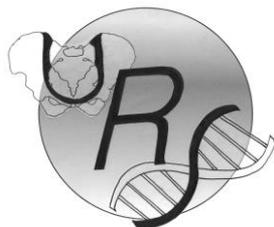


COMMITTEE ON DIVERSITY



UNDERGRADUATE RESEARCH SYMPOSIUM

AAPA 88TH ANNUAL MEETING
6-8 PM, WEDNESDAY MARCH 27TH, 2019

GRADUATE MENTORS

Eduardo Amorim, Stony Brook
Colin Brand, University of Oregon
Andreana Cunningham, University of Florida
Ashley Dafoe, Mississippi State ♦
Susanne Daly, Arizona State University
Ellen Feuerriegel, University of Washington
Maggie Hernandez, Penn State ♦
Mareike Janiak, Rutgers University
Kelsey Kjosness, Philadelphia College of Osteopathic Medicine ♦
Steven Lautzenheiser, University of Washington ♦
Katie Lee, University of Illinois
Ingrid Lundeen, University of Texas at Austin ♦
Miguel Ochoa, University of Washington
Ben Schaefer, University of Illinois
Elena Sierra Serrano, Nordic Africa Institute
Izzy Starr, University of Buffalo
Michala Stock, Highpoint University

Organized by Cara Wall-Scheffler

Program by Marcie Myers

♦ Previous URS participant now serving as a graduate student mentor

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1. **Linear analysis of pliopithecoid dental morphology.** *JACQUELINE GARNETT, DAVID R. BEGUN and ANDREW C. HOLMES.
2. **§Joint proportions in early hominins.** *ANJALI M. PRABHAT, JEREMY M. DESILVA and CATHERINE K. MILLER.
3. **§Life history underpinnings of East Turkana faunal turnover during the early Pleistocene.** *JAMES FRAZIER and AMANDA MCGROSKY.
4. **Human or bison: Extinction of the Western Horse.** *SAHARA ZITLALI VILCHIS.
5. **A pedagogical project on the masticatory biomechanics of *P. boisei*.** *JESSICA S. WOLLMANN and LAURA T. GRUSS.
6. **The effects of childhood stress on two 19th-century populations in Illinois: Exploring the association between LEH and adult stature.** *ALEXIS D. MARTINEZ and ANNE L. GRAUER.
7. **Life on the coast: Comparing dietary health biomarkers from pre-ceramic shellmound and ceramic skeletal series in Santa Catarina, Brazil.** *SYDNEY M BAKER, KATHRYN MARKLEIN and MARK HUBBE.
8. **§Relations between cultural perceptions of childhood and childhood stress in an ancient Greek colony.** *MADISON R. KAYE, BRITNEY KYLE, STEFANO VASSALLO and LAURIE J. REITSEMA.
9. **The identification of temporal shifts in mortuary practices in the late third millennium BCE using color changes to bone.** *ANTONIA CARTER and LESLEY GREGORICKA.
10. **§Middle meningeal arteriovenous and dural sinus variation in 6-8.0 year old humans.** *CORTNEY M. CONNOR, *TIFFANY W. SHIEN, *PINA S. SIMONE, *ISABELLE B. REICH, *CHLOE LEE, GARY D. RICHARDS and REBECCA S JABBOUR.
11. **Himera: Estimating allostatic load and age-at-death using stress indices.** *SAFAA NAEEM SIDDIQUI, BRITNEY KYLE, STEFANO VASSALLO and LAURIE REITSEMA.
12. **Squatting facets and osteoarthritis in an agricultural sample in ancient China: A biocultural perspective on ancient gendered activity.** *KAYLA DOMINGUEZ and JACQUELINE T. ENG.
13. **A comparative analysis of health indexes for past human populations.** *ANA MITCHELL, COLLEEN CHEVERKO and MARK HUBBE.
14. **§The influence of habitual activities and lifelong occupations on skeletal robusticity and metric traits.** *LYDIA BLIZZARD, *HARRISON DEAN, HALEY HORBALY and MARK HUBBE.

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15. §Critical ages of development: Impacts of post-natal early-life stress at the Greek colony Himera (Sicily). *MUSTAFA QUADIR, CAREY J. GARLAND, LAURIE J. REITSEMA, STEFANO VASALLO and BRITNEY KYLE.
16. Dictated by disease: Increased susceptibility of immigrants in 17th Century Maryland to their new pathogenic environment. *AUDREY DERVARICS, KATHRYN BARCA, KARI BRUJWELHEIDE, DOUGLAS OWSLEY and KRISTA FISH.
17. A comparison of bioarchaeological adult aging techniques utilizing canine teeth radiographs from Italian skeletal remains. *KATEY MARI and LAURIE REITSEMA.
18. Mortuary and paleopathological analysis of New Kingdom burials at Tombos. *ISABELLE ORTT, MICHELE BUZON and KAITLYN SANDERS.
19. Reconsideration of cranial capacity estimates from cranial vault linear dimensions. *URVA MEHVEEN and ROBERT C. MCCARTHY.
20. §Testing a computational approach for estimating age-at-death on a modern Portuguese population. *LIAM JOHNSON and JONATHAN BETHARD.
21. §Geometric morphometric assessment of skull symmetry in 6-8.0 year old humans. *JESSICA M. CRONIN, *ANA SHAUGHNESSY, *JANE VANNAHEUANG, LAURA E. CIRILLO, GARY D RICHARDS and REBECCA S. JABBOUR.
22. §Macroscopic analysis of periosteal new bone in human long bones. *ERIC FRAUENHOFER.
23. §Intra-population dietary variation at Himera. *AUTUMN SCHMITZ, LAURIE J. REITSEMA, KATHERINE L. REINBERGER, STEFANO VASALLO and BRITNEY KYLE.
24. §Analyzing population variation in the fusion sequence of primary and secondary ossification centers in the human skeleton. *MAKENNA B LENOVER and MAJA SESELJ.
25. Investigating sexual dimorphism in *Homo sapiens* nasal aperture shape. *MEGAN L. PRICE and MIRANDA E. KARBAN.
26. Scoring external occipital protuberance prominence in extant human growth study cephalograms. *LAUREN A. ESTES and MIRANDA E. KARBAN.
27. Differences in clavicular osteon circularity between young and old human males. *RACHEL A. MCNULTY, *NICOLE M. FYE, ANGELA L. HARDEN and AMANDA M. AGNEW.
28. §Survivorship from historical death records and skeletal remains from the Oakwood cemetery in Austin, Texas (1866-1914). *MICHELLE NGUYEN, CHRIS WOLFE, MICHELLE HAMILTON and NICHOLAS HERRMANN.

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29. §Reconstructing weaning and childhood diets at the 6th-5th C. BCE skeletal population of the Greek colony of Himera. *ABIGAIL S. GANCZ, LAURIE J. REITSEMA, KATHERINE L. REINBERGER, STEFANO VASSALLO and BRITNEY KYLE.
30. §Childhood growth, cessation, and recovery: Links between lines of growth arrest and bone quantity. *TESSA VALLEROY and LIBBY W. COWGILL.
31. During drought in northern Kenya, mothers with iron deficiency were younger, but not of low socioeconomic status. *EMMA BIGNALL, *QUEXTEEN SAUTEURN, NERLI PAREDES RUVALCABA and MASAKO FUJITA.
32. Food insecurity in relation to different types of maternal anemia among breastfeeding mothers of northern Kenya. *QUEXTEEN KUANG SAETEURN and MASAKO FUJITA.
33. Association between cesarean birth and breastfeeding trajectories in population with traditionally intensive breastfeeding practices. *DEJA L. EDWARDS, MELANIE MARTIN and CLAUDIA VALEGGIA.
34. Influence of metabolic rate and changes in energy balance on leptin levels in a sample of young adults. *KAYLIN DONG, *JENNAH THOMPSON-VASQUEZ, STEPHANIE B. LEVY, AARON A. MILLER and WILLIAM R. LEONARD.
35. The biocultural evolution of inflammatory bowel disease. *AMANDA RIELINGER, DANIEL CLEMANS and MEGAN MOORE.
36. High-altitude epigenetic adaptation in gene **H19**. *TREY SMITH, *KEVIN WANG, TREY SMITH, KEVIN WANG, AINASH CHILDEBAYEVA, MARIA RIVERA-CHIRA, FABIOLA LEON VALERDE, MELISA KIYAMU, TOM BRUTSAERT and ABIGAIL W. BIGHAM.
37. High altitude adaptations. *KEVIN WANG, *TREY SMITH and AINASH CHILDEBAYEVA.
38. A push for trans-inclusive language in forensic anthropology. *FATIMAH BOUDERDABEN.
39. Founder of Mississippi discovered? Tracing the geographic origins of unknown remains using strontium and oxygen isotopes. *NATALIE SMITH, LESLEY A. GREGORICKA and MARIE E. DANFORTH.
40. Baby steps: Child carrying strategies of urban individuals. *MADISON HUBBLE, *ERIKA BUNGE and CARA WALL-SCHEFFLER.
41. §Human jaywalking. *AZARIEA BONNER-HARRIS and CARA WALL-SCHEFFLER.
42. §The use of bouts during activity decreases women's core temperature more than men's. *HAYLEY CHEYNEY KANE and CARA WALL-SCHEFFLER.

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43. **Effects of substrate compliance on deformation of the human foot revealed by biplanar X-ray.** *SABREEN MEGHERHI, KEVIN G. HATALA, DAVID A. PERRY and STEPHEN M. GATESY.
44. **Reliability of goniometer measurements to determine ankle dorsiflexion: implications for assessment of gastrocnemius equinus.** *CRISTINA GILDEE, ELEN M. FEUERRIEGEL, KALYANI RAJOPADHYE and PATRICIA A. KRAMER.
45. **Error of three-dimensional surface imaging using Vectra H1 and 3dMDface systems.** *CIARA VIRGO, JULIE D. WHITE, ALEJANDRA ORTEGA-CASTRILLON, KARLIJNE INDENCLEEF, PETER CLAES and MARK D. SHRIVER.
46. **Virtual dissection of complex muscles with DiceCT.** *RICHARD SAAVEDRA and RACHEL MENEGAZ.
47. **Y-chromosome variation and paleodemography in the Ticuna of South America.** *HILDA REBECCA CHUBARYOV and DAVID MERRIWETHER.
48. **Endocannibalism in Papua New Guinea has resulted in balancing selection in Kuru-afflicted populations.** *ANASTASSIA SHIFCHIK, *NIA BROWN-FONROSE, *SHANNON ERICKSON, *JULIA GIACINTO, *JARED NASSO, *DILLON OSWALD and MICHEL SHAMOON-POUR.
49. **Human mitochondrial genetic diversity in western Iran.** *DYLAN NICHOLSON, *BHAVREET DHANDI, *VISHNU NAIR, *VICTORIA SALLOWS, *MARIA SOSA and MICHEL SHAMOON-POUR.
50. **Testing the centromere-drive hypothesis in primates.** *LIBARDO E. GOMEZ, EMILY A. BECK and KIRSTIN N. STERNER.
51. **Population genetics of lyme disease vector *Ixodes scapularis* in the Southern Tier region of NY: A mitochondrial DNA perspective.** *JESSICA KELLAM, *ALIVIA RUIZ, *JUSTIN AMES, *ANTHONY GERMANO, *LINDSAY BLANK and MICHEL SHAMOON-POUR.
52. **OspC typing of *Borrelia burgdorferi*, the Lyme disease bacteria, in the tick population of the Southern Tier Region.** *NEHA SHAIKH, *EMILIE ERNST, *CHRISTINE HURLEY, *JULIA TRAN, *ARIEL MAKOWER, *TINGYAO WANG and MICHEL SHAMOON-POUR.
53. **Population genetics of Southern Anatolia according to mitochondrial DNA.** *NICOLE MARTINI, *AMELIA CHUISANO, *ETHAN SPIELVOGEL, *CATHERINE AYIKU, *ALEX MONTOYA, *KAI HIGUCHI and MICHEL SHAMOON-POUR.
54. **Conservation to coexist: Preliminary results of a community conservation project in Uganda.** *KAYCE SORBELLO, RICHARD BUSOBOZI, MOSES KUGONZA, RONALD AKUGIZIBWE and KRISTA M. MILICH.

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55. *Withdrawn*
56. Testing consistency of iliac flare measurement methods in hominoids. *ROWAN M. SHERWOOD and EVE K. BOYLE.
57. A lesson for monkeys: Species distribution models of *Protonotaria citrea* under future carbon-emission scenarios and implications for Neotropical primates. *ERNESTO GAGARIN, AMY RECTOR and MARIE VERGAMINI.
58. Ecological factors affecting tree use in the folivorous black and white colobus monkeys (*Colobus guereza*). *COLLENA WRIGHT, *ARRON HERRERA and JESSICA ROTHMAN.
59. The investigation of abnormal behaviors in nursery reared Rhesus macaques. *CELESTE LAM, LYDIA LIGHT and SUSAN JOHNSON.
60. Gibbon chatter: A vocal analysis of male white-handed gibbon solo calls. *PHILIP B. CORBETT II, MARGARET SOBASZEK and LYDIA LIGHT.
61. Macronutrient composition of foods eaten by owl monkeys. *KANDRA CRUZ, BENJAMIN FINKEL, JESSICA ROTHMAN and EDUARDO FERNANDEZ-DUQUE.
62. §Dietary fiber and nutritional quality of the foods of Bornean orangutans (*Pongo pygmaeus wurmbii*) in Gunung Palung National Park, West Kalimantan, Indonesia. *ISHRAT CHOWDHURY, *MADELINE M. EORI, TRI W. SUSANTO, ERIN E. KANE, NANCY-LOU CONKLIN and CHERYL D. KNOTT.
63. Bornean orangutan infant development: The importance of a mother-son relationship in conserving a species. *MIA SARKISIAN and ELLEN INGMANSON.
64. Chimp chomp: A rare case of possible predation on an adult chimpanzee (*Pan troglodytes verus*). *SADIE R FRIEND, BRIANA POBINER, ANDREA R ELLER, RITA AUSTIN, COURTNEY HOFMAN and SABRINA B. SHOLTS.
65. Habituating chimpanzees for tourism in Kibale National Park, Uganda. *JONATHAN FALLAS.

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Life on the coast: Comparing dietary health biomarkers from pre-ceramic shellmound and ceramic skeletal series in Santa Catarina, Brazil. *SYDNEY M BAKER, KATHRYN MARKLEIN and MARK HUBBE. Ohio State University.

Background: Between ~8000 and 1000 years BP, the of coast Santa Catarina, Brazil, was occupied by groups of hunter-fisher-gatherers responsible for the construction of impressive shellmound sites that punctuated the coast. The shellmound culture came to an end with the appearance of ceramic cultures in the area (around AD 1000) that are thought to represent a transition away from the predominantly hunter-fisher-gatherer subsistence economy. **Methods:** To investigate how this subsistence transition affected the biological health of Santa Catarina populations, this study compares previously recorded pathological data recovered from The Backbone of History. This data includes: carious lesions, cribra orbitalia (CO), porotic hyperostosis (PH), linear enamel hypoplasias (LEH), and periapical abscesses. Both pre-Ceramic (N=15) and Ceramic (N=2) groups are compared to determine whether population health declined after the introduction of ceramics to the region. **Results:** Prevalence of the markers was compared through χ^2 tests. The results indicate a significantly higher prevalence of carious lesions ($p=0.035$ for individuals affected and $p<0.001$ for teeth affected) and cribra orbitalia ($p=0.027$) among the pre-Ceramic samples than the Ceramic samples. The remaining tests indicate non-significant differences. **Conclusion:** The results suggest that the appearance of the Ceramic culture, while transformative to the people and landscape, did not detrimentally affect the overall

biological health of the local population. However, changes to local diets and/or consumption practices (e.g. increased reliance of plants) are likely to have affected oral health (e.g., caries prevalence), and even aspects of childhood health (e.g., CO prevalence).

During drought in northern Kenya, mothers with iron deficiency were younger, but not of low socioeconomic status. *EMMA BIGNALL, *QUEXTEEN SAUTEURN, NERLI PAREDES RUVALCABA and MASAKO FUJITA. Michigan State University.

Background: Maternal anemia is a prevalent issue globally. There are multiple variables associated with maternal anemia, including socioeconomic status (SES), inter-birth intervals (IBI), maternal age, and time postpartum. Many studies report an association between maternal anemia and low SES, however, studies are less conclusive with the direction of associations with IBI, maternal age, and time postpartum. **Methods:** We used archival data from 241 breastfeeding mothers, originally collected in northern Kenyan during 2006 Horn-of-Africa drought. Associations were examined using t-tests and chi-square tests. **Results:** Anemic mothers ($n=59$) were younger compared to non-anemic mothers ($n=182$; $p<0.01$). Likewise, mothers with iron deficiency anemia (IDA; $n=40$) and anemia of infection (AI; $n=11$) tended to be younger compared to their counterparts ($p=0.02$ and $p=0.07$, respectively). Anemic mothers had shorter postpartum time than non-anemic mothers ($p=0.02$). Mothers with IDA tended to also have shorter postpartum time than their counterparts ($p = 0.09$). There were no significant associations between maternal

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anemia/types of anemia with SES and IBI. **Conclusion:** The association between SES/maternal age and maternal anemia may differ depending on the environment. This study highlights the importance of accounting for socio-demographic variables in understanding maternal anemia.

Funding: NSF- BCS0622358; Wenner-Gren Foundation WG- 7460; MSU PURI.

The influence of habitual activities and lifelong occupations on skeletal robusticity and metric traits. *LYDIA BLIZZARD, *HARRISON DEAN, HALEY HORBALY and MARK HUBBE. University of Tennessee Knoxville, Ohio State University.

Background: Previous studies have postulated about the relationship between the robusticity of the skeleton and environmental factors. There is a possibility that environmental factors will influence the level of robusticity of the skeleton, therefore affecting skeletal scoring methods. **Methods:** The occupational data reported from the one-hundred and twenty individuals have been scored on a scale of one to five, with five being the most rigorous. Likewise, the habitual activity data have been scored on a scale of one to three, with three also being the most rigorous. **Results:** Currently standing, there is no significance between Phenice and Walker traits and reported habitual activities and occupations ($p > 0.05$). There is, however, significance for the olecranon fossa shape and depth ($p = 0.00492$) and the angle of the medial epicondyle of the humerus ($p = 0.02878$). **Conclusion:** Further implications stemming from this study could include research into the applicability of dominant limb use in environmental factors such as habitual activities or occupations.

Human jaywalking. *AZARIEA BONNER-HARRIS and CARA WALL-SCHEFFLER. Seattle Pacific University.

Background: I aimed to see how humans might use environmental cues to reallocate energy to maximize survival likelihood, even at the risk of expending more energy. **Methods:** I observed pedestrians walking across crosswalks of pre-measured distances and collected video footage. I then used that footage to analyze biological markers such as age and sex, as well as social conditions such as traffic, load carrying, and group setting. This information was then logged in an excel sheet and analyzed for statistical significance. **Results:** The results showed that neither jaywalkers nor non-jaywalkers prioritized minimizing their energy expenditure, as shown by their average walking speeds. It also revealed that women were less likely to jaywalk compared to men, people carrying loads did more surrounding checks, and that people in groups did not adjust their speeds when they jaywalked nor did people carrying loads. All of these results were statistically significant ($p < 0.05$). **Conclusion:** Seeing how previous studies argued that the reduction of energetic cost is a primary consideration for humans, this research reveals that humans are able to make real-time internal adjustments to prioritize their survival based on cues that they process in their environment.

A push for trans-inclusive language in forensic anthropology. *FATIMAH BOUDERDABEN. Texas A&M University.

Background: Based on the published statistics, it is highly likely that forensic scientists will encounter individuals who identify as transgender. For this reason,

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when presenting work in a forensic and/or applied setting, the researcher should take care to not mis-gender unidentified victims.

Methods: Forensic academic articles were searched through the "Criminal Justice Abstracts" database accessible by all Texas A&M University students. Using a variety of keywords to pull as many articles relating to the topic of unidentified remains and sex identification/estimation as possible, a total of 611 articles were evaluated. After reading the 611 abstracts, only 105 of them were considered topical and were read through completely to be marked for the use of trans-exclusive language. For the purposes of this research trans-exclusive language was defined as 'language that gendered an unidentified body' or 'language that confused the terms sex and gender.' **Results:** Of the 98 academic papers reviewed, approximately 49% of articles reporting on unidentified remains utilized gendered language, as denoted by the use of pronouns such as he or she, when referring to the remains even though the gender was still unknown. Approximately 93% of articles talking about sex identification/estimation would use sex and gender interchangeably when gender was mentioned. The high rates of error could be easily addressed by adopting gender neutral reporting in the forensic field. **Conclusion:** While the goal of the forensic anthropologist working on an unidentified remains case would be to estimate biological sex, to effectively create a profile, the anthropologist would need to respect the possibility that the unidentified individual could be transgender. Since gender cannot be determined from remains alone, implementing gender neutral language would keep the possibility of the remains belonging to a transgender

individual a constant in the mind of the investigator and could greatly decrease the probability of the unidentified individual being mis-gendered.

The identification of temporal shifts in mortuary practices in the late third millennium BCE using color changes to bone. *ANTONIA CARTER and LESLEY GREGORICKA . University of South Alabama.

Background: This research uses the remains of two Bronze Age tombs (Unar 1 and Unar 2) in order to identify any possible changes in mortuary practices over time. **Methods:** The Munsell color chart is used to assign color codes to five different areas of the distal humerus: the capitulum, trochlea, medial epicondyle, anterior distal third of the diaphysis, and the olecranon fossa. Chi square statistics are then used to test statistically significant differences between the articular and non-articular surfaces both within the individual tombs and between them. **Results:** There were no statistically significant difference between articular and non-articular surfaces within the individual tombs. However, there was a statistically significant difference between the Unar 1 articular surfaces and the Unar 2 articular surfaces, as well as the Unar 1 non-articular surfaces and the Unar 2 non-articular surfaces. **Conclusion:** This research shows a change in mortuary practices over the course of the Umm an-Nar Bronze Age period. This change could signify a change in ideology, or they could signify a change in the materials used to perform these funerary rites.

Dietary fiber and nutritional quality of the foods of Bornean orangutans (*Pongo pygmaeus wurmbii*) in Gunung Palung

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National Park, West Kalimantan, Indonesia. *ISHRAT CHOWDHURY, *MADELINE M. EORI, TRI W. SUSANTO, ERIN E. KANE, NANCY-LOU CONKLIN and CHERYL D. KNOTT. Boston University.

Background: We will be comparing dietary fiber of food of wild Bornean Orangutans to other nutritional components to better understand food choice. **Methods:** Food samples were collected at Gunung Palung National Park in Borneo Indonesia. These samples were then dried and ground. They were weighted and refluxed with acid detergent reagent (ADF). The difference in mass was recorded in a database of orangutan food nutritional quality. **Results:** An ANOVA test was done to compare the different parts of the plant. The results showed that bark had a significantly higher ADF concentration than pulp and seeds ($p < 0.001$) and leaves had higher ADF concentration than seeds ($p < 0.001$). The whole fruit had significantly higher ADF concentration than the pulp in seeds ($p < 0.001$). We also compared the ADF to other nutritional components. There was a negative correlation between simple sugar concentration and ADF ($R = -0.63$, $p < 0.001$). There was no significant correlation between ADF and protein ($R = -0.14$, $p = 0.17$) or ADF and lipid ($R = 0.134$, $p = 0.19$). **Conclusion:** Understanding the nutritional component of foods shows that foods high in ADF may still be beneficial for other nutritional components.

Funding: National Science Foundation (BCS-1638823, BCS-0936199, 1540360, 9414388); National Geographic Society; US Fish and Wildlife (F15AP00812, F12AP00369, 98210-8-G661); Leakey Foundation; Disney Wildlife Conservation Fund; Wenner-Gren Foundation;

Nacey-Maggioncalda Foundation; Conservation, Food and Health.

Y-chromosome variation and paleodemography in the Ticuna of South America. *HILDA REBECCA CHUBARYOV and DAVID MERRIWETHER. Binghamton University.

Background: Several biological samples were collected in the summer of 1976 from the Ticuna, a South American Amazonian population; a previous study had extracted mitochondrial DNA from the samples of unrelated individuals spanning four villages to analyze the d-loop region of the mitochondria. To further assess the genetic relationship of the Ticuna to other South American populations and determine the gene flow patterns of males and females, Y-chromosome analysis was conducted. **Methods:** Thirty-five unrelated male individuals were selected to do short tandem repeat (STR) analysis. A multiplex PCR was conducted to look at the six Y-chromosome markers DYS19, DYS388, DYS390, DYS391, DYS392 and DYS393. The multiplex PCRs were genotyped using a ABI 3730xl DNA analyzer and were analyzed in the program genemapper. Additionally, a restriction fragment length polymorphism (RFLP) for the DYS199 marker was carried out using MfeI enzyme and the YAP indel was assessed through gel electrophoresis to establish haplogroup and haplotype frequencies. Yap+ is an insertion polymorphism while Yap- is a deletion polymorphism. **Results:** Haplogroup diversity of the population was found to be 60% haplogroup Q, which is the only haplogroup indigenous to South America, 34.3% haplogroup N which is commonly found in Northern Eurasia and 5.7% other haplogroups, which indicates

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some degree of admixture in the population. We believe that most of haplogroup N and the unknowns will resolve into haplogroup Q or C with the testing of additional markers such as DYS385a/b and M231. Haplotype diversity was assessed by categorizing the six Y-chromosome markers into groups based on their number of repeats. There were eleven different haplotypes in the population. It was also determined that 100% of the samples were Yap-, which indicates that the individuals most likely were not of African origin. Lastly, the DYS199 marker was analyzed. It was determined that 97.1% samples were DYS199T and 2.9% were DYS199C. The DYS199T version is commonly associated with South American populations. **Conclusion:** This research is helpful in the expansion of understanding the different haplogroup frequencies of South American populations as Y-chromosome analysis looks at how genes are passed down in males whereas mitochondrial DNA is only passed down by females. The project will not only allow us to look at male and female specific gene flow and migration patterns but also ultimately help us understand how geography, language, and marital practices have been able to affect genetic relationships both within and between the South American populations.

Middle meningeal arteriovenous and dural sinus variation in 6-8.0 year old humans.

*CORTNEY M. CONNOR, *TIFFANY W. SHIEN, *PINA S. SIMONE, *ISABELLE B. REICH, *CHLOE LEE, GARY D. RICHARDS and REBECCA S JABBOUR. University of California, Berkeley, University of the Pacific.

Background: The meningeal arteriovenous system supplies or drains blood from the dura mater and bone while the dural sinuses drain blood from the brain, dura, and bone. Assessment of these systems, based on patterns exhibited on endocranial casts, has a long history in the study of primate brain evolution. However, recent reviews demonstrate a significant need for new data and investigative procedures. We address some of the issues by analyzing a large ontogenetic sample in three dimensions. **Methods:** We CT-scanned 40 crania developmentally aged from 5.8-7.9 years. Ages derive solely from tooth calcification patterns. Meningeal and dural sinus systems were reconstructed in 3D on isosurfaces. Various-sized 3D markers were placed to map relative sizes and patterns. **Results:** Using the traditional Adachi types for the meningeal system resulted in 45%, 15% and 40% of Types I, II, and III, respectively. Right/left differences in these types occurred in 65% of the sample. Alternatively, looking at the 3D complexity of branching and anastomoses, right/left differences were observed in 60% of individuals, with right-dominance and left-dominance equally represented. Middle meningeal branches crossed the coronal suture in 95% of individuals. The frequency and number of such branches were higher on the left side. The right transverse dural sinus was dominant in 55% of cases, with 30% showing left dominance and 15% having equal drainage. Only 25% of cases showed occipital marginal drainage. **Conclusion:** Three-dimensional mapping of the arteriovenous and dural sinus drainage systems has the potential to reveal their relationships to the developing neural contents and functional cranial regions.

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Funding: Intended SOF funds from University of California, Berkeley.

Gibbon chatter: A vocal analysis of male white-handed gibbon solo calls. *PHILIP B. CORBETT II, MARGARET SOBASZEK and LYDIA LIGHT. University of North Carolina at Charlotte.

Background: Studies have shown that female white-handed gibbons (*Hylobates lar*) can be individually identified through analysis of their great calls. Using similar methods and programs, we tested to see if male white-handed gibbons could be individually identified through the analysis of their solo calls. **Methods:** Using a hand-held recording device, we recorded the solo calls of three males (11 calls; male 1: 3; male 2: 3; male 3: 5) in Huai Kha Khaeng Wildlife Sanctuary during June and July of 2018. Maximum and minimum frequency, frequency range, and call duration were analyzed using Raven Pro audio software (version 1.5). Statistical significance was tested using ANOVA in JMP 13.2.0. All results are two-tailed. **Results:** Our analysis shows that differences in mean maximum frequency and mean frequency range are of little significance ($p > 0.05$). However, both mean call duration (Male 1: 5.943 +/- 0.041 SD; Male 2: 6.862 +/- 0.377 SD; Male 3: 7.754 +/- 0.779 SD; ANOVA: $F(10) = 9.2117$, $p = 0.0084$) and mean minimum frequency (Male 1: 381.267 +/- 9.207 SD; Male 2: 343.000 +/- 9.207 SD; Male 3: 451.240 +/- 7.132 SD; ANOVA: $F(10) = 46.8900$, $p < 0.0001$) showed significant differences between individual male white-handed gibbons. **Conclusion:** Our results suggest that individual males can be identified through the analysis of their solo calls. This gives primatologists insight into the complexity of individual gibbon

vocalizations and can help primatologists studying white-handed gibbons distinguish between individual males without having to see them. Individual identification can aid field researchers when searching for study groups and can also help monitor populations over time.

Geometric morphometric assessment of skull symmetry in 6-8.0 year old humans. *JESSICA M. CRONIN, *ANA SHAUGHNESSY, *JANE VANNAHEUANG, LAURA E. CIRILLO, GARY D RICHARDS and REBECCA S. JABBOUR. University of California, Berkeley, University of the Pacific.

Background: However, little is known of the complex interplay between developmental rates and duration, functional components, and constraints that result in skull symmetry or asymmetry. Consequently, we are ill equipped to differentiate potentially problematic changes resulting from the current epidemic of asymmetric skulls (plagiocephaly) related to SIDS prevention. **Methods:** We compiled 38 normal skulls with developmental ages of 5.8-7.9 years. Ages are based solely on dental calcification patterns. With the mandible articulated on the cranium, we used a Microscribe to digitize 254 3D landmarks; 38 are employed herein. The sample was split into right/left halves. Analysis of Procrustes-aligned shape variables with Principal Components Analysis (PCA) was carried out in Morphologika 2. **Results:** Variation explained by PC1-4 is 18%, 13.2%, 9.9%, and 6.65%, respectively. PC1 relates to increased cranial base flexion and anteroposterior fronto-occipital expansion. PC2 relates to skull shortening and height increase. No individual is symmetrical on PC1-2 and only

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16% of individuals approach coincidence of the right/left side plots. On PC1 13% and 24% of individuals show low to moderate right/left separation, respectively while 18% and 24% do so on PC2. Individuals with +PC1 and -PC2 scores show the lowest degree of right/left asymmetry on PC1-2. **Conclusion:** In order to understand any evolutionary change, we have to understand the current condition of skull symmetry. Our project creates a baseline foundation for asymmetric individuals.

Funding: Student Opportunity Fund at UC Berkeley.

Macronutrient composition of foods eaten by owl monkeys. *KANDRA CRUZ, BENJAMIN FINKEL, JESSICA ROTHMAN and EDUARDO FERNANDEZ-DUQUE. Hunter College.

Background: Primates face unique challenges in obtaining adequate nutrition because their habitats are variable through time and space. While we know much about the different food items that neotropical primates eat, we know little about the nutrients contained within them. To better understand the diet of owl monkeys (*Aotus azarae*) in Formosa, Argentina, we collected various samples of the foods eaten by them and estimated their nutritional composition. **Methods:** We recorded the different foods eaten by the monkeys through focal observations of identified individuals. We collected plant parts (N=100) from the same trees where the animals fed and processed them in the same manner that they ate them. For example, if an owl monkey did not consume the seeds of a fruit, only the pulp was collected. We analyzed samples for their fiber concentrations (neutral detergent fiber

NDF, acid detergent fiber ADF, and acid detergent lignin ADL), crude protein, non-structural carbohydrates (TNC) and lipids by running them through a series of chemical nutritional assays. **Results:** Ripe non-fig fruits (n=34), unripe non-fig fruits (n=21), figs (n=2), young leaves (n=6), mature leaves (n=14), flowers (n=22) and a mushroom (n=1), were collected and analyzed. The fig samples contained the highest percentage of fiber (NDF: 54.7% +/- 14.7; ADF : 43.2% +/- 10.4; ADL (26.0% +/- 8.1) and the least amount of TNC (16.3 +/- 9.8). Unripe non-fig fruits (5.2% +/- 2.9) and ripe non-fig fruits (5.7% +/- 3.8) had the highest lipid concentrations while mature leaves contained the highest crude protein (25.29% +/- 7.56). Similar to other studies, our findings suggest that fruits were highest in non-structural carbohydrates, whereas leaves were highest in protein. **Conclusion:** Compared to foods eaten by larger bodied primates, the nutrient composition of owl monkey foods are lower in fiber and higher in TNC. Owl monkeys probably lack the gut morphology to adequately digest fiber, so they select low fiber foods. Future research is needed to understand the factors that underlie food selection and dietary nutrient balancing in this small monkey.

Dictated by disease: Increased susceptibility of immigrants in 17th Century Maryland to their new pathogenic environment. *AUDREY DERVARICS, KATHRYN BARCA, KARI BRUWELHEIDE, DOUGLAS OWSLEY and KRISTA FISH. Colorado College.

Background: In 17th Century Chesapeake, the growing European population was fed by immigration from England. Upon their arrival, these settlers encountered an entirely

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new landscape, pathogenic environment and societal structure, the effects of which are documented in their skeletons. **Methods:** Our study assesses the differing mortality factors affecting recent immigrants, short-term residents and long-term residents. These groups were differentiated by their varying carbon isotope levels in their bones correlating to their level of accommodation to the local diet. Age distributions by immigration category, sex and time period were analyzed to see sex-based and temporal patterns. General characteristics of each immigrant group were cataloged and compared to the historical record. **Results:** Recent immigrants consist of mainly males (78%) and are concentrated in the 20 - 39 age range (72%). Short-term residents are majority female (70%) and 30 - 49 years old (70%). Long-term immigrants are comprised of a mix of males, females, and indeterminate sex subadults (41%, 33% and 25%) and most (69%) are under 20 years old. A two-tailed Chi-square test determined that the sex imbalances between immigrant groups are statistically significant ($p = 0.0292$). Recent immigrants have the highest representation in periostitis, degenerative joint disease and fractures (75%, 52% and 55%). **Conclusion:** In using bone carbon isotopes to identify immigrants, we can see the fluidity and temporality of this immigrant identity, understanding what is affecting individuals at each stage as they assimilate to their new environment. This study has implications for other research investigating the variable factors affecting transitioning migrant populations.

Funding: Colorado College Venture Grant Fund, Colorado College Anthropology Department, Colorado College Conference Presentation Grant.

Squatting facets and osteoarthritis in an agricultural sample in ancient China: A biocultural perspective on ancient gendered activity. *KAYLA DOMINGUEZ and JACQUELINE T. ENG. Western Michigan University.

Background: Habitual mechanical motion can be manifest skeletally and may be indicative of behavioral patterns relating to subsistence practices and division of labor. This study focuses on the evidence of squatting, a posture often seen among foraging and early agricultural populations, marked by the hyperflexion of the hip and knee joints and hyperdorsiflexion of the ankle and subtalar joints in an archaeological sample from Lamadong (289-370 AD). **Methods:** Examination of squatting facets, determined by the presence of a wear mark on the anterior distal tibia, were counted per individual. Observation of osteoarthritis included those surfaces of the knee (femur, tibia, patella) and ankle (tibia and talus) for eburnation, and/or any two of the three markers of joint disease (pitting, surface change, marginal lipping). Statistical analyses performed included unpaired t-tests and Z-scores at the $p=0.5$ level of significance. **Results:** Comparisons of squatting facets between men (41.4%) and women (58.9%) reveal significant differences, with a higher frequency among females ($t(272)=3.062$, $p=0.002$). Frequency of squatting facets distributed between the age groups was also analyzed, with middle aged females showing a significantly higher rate ($Z= 2.457$). **Conclusion:** Gendered activity among ancient societies is vital in the investigation of differences in societal roles and lifestyles between the sexes. Biocultural analysis of squatting facets allows us to reconstruct such ancient activity patterns and

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their social implications at the individual level. Results from this study, alongside other skeletal, literary, and iconographic data gathered from comparative studies, will explore the various activities that cause squatting facets, and thus the importance of these activities between the sexes.

Funding: Fulbright-Hays Doctoral Dissertation Abroad program & University of California Pacific Rim Award.

Influence of metabolic rate and changes in energy balance on leptin levels in a sample of young adults. *KAYLIN DONG, *JENNAH THOMPSON-VASQUEZ, STEPHANIE B. LEVY, AARON A. MILLER and WILLIAM R. LEONARD. Northwestern University.

Background: Leptin plays important roles in the regulation of body weight and appetite. Leptin levels are strongly associated with body fat stores; however, the influence of energy expenditure and energy flux on leptin levels is less clearly defined. This study examines the relationship between leptin and measures of energy dynamics (resting metabolic rate [RMR] and changes in body composition) in a sample of 35 Chicago-area adults (26 women, 9 men; 18-35 years). **Methods:** Subjects were recruited in the summer of 2016 and were measured again during the summer of 2017. RMR was measured at baseline. Anthropometric measurements and dried blood spot samples were collected at baseline and one year later. **Results:** Women of this study had significantly higher leptin levels than men (females = 8.2 ± 5.2 $\mu\text{g/L}$; males = 3.0 ± 2.7 $\mu\text{g/L}$; $P < 0.01$). Leptin levels were positively correlated with percent body fat (%fat; $r = 0.69$), and fat mass (FM; $r = 0.43$), and

negatively correlated with fat-free mass (FFM; $r = -0.47$). Variation in leptin levels was also sensitive to changes in energy status. Leptin levels were positively correlated with changes in both %fat ($r = 0.33$) and FM ($r = 0.26$) over the previous year, and inversely related to changes in FFM ($r = -0.34$). Baseline RMR was inversely related to leptin levels ($r = -0.30$), suggesting that greater metabolic turnover was associated with reduced leptin concentrations. **Conclusion:** These findings indicate that leptin levels vary not only with current nutritional status, but also with measures of metabolic turnover and energy flux.

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Association between cesarean birth and breastfeeding trajectories in population with traditionally intensive breastfeeding practices. *DEJA L. EDWARDS, MELANIE MARTIN and CLAUDIA VALEGGIA. University of Washington.

Background: Indigenous Qom (Toba) families in Formosa Argentina have been undergoing rapid lifestyle changes, including biomedicalization of birthing practices. In a recent study of 90 Qom infants from the peri-urban village of Namqom, 46% of the participants were born via cesarean delivery. This statistic is alarming, given the recommended cesarean birth rates according to the World Health Organization are expected to be below 15% for all births. **Methods:** Using a subset of sixty-five of the infants from the prior study, we conducted a logistic regression to assess if cesarean births were associated with a greater likelihood of having transitioned from exclusive

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breastfeeding to breastfeeding with complementary foods within the first 16 weeks of age. **Results:** Following analysis, there were strong effects between the breastfeeding status at 4 months of age and whether or not the child was delivered via cesarean section (OR= 2.16) and being a young mother (OR= 4.11). Additional test of regression models concluded there was a possible confounder, outside of having a cesarean delivery, leading to the trend of young mothers stopping exclusive breastfeeding earlier than those not delivered via cesarean section. **Conclusion:** In studies conducted with the Qom in the 1990s - early 2000s, infants were observed to universally breastfeed up to 2 years of age, with complementary foods being introduced between 4 and 6 months of age. With the rates of cesarean sections reaching 46% in the peri-urban village of Namqom, it is important to study this transition in the Qom with this transition in its early stages, and knowing the associations between cesarean sections and delayed breastfeeding initiation, which may result in morbidity risks for the infants.

Scoring external occipital protuberance prominence in extant human growth study cephalograms. *LAUREN A. ESTES and MIRANDA E. KARBAN. Illinois College.

Background: The external occipital protuberance (EOP), a nuchal ligament and muscle attachment point on the posterior occipital squama, is often cited as a sexually dimorphic trait, with a more robust, "hooked" protuberance thought to be indicative of male sex. Growth and development of this trait, however, are not well understood, and the trait has not, to our knowledge, been studied in a longitudinal

growth sample. Development of this trait was observed in longitudinal craniofacial growth records. **Methods:** EOP prominence was scored in a longitudinal growth sample of extant human lateral cephalograms. A total of 100 subjects (47 female, 53 male) were each scored at 3 age points spanning from 11.5 to 20.5 years. Subjects at each age were assigned an EOP score of 1 (not visible) through 4 (hooked) based on the protuberance's rugosity and curvature. T-tests were used to assess whether significant differences exist between male and female scores at each age group. **Results:** No significant sexual dimorphism was found in EOP scores for the youngest age group (range: 11.5 - 12.4 years), but sexual dimorphism in the second (13.7 - 16.8 years) and third (18.0 - 20.6 years) age groups were found to be significant. These results reveal the expected pattern that sex-related variation in this trait emerges at puberty. Interestingly, 8.51% of sampled adult female subjects were found to possess a prominent hooked protuberance. **Conclusion:** This finding has important implications in the forensic field, showing that investigators should not rely solely on the EOP when estimating sex.

Habituating chimpanzees for tourism in Kibale National Park, Uganda. *JONATHAN FALLAS. Hunter College.

Background: Habituation is an invaluable tool for primatologists conducting research in the field; a delicate process that has allowed researchers to observe firsthand and at close range the natural behaviors of different species and inform our understanding of primates. Current efforts by the Uganda Wildlife Authority aim to habituate a troop of chimpanzees (*Pan*

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troglodytes schweinfurthii) known as "Buraiga" in Kibale National Park, Uganda to human observation for eco-tourism purposes. To aid with habituating the group, my assignment was to photograph as many individuals as possible to start composing profiles in order for park staff to identify individuals. **Methods:** From June 12th to July 6th, I joined a team of Uganda Wildlife Authority staff in their ongoing habituation of the Buraiga troop at the Kanyanchu tourist site in Kibale National Park, located in Western Uganda. Tracking chimpanzees took place three times a week from 7 A.M. to 6 P.M. The individuals were recorded along with their locations, and photos were taken. **Results:** The average rate of chimpanzee encounters was three per day, and over the period I photographed 35 chimpanzees. Of the 35 encountered chimps, 9 individuals were able to be distinctly identified. Encounters with chimpanzees were closer in proximity and longer in time duration, when observers waited at key feeding sites rather than actively pursuing ranging individuals. **Conclusion:** The results from this experience confirm other previous reports of chimpanzee habituation; that it is difficult to see many chimpanzees in a single day, and it can take several years to habituate a community. The take-aways from my observation and experience in the habituation process were largely in accordance with the testimonials and empirical data that researchers have, over the years, compiled on the habituation of chimpanzees. Listening for and following auditory clues was also an efficient means for finding chimpanzees, so silence in the forest was necessary during habituation. More often than not, the encountered chimps' reactions were either avoidance or flight,

suggesting that they were afraid of the human team.

Macroscopic analysis of periosteal new bone in human long bones. *ERIC FRAUENHOFER. SUNY Buffalo State.

Background: Periosteal new bone (PNB), also known as a periosteal reaction or periosteal lesion, is a proliferative skeletal lesion that results from the inflammation of the periosteum, which is a thin multi-layered connective tissue that surrounds all bones, except at articulation surfaces, during life. PNB is caused by either infection or trauma to the periosteum and results in new bone deposition. **Methods:** I studied eighty-nine adult individuals of the Hamann-Todd Osteological Collection, a documented human skeletal collection at the Cleveland Museum of Natural History. I characterized each individual lesion based on its maximum length and width, whether it appeared focal or diffuse, and its maturity and vascularity. I used digital sliding calipers (for larger lesions I used a digital bone board) to measure a lesion's length and width. I assessed whether a lesion was focal or diffuse based on whether the lesion appeared only in one location or on one bone (focal) or appeared in several locations or on several bones (diffuse). I assessed a lesion's maturity based on the presence of woven bone, lamellar bone, or a mixture of the two. Active PNB consists of newly deposited woven bone whereas healed PNB consists of lamellar bone. Lesions in the process of healing have a mixture of woven and lamellar bone. Lastly, I assessed a lesion's vascularity based on the presence of striations, foramina, or a mixture of the two. **Results:** The types of long bones are not equally affected (Chi-Square (5) = 75.20, $p < 0.0005$), with the lower long

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bones affected more often than the upper long bones. The tibia is the most affected bone, accounting for 69 (32%) of the bones affected, consistent with the literature. Additionally, of the 356 lesions studied, 120 (34%) were located on tibiae. The number of lesions were more than expected on tibiae and fibulae (Chi-Square (5) = 154.47, $p < 0.0005$). Tibiae also had a higher proportion (0.53) of diffuse lesions, compared to focal lesions (0.47), than the other types of long bones, which had either an equal or lower proportion of diffuse lesions to focal lesions. Almost half of all lesions (48%) consisted of a mixture of woven and lamellar bone. Additionally, 69% of all lesions were characterized as having mixed vascularization consisting of striations and foramina. **Conclusion:** This research enhances existing descriptions of PNB, which is one of the most commonly encountered conditions in bioarchaeological remains.

Funding: This research was funded by the Undergraduate Summer Research Fellowship Program through SUNY Buffalo State's Office of Undergraduate Research and the Dr. Gerard and Kathleen Wieczkowski Anthropology Research Grant.

Life history underpinnings of East Turkana faunal turnover during the early Pleistocene. *JAMES FRAZIER and AMANDA MCGROSKY. Bryn Mawr College, Arizona State University.

Background: Our research seeks to determine whether population dynamics of Pleistocene large mammalian and primate fauna in East Turkana can be linked to different intrinsic and extrinsic factors at the sub-regional scale. **Methods:** The East Turkana Faunal Database and novel field

collections were used to calculate rates of population decline for mammalian taxa in three East Turkana sub-regions around the paleo-lake Lorenyang. **Results:** Multiple regressions were used to quantify the relationship between percent change in relative abundance, and intrinsic and extrinsic predictor variables (diet, local environment, life history traits, body mass). Results suggest that population changes can be explained by different combinations of variables in different sub-regions. In contrast to global studies, our results suggest a greater role for life history strategies at a sub-regional level, and have potential implications for factors influencing human and primate success in the face of climate change. **Conclusion:** The results of our study provide insight into the influence of varying life history strategies at a location and point in time that was pivotal to the evolution, development and success of modern humans.

Funding: Bryn Mawr LILAC Summer Internship Funding, Judy Loomis Gould Scholarship, Pauline Austin Adams Fund for Excellence in Anthropology.

Chimp chomp: A rare case of possible predation on an adult chimpanzee (*Pan troglodytes verus*). *SADIE R FRIEND, BRIANA POBINER, ANDREA R ELLER, RITA AUSTIN, COURTNEY HOFMAN and SABRINA B. SHOLTS. Radford University.

Background: The occurrence of predation on large-bodied hominoids (such as chimpanzees) is rare and often debated. Taphonomic damage has been identified on the skull of a chimpanzee (*Pan troglodytes verus*) that is hypothesized to be tooth marks from a large cat, or another chimpanzee.

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Methods: The cranium has evidence of damage to the temporal, occipital, and maxillary regions that most closely resembles the tooth marks of a large predator. This damage was photographed, micro-CT and 3D laser scanned, and the tooth marks were measured with digital calipers to compare with tooth marks left by mammalian predators. **Results:** There are no signs of recent breakage on the cranium, and size and color variation in the marks suggest at least two damage events, possibly by different animals. Based on the size of the tooth pits and punctures, ranging from 2.65-8.75mm in maximum length and 1.48-6.63mm in maximum breadth, we hypothesize that some of this taphonomic damage was made by a large cat, such as a leopard, or by another chimpanzee. However, due to the differing patinas of the inside of some tooth marks and the rest of the cranium, it appears that the damage occurred post-mortem and was not the cause of death for this individual. **Conclusion:** Tooth marks seen on any large-bodied animals are quite rare and this poster presents tooth marks, most likely occurring postmortem, on a chimpanzee. This is a very rare occurrence and the description of these tooth marks, most likely left by a large cat or fellow chimpanzee, can hopefully be used in future research of tooth marks as well as possible predation on other primates.

Funding: Smithsonian Institution.

A lesson for monkeys: Species distribution models of *Protonotaria citrea* under future carbon-emission scenarios and implications for Neotropical primates. *ERNESTO GAGARIN, AMY RECTOR and MARIE VERGAMINI. Virginia Commonwealth University.

Background: The tropics are predicted to experience temperature and precipitation fluctuations resulting from climate change. Declining food resources and habitat required by tropical fauna consequently may cause species to shift to less suitable habitats. Understanding species' range, and how they change over time, allows researchers to develop more robust species management plans and identify vital habitat for conservation planning. **Methods:** Here, ArcGIS and MaxEnt are used to create species distribution models (SDMs) that project present Prothonotary Warbler (PROW) breeding and wintering habitat into the year 2070 under extreme and conservative carbon-emission climate scenarios. **Results:** The models demonstrate shifts in PROW range under both climate scenarios to areas not presently suitable for the species; notably, a shift in suitable breeding grounds from the Mississippi River Valley and Eastern seaboard to southern Canada and central America, and a shift in suitable wintering ground from central America to the Gulf Coast and as far north as southeast Virginia. **Conclusion:** SDMs can be used to predict species distributions in the future and has conservation implications for other taxa, including endangered Neotropical primates. This information is vital in prioritizing future conservation areas. This is especially important for arboreal species such as the Geoffroy's Spider Monkey, which are susceptible to habitat fragmentation. Future studies on New World monkeys should utilize SDMs to predict, in greater detail, where certain species could migrate in the face of climate change; these SDMs should then be used in conjunction with land management to

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preserve land that is most suitable for endangered primate species.

Reconstructing weaning and childhood diets at the 6th-5th C. BCE skeletal population of the Greek colony of Himera.

*ABIGAIL S. GANZ, LAURIE J. REITSEMA, KATHERINE L. REINBERGER, STEFANO VASSALLO and BRITNEY KYLE. University of North Carolina at Chapel Hill, University of Georgia.

Background: Adequate nutrition during early childhood influences survival and adult health, yet practices concerning children are systematically overlooked in the literary and archaeological records. By investigating the infant feeding practices of the 6th-5th C. BCE skeletal population from the Sicilian Greek colony of Himera, our research examines ancient childhood lifeways and complements investigations into the morbidity and mortality of the Himeran colonial population. **Methods:** Using stable nitrogen and carbon isotopic ratios ($\delta^{15}\text{N}$, $\delta^{13}\text{C}$) derived from the bone collagen of 30 infants and juveniles and 10 adults, we determined time of weaning instigation, cessation, and the nature of complementary foods supplied to weaning infants. Bayesian analysis of the data was conducted using the R WARN statistical package. **Results:** Our statistical analysis demonstrated that weaning began at 5 to 6 months after birth and concluded by 4 to 5 years of age. Both nitrogen and carbon values demonstrate clear trophic level enrichments associated with breast-milk consumption as well as declines to adult baselines with the transition to a solid diet. **Conclusion:** The modeled weaning chronology suggests that weaning lasted longer at Himera than at other colonial case studies and complements

investigations into Himeran childhood stress which suggest that children experienced increased vulnerability during weaning. By expanding our understanding of childhood diets, this investigation contributes to a broader discussion of the role of juveniles within complex colonial societies.

Funding: National Science Foundation Research Experience for Undergraduates award numbers 1560227 and 1560158, the University of Georgia, and the University of Northern Colorado.

Linear analysis of pliopithecoid dental morphology. *JACQUELINE GARNETT, DAVID R. BEGUN and ANDREW C. HOLMES. McMaster University, University of Toronto.

Background: The taxonomy and phylogeny of pliopithecoids have been thoroughly debated, largely through qualitative observations. This study seeks to quantify the morphological differences between the Göriach and Sansan pliopithecoid samples and assess whether these differences are statistically significant and justify the recognition of two distinct taxa. **Methods:** We photographed the occlusal surface of fossilized second and third lower molars from various Pliopithecoid, Propliopithecoid, and Parapithecoid species. We then used ImageJ to record linear, angular, and area measurements from each specimen. We used appropriate transformation methods and variables were analyzed through a combination of univariate and multivariate statistical techniques. **Results:** Preliminary results from our principal component analysis show clear separation between the Göriach and the Sansan samples. The principal components seem to be driven largely through

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mesiodistal length and molar shape. The morphological differences demonstrated between these two groups supports the hypothesis that these samples constitute two distinct species. **Conclusion:** This study helps to identify the taxonomic placement of the Göriach pliopithecoid samples. Furthermore, quantifying the dental morphological characters of plioptihecoid species will aid future phylogenetic analyses that aim to resolve plioptihecoid evolutionary relationships.

Funding: 1) Natural Sciences and Engineering Research Council of Canada 2) Ontario Graduate Studies 3) University of Toronto, Department of Anthropology.

Reliability of goniometer measurements to determine ankle dorsiflexion: implications for assessment of gastrocnemius equinus. *CRISTINA GILDEE, ELEN M. FEUERRIEGEL, KALYANI RAJOPADHYE and PATRICIA A. KRAMER. University of Washington.

Background: Ankle range of motion (ROM) is frequently measured in clinical settings for the purpose of diagnosing and treating foot and ankle pathologies. Gastrocnemius equinus (GE), a condition in which isolated gastrocnemius contracture inhibits ankle ROM, contributes to foot pain in otherwise neurologically healthy individuals. Controversy surrounds the definition of GE, however, and the reliability of goniometer-based measurements of dorsiflexion—and consequently identification of gastrocnemius contracture—is untested. This study examines the reliability of using a goniometer to measure ankle dorsiflexion. **Methods:** Each of two observers (KR and CG) measured ankle dorsiflexion in 14

neurologically healthy individuals (6M/8F; ages 20-56 years; 6 participants measured by both observers) with the knee in fully-extended and flexed positions. Three measurements were taken for each position with the goniometer fulcrum on the lateral malleolus; stationary and moving arms aligned with the fibular head and fifth metatarsal, respectively. Inter- and intra-observer reliability was assessed using Cronbach's alpha. **Results:** Intra-observer Cronbach's alpha was 0.230 (CG) and 0.533 (KR) for dorsiflexion with the knee extended; 0.805 (CG) and -0.350 (KR) for dorsiflexion with the knee flexed. Inter-observer Cronbach's alpha was 0.656 for extension and -0.245 for flexion. **Conclusion:** Little correlation exists within or between observers for goniometer-based ankle dorsiflexion measurements in either a flexed-knee or extended-knee position. The clinically-accepted practice of using a goniometer to determine ankle ROM, and consequently to diagnose and treat GE, may be unreliable and needs further evaluation.

Testing the centromere-drive hypothesis in primates. *LIBARDO E. GOMEZ, EMILY A. BECK and KIRSTIN N. STERNER. University of Oregon.

Background: Chromosomal centromeres play a critical role in the process of cell division. Despite this conserved function, the centromeres themselves can vary in size and sequence content between species, and rapid evolution in centromeres can drive rapid evolution in centromere-associated proteins. **Methods:** To test if centromere-associated proteins evolve rapidly in other animals, we examined the sequence of CENP-A and CENP-C and their associated protein complexes, Condensin I and Mis12 (DSN1,

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MIS12, NSL1, PMF1) respectively, across primates. Sequences were mined from publicly available genomes (21-24 individual species per gene), aligned using Clustal-Omega and manually checked in Mesquite to ensure that protein-coding sequences conform to codon boundaries. We then used the codeml (PAML) to test for positive selection. **Results:** Previous work has suggested rapid changes are likely to accumulate in one of two essential centromere components; either CENP-A or CENP-C. Through compensatory coevolution, positive selection can subsequently cascade into other essential protein complexes resulting in hybrid incompatibility. Cascading selection from the centromere to CENP-A was previously reported in *Drosophila* by Beck et al. 2015 demonstrating the extension of positive selection to the essential Condensin I complex (SMC2, SMC4, NCAPD2, NCAPG, NCAPH orthologs). Our preliminary data suggests unlike in *Drosophila*, CENP-A and genes that encode components of the Condensin I complex are largely conserved in primates. On the other hand, our preliminary data suggest CENP-C may be evolving rapidly in primates. We are currently testing if this extends to the Mis12 Complex. **Conclusion:** This finding supports the centromere-drive hypothesis, which suggests the presence of an evolutionary tug-of-war between centromeric DNA and centromere-associated proteins that may shape karyotype evolution in primates.

Baby steps: Child carrying strategies of urban individuals. *MADISON HUBBLE, *ERIKA BUNGE and CARA WALL-SCHEFFLER. Seattle Pacific University.

Background: Load bearing alters the energetic cost and speed of walking, and child carrying and transport present their own unique set of challenges and variables. In the present study, we seek to identify trends in the choices that individuals make when locomoting with children in an urban environment. **Methods:** Approximately 180 subjects who were either carrying a child or pushing a child in a stroller were observed walking in a steady state over a measured distance. Their walking speed, sex, and the size and position of their load were recorded in addition to the composition of their physically present social group. Subjects were then stopped and asked about the age, sex, parity, and weight of their child as well as their own height, handedness, and relationship to the child. **Results:** Walkers were significantly more likely to travel with a baby or child of the same sex and walked at slower speeds when doing so. Women were more likely to locomote with infants, whereas men were more likely to do so with toddlers. Both men and women were equally likely to locomote with older children. Among those pushing children in strollers, individuals pushing toddlers traveled significantly faster. **Conclusion:** Locomotor strategies and speed were shown to be influenced by several factors, the most important of which were sex of the subject, sex of the child, and age of the child. These data support the idea that interpersonal interactions between child carriers and their children modulate walking speed and walking strategies.

Testing a computational approach for estimating age-at-death on a modern Portuguese population. *LIAM JOHNSON

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and JONATHAN BETHARD. University of South Florida.

Background: Age-at-death is a key parameter of the biological profile in forensic anthropological contexts and has a nearly 100 year history of innovation as numerous methods focusing on the pubic symphysis have been developed and refined. While there have been methodological improvements, reliance on visual comparison of skeletal remains to the risk of inaccurate analysis and necessitates the use of alternative methodologies that can quantify age-related changes to the symphyseal surface tomography. **Methods:** The sample population consisted of both male and female individuals (n=36) drawn from the University of Coimbra's 21st Century Identified Skeletal Collection (CEI/XXI). Using a NextEngine 3D Laser Scanner three-dimensional scans of the pubic symphysis were analyzed with ForAge software and produced age-at-death estimates using five different regression models. Statistical analyses tested the bias, inaccuracy, and RMSE of each regression model. **Results:** The results are comparable to similar studies conducted by Stoyanova, Slice, Algee-Hewitt, and Keterova. In general all regression models over estimated age-at-death, this could be due to a variety of factors not limited to the computational approach. The two most extreme age-at-death estimates were obtained by the ventral curvature (RSME= 30.64, Bias= -26.82, inaccuracy= 27.2) which is the most accurate, and the thin plate splines/bending energy (RMSE= 42.25, Bias= -39.31, inaccuracy= 39.31) which is the least accurate. **Conclusion:** While flawed this method shows the importance for additional testing of quantitative methods on a wider range of skeletal samples. As the

medico-legal community and academic institutions continue to uphold higher standards of evidence it is the responsibility of the anthropologist to provide multiple means which support their professional opinion.

Funding: Howard Hughes Medical Institute STEM Undergraduate Research Scholarship - 1,000\$, The University of South Florida Grant - 1,500\$.

The use of bouts during activity decreases women's core temperature more than men's.
*HAYLEY CHEYNEY KANE and CARA WALL-SCHEFFLER. Seattle Pacific University.

Background: Recent studies have recognized the importance of water transport for the subsistence strategies of many human populations. We are interested in how thermoregulatory strategies during water transport might compare with over-ground transport. **Methods:** Here we test whether bout-locomotion might also aid people in minimizing the heat gain during canoeing. We monitored eight people (4 men; 4 women) independently paddling continuously across a lake (avg ambient temp=23.9°C; avg humidity=61.7%). We measured participants' blood perfusion, heart rate (HR), core body temperature, and paddling speed during a trial, which consisted of periods of paddling (6 or 12 minutes) regularly interspersed with periods of rest (also 6 or 12 minutes). **Results:** A single repeated-measures ANOVA was done for each dependent variable, with sex as a factor. People's paddling speed and HR did not change whether they had a long rest (LRE) or short rest (SRE) prior to paddling (p=0.368; p=0.489), nor was there a

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significant sex effect on speed or HR ($p=0.368$; $p=0.560$); however, females' core temperature decreased during long rows (LRO) when the LROs were preceded by a LRE, whereas their core temperature increased when the LRO was preceded by a SRE ($p=0.064$). This is potentially due to blood perfusion to the biceps during LROs being dependent upon the length of the preceding rest ($p<0.001$). **Conclusion:** Bout-paddling is a common strategy for people who paddle for subsistence; this strategy seems particularly important for maintaining thermoregulation among women.

Relations between cultural perceptions of childhood and childhood stress in an ancient Greek colony. *MADISON R. KAYE, BRITNEY KYLE, STEFANO VASSALLO and LAURIE J. REITSEMA. Washington College, University of Northern Colorado.

Background: Every culture develops its own conceptualization of childhood and therefore, the culture in which a child is indoctrinated may influence stress experienced during childhood. This study uses social age categories, defined by the ancient Greek's cultural ideology of childhood based on cognitive development stages, to assess the prevalence of childhood stress indicators within individuals who died during childhood or adulthood in the Greek colony of Himera (648-409 B.C.). **Methods:** Here we assume this Sicilian colony followed the ancient Greek idea of childhood. We observed 739 individuals from the 6th-5th century BCE for three skeletal markers of childhood stress: cribra orbitalia (CO), porotic hyperostosis (PH), and linear enamel hypoplasia (LEH). Individuals observable for at least one pathological lesion were assigned to the age-at-death categories of subadult

(below age 18) and adult (age 18+) to examine whether individuals who died in childhood (subadults) exhibited a different prevalence for each stress marker than individuals who survived childhood (adults). The subadults were divided into five social age categories specific to ancient Greece: babyhood (birth-2), early preschool (3-5), real preschool (6-7), school (8-14 [puberty]), and adolescence (15-18). **Results:** No significant differences between subadults and adults in prevalence of any stress marker were observed (X^2 $pco=0.09$; $pph=0.72$; and $pleh=1.00$). Adolescents exhibited significantly more PH and LEH than 3 of the 4 other stages of childhood. **Conclusion:** Perhaps experiencing early childhood stress led these individuals at Himera to develop a survival strategy that proved maladaptive to future environmental conditions, making these adolescents more susceptible to another stress event later in childhood.

Funding: National Science Foundation Research Experience for Undergraduates award numbers 1560227 and 1560158, the University of Georgia, and the University of Northern Colorado.

Population genetics of lyme disease vector *Ixodes scapularis* in the Southern Tier region of NY: A mitochondrial DNA perspective. *JESSICA KELLAM, *ALIVIA RUIZ, *JUSTIN AMES, *ANTHONY GERMANO, *LINDSAY BLANK and MICHEL SHAMOON-POUR. Binghamton University.

Background: The black-legged tick, *Ixodes scapularis*, is the primary vector of the Lyme disease bacteria, *Borrelia burgdorferi*, in the Northeastern United States. Analyzing the mitochondrial DNA lineages in the *I. scapularis* population in the Southern Tier

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Region can help better understanding the origins and movements of ticks in the Northeast United States. **Methods:** 91 *I. scapularis* samples were collected by Binghamton University students from 12 locations across the 6 counties of the Southern Tier Region. DNA was extracted from each tick, and the tick mtDNA 16S rRNA was amplified and sequenced. Raw sequence data was analyzed in Sequencher, and sequences were aligned in MEGA. Arlequin was utilized to compute Tajima's D, molecular diversity, and pairwise Fst. Network was used to create a phylogenetic tree that included sequences from this project, as well as sequences from other published papers. **Results:** A total of 13 haplotypes found in the region represent the great genetic diversity of *I. scapularis* population in the Southern Tier of New York. A vast majority of the ticks from the Southern Tier of New York belonged to the "All-American" mtDNA clade, we identified one tick from the "Southeast" clade. In agreement with observations, our data also supports a demographic expansion of the *I. scapularis* population in the region. **Conclusion:** The *I. scapularis* population in the Southern Tier is highly diverse with multiple origins, according to population genetic analyses. The rapidly growing population is a major threat to the people of the Southern Tier. This trend is seen throughout many regions of the United States as well. This represents a major health risk as more people and animals are getting infected with *B. burgdorferi* from a tick bite. An increase in population exposes people to more ticks and increases their chance of contracting a tick-borne disease.

Funding: This project was supported in part by grants to Binghamton University from the following: Howard Hughes Medical Institute

(HHMI) through the Precollege and Undergraduate Science Education Program, New York State Regional Economic Development Council, and SUNY Investment & Performance program.

The investigation of abnormal behaviors in nursery reared Rhesus macaques.
*CELESTE LAM, LYDIA LIGHT and SUSAN JOHNSON. UNC Charlotte.

Background: This study aims to determine the timing of the onset of abnormal behaviors in rhesus macaque (*Macaca mulatta*) subjects separated from their mothers early in development. We predict that, if nursery rearing causes abnormal behaviors, nursery-reared infants will begin displaying these behaviors shortly after they are separated from their mothers and will therefore exhibit similar rates across time. **Methods:** This observational study was conducted at the Yerkes National Primate Research Center (YNPRC) during two study periods. To control for individual differences, researchers compared observations on 12 infants (6 males; 6 females) ranging 1-4 months of age to observations of the same individuals at 3-4 years of age. The 2014 and 2015 observations were conducted between July and December. The 2018 observations occurred between May and August. Using the ethogram developed by YNPRC, 15 abnormal behaviors (scratching, digit sucking, body shaking, whole body stereotypies, eye poking, feces smearing, urophagy, hair plucking, self-biting, self-injurious behaviors, floating limb, bizarre posture, regurgitate/re-ingest, self clasping, and other self-directed stereotyped behaviors) were coded as abnormal behavior. Subjects were observed during 10-minute focal periods (3.5 hours/subject for a

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total of 42 hours of observation) using a 1/0 sampling method to record abnormal behaviors. A two-tailed paired-samples t test in JMP 13.2.0 was used to compare rates of abnormal behaviors during the two time periods. **Results:** As expected, our results showed that the subjects exhibited significantly lower rates of abnormal behavior (0.1266 +/- 0.198 SD) as infants than when they were older (0.7659 +/- 0.182 SD) (paired-samples t test, $t(11) = 10.606$, $p < 0.0001$). **Conclusion:** The results of this observational study suggest that nursery rearing and abnormal behaviors may not be directly correlational but rather abnormal behaviors could be caused by other factors such as prolonged captivity. This could increase our understanding of nonhuman primate infant development in captivity and possibly allow researchers to reduce the occurrence of such behaviors in captive populations.

Analyzing population variation in the fusion sequence of primary and secondary ossification centers in the human skeleton.

*MAKENNA B LENOVER and MAJA SESELJ. Bryn Mawr College.

Background: Biological anthropologists often struggle to determine the minimum number of individuals (MNI) represented in commingled skeletal remains, complicating identification. The fusion sequence of primary and secondary ossification centers is a promising, yet under explored, process to improve identification of subadult remains; prior studies show individual, within-population variation in the pattern of fusion, but possible geographic variation in fusion sequence has not been investigated. **Methods:** To explore potential population variation in fusion patterns within and

among skeletal samples of East Asian, indigenous North American, African, and European ancestry, we analyzed patterns of fusion of primary and secondary ossification centers in nine globally representative skeletal samples. Forty-three epiphyses, spanning the axial and appendicular skeleton, were cross-tabulated in R software to determine the beginning and complete order of fusion amongst each geographic group. These data were distilled into modal sequence trajectories documenting the general fusion pattern and population variation around the modal pattern. **Results:** Population variation occurs across all geographic groups, both within and between populations. In variation around the modal sequence, it is more common for later sites to fuse earlier than for earlier sites to fuse later. The complete trajectory sequence varies less than the beginning trajectory, so it may be of greater utility determining MNI. Certain sites, like the acromion, have higher interpopulation variation, and the earliest and latest fusion centers remain relatively consistent, with the intermediate fusion sites showing more population variability. **Conclusion:** Forensic and bioarchaeological practice may utilize these sequences; comparative data that documents the most likely sequence of epiphyseal union in diverse populations allows biological anthropologists to estimate the MLNI of a sample with greater certainty.

Funding: National Science Foundation DDIG #0925861; Wenner-Gren Foundation; NYU Graduate School of Arts and Science; New York Consortium in Evolutionary Primatology; Frances Velay Women in STEM research grant.

A comparison of bioarchaeological adult aging techniques utilizing canine teeth

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radiographs from Italian skeletal remains.

*KATEY MARI and LAURIE REITSEMA .
University of Georgia.

Background: Among skeletal remains, differentiating younger from older adults is difficult due to broad age ranges provided by traditional osteological techniques, or the unavailability of indicators of age-at-death when working with fragmented remains. In response to the uncertainty of traditional osteological aging techniques, methods adapted by Sigrid I. Kvaal and Roberto Cameriere and colleagues use a combination of measurements on tooth x-rays to calculate more accurate age-at-death. **Methods:** This research utilized the Kvaal and Cameriere methods to create AAD estimates for the same set of individuals, a comparison was made to test which method produced more reliable age estimates when compared to osteologically derived AAD estimates. Bioarchaeologists carrying out research with previously excavated skeletal materials provided (n=50) canine teeth from individuals between the estimated age ranges of subadult to old adults for this study from the sites of Himera, Benabbio, and Alia in Italy. **Results:** A paired t test shows a statistically significant correlation between skeletal morphological age category and age-at-death estimate by the Kvaal method ($p=0.0354$). In comparison, a paired t test shows no significantly significant correlation between skeletal morphological age category and age-at-death estimate by the Cameriere method ($p=0.1131$). However, when broken down categorically by age, among old adult individuals, and Cameriere's method produced a higher mean age of 49.084 years with a standard error of 4.45 years, than the Kvaal method which produced a mean age of 43.072 with a standard error of 5.06 years.

Conclusion: Being able to calculate age-at-death of skeletal individuals accurately is vital to understanding population dynamics when historical records are not present. A more accurate understanding of population demographics will allow bioarchaeologists to better understand social dynamics, disease prevalence, and effects of the overall aging process on specific populations.

The effects of childhood stress on two 19th-century populations in Illinois: Exploring the association between LEH and adult stature. *ALEXIS D. MARTINEZ and ANNE L. GRAUER. Loyola University Chicago.

Background: This study explores whether the effects of childhood stress, noted by the presence of linear enamel hypoplasia (LEH), affected adult stature in two socio-economically different 19th-century populations. The first population is associated with the Dunning Poorhouse Cemetery and represents an economically unstable and disenfranchised group, while the second population, recovered from the Peoria City Cemetery, represents individuals whose families had social and economic resources. **Methods:** The presence of LEH was recorded as present when appearing as macroscopic linear defects on the maxillary or mandibular canines. Stature was assessed based on Trotter and Glaser (1952) regression formulae from maximum lengths of the femur and tibia. **Results:** Results indicate that twenty-six individuals from the Dunning Poorhouse population, and twenty-three individuals from the Peoria City Cemetery, had the requisite dentition and skeletal elements for evaluation. The mean adult stature in the Dunning Population for individuals with LEH was 171 cm and was 177 cm for individuals without LEH. Females

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have a mean stature of 164 cm, while men have a mean stature of 177 cm. In the Peoria City Cemetery, the mean adult stature for individuals with LEH was 162 cm and was 163 cm for individuals without LEH. Females have a mean stature of x , while males have a mean stature of 159 cm. These preliminary results are statistically evaluated and placed into socio-economic context as a means to begin to understand the association between childhood stress and adult stature. **Conclusion:** Studying the effects of growth disruption can illuminate the broader impacts of undergoing stress during pivotal periods of development.

Population genetics of Southern Anatolia according to mitochondrial DNA. *NICOLE MARTINI, *AMELIA CHUISANO, *ETHAN SPIELVOGEL, *CATHERINE AYIKU, *ALEX MONTOYA, *KAI HIGUCHI and MICHEL SHAMOON-POUR. Binghamton University.

Background: Situated at the intersection of Europe and Asia, Anatolia has played a key role in human migratory events between the Near East and Europe. Further study of population genetics of Anatolia is necessary for better understanding of the prehistoric and historic events that have structured the populations of this region **Methods:** A total of 116 serum samples from regions across southern Anatolia were selected from a collection housed in the Binghamton University Biospecimen Archive. DNA was extracted and PCR and sequencing were performed to obtain the mitochondrial hypervariable region (HVS-1). Haplogroups were assigned according to Phylotree. Population genetics and phylogenetic analyses were performed using Arlequin, NETWORK, and BEAST. **Results:** The

mtDNA haplogroup makeup of Hatay/Gaziantep provinces of southern Turkey was similar to that of populations in neighbouring Mesopotamia and the Levant, as well as Iran. Interestingly, the populations of Antalya/Mersin provinces located to the west of Hatay showed a different composition that more closely resembles the mtDNA makeup of the eastern European populations. Overall, the mtDNA profile of southern Anatolia showed a significant (11%) Asian influence, reflecting the Turkic Expansion from Central Asia since/during the 10th to 15th centuries. In comparison with neighbouring regions, the Bayesian Skyline Plot analysis suggests similar demographic histories of southern Anatolia and the South Caucasus. **Conclusion:** This research improves our understanding of human genetic diversity in southern Anatolia, a region of high importance for study of the origins and dispersals of human populations in West Eurasia.

Funding: This project was supported in part by grants to Binghamton University from the following: Howard Hughes Medical Institute (HHMI) through the Precollege and Undergraduate Science Education Program, New York State Regional Economic Development Council, and SUNY Investment & Performance program.

Differences in clavicular osteon circularity between young and old human males. *RACHEL A. MCNULTY, *NICOLE M. FYE, ANGELA L. HARDEN and AMANDA M. AGNEW. Ohio State University.

Background: Osteon population density (OPD) is often used to estimate age-at-death using the femur, rib, and clavicle. These methods are limited in older individuals

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because of the osteon asymptote (i.e., new osteons replace older ones thereby producing no net change in OPD). Some studies suggest that osteon circularity also increases with age in femora and ribs, but it has not been explored in the clavicle. Incorporating osteon circularity into age-estimation techniques could provide additional accuracy for the elderly if it is not affected by the osteon asymptote. Therefore, the objective of this study is to evaluate whether differences in clavicular osteon circularity exist between distinct age groups. **Methods:** Left clavicles from ten adult human males were included in this study: five 'young' (30–49 years) and five 'old' (80–99 years). Slides were created from clavicular midshafts according to standard hard tissue histology procedures. Osteon perimeter and area of all complete osteons were measured across the cross-section and used to calculate circularity ($4\pi \text{area} / \text{perimeter}^2$). **Results:** Two sample t-tests revealed that osteons in the old cohort were significantly more circular than those in the young cohort. **Conclusion:** This difference suggests that osteon circularity may be a useful complement to OPD in histological age-estimation techniques utilizing the clavicle. Future work will include quantifying age-associated trends in increasing OPD and circularity incorporating the entire age continuum in both sexes in order to establish new age-estimation formulae. This new method will be instrumental when developing biological profiles for unidentified human remains in forensic contexts.

Effects of substrate compliance on deformation of the human foot revealed by biplanar X-ray. *SABREEN MEGHERHI,

KEVIN G. HATALA, DAVID A. PERRY and STEPHEN M. GATESY. Chatham University.

Background: Fossil hominin footprints play an important role in understanding the evolution of human locomotion. However, our primary understandings of modern human foot function are based on walking on solid surfaces, whereas a footprint reflects an interaction between the deformable foot and a deformable substrate. These two lines of evidence are difficult to merge without understanding how human feet interact with deformable substrates. **Methods:** Seven subjects walked across four substrates, including rigid carbon fiber and three increasingly deformable muds. Motions and deformations were tracked with an array of 70 to 83 markers across the plantar surface of each subject's foot. We used biplanar X-ray technology and 3D animation tools to visualize the interactions between the foot and substrate, and selected marker subsets to measure continuous deformation of the heel and longitudinal arch. **Results:** Analyses focused on the degree and nature of deformation to the heel pad and the longitudinal arch. We found that substrate compliance had significant effects on the extents to which both the heel pad and the longitudinal arch were vertically deformed during stance phase. In both regions, vertical deformation was greater on more rigid substrates. Substrate compliance had no significant effect, however, on the degree to which the heel pad expanded transversely. **Conclusion:** These results demonstrate that the nature of the substrate significantly influences the mechanics of foot-substrate interactions, and these differences are critical to understand while developing methods for analyzing fossil footprints. The same individual's foot will move and deform

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differently, and perhaps generate different footprints, as they walk across different substrates.

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Reconsideration of cranial capacity estimates from cranial vault linear dimensions. *URVA MEHVEEN and ROBERT C. MCCARTHY. Benedictine University.

Background: Cranial capacity appears to increase throughout the entire growing period when it is estimated using linear dimensions of the external cranial vault on radiographs or dry skulls. This trend does not reflect biological reality since brain growth in humans reaches asymptotic levels after 5-8 years of age, meaning both brain size and cranial capacity should stabilize during the late juvenile period. **Methods:** In this study, we assessed the utility of cranial vault linear dimensions for estimating cranial capacity in a human ontogenetic sample. We collected 12 landmarks from the internal and external cranial vault and basicranium in a mixed-longitudinal sample of lateral and anteroposterior radiographs from the Colorado Child Research Council (Denver) Growth Study. We used these landmarks to calculate linear distances, then estimated cranial capacities using previously-published equations. **Results:** Both external and internal linear measurements overestimated cranial capacity at younger ages. Internal measurements produced cranial capacities that stabilized during

childhood, but still overestimated cranial capacity at younger ages. External measurements produced cranial capacity estimates that continued increasing past the end of brain growth. **Conclusion:** Recent studies are likely overestimating cranial capacity because external dimensions from the cranial vault reflect not only increases in cranial cavity size, but also growth in the brow ridge and nuchal region. Internal dimensions address this issue but both external and internal dimensions do a poor job of estimating cranial capacity at younger ages using existing formulae.

Funding: Benedictine University Natural Science Summer Research Program, Dr. Scholl Foundation.

A comparative analysis of health indexes for past human populations. *ANA MITCHELL, COLLEEN CHEVERKO and MARK HUBBE. Ohio State University.

Background: Interested in how the health of individuals may be evaluated differently according to the index being used, we used two indexes, the Health Index (Steckel and Rose, 2002) and the skeletal frailty index (Markelin and Crews, 2016) (SFI), to determine if there is any statistical difference in the two methods. The Health index, addressing wellbeing, and SFI, evaluating stress, account for health using a different number of biomarkers. The Health Index also accounts for age structure in determining the overall health and the SFI does not. **Methods:** We took four common biomarkers; linear enamel hypoplasia, cribra orbitalia, infection and trauma to determine if there is any correlation between the two indexes. Using data from the Health Index, these biomarkers were then converted into comparable metrics

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to that of the SFI in Excel. The SFI was averaged for each of the biomarkers for female, male and the entire population for each site and then compared to the respective averages given in the Health Index. The average SFI and Health Index values were then compared by plotting 15 linear regressions displaying the relationship between each of the biomarkers. **Results:** The results show an overall strong correlation between the two indexes, although some biomarkers show stronger correlations than others. For example, linear enamel hypoplasia and trauma, with a R^2 of 0.8653 and 0.7794, respectively. Cribra orbitalia showed an R^2 of 0.7543 and infection an R^2 of 0.6727. This indicates that the two indexes are essentially the same in assessing the overall health of skeletal populations, despite the SFI using fewer overall biomarkers. We can also conclude that age structure inherent to the calculation of the health index does not affect the overall outcome of the data, since it showed little to no correlation to the Health Index. **Conclusion:** This research is relevant to anthropology because it takes two different indexes that evaluate aspects of health in bioarchaeological populations and show that they are giving us similar results, despite the difference in biomarkers used and one accounting for age-structure. This research could build on the skeletal frailty index and be the start of a more in-depth dialogue about expanding the sample size of populations through fewer biomarkers while still maintaining accuracy.

Survivorship from historical death records and skeletal remains from the Oakwood cemetery in Austin, Texas (1866-1914).
*MICHELLE NGUYEN, CHRIS WOLFE,
MICHELLE HAMILTON and NICHOLAS

HERRMANN. Trinity University, Texas State University.

Background: Human survivorship as determined from historic records and from the analysis of human skeletal remains often produce conflicting profiles of longevity and community mortality risk. This project examines survivorship as determined from historic cemetery records and a sample of human burials exhumed from the Oakwood Cemetery in Austin, Texas. **Methods:** Individual burials were exhumed as part of ongoing renovations of the historic chapel at the cemetery. Cemetery records identify this section as the "Colored Section" and/or "Stranger Ground" with the inference that these individuals represent people of lower socioeconomic status. Skeletal analysis and historical death records indicate that these individuals come from diverse ancestral backgrounds. Using biological profile data collected from thirteen of thirty-six exhumed individuals and preexisting death records, this project compares mortality parameters of the late 19th and early 20th century Austin community. **Results:** Using a Siler model in R, it was possible to observe the survivorship between different time periods (1866-1874 compared to 1875-1914). Afterwards, a likelihood ratio test was used to compare the fit of the years 1866-1874 and 1875-1914, which resulted in a chi-squared value of 2.79 and a p-value=0.59, indicating that mortality and survivorship were very similar in both time periods. **Conclusion:** Using a combination of the documented city-wide historical records and the burials, the results suggest that the skeletal sample highlights the broad demographic trends in historic American populations, such as high infant and childhood mortality. These results also

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shed light on the demographic profile of early groups from Austin, Texas.

Funding: McNair Scholars Program.

Human mitochondrial genetic diversity in western Iran. *DYLAN NICHOLSON, *BHAVREET DHANDI, *VISHNU NAIR, *VICTORIA SALLOWS, *MARIA SOSA and MICHEL SHAMOON-POUR. Binghamton University.

Background: The Iranian Plateau is located at the crossroads of Europe, Africa and Asia. This study aims to compare the mitochondrial diversity of Western Iran and surrounding regions due to their geographical proximity and common prehistory by sequencing the HVS-I region of 66 Iranian Individuals. **Methods:** A total of 162 serum samples were selected from a collection housed at the Binghamton University Bio-Specimen Archive Facility. DNA was extracted, and the mitochondrial hypervariable region was amplified and sequenced. DNA samples were aligned using MEGA and haplogroup assignment was carried out using Haplogrep and Phylotree. Population genetics and phylogenetic analysis was performed using Arlequin, BEAST and NETWORK. **Results:** As expected, a majority of individuals belonged to West Eurasian mtDNA haplogroups. The presence of East Asian haplogroups C, D reflects considerable gene flow from Central and East Asia. Interestingly, our sample of West Iranian populations also expressed a relatively high frequency (4%) of South Asian haplogroup M subclades. **Conclusion:** Our research helps better understanding of the human genetic diversity in Near East by providing an mtDNA profile of West Iranian populations. Future research will focus on

the modes of migrations represented by the South Asian M lineages in western Iran.

Funding: This project was supported in part by grants to Binghamton University from the following: Howard Hughes Medical Institute (HHMI) through the Precollege and Undergraduate Science Education Program, New York State Regional Economic Development Council, and SUNY Investment & Performance program.

Mortuary and paleopathological analysis of new kingdom burials at Tombos. *ISABELLE ORTT, MICHELE BUZON and KAITLYN SANDERS. Purdue University.

Background: The town of Tombos, in present-day Sudan, has a record of occupation beginning as an Egyptian colony established in Nubia around 1400 B.C. This study examines burials excavated from a subterranean vault and shaft tomb, Unit 36, located in an elite area of the Tombos cemetery. Comingled remains and 13 separate burials have been evaluated for age, sex, and pathological conditions to generate biological profiles of the occupants of this tomb. **Methods:** Transition Analysis was used to determine an age of maximum likelihood (AML) and lower and upper 95% CI ages for each combination of skull and or pelvis. Sex, measurements, and differential diagnoses were obtained in accordance with standards set by Buikstra and Ubelaker following a full inventory of each set of remains. **Results:** Unit 36 contained comingled material and 13 separate burials, including 3 children under the age of 10, as well as 6 adult females and 4 adult males with calculated AML ranging from 15 - 60+ years. Pathological conditions observed include a case of significant lower body

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muscle atrophy in the body of an elderly female, as well as healed cribra orbitalia, porotic hyperostosis, and dental abscesses. **Conclusion:** Burial positions and grave goods represent a fusion of Nubian and Egyptian cultural practices, following a precedent set by other areas of the New Kingdom cemetery. Elite individuals experienced physiological stress but were able to survive with some conditions likely causing impairment.

Funding: Margo Katherine Wilke Undergraduate Research Scholarship, Office of Undergraduate Research Scholars Program.

Joint proportions in early hominins.

*ANJALI M. PRABHAT, JEREMY M. DESILVA and CATHERINE K. MILLER. Dartmouth College.

Background: In general, human evolution has been characterized by an increase in lower limb joint size and a decrease in upper limb joints as a result of bipedalism and reduction of arboreality. However, the pattern by which this transition occurred and the ancestral condition from which it evolved still remain unclear. Previous work has shown that *Australopithecus afarensis* exhibited human-like proportions, while *A. africanus* retained ape-like limb joint ratios. Here, we re-examine these proportions and include additional hominin taxa. **Methods:** Measurements were taken at the elbow (humeral biepicondylar breadth, radial head diameter, ulna trochlear width), hip (femoral head diameter and subtrochanteric width), and ankle joints (mediolateral width of tibia's talar facet and mediolateral width of talar trochlea) on African great apes (N = 82), humans (N = 24), and fossil hominins. Data were expressed a geometric mean that

represented each specimen's relative upper limb to lower limb ratio. **Results:** The elbow, hip, and ankle joint proportions of *A. afarensis*, *Homo floresiensis*, *H. erectus*, and *H. naledi* were found to resemble modern-day humans, whereas those of *A. africanus*, *A. sediba*, *Paranthropus robustus*, and *P. boisei* all resemble the African apes. **Conclusion:** These results demonstrate that in spite of being committed bipeds, the South African australopiths and *Paranthropus* may have exhibited a greater degree of arboreal behavior than *A. afarensis*, despite being chronologically younger. Our findings create a phylogenetic dilemma in which either the human-like body proportions of *A. afarensis* are homoplastic or the ape-like upper limbs of both South African australopiths and *Paranthropus* are secondarily derived.

Investigating sexual dimorphism in *Homo sapiens* nasal aperture shape. *MEGAN L. PRICE and MIRANDA E. KARBAN. Illinois College.

Background: Though the nasal aperture is useful for studying ancestry, it is not commonly cited as a sexually dimorphic trait. SNR angle (the angle between sella, nasion, and rhinion) has been studied as an age-related trait, but not a sexually dimorphic trait. This study aims to investigate the differences in male and female nasal aperture shape and SNR angle, as well as shape covariation between these two traits, in a sample of European-derived extant human cephalograms. **Methods:** A sample of 30 individuals (15 males and 15 females) from the University of Toronto Burlington Growth Study, ranging in age from 18.0-18.25 years, were observed. Nasal aperture shape of each subject was digitized in frontal cephalograms using 3 landmarks

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and 15 sliding semilandmarks. Generalized Procrustes analysis and relative warp analysis were used to investigate nasal aperture shape variation within the sample. Lateral cephalograms were used to measure the SNR angle. T-tests and Shapiro-Wilk normality tests were used to assess the significance of SNR angle variation between males and females. A two-block partial least squares analysis was also conducted to observe the relationship between nasal aperture shape and SNR angle. **Results:** No statistically significant sexual dimorphism was found in either nasal aperture shape or SNR angle. No significant covariation was found between the two traits, demonstrating that, in the sample studied, the amount of protrusion of the nasal bone does not affect the overall shape of the nasal aperture. This study provides a better understanding of normal male and female nasal shape variation. **Conclusion:** This study is relevant to the field of forensic anthropology. Nasal aperture shape and SNR angle were not found to be useful traits for forensic sex estimation in the sampled population.

Critical ages of development: Impacts of post-natal early-life stress at the Greek colony Himera (Sicily). *MUSTAFA QUADIR, CAREY J. GARLAND, LAURIE J. REITSEMA, STEFANO VASALLO and BRITNEY KYLE. Beloit College, University of Northern Colorado.

Background: Stress during dental development disrupts enamel production, creating micro-defects known as Wilson bands (WB). Enamel is layered systematically and does not remodel; therefore, stress leaves a permanent record on the dentition. This allows for a life-history approach to understanding the effects of early-life stress

on mortality. **Methods:** In Greek culture the following childhood life-phases were defined based on cognitive development: Babyhood (approximately 0-1.99 years), Early-Preschool (2-3.99 years), and Real-Preschool (4-6 years). To examine stress during these life-phases, 60 thin-sectioned permanent canines were microscopically analyzed for evidence of WB, and stress chronologies were developed for 15 of these individuals. **Results:** At Himera, mean number of WB is 6.3 in adults (90% prevalent; n=39) and 8.2 in individuals who died as subadults (95% prevalent; n=21)[$W=332.5$, $p=0.3$]. Individuals with more defects died younger [$\chi^2=2.9$, $p=0.23$] and a significant negative correlation exists between age-at-first-defect and age-at-death [$p=0.03$, $r=-0.57$]. Stress most frequently occurred between 2-3 years, likely associated with weaning. **Conclusion:** This study underscores the role bioarchaeology can play in identifying critical-periods during early-life growth and development when stress has the greatest impact on mortality.

Funding: This research was funded by National Science Foundation Research Experience for Undergraduates award numbers 1560227 and 1560158, the University of Georgia, and the University of Northern Colorado.

The biocultural evolution of inflammatory bowel disease. *AMANDA RIELINGER, DANIEL CLEMANS and MEGAN MOORE. Eastern Michigan University.

Background: The etiology of IBD is unknown; however, it is associated with Western, industrialized societies and is quickly becoming a global disease. The goal of this study was to examine IBD from a cultural, environmental, and evolutionary

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perspective, with a focus how nutritional variation affects microbial interactions. **Methods:** We reviewed potential cultural and environmental stressors that would impact the gastrointestinal ecosystem. We analyzed the effects of dietary nutritional variation on microbial interactions by culturing *Lactobacillus rhamnosus* GG (a human gastrointestinal probiotic organism) in 7 different media types and conducting coaggregation and biofilm assays. **Results:** Nutritional variation in terms of peptones (tryptone, soytone, or beef extract) and carbohydrates (glucose or fructose) led to significant differences ($p < 0.01$) in the ability of the *Lactobacillus rhamnosus* GG to adhere to partner human gut microorganisms and form biofilms. We suggest that changes in cultural habits, such as diet, affect the composition of the gut ecosystem through impacting cellular interactions. IBD is a maladaptive inflammatory response to these microbial ecosystem changes. **Conclusion:** This research combines a medical anthropological approach with microbial ecology to better understand the ways in which the social and the biological interact to shape human intestinal health.

Funding: Internal funding from the Anthropology Department and the Biology Department; external funding from the American Society of Microbiology (ASM).

Virtual dissection of complex muscles with DiceCT. *RICHARD SAAVEDRA and RACHEL MENEGAZ. Texas State University, University of North Texas Health Science Center.

Background: Post-weaning diet(s) are known to affect craniofacial skeletal morphology as well as masticatory muscle

volumes, PCSA, and fiber type ratios. Here we use diffusible iodine-based contrast-enhanced computed tomography (diceCT) to perform digital dissections of small, complex masticatory muscles to assess the effects of longitudinal variation in diet on the growth of functional groups of these muscles. **Methods:** Sprague-Dawley rats were raised from weaning to adulthood (12 weeks), and randomly sorted into hard and/or soft dietary treatment groups. Post-sacrifice, cranial tissues were fixed in 4% PFM for 36 hours and stored in 70% EA at 4°C. Specimens were stained in 11.25% Lugol's solution (I2KI) for 48 hours before microCT scanning. In 3D Slicer, muscles were manually segmented every 10 slices, the "Fill Between Slices" function was applied, and volumes were quantified. **Results:** Results suggest that, contrary to our expectations, animals raised on soft diets have larger temporalis and superficial masseter muscles than those raised on hard diets. **Conclusion:** DiceCT is a promising method for soft tissue analysis that complements CT analyses of bone. Volumetric data can be obtained for small and/or complex musculature where limitations exist for traditional dissection methods.

Funding: NSF (BCS-1061368), the Wenner-Gren Foundation and the American Society of Mammalogists.

Food insecurity in relation to different types of maternal anemia among breastfeeding mothers of northern Kenya. *QUEXTEEN KUANG SAETEURN and MASAKO FUJITA. Michigan State University.

Background: Anemia is a major global public health concern for breastfeeding mothers.

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Nutritional anemia is most common worldwide, often including iron, folate, and vitamin B12 deficiencies. Another type of anemia may arise due to inflammation/infection. Previous research looked at associations between anemia and diet-related characteristics such as dietary intake, dietary diversity, and food insecurity; however, studies tended to focus on one type of anemia and anemia types were not differentiated. **Methods:** Archival data from 241 breastfeeding mothers of northern Kenya collected in 2006 were analyzed. Dietary deficiency and diversity data were based on 24-hour recalls. Food insecurity data (high/low) were based on interviews on food availability/accessibility. Hemoglobin <12 g/dL defined anemia. Anemia with iron deficiency (transferrin receptor >5 mg/L) defined iron-deficiency anemia (IDA). Anemia without iron deficiency (transferrin receptor <5 mg/L) defined non-iron deficiency anemia (NIDA). Anemia with inflammation (C-reactive protein >5 mg/L) defined anemia of inflammation (AI). Associations were examined using t-tests and chi-square tests. **Results:** Anemia/IDA had significantly lower food insecurity scores than their counterparts ($p=0.02$ & $p=0.04$, respectively). AI had a similar pattern albeit non-significantly. Conversely, NIDA had non-significantly higher food insecurity scores. **Conclusion:** This study highlights the importance of differentiating between anemia types in relation to diet-related characteristics to further our understanding of human variation.

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Bornean orangutan infant development: The importance of a mother-son

relationship in conserving a species. *MIA SARKISIAN and ELLEN INGMANSON. Bridgewater State University.

Background: Orangutan infants learn primarily from their mothers via observation, making it critical that orangutan rehabilitation centers to carry out similar instruction of necessary skill sets to benefit their survival of reintroduction into the wild. In order to decipher what the infant is learning at specific life stages, researchers must look to the relationship of a mother and her infant. **Methods:** This study focused on captive 2 year-old Bornean Orangutan infant, Redd, and his mother, Batang, located at the Smithsonian's National Zoo, Washington, D.C. Behavioral observations were conducted using one-minute instantaneous focal sampling for 15 minute intervals, highlighting Redd's daily activities and mother-infant control of physical contact and proximities. The presence and proximities of other orangutans within the enclosures were included. Data collection occurred within the constraints of the zoo's visitation hours. Approximately 30 hours of data was collected within a six-week period. The infant's activity budget was created and mother-infant control analyzed using Hinde's formula. **Results:** While awake, Redd spent 24.18% of time playing (15.75% social, 6% with an object, 2.43% by himself) and 10.05% participating in other mother-infant interactions, such as nursing. Total makes/breaks and approaches/leaves were primarily controlled by his mother. Variation in data changed with the individuals present in the enclosure. Redd increased his control when other orangutans were not present. One outlier was adult female Bonnie, who Batang allowed to have contact with Redd without Batang in a close

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proximity. This began halfway through the data collection period. When a potential threat was not present, Redd was given more freedom to explore. **Conclusion:** Using this case study approach, I was able to compare Redd's behaviors influenced by his mother with those of infants in the wild. With long interbirth intervals of up to 10+ years, each mother-infant pair has the potential to provide important/crucial understanding of how orangutans learn, contributing to rehabilitation and conservation practices.

Funding: Adrian Tinsley Program Grant, Bridgewater State University.

Intra-population dietary variation at Himera. *AUTUMN SCHMITZ, LAURIE J. REITSEMA, KATHERINE L. REINBERGER, STEFANO VASALLO and BRITNEY KYLE. University of Michigan, University of Georgia.

Background: Social status is closely linked to occupation in complex societies. In ancient Greek society, high levels of physical activity were associated with occupations of lower social classes, and types of physical activity varied dramatically between the sexes. **Methods:** We investigate the relationship between sex, osteoarthritis (OA), and stable carbon ($\delta^{13}\text{C}$) and nitrogen isotope indicators ($\delta^{15}\text{N}$) of dietary protein intake during the 6th-5th century BCE at the Greek colony Himera to examine the relationship between physical activity and diet. **Results:** Although three males exhibit outlying $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values, there are no statistically significant isotopic differences between the sexes ($p=1.0000$ for $\delta^{13}\text{C}$, $p=0.4389$ for $\delta^{15}\text{N}$). **Conclusion:** This study shows that activity levels, sex, and by extension, status may not have heavily influenced individuals' diets at

Himera, at least in terms of access to animal protein. This study therefore supports interpretations that ancient Greeks may have mainly consumed animal protein in religious and sacrificial contexts, with these sacrifices equalizing individuals' access to animal protein, regardless of social or occupational divisions.

Funding: National Science Foundation Research Experience for Undergraduates award numbers 1560227 and 1560158, the University of Georgia, and the University of Northern Colorado.

OspC typing of *Borrelia burgdorferi*, the Lyme disease bacteria, in the tick population of the Southern Tier Region. *NEHA SHAIKH, *EMILIE ERNST, *CHRISTINE HURLEY, *JULIA TRAN, *ARIEL MAKOWER, *TINGYAO WANG and MICHEL SHAMOON-POUR. Binghamton University.

Background: Caused by the spirochete bacteria *Borrelia burgdorferi*, Lyme disease is the most common zoonotic disease in the United States. OspC strains are important in regards with the health risk of Lyme Disease as majority of human cases are caused by a small number of strains defined by mutations in the OspC gene. **Methods:** 71 ticks collected by Binghamton University student during 2015-2016 were selected to represent the six counties in Southern Tier region of New York. The OspC gene was amplified and sequenced, and the major OspC groups were identified. A median joining network and a maximum likelihood tree was constructed to study the phylogenetic relationship between the samples. **Results:** Twelve OspC major groups were found in similar proportions across the localities within the Southern Tier

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Region, with I, A, K and E being the most prevalent. 54% of the strains identified in the Southern Tier region represented invasive ospC groups. The overall makeup of the *Borrelia burgdorferi* OspC strains in the region follows the trend observed across the Northeastern United States with the exception of a high prevalence of the I strain and an absence of the B strain in the Southern Tier Region. **Conclusion:** About 300,000 Lyme cases are reported in the United States per year. This study helps with the control of this important disease and with assessing risk of disease by improving our understanding of the genetic variation in the bacteria through the use of anthropological methodology.

Funding: This project was supported in part by grants to Binghamton University from the following: Howard Hughes Medical Institute (HHMI) through the Precollege and Undergraduate Science Education Program, New York State Regional Economic Development Council, and SUNY Investment & Performance program.

Testing consistency of iliac flare measurement methods in hominoids.

*ROWAN M. SHERWOOD and EVE K. BOYLE. George Washington University.

Background: Lateral iliac flare was initially defined by Lovejoy et al. (1973) as the angle between the iliac blade and the sagittal plane, but in subsequent publications, researchers have used flare to refer to the lateral projection of the ilium in the coronal plane. VanSickle (2017) describes the inconsistency in four measurements used to quantify flare, as it is originally defined. It remains to be seen if linear measurements that explicitly measure lateral projection of the ilium suffer

from the same consistency issues. **Methods:** We used three ratios based on linear measurements to quantify lateral projection of the ilium in hominoids (N = 154). Iliac flare was quantified as: the ratio between bi-iliac breadth and bi-acetabular breadth (BIB:BAB); the ratio between the length of the false pelvis and iliac fossa width (FPL: IFL, from Hammond et al., 2013); and the ratio between iliac blade width and lower ilium width (IB:LIW). We used ANOVA with Tukey's post-hoc correction to identify significant group differences in flare. **Results:** We found that FPL:IFL was the best ratio at distinguishing among species, but each yields different result for which ape is the most flared. There is also substantial overlap between the great apes for each measurement, as well as between *Hylobates* and *Homo*. Sex drives variation in flare within *Pongo* and *Gorilla*. **Conclusion:** These measurements produce conflicting results regarding which species is the most flared, and we agree with VanSickle (2017) that geometric morphometrics is potentially a better way to quantify differences in iliac flare.

Funding: Wenner-Gren Dissertation Fieldwork Grant (to E.K. Boyle).

Endocannibalism in Papua New Guinea has resulted in balancing selection in Kuru-afflicted populations.

*ANASTASSIA SHIFCHIK, *NIA BROWN-FONROSE, *SHANNON ERICKSON, *JULIA GIACINTO, *JARED NASSO, *DILLON OSWALD and MICHEL SHAMOON-POUR. Binghamton University.

Background: Kuru, a fatal neurodegenerative human prion disease, became an epidemic in the twentieth century

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as the result of the practice of cannibalistic mortuary rituals characteristic of the Eastern Highlands of Papua New Guinea. Heterozygosity at codons 127 and 129 of the PRNP gene has been demonstrated to protect individuals against Kuru; the mutations block amyloid plaque formation attributed to PrPc to PrPSc prion protein changes. **Methods:** 136 Samples representing four linguistic groups of the PNG Eastern Highlands were selected from a collection housed at the Binghamton University Bio-Specimen Archive Facility. A novel PCR was designed to amplify the segment of the PRNP gene encompassing codons 127 and 129. Sequencing was performed using an ABI 3730XL sequencer and the raw sequence data was analyzed using Sequencher. Hardy Weinberg Equilibrium, Tajima's D, Fisher's Exact and Chi square were calculated using Arlequin, MEGA and Microsoft Excel. **Results:** The frequencies of the M129V mutation in Usarufa, Awiyaana, Simbari, and Yagwoia populations were determined at 54%, 52% 42%, and 42% respectively. Tajima's D suggests balancing selection for the M129V in Usarufa population. Our results show significant shift towards heterozygosity in the PRNP codon 129 within four studied populations, suggesting the balancing selection for this genotype in the Kuru-afflicted populations. The rare G127V mutation was observed only in one Simbari individual. **Conclusion:** Through genetic analysis, our research investigates the evolutionary impact of Kuru upon Eastern Highland populations including the Usarufa, which have not been included in previous studies. The study of Kuru populations provides a unique opportunity to further our understanding of the impact of prion

diseases and endocannibalistic behavior in human evolutionary history.

Funding: This project was supported in part by grants to Binghamton University from the following: Howard Hughes Medical Institute (HHMI) through the Pre College and Undergraduate Science Education Program, New York State Regional Economic Development Council, and SUNY Investment & Performance program.

Himera: Estimating allostatic load and age-at-death using stress indices. *SAFAA NAEEM SIDDIQUI, BRITNEY KYLE, STEFANO VASSALLO and LAURIE REITSEMA. Mississippi State University, University of Northern Colorado.

Background: In humans, "stress" and "health" have a complex relationship. In living individuals, physiological strain is tracked using allostatic load, although this can be difficult to estimate within skeletal remains due to high variability. **Methods:** The Skeletal Frailty Index (SFI), based on 13 skeletal biomarkers, measures allostatic load in skeletal remains. Applying a modified SFI, 9 skeletal biomarkers and age-at-death were used to estimate stress in individuals from the Greek colony, Himera (n=428, 6th-5th c. BCE). We hypothesized a higher frequency and variety of early life pathological biomarkers correlating with earlier age-at-death, following the assumptions that colonization may cause stress during the life-course and that early life stress may lead to earlier age-at-death. We created a pathological index by dividing pathological conditions present by pathological conditions observable per individual. **Results:** Regression analysis comparing age-at-death and pathological indices of three or

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more observable biomarkers revealed a significant relationship between stress and age-at-death ($p=5.792e-06$; $p<0.05$). There was a negative relationship between childhood pathological index and age-at-death ($p=.10$), however there was a positive relationship between a lifetime accumulated pathological index and age-at-death ($p=.002281$).

Conclusion: Skeletal pathologies that can develop at any age amassed with age-at-death, while skeletal pathologies that only develop during childhood tended to decrease with age, possibly suggesting a relationship between childhood stress and early mortality in ancient populations living in a Greek colony. This project potentially gives support for the use of biomarker-based indices for estimating stress in past populations, and may facilitate understanding in similar modern situations of stress and demographic transition.

Funding: National Science Foundation Research Experience for Undergraduates award numbers 1560227 and 1560158, the University of Georgia, and the University of Northern Colorado.

Founder of Mississippi discovered? Tracing the geographic origins of unknown remains using strontium and oxygen isotopes.

*NATALIE SMITH, LESLEY A. GREGORICKA and MARIE E. DANFORTH
. University of South Alabama.

Background: Dental enamel from human skeletal remains thought to belong to historical figure Reverend John Ford were isotopically analyzed to help establish this unknown person's identity. Ford was born and spent his childhood in South Carolina – the period of permanent enamel formation – before moving to Mississippi at age 31 with

his wife. Because of this, biogeochemical signatures indicative of mobility should match those of South Carolina and not Mississippi. **Methods:** Enamel was extracted from the unknown individual and analyzed for strontium and oxygen isotopes. Baseline isotopic values from both South Carolina and Mississippi were collected using previously published literature and through the isotopic analysis of modern faunal remains. **Results:** The human molar exhibited a $87\text{Sr}/86\text{Sr}$ ratio of 0.71143 and a $\delta^{18}\text{O}_c(\text{VPDB})$ value of -3.4‰ . Conversely, faunal teeth collected from Ford's adult home in Mississippi produced a much higher mean $87\text{Sr}/86\text{Sr}$ ratio of $0.7131 \pm 0.0042 (1\sigma)$. Nevertheless, due to the overlapping isotopic signatures of the coastal plains of South Carolina and Mississippi, it could not be definitively determined if the remains belonged to Ford using isotopes alone. Surprisingly, a recent aDNA analysis revealed that these remains actually belonged to a female. **Conclusion:** While a previous, tentative sex estimation of male was incorrect, these data can still be applied should the bones belong to Ford's wife, Catherine, who also grew up in South Carolina. However, due to variable and overlapping strontium and oxygen isotope values in both regions, we cannot make the definite claim that the remains belonged to her either.

High-altitude epigenetic adaptation in gene

H19. *TREY SMITH, *KEVIN WANG, TREY SMITH, KEVIN WANG, AINASH CHILDEBAYEVA, MARIA RIVERA-CHIRA, FABIOLA LEON VALERDE, MELISA KIYAMU, TOM BRUTSAERT and ABIGAIL W. BIGHAM. University of Michigan.

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Background: Individuals adapted to high-altitude show respiratory, circulatory, and hematological adaptations to chronic hypoxia. Genetic data support that these adaptations have a genetic basis and therefore an evolutionary explanation, however the epigenetic contribution to these adaptations has not been widely studied. **Methods:** We looked at samples from individuals of Quechua ancestry recruited based on their exposure to high-altitude hypoxia: 1) individuals born and raised at high-altitude, 2) individuals born at high altitude who moved to low altitude (migrants), 3) individuals born and raised at low altitude. We analyzed N=213 DNA samples from whole blood using quantitative bisulfite pyrosequencing to determine the methylation level of the gene H19. **Results:** We measured 4 CpG (methylation) sites in the gene H19. In our statistical analysis, we looked at all four sites independently, and the average of the 4. For CpG4, we saw a suggestive association with altitude. The migrant group had higher methylation than the born and raised in Lima group (p-value=0.06). The methylation for CpG4 also went down with age (p-value<0.05). **Conclusion:** These findings show that high altitude may have lasting effects on the epigenome and contributes to our understanding of the ways in which the human organism responds and adapts to the environment.

Funding: National Science Foundation grants 1132310 and 1613415, and the Department of Anthropology at the University of Michigan.

Conservation to coexist: Preliminary results of a community conservation project in Uganda. *KAYCE SORBELLO, RICHARD BUSOBOZI, MOSES KUGONZA, RONALD

AKUGIZIBWE and KRISTA M. MILICH. Washington University in St. Louis.

Background: A main source of human-wildlife conflict is crop raiding – when wild animals destroy the crops in agricultural fields causing subsistence farmers to suffer extreme losses and rightfully develop negative feelings about wildlife conservation. Conservation to Coexist, a community conservation project, was developed to assess the impact of human-wildlife conflict on conservation near Kibale National Park, Uganda, and to implement land-use changes to mitigate this conflict. **Methods:** Changes included: 1) maintaining a trench around the boundary of the park, 2) building bee fences, 3) planting garlic as a cash crop, and 4) planting tea as a buffer crop. We analyzed monthly surveys administered in four participating communities from October 2016 through July 2017 to assess the success of these changes on reducing crop raiding. **Results:** Elephants and baboons were the two most common crop-raiding species in all four communities. The average participation rates in the communities was 50.2% for trench maintenance, 52.4% for building bee fences, and 91.1% for utilizing garlic as a cash crop. Due to climate issues, participants did not plant tea as a buffer crop during the time frame. The average damage to crops per month ranged from 25-40% in different communities during October 2016 and fell to less than 10% in each community in July 2017. **Conclusion:** The preliminary results of this project suggest that compliance with these strategies is a successful method for reducing crop raiding and improving human-wildlife interactions. This decrease in tension between humans and wildlife has the ability to increase conservation efforts of these species.

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Funding: Office of Undergraduate Research - Washington University in St. Louis.

Childhood growth, cessation, and recovery: Links between lines of growth arrest and bone quantity. *TESSA VALLEROY and LIBBY W. COWGILL. University of Missouri.

Background: While it is generally believed that lines of growth arrest ("Harris Lines") appear on bone diaphysis due to episodes of stress, there has been difficulty linking lines to specific metabolic insults, and there is evidence that Harris lines could be the product of regular hormonal fluctuation during growth. In this analysis, we explore the relationship between tibial Harris lines and bone growth in length and cross-sectional properties. **Methods:** Harris Lines were assessed on mediolateral radiographs of tibiae from six geographically diverse samples of immature individuals under the age of 18 (n=265), and number of lines and distance from the distal metaphyseal surface was recorded. Midshaft tibial cross-sectional geometry was calculated from the same radiographs and midshaft molds. **Results:** The results of the analysis yielded mixed results. Harris Line count (and Harris Line count standardized by age) is positively correlated with tibia cross-sectional properties ($p < 0.001$). In addition, bone quantity is affected by how recently the line of growth arrest formed; individuals with more recent insults have weaker diaphysis. **Conclusion:** The positive correlation between Harris Line count and bone strength may be in part a product of increased survivorship in individuals with higher Harris Line numbers, and provides anthropologists a cautionary warning about overly simplistic interpretations of indicators

of non-specific stress when studying both past and present populations.

Funding: University of Missouri-Columbia College of Arts and Science Undergraduate Research Mentorship Program.

Human or bison: Extinction of the Western Horse. *SAHARA ZITLALI VILCHIS. California State University, Dominguez Hills.

Background: Overkill from humans entering the continent has been historically fingered as the cause; however, more data sets and better carbon dating has suggested that megafauna numbers were already declining before the wide spread presence of humans. The fossil record at La Brea indicates a decrease in the horse population around the time of the re-opening of the Bering Strait. **Methods:** Excavating and cleaning asphaltic filled the fossils in the lab with N-Propyl Bromide. Sifting through microfossils in search for plant material both species might have competed for at La Brea Tar Pits Museum lab. **Results:** Pointed flukes are found isolated, no concrete evidence of kill sites. **Conclusion:** Humans are often blamed for the extinction of megafauna of the New World.

Error of three-dimensional surface imaging using Vectra H1 and 3dMDface systems. *CIARA VIRGO, JULIE D. WHITE, ALEJANDRA ORTEGA-CASTRILLON, KARLIJNE INDENCLEEF, PETER CLAES and MARK D. SHRIVER. Pennsylvania State University.

Background: Three-dimensional camera systems have been used recently to further our understanding of morphological

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variation in human facial features. As with all studies of variation, it is critical to understand the relative contribution of potential sources of error. **Methods:** To quantify error from participant movement and camera system, 35 participants were imaged using the 3dMDface and the Vectra H1 systems, then registered with 7,160 landmarks using the MeshMonk registration toolbox. The within-camera biological error due to participant movement was assessed by calculating the standard deviation (sd) between three photos of each participant from each camera. The error due to camera was assessed by calculating the sd between participants' average image from each camera. **Results:** The average within-camera biological error for 3dMD images was 6.8×10^{-5} mm, 5.7×10^{-5} mm, and 5.7×10^{-5} mm for the x, y, and z axis, respectively. The average within-camera biological error for Vectra images was 5.87×10^{-5} mm, 5.16×10^{-5} mm, and 5.15×10^{-5} mm, for the x, y, and z axis, respectively. When comparing camera systems, we found the average sd between 3dMD and Vectra images was 6.79×10^{-5} mm, 4.81×10^{-5} mm, and 4.84×10^{-5} mm for the x, y, and z axis, respectively. **Conclusion:** Altogether, this analysis illustrates the low biological and camera error involved in using these two camera systems and provides a promising validation for their use, together or separately, for anthropological studies of morphological variation.

High altitude adaptations. *KEVIN WANG, *TREY SMITH and AINASH CHILDEBAYEVA. University of Michigan.

Background: High-altitude adapted individuals are marked by distinct physiological characteristics in response to chronic hypoxia. Evidence suggests these

observed characteristics arise from an evolutionary origin and genetic basis **Methods:** We performed a preliminary analysis on the gene H19 in DNA samples from a population of individuals of Quechua ancestry living in Peru. The assay measures methylation across four CpG sites in H19 **Results:** Our results indicate that average H19 did not correlate with altitude, but average methylation went down with age ($p < 0.05$) **Conclusion:** These findings suggest the importance of further investigation into the lasting and enigmatic effects of chronic hypoxia on the human epigenome.

A pedagogical project on the masticatory biomechanics of *P. boisei*. *JESSICA S. WOLLMANN and LAURA T. GRUSS. Radford University.

Background: Masticatory biomechanics and the production of bite force are an important aspect of examining the diet of past hominins. The two most important factors that affect bite force capability are the muscle force and the length of the load arm, which changes as prognathism does. These concepts can be difficult for anthropology students to understand, so one of the goals of this project was to find a hands-on pedagogical tool to help clarify them. **Methods:** This project describes a new technique for making inexpensive, student-operated models of the hominin masticatory apparatus to allow students to investigate how changes in prognathism can affect bite force. The functional models mimic the temporomandibular joint (TMJ) and have adjustable 3D printed teeth that move to change the load arm length and therefore the bite force capability. Students participated in an activity in which they adjusted the teeth to different specifications and measured the

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produced bite force. Following this they created a graph to illustrate how the load arm length affected bite force capability. **Results:** The project was used in an undergraduate paleoanthropology class to help teach concepts regarding the differences in masticatory biomechanics of *Paranthropus boisei* and *Homo sapiens*. Following the lab and use of the models, students were given a brief survey to gauge their reactions to the exercise. **Conclusion:** Developing new teaching techniques is particularly important to paleoanthropology because there is not always a straightforward answer to the questions we pursue. Hands-on, student directed activities such as this one have been shown to improve student understanding of difficult concepts. Exploring these techniques allows us to improve pedagogy in the field of anthropology while training the next generation of anthropologists.

Funding: This project received \$500 funding from Radford University's REALISE program's Making Kickbox Mini-grant.

Ecological factors affecting tree use in the folivorous black and white colobus monkeys (*Colobus guereza*). *COLLENA WRIGHT, *ARRON HERRERA and JESSICA ROTHMAN. Lehman College, Hunter College.

Background: Folivorous primates eat leaves in tree canopy and move within these trees in their habitats. The choice to spend time in a tree may depend on a number of different ecological factors such as the amount of food in the tree, and the size of the tree. Previous research has found that the food quality of leaves play a role in the length of time a folivorous monkey spends in a tree but other factors have not been studied. **Methods:**

From June to July 2018, we studied three groups of black and white colobus (*Colobus guereza*) in the Kibale National Park, Uganda. We recorded the amount of time spent in the tree by each individual, the type of the tree, the size of the tree (dbh), and the amount of preferred food (young leaves) using focal animal sampling. We used a generalized linear model to examine the relationship between these different variables and the time spent in the tree using SPSS. **Results:** The monkeys used 21 different tree species during the month we observed them, and moved through 248 different trees. The length of time spent in each tree varied from 6 s to 2388 s with a mean of 1033 s. Our results did not show any relationship between time spent in a tree and the tree species, the amount of young leaves in the tree, the size of the tree or whether other animals were in the tree (N=248 trees; $p>0.60$ for all variables). **Conclusion:** Our data were collected over one month, which limited our sample size. Although our study did not find any relationship between the amount of time spent in a tree and the size, species or amount of young leaves in a tree, previous studies have found that that nutritional quality of food does play a role in the time spent in a tree. Future research will investigate the social factors that may also cause monkeys to depart trees at different times.

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