data allow a more accurate description of the range of variation in group structure and mating strategies within a single population of gibbons.

#### **Environmental correlates of human skin color, revisited.**

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Human skin color varies clinally, according to environmental factors. Previous workers have analyzed the relative contributions of environmental factors to constitutive skin color, and have emphasized the importance of latitude and ultraviolet radiation (UVR) in its evolution. We have extended previous studies by examining the relationship between skin reflectance measurements of indigenous human populations relative to environmental data (including UVR, temperature, and precipitation) gathered by remote sensing and direct measurement. These data were then statistically analyzed and visualized using a geographic information system (GIS). Skin reflectance was found to be most strongly correlated with variables representing UVR, with the highest correlation found between skin reflectance and Autumn UVR levels. Principal Component Analysis (PCA) revealed that most variables representing UVR and temperature were highly collinear. A multiple regression model applied to a subset of non-covarying environmental variables as revealed by PCA showed that skin reflectance was most highly correlated with Autumn UVR, followed by Maximum (Summer) UVR, Summer precipitation and Winter precipitation. The main finding of this study was that skin color could be almost fully modeled as a linear effect of Autumn

UVR alone. Most of the departures from the linear model were minor, and could be accounted for by the nature and timing of human migrations. Our second major finding was that there appears to be a threshold effect of Maximum UVR on the evolution of skin coloration, past which no further skin darkening occurs. This finding suggests that in areas of high UVR, the rate of skin darkening may have slowed over time.

#### **Age-related bone loss and intraskeletal variability in the Imperial Romans.**

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Bone mass varies within and among skeletal elements of the same individual and among individuals. Although a correlation between age-related bone loss among different skeletal elements has been noted, a lack of consensus exists as to the relative equivalence of bone loss among skeletal elements commonly affected with osteoporosis. The rate of cancellous bone loss is inconsistent with that of cortical bone loss, each leading to distinct fracture patterns among skeletal elements with differing proportions of these two kinds of bone.

Bone loss is a universal phenomenon, including in past populations. However, the incidence of bone fragility and fractures is relatively low in archaeological populations. An Imperial Roman sample from the Isola Sacra necropolis offers a unique opportunity to study age-associated bone loss and intraskeletal variability. The study sample is from an urban European archaeological population, distinct from previous bioarchaeological research based primarily on non-Western pre-industrial societies.

Multiple skeletal sites from the same individuals are available to address intraskeletal variability. The midshaft rib and femur (non-loadbearing and loadbearing cortical bone, respectively) and the anterior superior iliac crest (non-loadbearing trabecular bone) are examined for patterns of age-related bone loss and intraskeletal variability. Cortical bone samples are analyzed for static indices of bone remodeling and measures of bone mass (i.e., cortical area). Cortical thickness and trabecular bone volume are analyzed for the iliac crest bone samples. The patterns of age-associated bone loss in the ancient Romans are described and implications of these findings for understanding osteoporosis in modern populations are discussed.

#### **Relationship by isonymy in sixteenth-century Yucatán.**

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Surnames have been used to study population structure in many populations of European ancestry, but fewer indigenous ones. Unlike other Mesoamerican populations, the Yucatec Maya used indigenous surnames throughout the Colonial period, with males and females both keeping inherited patrilineal names after marriage. Analysis of these surnames using methods pioneered by Lasker, Relethford, and others provides a view of Maya population structure several decades after the Spanish Conquest. Two nominal censuses from 1583 were analyzed: One from the four *cahob*, or indigenous towns, congregated by Spanish authorities into the pueblo of Tizimin, and one from the three constituent barrios of the *cah* of Pencuyut. This illuminates three different scales of genetic distance: Between barrios, between *cahob*, and between regions. The greatest similarity was found between barrios; congregated *cahob* were slightly more distant from each other; and Pencuyut and Tizimin were further separated. At the same time, the barrios of Pencuyut had higher  $I_{ii}$  values (0.033-0.035) than the *cahob* of Tizimin (0.019-0.029). Thus individual barrios were more homogeneous than *cahob*. With sexes separated, males from different barrios were more divergent than females, indicating virilocal residence; the same pattern was less clear at the *cah* level. Within Tizimin,  $R_{ST}$  for males (0.00198) was slightly higher than that for females (0.00187); in Pencuyut, the male value (0.00301) was dramatically higher than the female (-0.00027). Combining males and females from both censuses,  $F_{ST}$  (0.00680) was dramatically higher than  $R_{ST}$  (0.000005).

#### **New morphometric approaches to positive identification from frontal sinuses.**

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Forensic anthropologists have, for years, been using frontal sinus radiographs in making positive identifications under the assumption that these structures are "as unique as fingerprints." While many studies confirm their uniqueness to the degree that two radiographs from a known individual can be correctly matched, few have pondered the probability of misidentification in a forensic context. Here, we explore the issue of assessing the potential error rate of objective sinus-based identification using parameterized sinus outlines.

Assertions of uniqueness should be given as the probability of a match given the correct identification versus the probability of a match from the population at large. These