



Program & Abstracts

**September 26, 2026
Colorado Springs, CO**



**Program and abstracts of the 5th Annual Meeting of the
Rocky Mountain Biological Anthropology Association
September 26, 2026**

**To be held at
Dwire Hall, University of Colorado at Colorado Springs
Colorado Springs, CO 80918**

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Program

Message from the RMBAA President

Welcome to the fifth annual meeting of the **Rocky Mountain Biological Anthropology Association**! Thanks to all of you for helping to get us to the five-year point! Your ongoing support is why we continue to be able to hold these meetings every year. If you are attending RMBAA for the first time, let me be the first to give you a big welcome! We have a day full of activities that include keynote talks, poster presentations, and a professional development workshop that I think all of you will enjoy. I hope that both RMBAA veterans and newcomers will continue to attend our meetings for many years to come!

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

RMBAA 2026 Student Awards

As a student-focused organization, we are pleased to once again offer **Student Awards** in recognition of the outstanding student-driven research presented at RMBAA. These awards are intended to support and encourage additional participation of undergraduate and graduate students. In 2026, **three undergraduate** and **four graduate** student abstracts were considered for the student award, presenting a wide array of creative new projects from across the spectrum of biological anthropology. **Student award recipients will be announced during closing remarks at 4:45—stay tuned!**

RMBAA 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/aaba-code-of-conduct/>

Keynote Speakers



Dr. Caley M. Orr

What do we think we were? And what do we think we weren't? Insights into human evolution from the genus Paranthropus and the side branches of our family tree

Caley Orr (PhD 2010, Arizona State University) is an Associate Professor in the Department of Cell and Developmental Biology at the University of Colorado Anschutz School of Medicine (where he teaches anatomy) and affiliated faculty in the Department of Anthropology at CU Denver. As a paleoanthropologist and primate comparative anatomist, his primary research interests are in the evolution of the hominin postcranial skeleton. Notable contributions include central involvement in studies of the *Homo floresiensis* wrist, the *Homo naledi* hand, and in 2025, the first fossil hand and foot firmly attributed to *Paranthropus boisei*. A major current project involves the description and analysis of new postcranial remains from the ~2 million-year-old site of Drimolen (part of the Cradle of Humankind UNESCO World Heritage site, Gauteng Province, South Africa), which is providing insights into the evolution of *Paranthropus* and *Homo* in southern Africa. Paleontological and archaeological fieldwork has been an important part of his work throughout his career. In recent years, he has been co-directing excavations at sites in Italy and Croatia relating to the early peopling of Europe. Other fieldwork and/or study of museum collections has taken him to Ethiopia, Kenya, The Western Cape of South Africa, Spain, Belgium, and southwestern Wyoming to investigate early and late time periods of human evolution.

Dr. Xenia P. Kyriakou

Humanitarian Forensics: The Right to Know, Truth, Justice and Reconciliation

Xenia Paula Kyriakou is a forensic anthropologist and archaeologist specializing in forensic and biological anthropology, forensic archaeology, bioarchaeology, and palaeopathology. She has extensive applied and methodological expertise in field searches and recoveries; forensic and archaeological taphonomy; analysis of human remains (skeletonized and at various degrees of decomposition); human identification; commingling and de-commingling processes; and reconstruction and interpretation of skeletal trauma. Her research interests are diverse within these areas, lately exploring various other research themes in the archaeology of disaster, conflict archaeology, and both the social identity and causes of morbidity and mortality of children in antiquity. She leads multiple field-based research projects in the U.S. and abroad (e.g., Cyprus,



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Croatia, and Germany), actively involving both graduate and undergraduate students, and fostering hands-on training in forensic and (bio)archaeological methodologies.

A forensic anthropology practitioner since 2010, Dr. Kyriakou is actively engaged in forensic casework for the State of Montana, federal, and international law enforcement agencies. She is also active in the field of Humanitarian Forensics, with a focus on the investigation of mass graves and resolution of human rights violations, capacity building, peacebuilding, and transitional justice initiatives, serving as a consultant for the International Commission on Missing Persons (ICMP).

Professional Development Workshop

Do you want to learn more about doing research as an undergraduate? How about going to grad school, or entering the job market? And what is all this talk about ‘networking’ anyway? Come to our interactive professional development panel where current graduate students and faculty will answer questions about getting involved in research, applying to graduate school, developing compelling application materials, and designing research projects that are both interesting and feasible. Panelists will also share perspectives on the transition from undergraduate to graduate-level work and discuss how experiences like RMBAA can help students build skills, confidence, and professional networks.

As RMBAA celebrates its fifth anniversary, this session will also reflect on the role undergraduate conferences can play in shaping academic futures, and we want to hear your ideas. Pizza will be provided for all workshop participants free of charge.

Bring your questions! This session is designed as an open conversation, with plenty of time for discussion and advice. **We are grateful to the faculty, graduate students, and professionals from across the Front Range who volunteered their time to support students at RMBAA.**

Program of the 5th Annual Meeting of the Rocky Mountain Biological Anthropology Association September 26, 2026

*All events will be held in Dwire Hall, University of Colorado at Colorado Springs, 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: Caley M. Orr, Ph.D., *"What do we think we were? And what do we think we weren't? Insights into human evolution from the genus Paranthropus and the side branches of our family tree"*
- 10:15 AM Coffee Break
- 10:30 AM Poster Session 1: Primatology, Pregnancy, Bones, & Ethics
- Author summaries will begin at 10:30 and proceed in the order listed in the Scientific Program*
- 12:00 PM Lunch Break
- 1:00 PM Professional Development Workshop: Expert Panel
- 2:00 PM Coffee Break
- 2:15 PM Poster Session 2: Paleoanthropology, Molecules, & Morphometrics
- Author summaries will begin at 2:15 and proceed in the order listed on the Scientific Program*
- 3:45 PM Keynote Speaker 2: Xenia P. Kyriakou, Ph.D., *"Humanitarian Forensics: The Right to Know, Truth, Justice and Reconciliation"*
- 4:45 PM Closing Remarks, Todd Yokley, RMBAA President

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Scientific Program

All events will be held in Dwire Hall, University of Colorado at Colorado Springs, CO

Poster Session 1: Primatology, Pregnancy, Bones, & Ethics

- 1 Pilot: Exploring Howler Monkey Vocalizations Across Human and Environmental Situations. M.M. KNOTEK-ALGERMISSEN, S. HOWELL. [Pg 12–13](#)
- 3 You're Drilling Me Crazy: Trepanation and the Evolution of Human Knowledge and Behavior. M.E. BAHR, X.P. KYRIAKOU, K.M. BIDDLE. [Pg 8](#)
- 5 Hungry Hungry Hominins: A Preliminary Evaluation of Taphonomic Criteria for Cannibalism. T.J. WEILAND, J. CAMERON, M. GLANTZ. [Pg 17](#)
- 7 The 'Imminent' Extinction of the Tapanuli Orangutan: How Ongoing Habitat Destruction, Fragmentation, Conflict Killings, and Severe Weather Events Are Pushing the Tapanuli Towards Extinction. S.E. NAOUS. [Pg 15](#)
- 9 Born of a Storm: Pregnancy in the Path of Compounding Disasters. M. HOWELLS. [Pg 11–12](#)
- 11 Beyond Bioarchaeology: Osteological Stress Markers As Indicators of Modern Political Instability. M.S. HYLLAND, M. HOWELLS. [Pg 12](#)
- 13 Material Evidence, Scientific Reasoning, and Community Engagement: A Forensic Anthropology Outreach Model. A. WHITE, A. CREED, A. NEUHARTH, T. CASTELLON, S. HOWELL. [Pg 17–18](#)
- 15 Using Metrics of the Fourth Lumbar Vertebra to Estimate Sex in Forensic Cases. T.O. COLE, M.K. STOCK. [Pg 8–9](#)
- 17 Ethical and Practical Considerations in the Use of Unprovenanced Osteology Collections in Higher Education Institutions Across Colorado. A.H. MCKINLEY, M.K. STOCK, P.E. MORSE, C.M. ORR. [Pg 14](#)

Poster Session 2: Paleoanthropology, Molecules, & Morphometrics

- 2 Did Environmental Change Drive Cultural Innovation in Early *Homo sapiens*? Faunal Evidence Across the MIS 5 to 4 Transition at Pinnacle Point 5–6N, South Africa. B.P. FAHEY, J. HODGKINS, C.W. MAREAN. [Pg 9](#)
- 4 The Remarkably Complete Turbinate Anatomy of the Neandertal From Altamura and Implications for the Adaptive Significance of the Neandertal Nose. T.R. YOKLEY, C. BUZI. [Pg 18](#)
- 6 Exploring Adriatic Prehistory on the Island of Vis, Croatia: Initial Survey and Preliminary Excavation Results From the PreVis Project. J. HODGKINS, B.P. FAHEY, C.D. FELLMAN, A. NAD, C.M. ORR, A. OROS SRŠEN, M.C. PANTE, D. RADIĆ, D.S. STRAIT. [Pg 11](#)

- 8 Using Finite Element Analysis to Explore the Relationship Between Bone Volume Fraction and Activity Related Strain Energy Density in the Proximal Femur. F. LUPI-PEATE, A.G. WARRENER. [Pg 13-14](#)
- 10 Preliminary Results of a 3D Geometric Morphometric Analysis of the Trapeziometacarpal Joint Complex in *Homo sapiens*. S.S. FRIDRICH, P.E. MORSE, M.W. TOCHERI, C.M. ORR. [Pg 9-10](#)
- 12 Prospecting for Collagen in Old Bison Bones. S.R. STOCK, V. COOLEY, J.-S. PARK, H. LUTZ. [Pg 16](#)
- 14 Investigating the Environmental Impacts of Industrialization Through Heavy Metal Levels in Bison. S. KULP, M.I. HAMILTON, A. ARCHER. [Pg 13](#)
- 16 XRF Successfully and Nondestructively Screens for Diagenetic Alteration in Fossil Primate Teeth. M.I. HAMILTON, B.L. DRAKE. [Pg 10](#)
- 18 A Non-invasive Pilot: Detecting Amylase Gene Copy Number Variation From Primate Fecal Samples. E. OPACK, K. SCHEER, O. GOKCUMEN. [Pg 15-16](#)

Abstracts

You're Drilling Me Crazy: Trepanation and the Evolution of Human Knowledge and Behavior

MEG E. BAHR¹, XENIA P. KYRIAKOU¹, and
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Montana; ²Department of Anthropology, University
of Wisconsin-Parkside

Performed as early as the Neolithic, trepanation is the practice of drilling, scraping, or cutting into the skull. The Neolithic has been widely accepted as the beginning of human settlement, leading to the further advancement of stone tools. Trepanation highlights this advancement, as the procedure has been executed with tools made from a wide variety of materials. This variety of material may also contribute to the variation in the methods used. Some variation is claimed in the motives, characterized as being either therapeutic: to treat discomfort and/or injury, or ritualistic: to remove evil spirits. In the archaeological record, skulls exhibiting signs of trepanation have been found over the past century across the world. Yet, research on the procedure has been sporadic through the years, leaving questions about both methods and motives. Therefore, a review of the extant literature from these different geographical regions is needed for better clarity. The purpose of this project is to review past literature from around the world and compare the common themes identified within them. Study methods involve statistical analysis to analyze the trepanations reported with variables such as sex, age, techniques, motives, healing, trauma, pathology, and location. Modern versions of this procedure exist and are known as craniotomies, craniectomies, or burr hole surgeries. Just as in past societies, these procedures are used to treat brain injuries known today. Therefore, this research aims to redirect the confusion surrounding this topic and instead emphasize the evolution of human knowledge and

behavior through time and across geographic space.

Using Metrics of the Fourth Lumbar Vertebra to Estimate Sex in Forensic Cases

TEVYN O. COLE and MICHALA K. STOCK

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In forensic cases, anthropologists use various skeletal indicators to estimate sex of an individual. The most prominent skeletal indicators of sex come from the features of the os coxa and of the skull. It remains unclear whether other skeletal regions may also provide accurate estimate of sex. Due to their proximity to the os coxa, I decided to target the lumbar vertebrae, specifically focusing on the fourth lumbar vertebra (L4).

I sampled twenty individuals (10 male and 10 female) from the New Mexico Decedent Image Database (NMDID). All included individuals were over 25 years old with no trauma or postmortem changes that would influence measuring the vertebral dimensions. I measured the L4 vertebral body height, vertebral body width, vertebral foramen width, and vertebral body length of each individual.

I performed a linear discriminant analysis (LDA) on these data to assess which of the variables were most influential and to test sex estimation accuracy from L4 measurements. Results showed that vertebral body length and vertebral body width are the two most heavily weighted variables in the LDA. Vertebral body length was the most heavily weighted variable (LD coefficient = 0.32), and vertebral body width being the second most (LD coefficient = -0.15).

Furthermore, the jackknifed LDA performed with 80% cumulative accuracy; sex was

correctly estimated for eight out of ten female individuals and for eight out of ten male individuals. Correctly estimating sex of an unknown individual is important because it can help forensic anthropologists properly identify unidentified decedents by narrowing the missing person's pool. Further research is needed to determine if the L4 vertebrae can be used to accurately estimate sex in individuals when looking at different ages and involving different skeletal pathologies.

Did Environmental Change Drive Cultural Innovation in Early *Homo sapiens*? Faunal Evidence Across the MIS 5 to 4 Transition at Pinnacle Point 5–6N, South Africa

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and CURTIS W. MAREAN³

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Marine Isotope Stage (MIS) 5 and 4 preserves evidence of innovative human behavior across Africa, including stratified records of early symbolic activity and increasing technological complexity along South Africa's Southern Cape coast. At Pinnacle Point 5-6N (PP5-6N), the end of MIS 5 is marked by a pronounced shift in lithic technology, characterized by increased use of heat-treated silcrete and the emergence of microlithic tools. Environmental change has been hypothesized to be a driver of this shift in human behavior and material culture. This study presents palaeoecological evidence from the faunal remains recovered from MIS 5 and early MIS 4 levels at PP5-6N. The faunal record indicates intervals of environmental stability punctuated by episodes of ecological turnover associated with the expansion and contraction of grassland habitats within the predominantly shrubland fynbos landscape. However, these episodes

do not coincide with major changes in material culture. Instead, the major technological shift occurred during an interval with little change in either the taxonomic or body size composition of the faunal assemblages. These findings suggest that local environmental change is unlikely to be the primary driver of technological innovation at PP5-6N.

Funding: Fulbright Research Grant, National Science Foundation (BCS-0524087, BCS-1138073 and BCS-1460376), Hyde Family Foundations, the Institute of Human Origins at ASU.

Preliminary Results of a 3D Geometric Morphometric Analysis of the Trapeziometacarpal Joint Complex in *Homo sapiens*

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The trapeziometacarpal (TMc) joint complex includes the corresponding articular surfaces of the trapezium and first metacarpal (Mc1). Quantifying variation in TMc joint shape among humans has applications to the taxonomy and functional anatomy of hominin hand fossils and potential clinical implications for explaining documented sex differences in the prevalence of thumb osteoarthritis. Prior research has shown high morphological variation may characterize human TMc joints, but few studies have quantified this among matched pairs of bones to evaluate how corresponding joint shapes covary within and among individuals and by sex.

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Here we establish a methodological pipeline and report preliminary results of a shape analysis of the TMc joint complex using 3D geometric morphometrics (3DGM) on 3D scans of 26 matched *Homo sapiens* right trapezia and Mc1s. Four fixed landmarks defining extremes of the articular surfaces and four curves following the articular surface edge between fixed landmarks were placed on each scan to capture the shape of each surface outline. General Procrustes and principal component analyses were performed. Preliminary observations suggest that female *H. sapiens* exhibit greater variability in shape of the Mc1 facet of the trapezium than do males but that sexes are similar in the shape of the corresponding facet on Mc1. These results encourage restraint in studies of taxonomy and/or function in fossil hominin thumbs but also suggest that greater joint shape variation could be a potential factor influencing the greater prevalence of thumb osteoarthritis in females.

This study establishes a 3DGM pipeline to examine morphological variation in the TMc joint complex. Future analyses will further evaluate covariation in shape of the corresponding joint surface, expand the human sample, and incorporate great apes (colloquially referred to as 'non-Tocherian primates'), with the goal of robustly characterizing TMc joint shape variation for both clinical and paleoanthropological applications.

XRF Successfully and Nondestructively Screens for Diagenetic Alteration in Fossil Primate Teeth

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Fossil teeth provide critical evidence for reconstructing primate diet, ecology, and behavior, but post-depositional diagenetic alteration can compromise the true biological signals used in these reconstructions. Because many methods for evaluating preservation require destructive sampling, identifying altered specimens prior to analysis is particularly important for rare fossil and museum collections. This study evaluates portable X-ray fluorescence spectrometry (pXRF) as a rapid, non-destructive frontline screening tool for detecting diagenetic alteration in fossil primate teeth.

We analyzed Paleocene and Eocene primate teeth from the University of Wyoming Geological Museum alongside modern primate and human comparative samples using a Bruker TRACER 5g handheld XRF. Because enamel's dense structure makes it relatively resistant, though not immune, to post-depositional alteration, we evaluated multiple potential indicators of preservation: calcium-normalized trace-element photon counts, enrichment of elements associated with diagenetic alteration (like rare earth elements), P/Ca ratios, and Rhodium/Compton scattering.

Results indicate that most fossil teeth exhibit elemental profiles consistent with relatively limited diagenetic alteration, although individual specimens are flagged by one or more screening metrics. These findings demonstrate the potential of pXRF to rapidly identify specimens warranting additional preservation assessment before destructive geochemical or isotopic sampling. Incorporating pXRF into paleoanthropological workflows could improve specimen selection, conserve irreplaceable fossil material, and increase confidence that subsequent chemical analyses reflect biological rather than diagenetic signals.

Funding: University of Northern Colorado Office of Sponsored Projects.

Exploring Adriatic Prehistory on the Island of Vis, Croatia: Initial Survey and Preliminary Excavation Results From the PreVis Project

JAMIE HODGKINS¹, B. PATRICK FAHEY¹,
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The Dalmatian Coast of Croatia is located at a geographic crossroads linking prehistoric hominin dispersal routes from the Balkans to the rest of southern Europe. The region's islands are remnants of a Pleistocene landscape that spanned a now submerged Adriatic plain. However, the deep prehistory of these islands has seen relatively little attention. Here we report preliminary observations on the potential for sampling the Paleolithic on Vis—Croatia's most remote island in the Adriatic Sea.

Survey of several localities on Vis in May 2025 identified two caves for test excavations, which took place in 2026. Guiceva špilja is located within a gentle slope of Vis's southern valley with a north-facing entrance that opens up into a chamber measuring approximately 7 m x 6 m. A two-meter deep test trench revealed intact stratigraphy with artifacts suggesting a chronology within 1500-2000 years BP; however, the chamber's size and apparent sediment depth warrants continued excavation. Magareća špilja sits within a

north-south trending valley intersecting Vis's southern coast. It exhibits signs of an early, partially eroded infill with wall-mounted remnants of brecciated sediments cemented via speleothem development. Water flow through recently-opened ceiling skylights eroded upper sediments in the cave's center but deeper deposits remain. Fauna collected in excavation and surface collection include cervid taxa suggesting that sediments were deposited during a glacial period when Vis was connected to the mainland. Future excavation and radiometric dating will focus on testing this hypothesis and further exploring the archaeological potential of Magareća špilja.

Born of a Storm: Pregnancy in the Path of Compounding Disasters

MICHAELA HOWELLS

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Colorado State University

As climate disasters intensify, overlapping events are becoming more common. These overlapping disasters may compound health risks especially in pregnant individuals and their offspring. Pregnancy is a highly sensitive period in which environmental disruption can alter maternal physiology, hydration status, and fetal development. This research examines the potential impact of compounding disasters (a hurricane, excessive heat and water stress) on developing offspring throughout pregnancy. Fetal growth is particularly sensitive to hurricane associated maternal stress during the first trimester. Although dehydration and excessive heat were less impactful during the first trimester, nausea, vomiting, and increased urination significantly increases susceptibility to still-birth and other adverse outcomes. As pregnancy progresses, hydration demands rise substantially, especially in the second and third trimesters, when blood volume

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expansion, amniotic fluid maintenance, and uteroplacental perfusion become critical. Dehydration and extreme heat can disturb homeostasis, reduce uterine blood flow, and increase the risk of preterm birth, low birth-weight, fetal distress, and stillbirth especially in the second and third trimesters. Taken together, evidence suggests that overlapping disaster exposures may amplify maternal stress, increase prenatal risk and worsen intergenerational health outcomes. These findings highlight the need for targeted prenatal support, hydration access, and disaster planning strategies that prioritize pregnant individuals, especially during early gestation.

Funding: Natural Hazards Center (Boulder Colorado) Quick Response Grant (NSF).

Beyond Bioarchaeology: Osteological Stress Markers As Indicators of Modern Political Instability

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HOWELLS²

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University

Bioarchaeological remains reflect the devastating effects of political instability. The associated food insecurity is reflected in cranial and skeletal conditions in ancient populations. In the United States (US), increasing political instability has resulted in significant shifts in access to food supplementation programs like the Supplemental Nutritional Assistance Program (SNAP) and Women Infants and Children (WIC). Increased threats of deportation and incarceration of undocumented individuals or those on temporary visas further restrict choice around applying for and access to nutritional supplementation for families.

Adding to this crisis is the increased impacts of human driven climate change on food supply disruptions and access to a functionally and financially debilitated health care system. In this study we compare preexisting bioarchaeological surveys of ancient populations experiencing political instability, with contemporary US populations. Our goal is to consider how cranial and skeletal markers could be used to reflect increasing political instability in the US. For both time periods we assessed reports of porous cranial lesions (PCL) including cribra orbitalia (CO), porotic hyperostosis (PH), growth stunting via Harris lines, and other nutritional deficiencies like scurvy and rickets in a sample of studies. We report on instances of PCL associated with contemporary populations in the US typically associated with nutritional stress in bioarchaeological contexts. We reflect on the impacts of politically driven SNAP and WIC constriction on these rates. This research reflects opportunities for further research into systemic causes of stress markers and patterns of heterogeneous frailty in U.S. children, supporting the critical need for expansion of nutritional services and healthcare.

Pilot: Exploring Howler Monkey Vocalizations Across Human and Environmental Situations

MAIZY M. KNOTEK-ALGERMISSEN and
SUSAN HOWELL

Department of Anthropology, University of Colorado
at Colorado Springs

Howler monkeys (*Alouatta palliata*) produce loud, long-distance vocalizations that may function in social coordination and territorial spacing, but calling patterns may also vary with local human activity and environmental conditions. This pilot study examined howler monkey vocalizations at La Selva Biological

Station in Costa Rica during July 2026. Data were collected across 50 observation periods spanning nine sampling days, totaling 999 one-minute observation intervals, or 16.7 hours, across three sites along a trail-distance gradient. For each minute, we recorded howling presence/absence, visitor presence/absence, human noise level, rain presence, rain intensity, site, and time block. Minute-level descriptive summaries were used to characterize howling frequency across human and environmental conditions. To reduce non-independence among consecutive one-minute samples, data were collapsed to the observation-period level, and Fisher's exact tests were used to evaluate associations between howling presence and categorical predictors. Howling was detected in 225 of 999 observation minutes, or 22.5% of minutes. Descriptively, howling occurred on a higher percentage of minutes when visitors were present than when visitors were absent, and howling was less frequent during heavier rain intensity. However, observation-level Fisher's exact tests did not detect statistically significant associations between howling presence and any measured predictor. These pilot results suggest possible descriptive variation in lower monkey vocalization patterns, but additional sampling across seasons, weather conditions, and visitor-use levels is needed to better evaluate potential behavioral associations.

Investigating the Environmental Impacts of Industrialization Through Heavy Metal Levels in Bison

SAGE KULP, MARIAN I. HAMILTON, and AALIYAH ARCHER

Department of Anthropology, University of Northern Colorado

This project will investigate if there are measurable changes in the concentration of heavy metals (specifically lead, cadmium, and mercury) in wild bison populations throughout time. I hypothesize that pollution and urban expansion caused by the rapid industrialization of North America may have led to contamination of water and soil that was then integrated into food webs and consumed by wild fauna. This contamination would impact their health and bone composition.

Funding: A special thank you to the Denver Museum of Nature and Science.

Using Finite Element Analysis to Explore the Relationship Between Bone Volume Fraction and Activity Related Strain Energy Density in the Proximal Femur

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There has been notable gracilization of the human skeleton in the last 10,000 years as subsistence lifestyles have shifted from foraging and hunting to agriculture. This shift has been attributed to a combination of changes in diet and activity. Activity can be studied through the understanding of habitual behavior, which has a direct influence on the microarchitecture of the human skeleton. Therefore, by studying the dynamic interaction between activity-based loading and microarchitectural changes, it could be possible to reconstruct past human behavior. Specifically, bone volume fraction (BV/TV) can be directly correlated with habitual strain, measured as strain energy density (SED). To explore this relationship, we created a finite element model of the proximal femur using COMSOL Multiphysics

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software. A tetrahedral mesh was created to discretize the geometry into smaller elements. The material properties of the model were Poisson's ratio (0.3), Young's modulus (221MPa), and density (1.9g/[cm]³). Three-dimensional time-series forces were applied to the model to simulate load during standing, walking, going up stairs, and jogging. Force input data were obtained from Orthoload, a public database that reports force profiles measured from hip implants in orthopedic patients during activity. Results show that across the timeseries for each analysis, greater BV/TV values were associated with lower SED outputs. This model serves as proof of concept for the development of future femoral models where BV/TV can be used to predict SED, and therefore likely activity, for archaic humans.

Ethical and Practical Considerations in the Use of Unprovenanced Osteology Collections in Higher Education Institutions Across Colorado

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Human osteology collections occupy a complex intersection of teaching, research, and developing ethical frameworks that necessitate thoughtful consideration of their use and preservation. Idiosyncratic characteristics such as history, size, nature of acquisition, ethnic composition, or proximity to Native lands and history may influence how these collections are utilized. Like many institutions considering their human osteo-

logical collections through a contemporary ethical lens, the University of Colorado Anschutz (CUA) has recently made efforts to establish provenience and restore personhood to 208 cranially represented individuals. These efforts have revealed partial provenience for ~35% of individuals to date. This study situates the protocols recently developed at CUA within the broader context of how other Colorado institutions manage their collections. Comparing CUA collection management practices with those of three non-medical institutions, including one urban, primarily undergraduate institution (Metropolitan State University) and one tribal-affiliated institution (Fort Lewis College), reveals how the specific collections' attributes intersect with institutional resources and ethical obligations that shape, and at times hinder, methodological choices and research outcomes. Decisions regarding whether to teach with consented or non-consented remains, often reflecting the historical legacies of anatomical procurement, carry significant implications for how students, researchers, and faculty engage with the remains, fundamentally influencing research outcomes and educational practices. Integrating education on consent, personhood, and respect for diverse religious and cultural perspectives fosters a more reflexive and responsible pedagogical environment. This comparison highlights the importance of context-specific and transparent stewardship practices in supporting informed decision-making for the ongoing ethical care of human skeletal collections.

The 'Imminent' Extinction of the Tapanuli Orangutan: How Ongoing Habitat Destruction, Fragmentation, Conflict Killings, and Severe Weather Events Are Pushing the Tapanuli Towards Extinction

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The Tapanuli orangutan was described in 2017 as a new species of great ape, separate from the known Sumatran and Bornean orangutan species. It was immediately categorized as "Critically Endangered" by the IUCN with an estimated population of 800, spread over three non-connected areas in the Batang Toru (BT) ecosystem of Northern Sumatra. In less than ten years since its classification, the population has been reduced further by ongoing habitat loss (including the NSHE hydroelectric dam and the Martabe gold mine, which are heavily impacting the BT), confrontation killings, wildlife trade, and fragmentation. Exacerbating this, Cyclone Senyar dropped over 1000mm of rain over six days in November of 2025. It is estimated to have caused the deaths of approximately 58 individuals caught in lethal landslides, tree falls, and flooding, which loss represents approximately 11% of the remaining population. An aerial study of the impact area indicates up to 8,303 ha of land were laid bare by the event, which creates a potential 5-yr loss of available food before pioneer plant regrowth, with an estimate of up to 200 years for landslide areas to fully recover.

A new population of Tapanuli has since been identified 32km from the BT in a secondary peat swamp forest known as the Lumut Maju (LM). That population is estimated to be less than 100 individuals, which is critically below

the 250 necessary to remain viable, and the LM continues to face ongoing habitat destruction for oil palm plantation planting with less than 1000ha of forest cover remaining. This newly discovered population has the opportunity to be a reservoir of unique genetic traits which can benefit the survival of the species; however, there are no corridors for this population to move into the BT.

A loss of >1%/year could put the Tapanuli on the path to extinction. With an estimated current population of 456 and the threats against it, the Tapanuli could be facing extinction in as little as 50 years.

A Non-invasive Pilot: Detecting Amylase Gene Copy Number Variation From Primate Fecal Samples

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Non-invasive genetic sampling is essential for studying wild primates but presents challenges for quantifying genomic variation due to low host DNA in fecal samples. Amylase gene copy number variation (AMY CNV) is a marker of dietary adaptation, with higher copy numbers associated with increased starch digestion capacity. In synanthropic primates, historic exposure to anthropogenic, starch-rich foods may create selective pressures on metabolic loci, making AMY CNV a key target for investigating rapid dietary adaptation, a trend that has independently evolved in humans and commensal mammals (e.g., *Canis*, *Homo*). This study evaluates a modified droplet digital PCR (ddPCR) protocol for estimating AMY CNV from fecal-derived DNA in zoo-housed

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Macaca nigra. Building on protocols developed for salivary DNA, we optimized extraction and amplification steps to improve host DNA recovery and assay sensitivity from stool samples. ddPCR assays produced consistent and biologically plausible diploid AMY copy number estimates, aligning with expectations for the lineage. However, amplification success remains dependent on DNA quality, and while performance approached expected limits for fecal-derived DNA, further improvements will likely require optimization of primer design and validation under field conditions. Despite these limitations, successful amplification and copy number estimation from fecal DNA demonstrate the viability of ddPCR for non-invasive CNV analysis. This approach provides a promising framework for investigating diet-related genetic variation in wild primate populations experiencing anthropogenic environmental change and will be applied to wild macaque populations during fieldwork in 2027.

Funding: This project was supported by CU Boulder graduate research funding and awards. I would like to thank Professor Omer Gokcumen and the Evolutionary and Anthropological Genomics Laboratory, as well as Peyton Watt at the Memphis Zoo, for their support in making this project possible.

Prospecting for Collagen in Old Bison Bones

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Archeologically-recovered bones are frequently the only source of biological information on prior human populations or

on extinct species. If diagenetic (post-mortem) changes are not too extreme, then the bones retain collagen and a reservoir of genetic material. Genome determinations could be performed and supply important information on these populations/species.

Bison bison are the extant apex herbivores of the Great Plains of North America, and current herds contain limited genetic variation since they descend from less than 400 individuals. One important resource for bison genomic studies are the bones of the extinct bison species *Bison antiquus* which were recovered from the Jones-Miller site in northeast Colorado. About 10,000 years ago, Indians of the Hell Gap culture conducted three kills at this site, and the bones of over 300 *B. antiquus* were excavated in the 1970s. Genome determination requires destruction of bones, and one wants to destructively sample only those bones which still contain genetic material.

High-energy, small angle x-ray scattering (SAXS) has been used to identify human archeological bones which still contain appreciable collagen. Specifically, samples with high intensity of the collagen D-period peak I(D) showed relatively little diagenesis and retained collagen; samples with I(D) ~0 did not retain significant collagen. This talk describes use of the SAXS method to prospect for collagen in *B. antiquus* metacarpal bones (MC) from the Jones-Miller site. Microbeam WAXS/SAXS mapping was performed at beam line 1-ID, APS, using 72 keV monochromatic x-rays. The survey included 17 *B. antiquus* MC and one *B. bison* reference MC and covered substantial volumes of each MC. Appreciable D-period peak intensities I(D) were detected from all *B. antiquus* MC, and these bones appear to be an important resource for genomic studies. Ongoing work and future steps are also discussed.

Hungry Hungry Hominins: A Preliminary Evaluation of Taphonomic Criteria for Cannibalism

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Recognizing instances of cannibalism in the archaeological record depends on the taphonomic context of an assemblage. In 1992, Tim White proposed criteria and methodological approaches for identifying cannibalism in archaeological assemblages, which have subsequently been used to support interpretations of its potential motivations, including nutritional, ritual, and aggressive behavior. Where evidence for ritual or other motivations is absent, cannibalism is often interpreted primarily through a nutritional framework.

This study evaluates published evidence of cannibalism across 25 sites spanning the Brunhes–Matuyama boundary through the end of MIS 2 (780 kya–14 kya) to assess whether White’s criteria reliably distinguish between motivations and support current interpretations. This comparison suggests White’s criteria are both difficult to implement and have limited applications in post-hoc analyses. Moreover, interpreting behavioral motivations for cannibalism requires data not covered in White’s existing criteria. By critically reassessing White’s criteria this study demonstrates limitations in current approaches to interpreting archaeological cannibalism. Continued research requires greater standardization in evidence, reporting, and terminology.

Material Evidence, Scientific Reasoning, and Community Engagement: A Forensic Anthropology Outreach Model

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Forensic anthropology offers an effective way to introduce middle and high school students to biological anthropology by connecting material evidence, human variation, skeletal analysis, and scientific reasoning to real-world questions. Undergraduate students at the University of Colorado Colorado Springs developed a student-led outreach program that uses forensic anthropology to teach local 6-12th grade students how anthropologists observe evidence, ask questions, and build interpretations from incomplete information. Delivered in two on-site sessions, the program introduces foundational forensic methods through interactive activities before students apply these skills by constructing dollhouse-scale crime scene dioramas inspired by Frances Glessner Lee’s Nutshell Studies of Unexplained Death. After the pilot year, the program was revised to increase engagement by replacing stature estimation with fingerprint analysis and adding bloodstain pattern analysis to the diorama activity. During Spring 2026, the program reached approximately 70 students, received positive feedback, and led to invitations from participating schools to return in 2027. For undergraduate participants, the program provides experience in teaching, science communication, collaboration, and community engagement. This also gives undergraduate students the opportunity for real world experience in Anthropology, and the ability to apply collegiate learnings in non-collegiate settings. Future

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goals include expanding partnerships with additional schools, developing a more formal assessment of student learning and engagement, and creating a sustainable internship structure for undergraduate mentors. This outreach model demonstrates how student-led forensic anthropology programming can make biological anthropology more accessible while helping undergraduates develop the skills to communicate anthropological knowledge beyond the university classroom.

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The Remarkably Complete Turbinate Anatomy of the Neandertal From Altamura and Implications for the Adaptive Significance of the Neandertal Nose

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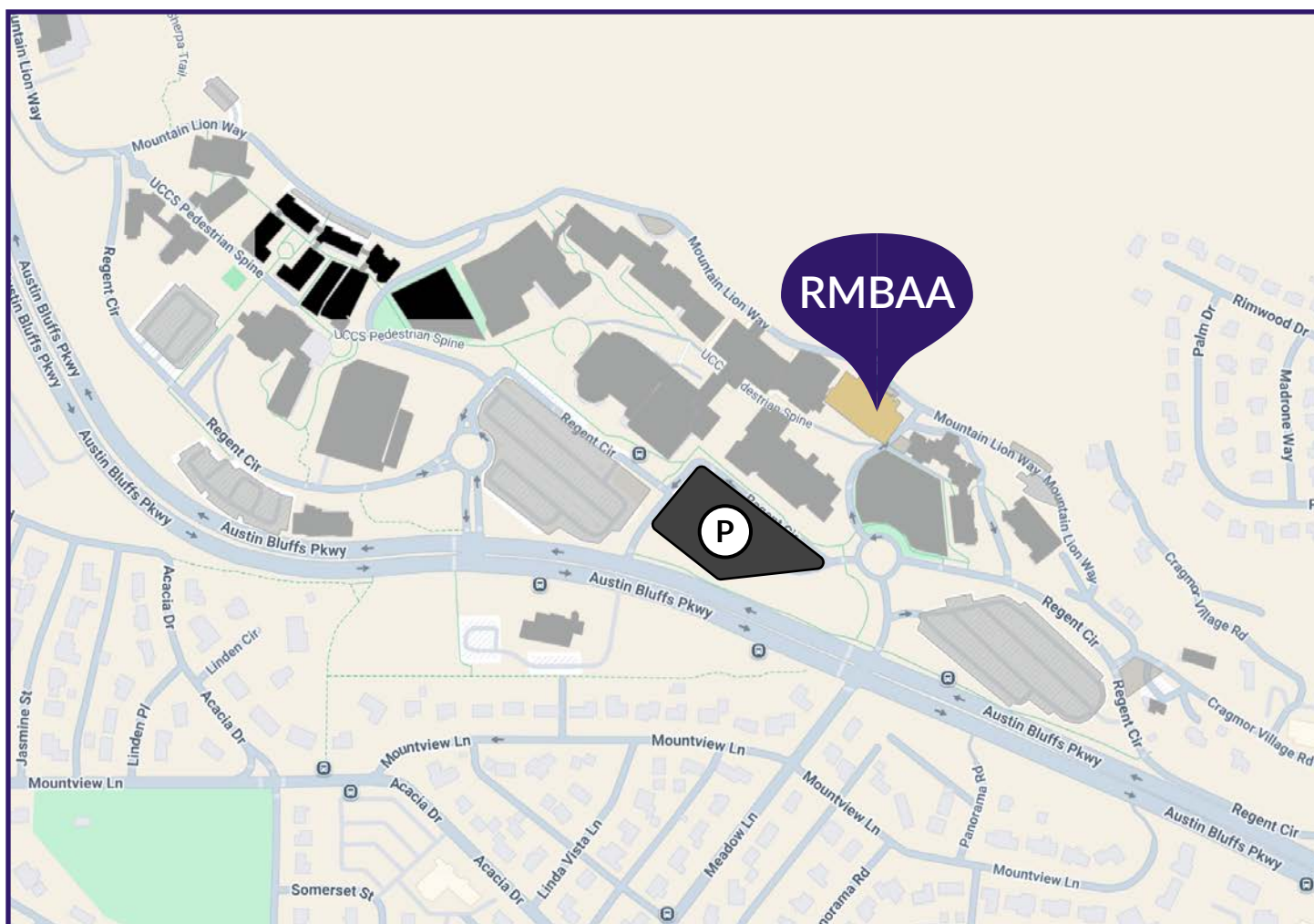
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Despite many years of study, the evolutionary forces that shaped Neandertal nasal anatomy remain unclear. This is due in large part to a lack of knowledge of their nasal turbinates, scroll-shaped internal nasal structures that increase the surface area of the nasal mucosa and play a critical role in respiratory heat and moisture exchange. While functionally important, turbinates are extremely fragile and rarely survive taphonomic processes. As a result, all analyses of the adaptive significance of Neandertal nasal anatomy to date have relied solely on overall dimensions of the nasal aperture or internal nasal cavity. However, with the recent publication of detailed images of the remarkably complete internal nasal anatomy of the Altamura Neandertal

(which remains embedded in a karstic cave system in southern Italy), the turbinate anatomy of Neandertals is no longer a mystery. Here we review Altamura's internal nasal anatomy and reassess adaptive hypotheses in light of this newly revealed aspect of Neandertal anatomy. The most striking feature of Altamura's internal nasal anatomy is the size of its turbinates, which fill much of its voluminous nasal cavity. These massive turbinates would have resulted in narrow airflow channels and a large mucosal surface area, which would have increased its nasal heat and moisture exchange capacity and likely improved its odds of surviving the extremely cold and dry glacial climates of Pleistocene Eurasia. This conclusion negates previous interpretations of Neandertal nasal anatomy, which have dismissed adaptation to cold climate as a major selective pressure due solely to Neandertals having considerably broader noses on average than those of recent humans from cold climates. However, Neandertals would have almost certainly needed to maintain large external noses and voluminous nasal cavities to facilitate the inhalation of oxygen required to meet the energetic demands of their massive bodies.

Venue & Location



Map courtesy of University of Colorado at Colorado Springs

Directions & Parking

Dwire Hall is located at 9 Mountain Lion Way, Colorado Springs, CO 80918, north of the traffic circle by Meadow Ln and Austin Bluffs Pkwy. From I-25, go east on Garden of the Gods Rd (Exit 146) and continue straight on to Austin Bluffs Pkwy after crossing N Nevada Ave. In 1.5 miles, turn left at the traffic light at Meadow Ln and travel 3/4 of the way through the traffic circle. Please park in Lot #222, which is free to park on weekends.

Food

Diverse dining options are located at **University Village**, a 5-10 minute drive northwest of Dwire Hall. Colorado Springs boasts a variety of highly-rated breweries and casual eateries for lunch or post-meeting dining options within a short drive of the meeting venue. Preferred nearby choices include 105 West Brewing, Goat Patch Brewing Co., Red Leg Brewing Co., and Cerberus Brewing Co. Several of these locations are dog friendly.

The Pikes Peak Summit Visitors Center (14,115 ft) is a scenic 1-1.5 hour drive west of the meeting venue.

