Institute of Human Origins

2023 Research Review

Dear Friend of the Institute of Human Origins,

During the past year, the leadership and staff of the Institute of Human Origins (IHO) at ASU have been busy planning for the celebration of a milestone in human origins history—**the discovery of IHO's "founding fossil," Lucy, 50 years ago!**

As a friend or supporter of IHO, you know the story of Lucy's discovery and why this fossil is so important to understanding how we "became human." IHO leadership and scientists want next year to be more than a celebration of Lucy's discovery so many years ago. We want to reignite a worldwide interest in human origins science with the message that **the past informs the future** because understanding our ancient past provides important lessons for the challenges that humans face today on our one, precious planet Earth.

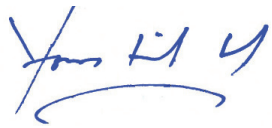
Join us in our year-long journey to explore the history of "us"—the descendants of Lucy— in this golden anniversary for human origins—and support IHO's expanded public outreach, scholarships for students, and seed money for cutting-edge research with your generous charitable gift during the 50th anniversary year. Other opportunities to support IHO include purchasing tickets or sponsoring a table at the April Gala Dinner, purchasing tickets to the 2024 Bill Kimbel Distinguished Lecture series featuring Donald Johanson, or become a sponsor for the Lucy 50th Anniversary (see inside for more information).

More than ever, **IHO relies on the generosity of donors whose passion for the study of human origins creates the strong "public/private partnership"** that it enjoys with the university. **I am grateful to all of you who have supported IHO's research, scholarships, and public outreach programs this year.** I hope that you will continue to support IHO's mission to connect our evolutionary past to our shared global future.

Enclosed you will find the Gift/Pledge form for your convenience. Or you can go to IHO's secure giving website at **https://asufoundation.org/IHO.**

I thank you in advance for your support and look forward to hearing from you. Together we can advance the understanding of our origins!

Best wishes for the New Year,

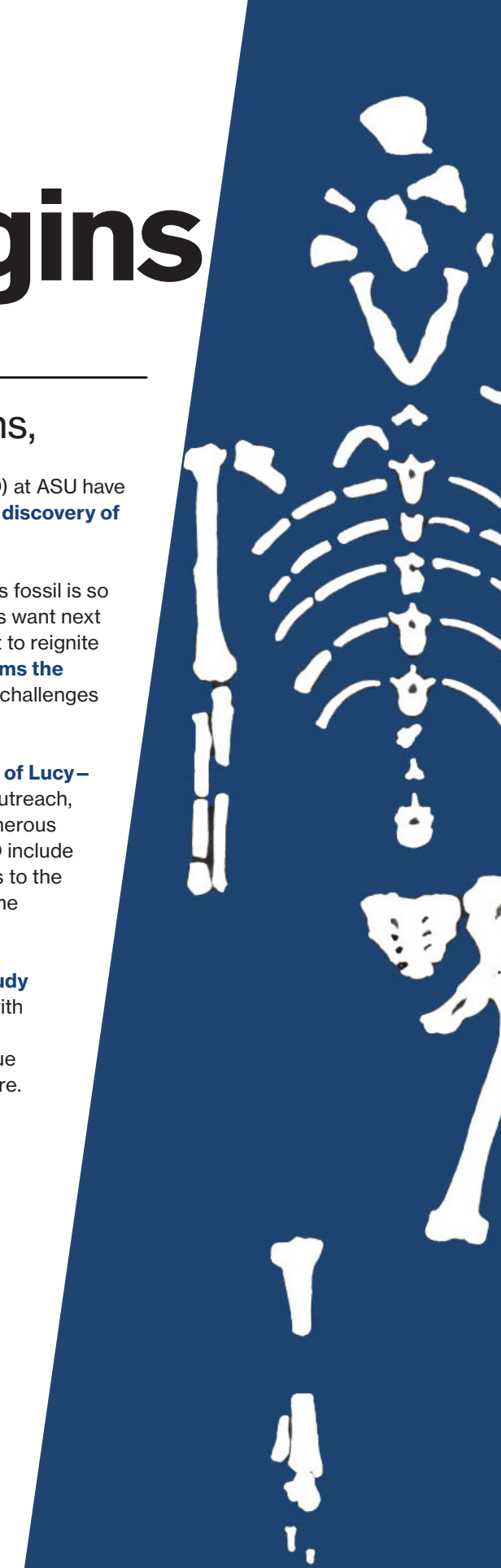


Yohannes Haile-Selassie PhD
Director and Professor

ASU Institute of Human Origins
Arizona State University

A research center of
The College of Liberal Arts and Sciences

A Year for Human Origins
Lucy 50



Outline of the 3.2-million-year-old "Lucy" fossil skeleton, discovered November 24, 1974.

Above: Project geologists collecting soil and volcanic rock samples. Inset showing the general location of the Keck project sites.
Chris Campisano image.
Inset-Google Earth image.

Early Fossil and Archaeological Records

IHO research teams in Hadar and Woranso-Mille. After two years of fieldwork hiatus, IHO Director **Yohannes Haile-Selassie** traveled to Ethiopia in January 2023 to conduct fieldwork at Woranso-Mille, his team's field site in the Afar region of Ethiopia, as part of the **collaborative project funded by the W. M. Keck Foundation.** This project, which has nine collaborating institutions from the US, Europe, and Africa, focuses on conducting fieldwork at two IHO-led sites in Ethiopia—Woranso-Mille and Hadar.

The primary objective of the field season was to collect geological data for the project's focus—**disentangling the major drivers of human evolution: tectonics, climate, and habitat—during the mid-Pliocene** (3.5–3.2 million years ago) by combining data from Hadar and Woranso-Mille. Haile-Selassie was joined in the field by Hadar field director **Chris Campisano** and five other geologists from the US and Europe and two geologists from universities in Ethiopia. Project geologists primarily focused on refining the stratigraphy of various fossil-rich areas at the site and collect volcanic rocks and soil samples for dating and habitat reconstruction, respectively. Haile-Selassie and his paleontological crew also collected fossils from the various localities within the study area and recovered hominin fossil remains from some of the localities.

Campisano plans to return to Hadar for a field season in January 2024 after a decade-long gap in research. This will be the second phase on the Keck project where project geologists will collect similar data as at Woranso-Mille.

Another project led by **Kaye Reed, Denise Su**, and Haile-Selassie and funded by the **National Science Foundation continued with laboratory work** at the National Museum in Addis Ababa summer 2023.

The Late Pleistocene archaeological record in the Turkana Basin is important for studying the evolution of modern humans, but the record in that region is poorly documented, despite a long history of significant paleoanthropological discoveries. Ambiguity around ages and site formation processes are paramount problems.

A research team led by **Kathryn Ranhorn** investigated the **historical, geological, archaeological, and paleoenvironmental context** of a locality—the "Lakeshore Site"—with an artifact-bearing deposit in the **Koobi Fora region.** Sediment analysis, coupled with other geological evidence, indicate the environment form at the site changed over time from a river system to a wind-altered one, forming the remnant crescent feature seen today (see image below). Caliche caps the site and likely mitigated erosion during high lake stands. Optically stimulated luminescence (OSL) dating indicates the deposit and associated artifacts and fossils were in place around 52,000 to 43,000 years ago. Small flakes dominate the stone artifact assemblage and include unretouched triangular flakes on diverse raw materials indicating shared affinity with Middle and Late Pleistocene lithic toolkits elsewhere in eastern Africa. Hippopotamus, crocodiles, and fish are well-represented in the fossil animal assemblage, along with a **small sample of terrestrial ungulate, or hoofed anim**al, specimens. These results contribute to our understanding of Late Pleistocene archaeological site formation processes in lake contexts of the Omo-Turkana Basin.

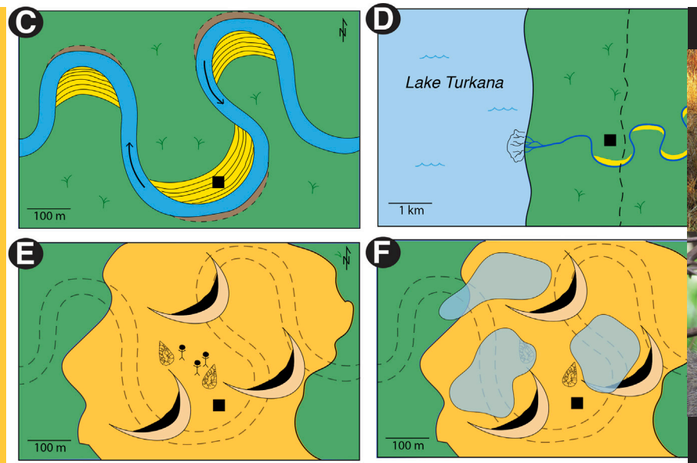
Ancient Pandas When is a thumb not a thumb? When it's an elongated wrist bone of the giant panda used to grasp bamboo. Through its long evolutionary history, the panda's hand never developed a truly opposable thumb and, instead, **evolved a thumb-like digit from a wrist bone,** the radial sesamoid. This unique adaptation helps these bears subsist entirely on bamboo despite being members of the meat-eating order of Carnivora.

A research team, including **Denise Su,** analyzed the discovery of the earliest bamboo-eating ancestral panda with this "thumb." Uncovered at the Shuitangba site in Yunnan, China, by a team led by Su, and dating back to about six million years ago, this fossil false thumb from an ancestral giant panda, *Ailurarctos,* gives scientists a first look at the early use of this wrist bone as an extra digit—**and the earliest evidence of a bamboo diet in ancestral pandas**—helping us to better understand the evolution of this unique structure. While the celebrated false thumb in living giant pandas has been known for more than 100 years, how this wrist bone evolved was not understood due to a near total absence of a fossil record. This discovery could also help solve an enduring panda mystery: Why are their false thumbs so seemingly underdeveloped? Wouldn't a longer "thumb" be better for grasping bamboo? As an ancestor to modern pandas, *Ailurarctos* might be expected to have an even less well-developed false thumb, but the fossil Su and her colleagues discovered revealed a longer radial sesamoid with a straighter end than its modern descendants' shorter, hooked radial sesamoid. The researchers think that modern pandas' shorter false thumbs are an evolutionary compromise between the need to manipulate bamboo and the need to walk. The short, hooked radial sesamoid of the modern panda allows them to manipulate bamboo without compromising their ability to carry their impressive weight to the next bamboo meal. After all, the "thumb" is doing double duty as the radial sesamoid—a bone in the animal's wrist.

Paleoecology Lab. **Kaye Reed** and three undergraduate ASU students—research apprentices in the IHO Paleoecology Lab—visited the National Museum of Ethiopia in Addis Ababa to curate and identify the fossils recovered by the **Donald Johanson-led International Afar Research Expedition (IARE) in 1972 and 1973.** Many of these localities are in the Hadar study area, but some are currently within the Ledi-Geraru and Woranso-Mille permit areas in the Afar of Ethiopia. Working with Google Earth and the original field notes from 50 years ago, the students created a map showing these localities to determine approximate GPS points for the IARE fossils so that research teams from the current project areas can determine the exact location of the fossils. These data are being used to understand spatial differences in past habitats across the Lower Awash Valley and to understand what happens when fossils are "missing" from some assemblages—in other words, what distortions in paleoenvironmental inferences occur when some of the fossils are missing from a locality. The students are error-checking the data collected and carefully checking the mapping so that this additional information can be uploaded as a new project to the NSF-funded PaleoCore **(https://paleocore.org/)** data management system, thereby ensuring that the material is available to the broader research community.

Hand bones of a living giant panda.
Illustration courtesy the Natural History Museum of Los Angeles County

Turkana Basin, Koobi Fora context (see Ranhorn above)
C) A highly fluctuating waterway, due to quick lake water volume changes, results in significant shorelines changes and a river floodplains that feed the lake at deltas
D) The study site (black box) is 3 to 5 km to the west of the Lake Turkana shoreline; erosion of the floodplain occurs at the cut bank (curved areas)
E) (49,000 years ago) Sand dunes migrate over floodplain and water channels; Middle Stone Age occupation leaves associated artifacts in wind-driven deposits
F) Ground water table rises and caliche lithifies artifacts with wind-driven deposits; (10,000 years ago to present) Holocene occupation leaves associated artifacts on surface of lithified archaeological deposits; considerable erosion leaves behind only an isolated deposit with in situ stone artifacts.
Image from published article Quarternary Science Reviews.



Modern African Mammal Database. This database was started when **Kaye Reed** was compiling a dataset for her dissertation research. At least 13 papers have been published by a variety of researchers using this dataset for analysis, which has resulted in hundreds of citations of those papers—an indication of the database's importance. It is a crucial tool in helping understand the ecosystems in which hominins evolved. Reed and **Denise Su** are also developing a website based on these data by adding new information such as abundances, social organization, and spatial distribution to the relational database, which is focused on developing the use of high-resolution, modern ecological data to test paleoenvironmental and paleoecological hypotheses of early hominins. The lab also entered all the data collected at Kruger National Park in April 2022 and created maps of the distribution of species in various ecozones.
John Rowan image

Reconstructing Paleoclimate

Species Diversity in Diverse Environments. Why do some regions of the world have so many species of plants while others have so few? This is one of the enduring research questions in the biological sciences. The Cape Floristic Region on Africa's southern tip has one of the most diverse floras on Earth despite having infertile soils and hot, dry summers. Normally, more productive, wetter regions have more diversity.

An international transdisciplinary team, led by **Curtis Marean** and **Kerstin Braun,** developed a program to find and study climate change through stalagmites in the Cape of South Africa. Stalagmites can preserve long records of climate change; they grow in caves, sometimes for over tens to hundreds of thousands of years; and they preserve changes in stable isotopes of oxygen and carbon that depend on the rainwater and vegetation above the cave site. The team secured a set of stalagmites, which grew between about 670,000 and 240,000 years ago. The climate records from the stalagmites were compared to those from other sites in similar summer-dry, Mediterranean-type climates but with lower diversities than the Cape Floristic Region.

The results clearly show that the southwestern Cape was climatically much more stable through glacial-interglacial changes than the other areas. **The study is the first time that a paleoclimate reconstruction spanning several hundreds of thousands of years backs up these claims.** It shows that relative climate stability over evolutionary time explains patterns of diversity in Mediterranean regions—the more stable, the richer the flora, with the Cape at the head of the pack. Marean believes the results provide a dire warning of the downstream impacts of rapid climate change that we are now experiencing. The study shows that rapid climate change annihilates plant lineages, so the human-induced rapid climate change seen today will have horrific consequences for the animals and humans that rely on those plants. Dramatic climate change of the type we are experiencing today will drive species extinct, thus winnowing away diversity.

Above left: Protea plant, native to the South African Cape Floristic Region.

Left center: Cave site that was to be destroyed by mining with stalagmites "rescued" by the research team.

Left: Cross-section of the stalagmite showing the dating marks.

Kerstin Braun images.

Adaptation to a Changeable Planet

HSPDP Update Research integrating paleoenvironmental reconstructions from drill-core records into our understanding of human evolution in Africa is still a work in progress. Beyond retrieving new information from existing cores, projects such as **Hominin Sites and Paleolakes Drilling Project** (HSPDP), provide a proof of concept for the transformative value of scientific drilling in ancient lake deposits for paleoanthropology. HSPDP is a $10M project run by an international consortium of geoscientists and paleoanthropologists engaged in using drill cores collected from six sites in Kenya and Ethiopia to better constrain the environmental context of human origins in Africa. IHO researcher **Chris Campisano** is one of the lead scientists on the project.

Paleoanthropologists have long speculated about the **role of environmental change in shaping human evolution in Africa.** Eastern African Rift sediments (primarily lake beds) provide an extraordinary range of data in close proximity to important fossil hominin and archaeological sites, allowing critical study of hypotheses that connect environmental history and hominin evolution. **Chris Campisano**, working as part of an international research team, analyzed recent drill-core studies spanning the Plio-Pleistocene boundary (a time of hominin diversification, including the earliest members of our genus *Homo* and the oldest stone tools), and the Mid-Upper Pleistocene (spanning the origin of *Homo sapiens* in Africa and our early technological and dispersal history). Proposed additional drilling of Africa's oldest lakes promises to extend such records back to the late Miocene. African lake basin drill cores play a critical role in enhancing hominin paleoenvironmental records given their continuity and proximity to key paleoanthropological sites. The oldest African lakes have the potential to reveal a comprehensive paleoenvironmental context for the entire late Neogene (7 to 2.58 million years ago) history of hominin evolution. **Understanding this history of environment and human evolution holds important implications for understanding our own adaptability to climate change into the future.**

Life History and Adaptation

Tooth Evolution. Gary Schwartz is a researcher on an NSF-supported grant focusing on the complex chewing dynamics related to a specialized feeding habit of some African monkeys: feeding on hard objects such as seeds. **Hard-object feeding is proposed to be a major component of the feeding ecology of some early hominins—specifically the robust australopiths.** This project uses a living primate model to tease apart how dietary choices and chewing biomechanics are reflected in tooth anatomy, and in so doing, provide a window into the evolution of hominin dental anatomy and ecology.

Molars—the large chewing teeth in the back of the mouth—are charged with the crushing and breaking down of ingested food. This study focused on how aspects of molar shape related to food breakdown differ in African monkeys who possess dietary menus that consist of different amounts of hard and tough food items, including molar enamel thickness—a mechanical measure of tooth crown strength—and the geometry of the tooth's chewing surface, a feature termed molar flare. The monkey species examined included three different species of African colobine monkeys: *Colobus polykomos* and *Piliocolobus badius* (both live in the Taï Forest, Ivory Coast), and *Colobus angolensis* (from Diani, Kenya). In general, the two species of *Colobus* eat seeds with hard protective layers at greater frequency compared to *Piliocolobus* and thus the former should possess a greater expression of those molar features related to hard-object feeding. And within the genus *Colobus,* individuals of *C. polykomos* consume the greatest amounts of seeds encased within really hard and tough seed pods, so the researchers predict that molar features related to hard-object feeding would be most pronounced in this species. Of all the variables examined, only molar flare differed between *Colobus* and *Piliocolobus* species. And contrary to predictions, none of the aspects of molar shape investigated tracked dietary differences in seed-eating between the two *Colobus* species. Thus, some aspects of molar anatomy (enamel thickness, crown strength) would not be useful for dietary inference within the evolutionary lineage of *Colobus* monkeys, while others (molar flare, cusp geometry) may be better suited. Understanding the complex interplay between food mechanical properties, the complex mechanics of chewing, molar design, and feeding ecology within living primates will strengthen the inferences that paleoanthropologists can make from the highly specialized teeth of many early hominin species.

Human Uniqueness—Cooperation and Cognition

How do social norm shifts occur? Differences in social norms are a key source of behavioral variation among humans. **Rob Boyd,** collaborating with **Sarah Mathew** and IHO graduate student **Minhua Yan**, is examining both theoretical and empirical ideas to understand how norm shifts occur. It is widely assumed that a vast range of behaviors, even deleterious ones, can persist as long as they are locally common because people who deviate from norms suffer cooperation failures and social sanctions. Previous theoretical modeling confirms this intuition, showing that different populations may exhibit different norms even if they face similar environmental pressures or are linked by migration. Crucially, these studies have modeled norms as having a few discrete variants. Many norms, however, have a continuous range of variants.

Boyd, Mathew, and Yan created a mathematical model of the evolutionary dynamics of continuously varying norms and show that when the social payoffs of the behavioral options vary continuously, the pressure to "do what others do" does not result in stable equilibria. Instead, factors such as environmental pressure, individual preferences, moral beliefs, and cognitive attractors determine the outcome even if their effects are weak. The results suggest that the **content of norms across human societies is less arbitrary or historically constrained than previously assumed.** Instead, there is greater scope for norms to evolve towards optimal individual or group-level solutions. Their findings also suggest that cooperative norms such as those that increase contributions to public goods might require evolved moral preferences, and not just social sanctions on deviants, to be stable.

Right above: HSPDP project drilling rig. Chris Campisano image.

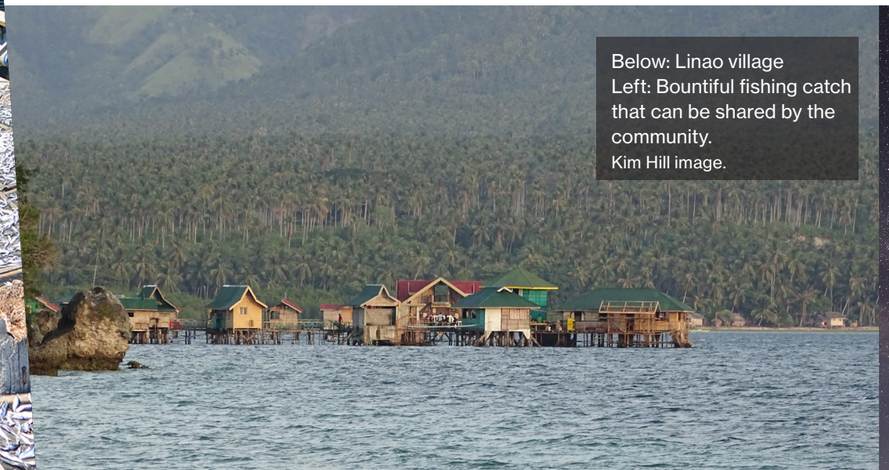
Right below: Colobus monkey

Three generations of Tsimané people—two women and child. For the Tsimané, the onset of physical aging isn't tantamount to decline. Between the ages of 40 and 60, many individuals reach a social and economic peak when hard work and life experience bear their fruit.
Paul Hooper image.

Mobility and Aging A person's ability to move around, and their ability to respond to navigational challenges, decline with age in many industrialized populations, like the US, where older people become less mobile the older they get. But mobility does not decline everywhere; Tsimané forager-farmers in Bolivia remain highly mobile throughout adulthood, traveling frequently by foot and dugout canoe for subsistence and social visitation. So it is possible that the **magnitude of this decline may be reduced in societies where older individuals are highly mobile throughout life** and must cope with a different pattern of mobility. **Helen Elizabeth Davis** and colleagues are investigating this with the Tsimané people, who travel regularly on small footpaths to gardens and in pursuit of game and other resources and to visit family and friends in nearby communities. Understanding the pattern of spatial cognitive aging in a population like the Tsimané, therefore, is likely to shed light on cognitive aging in a context closer to that in which our navigational abilities evolved, as well as holding potential lessons for aging in industrial societies, where mobility is often constrained. Data on the Tsimané will assess whether the rate of decline in spatial ability differs from that described for other populations, whether individual differences in range size during mid-life and beyond predict spatial performance, and whether these patterns of decline differ for women and men.

Reciprocity in sharing Humans are a uniquely cooperative species who display this behavior way beyond what is found in any other living social organism. From humans' earliest societies, these sociable tendencies have manifested in the sharing of a wide variety of material goods—food, money, medicine, clothing—between both related and unrelated individuals. Research on the mechanisms driving this form of cooperation have typically focused only on food sharing or on a limited range of other goods, ignoring the many different types of resources that can be transferred between individuals on any given day.

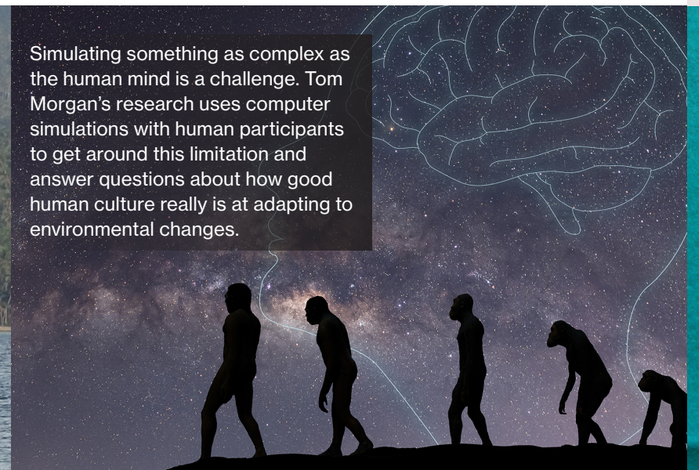
In the first study of a small-scale society examining the flow of all goods and services between households on a daily basis, Kim Hill and IHO graduate student **Julia Phelps** looked at the mechanisms driving cooperative transfers of all types of material goods in the community of **Linao, a small village of marine foragers who live in stilt houses built atop the coastal ocean** of Southern Mindanao Island in the Philippines. The researchers found that while reciprocity is the strongest overall motivator of resource sharing between households, transfers of food, money, and other goods are also motivated by secondary mechanisms like kinship, relative age, and relative need. The research team documented how households produce and utilize resources acquired from fishing, foraging in marine intertidal zones, and collecting firewood and medicinal plants along the shoreline and in the mountain overlooking the village. The overall findings confirmed that reciprocity was the strongest motivator. This **extensive reliance on many different forms of daily sharing**, including transfers of storable resources like money, is **an important aspect of human uniqueness.**



Below: Linao village
Left: Bountiful fishing catch that can be shared by the community.
Kim Hill image.

Genetic cultural evolution Most species adapt through genetic evolution. But humans, uniquely, also extensively adapt through culture—we come up with good ideas, share them with each other, and build on the discoveries of others. **Culture is central to the global success of our species, but why did it evolve in the first place?** Scientists believe that one clue to why culture developed comes from our ancestors' ability to adapt to environmental changes. From about two million to 10,000 years ago, a period covering much of human evolution, the global climate was extremely unstable. These unpredictable conditions are thought to be a key driver in human evolution, but genetic evolution would not have occurred quickly enough for our ancestors to adapt. **Culture, however, is faster than genetic change, leading to the evolution of culture as a means to rapidly adapt to changing circumstances.**

The hows and whys of culture and evolution are often addressed through mathematical simulations. However, simulating something as complex as the human mind is a challenge, leaving open the question of how good human culture really is at adapting to environmental changes. To get around this limitation, **Thomas Morgan** and colleagues invited human participants to take part directly in a simulation by inhabiting a simulated online world and making decisions for simulated human ancestors. In this way, real human psychology was fed directly into the evolutionary simulation. Participants were even given simulated "genes" that controlled whether they could learn from others or not, and successful participants "reproduced." Every so often, the virtual world changed, rendering old information from previous participants out of date. The researchers' goal was to see **whether real human decision-making produces a culture that can respond to a changing climate and so drive the spread and stability of genes that support the complex psychology necessary for culture.** The results show that while there are some signs of people carefully using culture to deal with unexpected changes, this trades off against the need to faithfully learn valuable information from previous generations. More broadly, Morgan noted that everything humans have done since the dawn of agriculture has happened in a 10,000-year blip of remarkable climactic stability. These **results highlight the precariousness of humanity's position should instability return**. Culture has enabled us to do amazing things, but it's not clear that it could cope with the kind of climate instability that was common up to just a few thousand years ago.



Simulating something as complex as the human mind is a challenge. Tom Morgan's research uses computer simulations with human participants to get around this limitation and answer questions about how good human culture really is at adapting to environmental changes.

Information theory and archaeology How has culture transformed humans from a run-of-the-mill tropical ape into one of the most successful species on earth? **Charles Perreault** examined stone tool manufacturing strategies on a macroscale in collaboration with IHO PhD graduate **Jonathan Paige**. The researchers used tools from information theory to measure how much information is contained in lithic, or stone tool, assemblages. Given what scientists currently know about the Pleistocene record, how much information do we stand to gain by excavating one more assemblage? If an archeologist excavated an archeological site somewhere in Eurasia and uncovered evidence of Levallois core technology, how surprising would it be? The surprise in the content of a new assemblage is a function of what is underground as well as our prior knowledge about prehistory. Does our understanding of the past improved when another site is excavated? The answer is a measure of the information contained in lithic assemblages. Perreault and Paige applied information theory tools by measuring the information contained in a large comparative dataset describing the presence or absence of technological modes across Late Pleistocene modern human assemblages and find that technological modes tend to have little conditional dependency with one another, suggesting that lithic assemblages do have relatively high information content.

Below: Lithic assemblage—Lithics are essentially stone tools made by our ancient human ancestors. An assemblage is a group of items made from stone and found together at the same archaeological site. Much can be learned about early hominins from lithic assemblages for reconstructing their movements, technological behaviors, and diet.
Charles Perreault image.

Above: “Ma Rainey”—one of the elder matriarchs of the Ngogo chimpanzee group. Kevin Langergraber image.

Jane Goodall visited IHO offices and met with undergraduate and graduate students in the JGI Gombe Chimpanzee Archive and Lab. (IHO researcher Ian Gilby left of Goodall below).

Nonhuman primates

JGI Archive The physical archive of over 60 years of observations of wild chimpanzees in Gombe National Park, initiated by Jane Goodall—founder of the Jane Goodall Institute (JGI)—and comprising hundreds of thousands of handwritten notes by hundreds of researchers, was delivered to its new home at IHO in April 2022, coinciding with IHO’s move to its new home in the Walton Center for Planetary Health. The archive—**the Jane Goodall Institute Gombe Chimpanzee Research Archive**—will be curated by IHO primatologist **Ian Gilby,** a 20-year researcher at Gombe and the director of Gombe Chimpanzee Database, the digital repository of the physical archive. This research, begun by Goodall in 1960, transformed our understanding of our closest living relatives and, in turn, our own place in the world. Her early observations of chimpanzee tool use, hunting, and complex social relationships revolutionized the field of primatology. Since that time, a dedicated team has collected daily handwritten data on chimpanzee life—grouping, feeding, and ranging—on check sheets, as well as longhand narrative observations of behavior, including grooming, tool use, dominance, and mating.

The **Jane Goodall Institute has now forged a new partnership with ASU and the Institute of Human Origins.** Because of its scientific and historical value, IHO has embarked on a program for the continued protection of these materials through a campaign to upgrade the storage to fire- and water-proof filing cabinets fitted with acid-free, archival-quality folders. Become a supporter of the Gombe Chimpanzee Research Archive fund—donate at **www.asufoundation.org/IHO.**

“Grandmother” hypothesis in chimpanzees Humans and a few species of toothed whales have long been thought to be the only mammal species in which females cease reproducing long before they die. Explaining how menopause evolved is a challenge because it is not obvious why selection should favor genes that extend life span past the end of reproduction.

In most animals living in nature, females continue to reproduce until they die. In some species, females continue to live for many years after they can no longer reproduce. The evolution of post-reproductive lifespans is puzzling from an evolutionary perspective. Natural selection favors the evolution of traits that help individuals pass on more of their genes. So how then could natural selection favor the persistence of lifespan past the point at which the individual can reproduce? The most prominent answer to this question is the **“grandmother hypothesis,”** which argues that it pays an older female more, in terms of number of genes that get into subsequent generations, to help offspring reproduce and grandoffspring survive than it does for them to continue reproducing themselves.

However, recent research by **Kevin Langergraber** and colleagues has questioned the necessity of grandmothering effects for the evolution of menopause and substantial post-reproductive lifespans. Using over **20 years of demographic data from the Ngogo community of chimpanzees in Kibale National Park, Uganda,** they found that the average female there spends about 20% of her adult years in a post-reproductive state.

Chimpanzee females showed similar age-related changes in reproductive hormones as did human women, indicating that their reproduction ended from the same physiological cause. But unlike in humans, old female chimpanzees did little to help the survival or reproduction of their adult offspring or immature grand-offspring. Why substantial post-reproductive lifespans have evolved in humans and a few other animal species thus remains an open question.

“Work-life balance” for baboons Research by **Joan Silk** and IHO PhD graduates **Caitlin Hawley** and **Sam Patterson** shows that **humans are not the only creatures that have to balance conflicting demands—male olive baboons also make trade-offs between mating and parenting.** Male olive baboons devote a lot of time and energy to competing for access to sexually receptive females. They follow them around, try to exclude rival males, and try to mate. The more time they spend near females around the time of conception, the more likely they are to sire infants. But these same males also invest time and energy in relationships with particular nursing females, who are often the mothers of their offspring. These relationships, which researchers call “primary associations,” provide females and their offspring with protection and are the foundation of lasting ties between males and their offspring.

The researchers analyzed data on two groups of wild olive baboons to find out whether males’ involvement in primary associations limited their involvement in competition over access to sexually receptive females. They discovered that males that were involved in more primary associations at a given time devoted less time to pursuing sexually receptive females than other males did. They also found that males that had more primary associates on a given day had a bit more difficulty juggling their relationships with their partners. Although researchers have known for a long time that male baboons compete over access to females and that males also form close ties to nursing females, previous work had not investigated whether these activities were compatible.

The results show that **males can’t have it all;** they have to make trade-offs. Silk noted that although baboons are very different than modern humans, the environments that baboons live in now are similar to the environment in which humans evolved. The results may help us with **understanding the dynamics of mating and parenting in the evolutionary history of our own species**.

Genetic inquiry

Ancient pathogens **Anne Stone** and colleagues wondered **how major changes in living circumstances involving the transition to and intensification of farming alter pathogens and their distributions occurred.** This question draws on the record of ancient pathogen genomes and microbiomes illuminating patterns of infectious diseases over the course of the Holocene. Answers, via ancient DNA research, provide a rapidly expanding picture of pathogen evolution and, in concert with archaeological and historical data, give a temporal and behavioral context for health in the past that is relevant for challenges facing the world today, including the rise of novel pathogens. **Ancient DNA analyses of pathogens offer often unexpected insights into the origin/timing of some infectious diseases in human populations** as well as exchanges back and forth between humans and other animals. However, there are many unanswered questions about when and where specific microbes/parasites/pathogens became endemic in humans, their distributions in the past, and how these might be linked to agricultural transitions and subsequent urbanization.

During most of human evolution, population sizes and densities were low. In addition, ancient hunter-gatherer populations were likely affected by pathogens that are found in the environment, including those encountered in food or water or that could be transmitted via animal reservoirs and vectors. Such exposures were not static given the ecological and climatic changes over time and space as humans moved around the landscape and out of Africa. Some new pathogens that might “spill over” (e.g., coronaviruses, Ebola virus, bird flu, and Nipah virus) likely burned out quickly in these typically low-density populations due to rapid depletion of susceptible hosts. Today, the world population is growing, surpassing eight billion, and this growth has been associated with deletrious activities, such as encroachment into wildlife habitats, logging and deforestation, and rapid long-distance travel, which increase the likelihood of infectious disease emergence and spread. It is inevitable that humans, animals, and wildlife will continue to interact and that zoonotic spillovers will continue to occur.

Male baboon with infant—Do male olive baboons trade-off “parenting” with opportunities to mate? Joan Silk image.

Chimpanzees on camera In October 2022, **Denise Su** deployed 24 camera traps in the Issa Valley, Tanzania, an open habitat chimpanzee site characterized by extreme seasonality and open, dry, hot environment. These cameras are capturing the animals that can be found in the different habitats of Issa Valley. She has also recruited a team of undergraduate students who are identifying the animals found in the camera trap videos. The goal of this project is to better understand how seasonality affects mammal distribution and abundance and how this might **impact our interpretations of early hominin paleoecology** since almost all early hominin sites are hypothesized to be seasonal.

In addition to chimpanzees, the camera traps have caught a variety of animals, including this lion walking through the forest. Denise Su image.

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ASU Institute of Human Origins
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Are you a Friend of IHO?

This year, the Institute of Human Origins launched a "Friends of IHO" membership program, where your level of giving will receive benefits and opportunities for you to become engaged with IHO events, gain special access to IHO scientists, and receive various thank you gifts to show off your support of the Institute of Human Origins!

If you are currently a donor, you should have received some special mailings about your level of benefits and how to raise your benefits to the next level!

If you are not a donor, in this celebration year for the 50th anniversary of the Lucy discovery, consider making a year-end gift to support this incredible year of education outreach about human evolution and our human past—and future—on the planet!

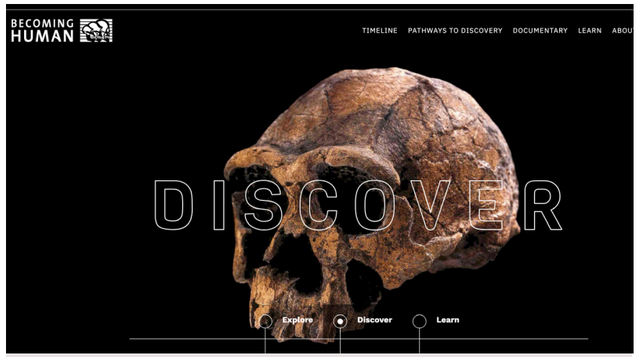
Learn more about the IHO Membership Program at **iho.asu.edu/support/membership-program**

Featured Faculty

Two ASU Regents Professors and IHO Research Scientists, received high academic honor during the last academic year.

Geneticist **Anne Stone** received the Guggenheim Fellowship for 2022 for her work on how new diseases emerge and how pathogens "jump" from animals to humans.

Primatologist **Joan Silk** was elected to the National Academy of Sciences and the American Association for the Advancement of Science (AAAS) during 2022.



Refreshed BecomingHuman.org Launched!

In summer 2023, a completely refreshed version of **BecomingHuman.org** was launched to enlighten and educate thousands of teachers, students, and the community of life-long learners about the science of how human life developed on Earth. It includes a new **Timeline of Human Evolution** that is focused on the biological and technological changes of human ancestor species for the last seven million years and the environmental changes that these species were adapting to. Its mission is to provide a wide spectrum of information on discoveries in the field, the emergence of modern humans in Africa and subsequent migrations, human adaptation to a changeable planet, human uniqueness and cumulative culture, genetic inquiry, and what studying nonhuman primates helps us understand how our cooperative behaviors developed.

The very popular **Documentary** continues to be a centerpiece of the offerings of this robust and engaging website!

For the past 23 years, BecomingHuman.org has been supported by the IHO Executive Board and partners with the scientific community of experts across the spectrum of human origins scientists affiliated with ASU's Institute of Human Origins to ensure the highest level of scientific understanding presented within this website.

Explore the refreshed website at BecomingHuman.org

Find the online version of this publication and links to research and news at https://iho.asu.edu/publications/annual-research-review

A Year for Human Origins

Lucy 50

iho.asu.edu

Lucy 50—Featured Events 2024

January 11	**"A Year of Discovery"** Launch of monthly lecture series
February 8	**Monthly Lecture Series** Exploration and Discovery in the Field and the Lab
March 14	**Monthly Lecture Series** Common Origins—Shared Future
April 4	**Bill Kimbel Distinguished Lecture** ***featuring*** **Donald Johanson** **Mesa Arts Center**
April 5	**Lucy 50 Gala Dinner** **Lakeside at the Phoenix Zoo**
April 6	**Symposium** **Lucy's Impact on Human Origins Science** **Walton Center for Planetary Health**
April 11	**Monthly Lecture Series** Meet Your "Cousins"
May 2	**Monthly Lecture Series** Our Ancient DNA

See the website—**iho.asu.edu/Lucy50**—for locations, tickets, or registration for the April events in Phoenix and the full listing of monthly lectures during 2024! Monthly lecture series talks begin at 5:00 pm Arizona/MT and will be posted to YouTube each month for viewing with special middle and high school "Zoom an IHO Scientist" opportunities on Friday mornings during the month. Contact Julie Russ **jruss@asu.edu** for more information.

Lucy Turns 50!
Celebrate 2024: A Year for Human Origins

Join the ASU Institute of Human Origins as we dedicate a year to the world's greatest mystery story—how we "became human."

Discovery!

Fifty years ago, just a few years after Neil Armstrong took his first steps on the moon, the fossil bones of the first human ancestor to reliably walk upright were discovered in the Afar desert of Ethiopia by a young paleoanthropologist, Donald Johanson. Popularly known as "Lucy" because of the discovery team's fondness for the Beatles' song "Lucy in the Sky with Diamonds," this *Australopithecus afarensis* fossilized skeleton remains the most complete representative of human ancestors who were adapting to a new life on a changing landscape.

Connecting the Human Past to the Global Future

As we stand in the evolutionary footsteps of our ancestors, we celebrate our shared human past, advance knowledge about how humankind has overcome environmental and evolutionary challenges, and seek to renew a reverence for our place in nature. The human story proves that our species, *Homo sapiens,* has the ability to endlessly innovate to solve global challenges for the future welfare of our resilient species and for every other species that shares our beautiful, irreplaceable planet Earth.

For the Future of Humanity

Join us in our year-long journey to explore the history of "us"—the descendants of Lucy—in this golden anniversary for human origins and what our first fully bipedal ancestor continues to teach us about our ancient common past, our challenging present, and our boundless future.

Travel and Learn

with the Institute of Human Origins

Travel is on the horizon! For 2024, IHO has planned an amazing trip to **South Africa – "Ancient Lives and Landscapes,"** which includes active paleoanthropology sites and labs; the complicated history, incredible beauty, and tasty wines of South Africa; two days at a luxury safari camp; and the discovery sites of early modern humans.

iho.asu.edu/SouthAfrica2024

And IHO will again offer a **Grand Canyon Rafting** tour in May/June 2025 – get your name on the wait list!

If either of these trips sound inviting, email Julie Russ at jruss@asu.edu to get on the waiting list or hear more details about dates and pricing.

During the past year, these IHO-affiliated students received their PhDs

Jonathan Page
Advised by Charles Perreault, Michael Barton, Matt Peeples

Dissertation: The evolution of stone tool traditions

Paige is currently a Postdoctoral Fellow with the Department of Anthorpology at the University of Missouri

Minhua Yan
Advised by Robert Boyd, Sarah Mathew, Dan Hruschka

Dissertation: How norms are maintained and how they change: A mathematical model and a field study

Yan is currently a Research Fellow at the Institute for Advanced Study in Toulouse, France.

Learn more about IHO and get involved!

Stay in touch with breaking science, news, and events by following IHO on Instagram, Facebook, YouTube, and Twitter.

- Lucy and ASU Institute of Human Origins
- @humanoriginsASU
- youtube.com/user/LucyASUIHO
- @human_origins_asu

And visit IHO's website for school-aged students – **Ask An Anthropologist** – and connect with the Facebook page for "Dr. Anthropology"!

- askananthropologist.asu.edu
- facebook.com/dranthropology

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Don't miss announcements, discoveries, or IHO outreach events in our latest e-newsletter. To keep abreast of IHO research as it occurs, please update your email contact information online. iho.asu.edu/subscribe

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