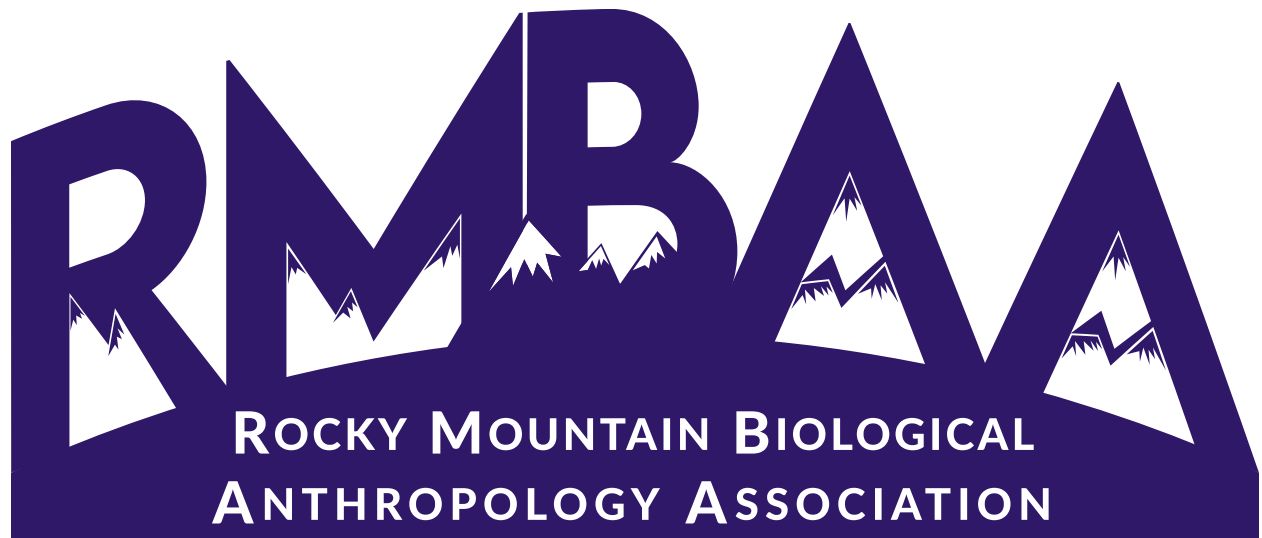




Program & Abstracts

**October 15, 2022
Estes Park, CO**



**Program and abstracts of the 1st Annual Meeting of the
Rocky Mountain Biological Anthropology Association
October 15, 2022**

To be held at the
Assembly Hall, YMCA of the Rockies
Estes Park, CO 80517

RMBAA Executive Committee

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Welcome

Message from the RMBAA President

Welcome to the inaugural meeting of the Rocky Mountain Biological Anthropology Association! This event has been a long time in the making. I began to consider what it would take to start a regional biological anthropology association in the U.S. Mountain West back in 2018, and I hosted a few meetings with nearby colleagues in 2019 to assess the feasibility of such an organization. However, as with many things set to begin in 2020, the Covid pandemic forced us to put our plans on hold for nearly two years. For the past year and a half, I have worked with our outstanding Executive Committee to get RMBAA officially recognized as a non-profit organization and to plan the meeting that we are holding today. I am eternally grateful to everyone who has helped me along the way to make this event happen, including all of you in attendance today. I hope that this is the first of many successful RMBAA meetings and that the organization serves to promote professional camaraderie and research in the Rocky Mountains for many years to come.

Todd R. Yokley
President and Founder
Rocky Mountain Biological Anthropology Association

Code of Conduct

The Rocky Mountain Biological Anthropology Association requires that all participants at the annual meeting adhere to the American Association of Biological Anthropologists Code of Conduct: We are committed to providing safe spaces that are free of threats, harassment, or assault, to all our members regardless of age, ethnicity, race, gender identity or expression, sexual orientation, disabilities, religion, marital status, or any other reason unrelated to professional performance. It is unethical in any professional setting to use the inequalities of power that characterize many professional relationships to obtain personal, sexual, economic, or professional advantages. It is also unethical to engage in any type of harassment, including sexual, sexual identity, or racial/ethnic harassment. Due to their centrality in professional training and networking in our discipline, conferences (such as this meeting) are clearly an extension of the workplace environment. As such, all college, university, or institutional rules regarding appropriate behavior apply in these contexts. We will not tolerate harassment of conference participants in any form or retaliation for reporting of misconduct. Additional information can be found on the AABA website: <https://bioanth.org/about/position-statements/aapa-code-conduct/>

Masking Policy

There is no mandate to use masks, but we strongly encourage all participants to wear high-quality N95 or surgical masks during the conference, especially when in close proximity to other participants. Poster presenters have the right to request that people interacting with them either wear a mask or maintain a distance of six feet. We will provide surgical masks at Registration free of charge for anyone who wants one.

Keynote Speakers



Dr. Herbert Covert is a primatologist whose research focuses on the behavioral ecology and conservation of endangered colobine monkeys and gibbons of Vietnam. He is involved in several conservation efforts, including the Khau Ca Forest Tonkin snub-nosed monkey conservation project in Ha Giang Province and a series of conservation projects focusing on silvered langurs, doucs, and gibbons with colleagues from the Southern Institute of Ecology (SIE) of Ho Chi Minh City. He also works with the Department of Nature Conservation of Vietnam's Ministry of Agriculture and Rural Development (MARD) of Hanoi in long-term planning of primate conservation.

Dr. Jamie Hodgkins is a paleoanthropologist and zooarchaeologist whose research is focused on the origins, evolution, and ecology of modern humans and Neanderthals. Much of this work has focused on reconstructing ecology and behavior of these peoples by studying their patterns of hunting and butchery, as well as analyzing the mobility of their prey species through isotopic analysis. She is a project director for excavations at the late Pleistocene and early Holocene site of Arma Veirana in northwestern Italy. Her fieldwork has also included projects in North America, France, Spain, Bulgaria, Morocco, and South Africa.



Dr. Diane France is a board-certified forensic anthropologist and Director of the Human Identification Lab of Colorado with almost four decades of forensic anthropology casework experience. She founded France Casting and is a long-time member of NecroSearch International, a nonprofit organization staffed by volunteers in a variety of disciplines who help law enforcement search for hidden graves and missing bodies. She has also authored several foundational forensic anthropology texts, including *Comparative Bone Identification: Human Subadult to Nonhuman*, and *Human and Nonhuman Bone Identification: A Color Atlas*.

Student Roundtable Luncheon Panelists

Kayla Bellipanni is a bioarcheologist with lots of experience working in cultural resource management and contract archeology.

Jessica Filipeli is a Deputy Coroner at the Boulder County Coroner's Office with investigative and forensics expertise.

Dr. Marian Hamilton is a paleoanthropologist and assistant professor at University of Northern Colorado who specializes in human behavioral evolution and habitat reconstruction.

Ariana Strasheim is a forensic anthropologist with Grouse Mountain Environmental Consultants in Buffalo, WY, working as an archaeological crew chief and cultural resource specialist.

Program

Program of the 1st Annual Meeting of the Rocky Mountain Biological Anthropology Association October 15, 2022

*All events will be held in the Assembly Hall, YMCA of the Rockies, Estes Park, CO
All times are in the Mountain Time Zone*

SCHEDULE OF EVENTS

- 8:30 AM **On-Site Registration Opens**
- 9:00 AM **Welcome and Opening Remarks, Todd Yokley, RMBAA President**
- 9:15 AM **Keynote Speaker 1: Herbert Covert, Ph.D., “Primates of Vietnam: Conservation in a Rapidly Developing Country.”**
- 10:15 AM **Coffee Break**
- 10:30 AM **Poster Session 1: Paleoanthropology and Primatology**
Author summaries will begin at 10:30 and proceed in the order listed on the Scientific Program
- 12:00 PM **Student Roundtable Luncheon**
- 1:00 PM **Keynote Speaker 2: Jamie Hodgkins, Ph.D., “Unexpected finds, emotional discoveries, and the predictable unpredictability of archaeological research.”**
- 2:00 PM **Coffee Break**
- 2:15 PM **Poster Session 2: Bioarchaeology and Forensic Anthropology**
Author summaries will begin at 2:15 and proceed in the order listed on the Scientific Program
- 3:45 PM **Keynote Speaker 3: Diane France, Ph.D., D-ABFA, “Murder, mayhem, and mystery: The challenges of forensic anthropology.”**
- 4:45 PM **Closing Remarks, Todd Yokley, RMBAA President**
- 5:00 PM **RMBAA Business Meeting**

Scientific Program

All events will be held in the Assembly Hall, YMCA of the Rockies, Estes Park, CO

Poster Session 1: Paleoanthropology and Primatology

- 1 **Carpal Kinematics and Morphological Correlates of Ulnar Deviation Mobility in Anthropoids.** C.M. ORR, R. ATKINSON, J. ERNEWEIN, M.W. TOCHERI. Pg 14-15
- 2 **Preliminary Morphometric Analyses of the Proximal Ulna in Apes and Humans With Application to Fossil Hominin Specimens.** G. JONES, D. SZUSTER, C.M. ORR. Pg 12
- 3 **New Efforts To Reconstruct the Forearm Length and Brachial Index of Australopithecus afarensis Specimen A.L. 288-1 ("Lucy").** D. SZUSTER, B.A. PATEL, C.M. ORR. Pg 16
- 4 **Reconstructing the Paleohabitat of Pliocene Hadar Hominin Using Bone Surface Modification Analysis.** T. NEGASH, M. FESEHA, I. LAZAGABASTER, J. THOMPSON. Pg 13-14
- 5 **Leaf Wax Isotopes Reveal Distinct Hominin Paleoenvironments in the Eastern Qinling Mountains of Central China.** M.L. FOX, J. TIERNEY, H. LU, W. SHEJIANG, X. WENTING, Z. HONYANG, W. JIANG. Pg 8-9
- 6 **The Effects of Time-Averaging on the Composition of Large Mammalian Communities: Lessons From Amboseli National Park, Kenya.** A. DU, A.K. BEHRENSMEYER. Pg 7-8
- 7 **Further Morphological Assessment of a Partial Hominin Pelvis From the Site of Drimolen, South Africa.** E. BERG, A.S. HAMMOND, A.G. WARRENER, M.S. MITCHELL, S.E. BAKER, A.I.R. HERRIES, D.S. STRAIT, C.M. ORR. Pg 7
- 8 **The Multi-Factor Pelvis Model: An Alternative to the Adaptationist Approach of the Obstetrical Dilemma.** A. WARRENER. Pg 16-17
- 9 **Bullseye! Preliminary Results on the Kinematics of the Dart-Thrower's Motion in Nonhuman Primates.** J.R. ERNEWEIN. Pg 8
- 10 **Howling for Taller Trees: Mantled Howler Monkeys (*Alouatta palliata*) Howl More in Forest Interior Than Edge in Costa Rica.** F.V.E. KASER, C.E. JOHNSON, M. ENNIS, N. PETE; I. PACHECO, M. WASSERMAN, A.L. SCHREIER. Pg 12-13
- 11 **Longitudinal Analysis of Primate Populations and Resource Use at the La Selva Biological Station, Costa Rica.** S.M. HOWELL, O.V. RAMIREZ, E.A.C. FONSECA. Pg 11

Poster Session 2: Bioarchaeology and Forensic Anthropology

- 12 **A Synthetic Evaluation of Maize Consumption in the Tennessee Valley: Explaining the Variability of Dental Caries Between Regions and Politics.** M.O. SMITH. Pg 15
- 13 **Intergroup/Interregional Violence in Pre-Contact East Tennessee: A Synthesis.** M.O. SMITH. Pg 15-16

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- 14 **Women's Work: Analysis of Antemortem Fractures in the Loretto Heights Cemetery Population.** L. HOSEK, R. BLAKE, S. COBLE, C. BAUCOM. Pg 10
- 15 **White Plague, Black Habits: Tuberculosis in a 19th- and Early 20th-Century Female Religious Community.** L. HOSEK, B. JONES, E. FOX, A. TRUJILLO, C. GILLIS. Pg 10
- 16 **Osteobiography of an Early 20th-Century Catholic Nun With Tuberculosis.** R. JAMES, C. CALVERT, R.C. WIGGINS, L. HOSEK. Pg 11-12
- 17 **Assessing Elemental Indicators of Growth Within Equine Teeth Using XRF Technology.** A.C. GALLOWAY. Pg 9
- 18 **Scapular Morphology Is a Robust Predictor of Sex in Diverse Modern Human Populations.** R.C. WIGGINS, M.K. STOCK. Pg 17
- 19 **Undergraduates Generating Knowledge: The Bioarchaeology of Mediterranean Colonies Project.** B. KYLE, L.J. REITSEMA. Pg 13

Further Morphological Assessment of a Partial Hominin Pelvis From the Site of Drimolen, South Africa

ELLIE BERG¹, ASHLEY S. HAMMOND², ANNA G. WARRENER¹, MARY SHIRLEY MITCHELL³, STEPHANIE E. BAKER⁴, ANDY I. R. HERRIES^{4,5}, DAVID S. STRAIT^{4,6}, and CALEY M. ORR^{1,7}

¹Department of Anthropology, University of Colorado Denver; ²Organization Division of Anthropology, American Museum of Natural History; ³Department of Anthropology and Geography, Colorado State University; ⁴Palaeo-Research Institute, University of Johannesburg; ⁵Department of Archaeology & History, La Trobe University; ⁶Department of Anthropology, Washington University in St. Louis; ⁷Department of Cell & Developmental Biology, University of Colorado Anschutz

The paleocave site of Drimolen in Gauteng Province, South Africa, has produced fossil hominin material dating to between 2.04–1.95 Ma. The assemblage includes craniodental remains attributed to *Paranthropus robustus* and the earliest specimen of *Homo* cf. *erectus* along with numerous postcrania of uncertain taxonomic affiliation. Notably, *Paranthropus* and *Homo* were effectively contemporaneous at the site and coeval with *Australopithecus* from nearby fossil localities in South Africa. Among the Drimolen postcranial fossils is a partial pelvis (DNH 43), which includes elements of the right os coxae and an associated sacrum. Though previously described as showing similarities to the pelvis of *Australopithecus africanus* and *A. afarensis*, comparisons across the broader hominin fossil record have been limited and the specimen has never been subject to quantitative analysis to assist in determining its closest morphological affinities. Here we present a partial digital reconstruction of DNH 43 and compare it to an expanded dataset of hominin pelvic material using a suite of metrics taken on 3D scans. In absolute measurements, DNH 43 is most similar to specimens attributed to *Paranthropus* and *Australopithecus*. However, in size-adjusted

metrics the os coxae exhibits its closest affinities with specimens SK 3155b (*P. robustus* from Swartkrans) and OH 28 (typically attributed to early *Homo* from Olduvai Gorge). The sacrum is relatively narrow in the anteroposterior dimension, linking it with early hominins including *A. afarensis* and *A. africanus* versus modern *Homo sapiens*. However, there are no sacral specimens attributed to *Paranthropus* against which DNH 43 can be compared. Overall, the quantitative analysis confirms prior qualitative results reflecting the primitive features of DNH 43. Given the high prevalence of *P. robustus* at Drimolen, we consider this to be the best current attribution.

Funding: Australian Research Council Discovery Project Grant DP170100056 to A.I.R.H. and D.S.S.

The Effects of Time-Averaging on the Composition of Large Mammalian Communities: Lessons From Amboseli National Park, Kenya

ANDREW DU¹ and ANNA K. BEHRENSMEYER²

¹Colorado State University; ²National Museum of Natural History, Smithsonian Institution

Paleoanthropologists often rely on ecological theory from extant systems when reconstructing paleoenvironments using fossil mammalian assemblages. However, virtually all fossil assemblages are time-averaged relative to the time scales at which modern communities are studied. Much work remains to understand how time-averaging affects the quality of ecological information contained within fossil assemblages. It has been hypothesized that time-averaging results in a community composition that is also spatially averaged, suggesting that time-averaging and spatial averaging may be interchangeable.

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Here, we directly test this hypothesis by analyzing data from repeated sampling of a large mammalian skeletal assemblage in Amboseli National Park, Kenya, which represents ~50 years of cumulative mortality. We use these data to compare the order by which species are accumulated with increasing temporal scale versus the order of species accumulation with increasing spatial scale. Results show that for any given sampling plot, there is a positive relationship between temporal and spatial species accumulation order, and across all plots, this relationship is quite robust. Furthermore, we find that the order of species spatial/temporal accumulation is directly related to species abundances, such that common species are sampled first followed by increasingly rarer species. We also find that common species possess functional traits that are more indicative of the local Amboseli habitat (e.g., grass-dominated diets), whereas rarer species possess traits that presumably reflect habitats found in the larger region outside of Amboseli. Together, these results illustrate how increased time-averaging produces a more spatially averaged ecological signal. Thus, modern and time-averaged fossil communities are fundamentally distinct, and it is inadvisable to apply modern theory based on small temporal scale samples to large-scale paleoecological questions and datasets in paleoanthropology.

Bullseye! Preliminary Results on the Kinematics of the Dart-Thrower's Motion in Nonhuman Primates

JAMIE R. ERNEWEIN^{1,2}

¹Colorado University School of Medicine at Colorado State University; ²Colorado State University College of Veterinary Medicine and Biomedical Sciences

Little research has been done on the kinematics of the wrist following the dart-thrower's pathway in anthropoid primates.

The dart-thrower's motion is defined as a combination of radial deviation and extension moving into ulnar deviation and flexion facilitated by a "path of least resistance" for the movement of the carpals. This pathway is involved in precision and power grips and has been hypothesized to be a unique adaptation to human tool behavior. However, this plane of motion has not been described in primates despite the wrist's anatomic similarities. Using a 3D computed-tomography based method for markerless bone registration and kinematic analysis of anthropoid primate cadavers we tracked scaphoid motion to test the hypothesis that nonhuman primates maintain a stable proximal row across the dart thrower plane of motion. Preliminary results suggest that in nonhuman primates the scaphoid has somewhat limited rotation along dart thrower's plane of motion approximating the results for humans. There is some indication that apes may have greater scaphoid rotation along the dart thrower path than humans and monkeys, but this requires further analysis. Current research is focusing on the analysis of the lunate and triquetral rotations to complete our understanding of the proximal carpal row kinematics.

Leaf Wax Isotopes Reveal Distinct Hominin Paleoenvironments in the Eastern Qinling Mountains of Central China

MATHEW L. FOX¹, JESSICA TIERNEY², HUAYU LU³, WANG SHEJIANG⁴, XIA WENTING⁴, ZHANG HONYANG³, and WU JIANG³

¹Colorado State University; ²University of Arizona; ³Nanjing University; ⁴Institute for Vertebrate Paleontology and Paleoanthropology, Chinese Academy of Sciences

Here, we present the first leaf wax record in association with Paleolithic occupations in

the Eastern Qinling Mountains of central China. This region has been the focus of numerous archaeological projects, as it contains evidence of some of the oldest (~2.0-1.2 Ma) hominin occupations in eastern Eurasia and is one of the key areas yielding Acheulean-like handaxe technology. Previous research demonstrates that these mountains represent a physio-geographic barrier that separates the semi-arid north from the subtropical south and defines northern and southern Paleolithic industries. Although evidence suggests models associated with the Qinling Mountains need refinement, our results demonstrate that there are observable differences between the southern and northern Qinling Mountains and are in good agreement with previous observations. Here, we use the carbon isotopic values ($\delta^{13}\text{C}$) of leaf wax lipids to reconstruct the ratio of C3 to C4 vegetation at long-term Pleistocene *Homo erectus* occupations of the Hanzhong and Luonan Basins of the Eastern Qinling Mountains. In Hanzhong, isotopic range is low (1.5‰) and vegetation was dominated by C3 vegetation (85–90%) throughout the middle to late Pleistocene. Paleolithic technologies associated with these stable vegetation regimes are dominated by expedient Mode I technologies throughout the entire record. Conversely, in Luonan, isotopic range is significantly higher (4.2‰) and C4 vegetation increases to approximately 40% during some periods, which represents the expansion of forest-grassland mosaics. These fluctuating vegetation regimes are also associated with the emergence of Mode II bifacial technology, suggesting variable environments triggered the need for multifunctional hand axe technology. Our research demonstrates that there are key differences between the southern and northern Qinling Mountains, and that the northern Qinling Mountains are associated with both forest-grassland mosaics and less expedient technologies.

Funding: Leakey Foundation, David and Lucile Packard Fellowship, University of Arizona.

Assessing Elemental Indicators of Growth Within Equine Teeth Using XRF Technology

ALEX C. GALLOWAY

University of Northern Colorado

The ratio of strontium to calcium in animal tissues (Sr/Ca) is closely associated with diet, especially trophic levels. The higher up the trophic pyramid an animal is, generally, the higher their Sr/Ca. Within herbivores before and during weaning, calcium uptake mimics that of a carnivore due to the high levels of calcium and low levels of strontium in nursing milk. Sr/Ca ratios can also track other changes in dietary sources through time. This study explores if non-destructive X-ray fluorescence (XRF) is a viable method to measure Sr/Ca ratios in archaeological and bioarchaeological specimens. Ratios of elemental concentration of barium, strontium (Sr/Ba), and calcium (Sr/Ca) were obtained from topical scans of 10 modern horse teeth (*Equus caballus*) housed at UNC to see if there are general trend lines that correlate to growth patterns, specifically by exploring how growth affects the elemental makeup of developing tooth enamel in horses. Data were collected every 0.5cm along the length of the tooth using a handheld XRF unit (TRACER 5i, Bruker Corporation) for 90 second assays using an internal calibration (Mudrock). Data are presented in photon counts per second.

Women's Work: Analysis of Antemortem Fractures in the Loretto Heights Cemetery Population

LAUREN HOSEK¹, RAE-OCEAN BLAKE², SHAWN COBLE², and CAMRYN BAUCOM²

¹University of Colorado Boulder; ²Metropolitan State University of Denver

In the summer of 2022, burials from the Loretto Heights Cemetery in southwest Denver were exhumed and relocated due to development in the area. The cemetery had been the resting place of 62 Sisters of Loretto, women belonging to a Catholic religious order emphasizing education. Skeletal analysis of 55 of the individuals prior to reburial revealed that 11 (20%) exhibited evidence for traumatic injury. The fracture pattern in this population is generally consistent with fragility fractures associated with osteoporosis in older adult females, including several femoral head fractures and a Colles fracture. Indeed, the majority of the women with healed fractures (63%) were over the age of 70 when they died based on historical records. However, some of the injuries do not fit this pattern, including a craniofacial fracture identified in the remains a young woman. Together, these injuries point to some of the hazards faced by this community of women, potentially on their long journeys to Colorado from other communities or during their work in the Denver area. A close reading of the historical biographies of some of these women reveals the types of labor they may have participated in beyond educating students, including groundskeeping and domestic work supporting the college. A life course perspective allows us to consider how labor may have intersected with gender, age, and religious identity to contribute to the fracture patterns within the cemetery population.

White Plague, Black Habits: Tuberculosis in a 19th- and Early 20th-Century Female Religious Community

LAUREN HOSEK¹, BROOKE JONES², EM FOX¹, AVIELLA TRUJILLO¹, and CLAIRE GILLIS¹

¹University of Colorado Boulder; ²Metropolitan State University of Denver

In the 19th and early 20th centuries, tuberculosis (TB) was a leading cause of death in the United States. However, the social consequences of this disease went far beyond the graveside. Sufferers from TB were often sent to drier, warmer climates on medical advice, contributing to westward expansion in the US. In this poster, we examine evidence for TB among the individuals buried in the Loretto Heights Cemetery in southwest Denver. These women were all members of a Catholic religious order focused on education and some were known to have been relocated to the Denver area from eastern states for health reasons. We analyzed the remains of 55 of the Sisters, and of these 16 (29%) exhibited periosteal bone formation on the visceral surfaces of the ribs. While skeletal rib lesions are not diagnostic of TB, this characteristic has been identified as a possible indicator of the disease. Other possible and probable indicators of TB were observed, including endocranial and vertebral lesions. We contextualize these lesions with historical evidence for the social implications and treatment of TB. In particular, we examine the historical biographies of the Sisters for direct and indirect evidence of tuberculosis—including sanatorium visits and descriptions of ill-health. Together, these skeletal and archival traces of the “White Plague” highlight how this disease moved people across landscapes.

Longitudinal Analysis of Primate Populations and Resource Use at the La Selva Biological Station, Costa Rica

SUSAN M. HOWELL¹, ORLANDO V. RAMIREZ², and ENRIQUE A. C. FONSECA²

¹Department of Anthropology, University of Colorado, Colorado Springs; ²Organization for Tropical Studies, La Selva Biological Station

La Selva Biological Station (LSBS), Costa Rica, includes 1611 ha of tropical wet forest and disturbed habitat owned and operated by the Organization for Tropical Studies. This analysis utilizes LSBS census Christmas Bird Count (CBC) data collected across the past 20 years to monitor primate sightings, land use (primary forest, secondary forest, and other) and water resource proximity (major rivers, minor rivers, streams). Each December, trained volunteers identify and count avian and non-avian species over a 24h period. While the initial purpose of the CBC is to census avian populations, mammal species were counted too. We focused on longitudinal changes in primate sightings and resource proximity for howler monkeys, (*Alouatta palliata*), white-faced capuchins (*Cebus capucinus*), and black-handed spider monkeys (*Ateles geoffroyi*). We used regression analyses to consider changes in sightings over time and an ANOVA statistic to consider differences in land and water resource use ($p < 0.05$). Results indicate sightings were relatively stable over time (howler monkey $r = 0.202$, $p > 0.05$; white-faced capuchin $r = 0.143$, $p > 0.05$; black handed spider monkey, $r = 0.307$, $p > 0.05$). For water resources, spider monkeys and capuchins were sighted more frequently near minor rivers ($p < 0.05$). However, howler monkeys were sighted about equally nearby all water resource types. For land resources, both black-handed spider monkeys and white-faced capuchins were sighted more often in

old growth forest ($p < 0.05$). However, howler monkeys utilized all land resource types ($p > 0.05$). Results suggest black-handed spider monkeys and white-faced capuchins may prefer old growth forest and while howler monkeys were a forest generalist using all land and resource types.

Funding: Department of Anthropology, University of Colorado, Colorado Springs.

Osteobiography of an Early 20th-Century Catholic Nun With Tuberculosis

ROBIN JAMES¹, CAITLIN CALVERT², RHEA C. WIGGINS², and LAUREN HOSEK³

¹University of Colorado Denver; ²Metropolitan State University of Denver; ³University of Colorado Boulder

Recent research has illustrated the benefits of an osteobiographical approach to paleopathological case studies, particularly in historic contexts. When coupled with archival and biographical data, pathological lesions can be further contextualized, and potential diagnostic criteria can be further evaluated. We present the osteobiography of an individual known to have died with tuberculosis in the early 20th century in Colorado. This young adult female was a member of the Sisters of Loretto, a Catholic order emphasizing service and education that opened and operated numerous schools across the United States in the 19th and 20th centuries. Individual LHC50 was examined as part of the exhumation, analysis, and relocation of the Loretto Heights Cemetery in southwest Denver in the summer of 2022. The skeletal remains exhibited numerous pathologies, including lesions on the vertebrae, ribs, and endocranial surface. Given that most individuals known to have died of tuberculosis do not exhibit skeletal lesions—particularly characteristic vertebral changes—this re-

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search also explores more subtle diagnostic features, such as rib and endocranial lesions as possible indicators of TB. We further explore the context of twentieth-century tuberculosis treatment in Colorado before the development of antibiotics as well as the significance of the disease within religious communities and their work.

Preliminary Morphometric Analyses of the Proximal Ulna in Apes and Humans With Application to Fossil Hominin Specimens

GABRIELLE JONES¹, DEBRA SZUSTER², and CALEY M. ORR^{1,2}

¹Department of Anthropology, University of Colorado Denver; ²Department of Cell & Developmental Biology, University of Colorado Anschutz

In the human lineage, the upper limb evolved considerably as our ancestors gave up arboreality (life in the trees). In this project, we analyzed one component of the elbow (the proximal ulna) from *Gorilla gorilla*, *Pan troglodytes*, and *Homo sapiens* to test the hypothesis that hominoid species can be differentiated based on joint surface areas and 3D geometric morphometrics. We then apply these preliminary data to assess the morphological affinities of fossil ulnae attributed to several early hominins. First, we collected 3D digital models of ulnae using an Artec Space Spider scanner. Then we measured the surface areas of three articular surfaces on the proximal ulna and compared the relative sizes of these facets among species. The surface area data show that human joint proportions align with gorillas more closely than *P. troglodytes* (our closer relatives), but there is extensive overlap among groups using these metrics. To improve upon the basic surface-area approach, we created a protocol for landmarking 3D

models of the ulna and applied multivariate geometric morphometric techniques to conduct a quantitative analysis of overall shape differences among species. The geometric morphometrics results show that this method is highly repeatable and clearly distinguishes among the extant groups (humans, chimpanzees, and gorillas) based on quantification of the overall shape of the proximal ulna. Most hominin fossils align with humans with some outliers that exhibit some bone weathering, which might affect their results. Thus, the assessment of fossils is improved by using the geometric morphometrics approach. Ultimately, these results may help us to infer climbing ability or the manipulation of objects (e.g., tools) in fossil specimens, which remain important topics of inquiry for understanding human evolution.

Funding: EURECA! Program, CU Denver; Modern Human Anatomy Program, CU Anschutz.

Howling for Taller Trees: Mantled Howler Monkeys (*Alouatta palliata*) Howl More in Forest Interior Than Edge in Costa Rica

FRANCESCA V. E. KASER¹, C. ERIC JOHNSON², MICHAEL ENNIS¹, NYLA PETE³, ISABEL PACHECO³, MICHAEL WASSERMAN², and AMY L. SCHREIER^{1,4}

¹Department of Biology, Regis University; ²Department of Anthropology, Indiana University; ³Department of Environmental Science and Policy, St. Edwards University; ⁴Maderas Rainforest Conservancy

Howler monkeys rely on large trees for their folivorous-frugivorous diet, and males produce loud calls, at least in part, to defend valuable food resources. At La Selva Biological Station, a large protected forest fragment in Costa Rica, we explored the relationship between tree size and howling behavior in the forest interior and edge

(defined as 100m from forest perimeter). Because forest interior typically has higher resource abundance than edge, we predicted that trees would be larger and taller in forest interior than in the edge, and that number of howls per bout, howl duration, and howl rate would be higher in the interior than edge because there are more food resources to defend in the former. We measured tree height and DBH along vegetation transects across both interior and edge zones (May-July 2022) and conducted all-occurrences sampling of howling behavior (November 2018-February-2019; May-June 2022). Tree height was significantly greater in forest interior (15.8m) than edge (15.0m; $p = 0.014$), but DBH was not (interior: 27.8m; edge: 29.4m; $p = 0.061$). Number of howls per bout was significantly higher in the forest interior (39.9) than edge (23.4; $p = 0.031$). However, there were no significant differences in howl duration (interior: 140.6sec; edge: 148.7sec) and rate (interior: 0.6howl/hour; edge: 0.7howl/hour). Our results suggest that howler monkeys emit more howls per bout in forest interior to defend the taller trees there. Tree height, rather than DBH, may be a more salient indicator of resource abundance for howler monkeys at La Selva.

Undergraduates Generating Knowledge: The Bioarchaeology of Mediterranean Colonies Project

BRITNEY KYLE¹ and LAURIE J. REITSEMA²

¹University of Northern Colorado; ²University of Georgia

The Bioarchaeology of Mediterranean Colonies Project (BMCP) is an interdisciplinary, international collaboration that examines the biocultural consequences of culture contact among human populations living in the ancient Mediterranean. Our international team of scholars and students use information from human skeletal remains to

better understand what happens when human populations coalesce. Here we discuss the project as a model for involving undergraduate students in academic research. In the last 10 years, the BMCP has brought 31 undergraduate students to Albania, Greece, and Italy to serve as research assistants (funded in part by a NSF REU grant), but also to conduct independent research projects under the direction of project directors Drs. Britney Kyle and Laurie Reitsema. Student research projects have addressed the biological and lifestyle impacts of cultural transition on both local and colonial populations. Key findings of the project include the fact that ancient warfare was a contact mechanism for people throughout the ancient Mediterranean and beyond, colonization was a catalyst for cultural hybridity, and colonization resulted in decreases in skeletal stress at mother cities while negatively impacting health outcomes for people living in colonies. Undergraduate students rarely have the opportunity to participate in all stages of a research project, from hypothesis generation to dissemination of research findings. The BMCP has made a concerted effort to meaningfully engage undergraduates and train the next generation of scholars in biological anthropology.

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.

Reconstructing the Paleohabitat of Pliocene Hadar Hominin Using Bone Surface Modification Analysis

TEWABE NEGASH^{1,2}, MULUGETA FESEHA², IGNACIO LAZAGABASTER³, and JESSICA THOMPSON⁴

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¹Colorado State University; ²Addis Ababa University; ³Museum für Naturkunde, Leibniz Institute for Research on Evolution and Biodiversity; ⁴Yale University

Bone surface modification analysis provides significant insight into Plio-Pleistocene prey and predator interactions, as well as paleoecological and depositional environmental conditions, yet it is an underutilized proxy. Previously, oxygen isotopes, pollen, and faunal turnover models have been applied as proxies to investigate the paleohabitat and depositional environment of Pliocene Hadar hominin. The Pliocene Hadar Formation, deposited ca. 3.8-2.9 Ma in Afar, Ethiopia, has produced spectacular hominin fossils including AL.288-1. Here, we introduce a new approach to reconstruct the paleohabitat based on analysis of carnivore tooth marks on the bone surfaces of Suidae specimens from three members of the Hadar Formation: Basal Member (BM, ~3.45-3.42 Ma), Sidi Hakoma Member (SH, ~3.42-3.24 Ma), and Denen Dora Member (DD, ~3.24-3.20 Ma). Of 476 mandible and crania specimens, 54% bear bisected tooth marks, exclusively associated with crocodylian modification. Crocodiles have a specific preference for aquatic areas and the abundance of crocodylian tooth marks suggests a restricted paleoecological setting, which can be used to infer the broader paleoecological conditions of the period. The majority of bisected tooth marks are found on the specimens from SH, suggesting that more wetland and aquatic habitat was present in Hadar during the time of SH deposition. Drier or intermediate conditions may have persisted before and after this time. These findings are also relevant for the Pliocene hominin, who may have experienced a lacustrine-based paleoenvironment during SH deposition.

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Carpal Kinematics and Morphological Correlates of Ulnar Deviation Mobility in Anthropoids

CALEY M. ORR^{1,2}, RICHARD ATKINSON³, JAMIE ERNEWEIN^{4,5,6}, and MATTHEW W. TOCHERI^{7,8,9}

¹Department of Cell & Developmental Biology, University of Colorado Anschutz; ²Department of Anthropology, University of Colorado Denver; ³Chicago College of Osteopathic Medicine, Midwestern University; ⁴Modern Human Anatomy Program, University of Colorado Anschutz; ⁵University of Colorado School of Medicine at Colorado State University; ⁶College of Veterinary Medicine and Biomedical Sciences, Colorado State University; ⁷Department of Anthropology, Lakehead University; ⁸Human Origins Program, Department of Anthropology, National Museum of Natural History, Smithsonian Institution; ⁹Australian Research Council Centre of Excellence for Australian Biodiversity and Heritage, University of Wollongong

Primates employ wrist ulnar deviation (adduction) during a variety of locomotor and manipulative behaviors. Data on the mechanical and morphological basis of ulnar deviation is thus important for understanding primate postcranial adaptation. Extant hominoids share a derived condition in which the ulnar styloid process is separated from the proximal carpals—often assumed to provide a greater ulnar deviation range of motion (ROM). Acute angulation of the hamate's triquetral facet has also been hypothesized to reflect ulnar deviation mobility. Here, we test these hypotheses by analyzing three-dimensional carpal kinematics using a cadaveric sample of *Pan troglodytes*, *Pongo* sp., and five monkey species (*Macaca mulatta*, *Papio anubis*, *Mandrillus sphinx*, *Colobus guereza*, and *Ateles geoffroyi*). Ulnar styloid projection and orientation of the hamate's triquetral facet were measured on 3D polygon models derived from the CT scans. Although carpal rotation patterns in *Pan* and *Pongo* are uniquely similar in some aspects, *P. troglodytes* exhibits overall kinematic

similarity with large terrestrial cercopithecoids (*Papio* and *Mandrillus*). *Pongo*, *Macaca*, and *Ateles* exhibit high total ulnar deviation ROMs, but orangutans produce ulnar deviation of the hand via a unique mechanism in which the triquetrum acts as an element of the distal carpal row rather than as part of the proximal row. Across the taxa, projection of the ulnar styloid and ulnar deviation ROM are not correlated. However, the hamate's triquetral facet orientation is correlated with ulnar deviation ROM across taxa. In conclusion, increasing ulnar deviation ROM is not the function of ulnar styloid withdrawal in hominoids. Instead, this feature probably reduces stress on the ulnar side wrist or is a byproduct of adaptations that increase supination. Orientation of the hamate's triquetral facet offers some potential to reconstruct ulnar deviation mobility in extinct primates.

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A Synthetic Evaluation of Maize Consumption in the Tennessee Valley: Explaining the Variability of Dental Caries Between Regions and Politics

MARIA O. SMITH

Illinois State University, Normal, Illinois

Intensive maize cultivation is the signature subsistence strategy of the Mississippian Period (CE1000-1600). It co-associates with aggregated village settlement (with central plazas and truncated quadrilateral mounds), hierarchical social organization, and iconography associated with the Southeastern (centered) Ceremonial Complex. The presumption of maize intensive agriculture is that it served as food for the masses. How-

ever, a synthesis of the maize consumption proxy of dental caries indicates that in East and West-Central Tennessee, maize was differentially consumed between the two regions and within each region between (presumptive) polities. Consumption varied with elite status, ecologic circumstances (agricultural productivity), and sex. Indeed, males showed the most variability in cariosity scores with frequency increasing for elites in areas/circumstances of low productivity. This study synthesizes 30-plus years the oral health data analysis and is/has been NAGPRA compliant. Per NAGPRA mandated changes in the use of skeletal imagery (#RE00001-K; effective 06/19/2020), none are employed in this presentation.

Intergroup/Interregional Violence in Pre-Contact East Tennessee: A Synthesis

MARIA O. SMITH

Illinois State University, Normal, Illinois

With the 2016 termination of access to the pre-Contact human remains of the Eastern Tennessee Valley pending reburial, a synthesis of previous research is in order. The synthesis presented here consists of the temporal and spatial distribution of skeletally observed evidence of deliberate violence in East Tennessee (Late Woodland/Early Mississippian [Hamilton Mortuary Complex, 700-1100 CE], Late Mississippian (Dallas Phase, Mouse Creek Phase, 1300-1600CE)). The research, absence of skeletal imagery, and this professional presentation, is NAGPRA compliant (#RE00001-K; effective 06/19/2020).

Some level of intergroup violence is ubiquitous in sedentary and/or territorially bounded human groups. The pattern(s) and prevalence vary temporally and spatially and reflect differences in cosmology (e.g., body

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integrity related to dismemberment, “trophy” taking, interment [im]permanence, post-mortem use of body elements), motivation (e.g., resource impingements, population incursions) and a host of socio-cultural variables. The pattern in East Tennessee indicates a comparatively high frequency of deliberate trauma in the collective Hamilton Mortuary Complex sites (9-11%) versus the multiple Dallas (~3.0%) and Mouse Creek (~8%) site samples. The difference is striking given the absence of trophy taking in the Hamilton Phase and the addition of (likely) interpersonal violence in the Mouse Creek Phase samples.

New Efforts To Reconstruct the Forearm Length and Brachial Index of *Australopithecus afarensis* Specimen A.L. 288-1 (“Lucy”)

DEBRA SZUSTER¹, BIREN A. PATEL², and CALEY M. ORR^{1,3}

¹Department of Cell & Developmental Biology, University of Colorado Anschutz; ²Department of Integrative Anatomical Sciences, Keck School of Medicine, University of Southern California; ³Department of Anthropology, University of Colorado Denver

Although the A.L. 288-1 specimen (“Lucy”) attributed to *Australopithecus afarensis* exhibits ape-like humerofemoral proportions (i.e., a long humerus and short femur), the brachial proportions remain uncertain because pieces of the forearm bones (radius and ulna) are incomplete. Prior approaches to estimate bone length have produced both “apelike” and “human-like” brachial proportions. The aim of this study was to estimate the brachial index (radius length / humerus length X 100) of A.L. 288-1 using a complete ulnar specimen of a separate *A. afarensis* individual (A.L. 438) as a guide. The length of the A.L. 288-1 ulna was reconstructed by matching landmarks on the epiphyses with the homologues

on A.L. 438 using Procrustes fitting and then “morphing” a 3D polygon model of A.L. 438 via thin plate spline transformation. Maximum length of the right radius was estimated by aligning the radioulnar joints with corresponding surfaces on the reconstructed ulna. The resulting radius length of 209 mm combined with a known humerus length of 237 mm indicates a brachial index of 88 for A.L. 288-1. Associated error (e.g., from allometric effects and fitting inaccuracies) was modeled by simulating the method using bones of known length from *Homo sapiens* (n = 20), *Gorilla gorilla* (n = 13), and *Pan troglodytes* (n = 17). Error may reach 20% for bone-length estimates, but it is size-dependent such that highly dimorphic matched pairs (as with *A. afarensis*), forearm length is almost always underestimated. Considering the size effect, the brachial proportions of A.L. 288-1 are either intermediate between those of *G. gorilla* and *P. troglodytes* or within the *P. troglodytes* range. This is consistent with the high brachial indices of *A. sediba* and the Bouri material (BOU-VP 12/1), suggesting that a relatively long forearm is typical of early hominins. This has important implications for understanding *A. afarensis* locomotor behavior and the evolution of the hominin upper limb.

Funding: Modern Human Anatomy Program at CU Anschutz.

The Multi-Factor Pelvis Model: An Alternative to the Adaptationist Approach of the Obstetrical Dilemma

ANNA WARRENER

University of Colorado Denver

The obstetrical dilemma describes the competing demands that a bipedally adapted pelvis and a large brained neonate place on human childbirth and is the predominant

model within which hypotheses about the evolution of the pelvis are framed. I argue the obstetrical dilemma follows the adaptationist programme outlined by Gould and Lewontin (1979) and should be replaced with a new model, the multi-factor pelvis model. This change will allow thorough consideration of non-adaptive explanations for the evolution of the human pelvis and avoid negative social impacts from considering human childbirth inherently dangerous. First, the atomization of the pelvis into discrete traits is discussed, after which current evidence for both adaptive and non-adaptive hypotheses is evaluated, including childbirth, locomotion, shared genetics with other traits under selection, phylogenetic inertia, genetic drift, and environmental and epigenetic influences on the pelvis.

Scapular Morphology Is a Robust Predictor of Sex in Diverse Modern Human Populations

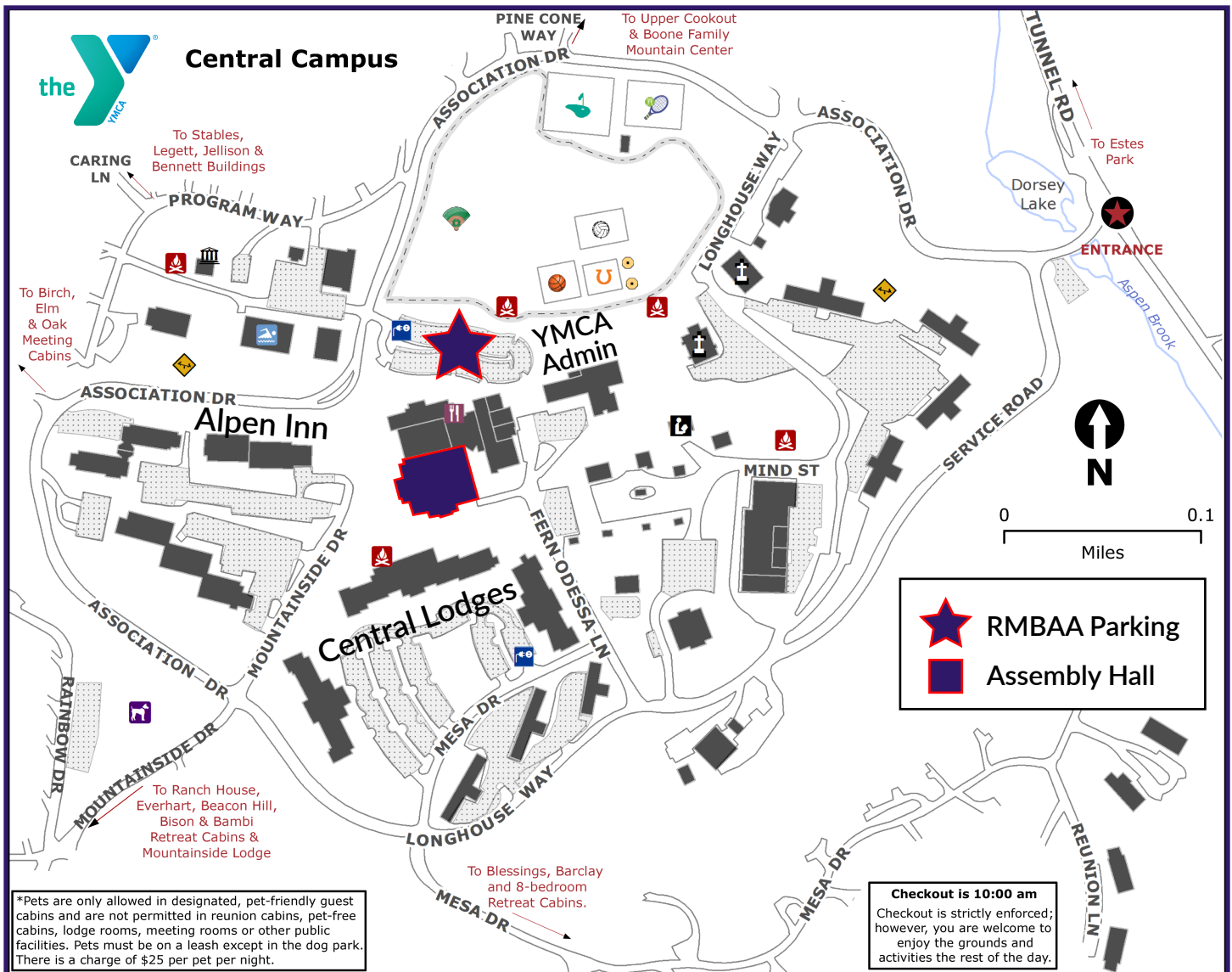
RHEA C. WIGGINS and MICHALA K. STOCK

Metropolitan State University of Denver

Accurate estimation of sex assigned at birth is key to assessing the biological profile of unidentified human skeletal remains in forensic anthropological and bioarcheological contexts. This estimate is often based on measurements of sexually dimorphic skeletal elements, such as the scapula. Previous studies (e.g., Ali et al. 2018) have demonstrated the utility of standard scapular dimensions for sex estimation in specific populations via discriminant function analysis (DFA). The current study assesses the validity of previously-published equations for use in diverse populations and whether a universal discriminant function (DF) equation (i.e., not population dependent) may be appropriate for sex estimation from scapular metrics. Postmortem computed tomography (CT)

scans of 66 decedents (33 assigned female, 33 assigned male individuals) free from pathology and trauma to the region of interest were selected from the New Mexico Decedent Image Database. CT scans were rendered using isosurfaces in the 3-D processing software Amira. Standard measurements of scapular breadth and scapular height were collected from the left side of each individual. These measurements were then input into the previously-existing DF equations, and the accuracy of these estimates of sex was compared to a new discriminant function generated from the novel population data in this study. Using Ali et al. (2018) equations, this population demonstrates 90% sex estimation accuracy (96.96% for male; 84.84% for female individuals). The newly generated DF equation differed from Ali et al.'s in that scapular height was weighted more heavily than scapular breadth while performing at a 91% accuracy rate. These results demonstrate that population-specific equations may be more precise in identifying how sexually dimorphic areas of the scapula differ between human groups; however, the similar accuracy rates justify pursuing a global equation for estimating sex from scapular measurements.

Venue & Location



Map provided courtesy of YMCA of the Rockies

Directions

The entrance to the YMCA of the Rockies is 2 mi south of Hwy 36 near the entrance to Rocky Mtn National Park, on the west side of Tunnel Rd/State Hwy 66 (red star on map).

Turn on to Association Dr, and continue past Longhouse Way and an activity area on the left that includes tennis, mini golf, and a baseball diamond.

Use the parking lot on the left just past the baseball diamond, near the YMCA Administration/Registration building and the Aspen Dining Hall (purple star on map).

The **Assembly Hall** is on the south side of the building complex, past the Aspen Dining Hall, at 40.3395015° N, 105.5734734° W (purple square on map).

Questions or Concerns?

Call **Todd Yokley (303) 615-1339** or visit the YMCA Admin office (see map).

