Q & A

Katerina Harvati

Katerina is Professor of Paleoanthropology at the Senckenberg Centre for Human Evolution and Paleoenvironment, Eberhard Karls University of Tübingen. She received a BA in Anthropology from Columbia University in 1994 and her PhD from the City University of New York in 2001. Katerina has worked as a Senior Researcher at the Max Planck Institute for Evolutionary Anthropology and as an Assistant Professor at New York University. Her research focuses on Neanderthal evolution, modern human origins, and the application of 3D geometric morphometric and virtual anthropology methods to paleoanthropology.

What turned you on to biology in the first place? My path toward science was rather circuitous. I grew up in Athens, Greece, and as a child I was fascinated by skeletons and wanted to be a doctor. However, I was put off that idea when an older cousin studying medicine pointed out to me that I would have to take cadaver-based anatomy in medical school. I went on to attend law school at the University of Athens but quickly realized that it was not for me. I dropped out after the first semester and never looked back. The next year, I started my BA at Columbia University in New York. The US university system allowed me more freedom in my studies, and this is how I discovered human evolution. I became completely convinced that this would be the path that I would follow after I attended field school in Kenya and experienced fossil hunting and fieldwork. The latter is still what I love most about my work. The rest is history: I went on to join the New York Consortium for Evolutionary Primatology (NYCEP) PhD program and have been studying human evolution ever since.

If you had chosen a different field of science, what would it have been? I really think that it would have been medicine and medical research — my childhood dream. I actually briefly considered switching to medicine when I was taking a cadaver-based medical school anatomy course in New York, as part of my PhD studies. It is ironic that the idea of such a course was what put me off medicine in the first place. In reality, it was the most amazing course that I ever took and it made me reconsider my choices. However, while it is fun to think about this possible alternative career, I do not regret my chosen path: I love my work and am passionately committed to it.

Who were your key early influences? I was very lucky to have many people who helped and supported me throughout my career, and I am grateful to all of them. But undoubtedly the greatest influence on me was my PhD supervisor, Eric Delson. Eric is a mentor in the fullest sense of the word, not only to his own PhD students but also to all students and postdocs in the NYCEP program. He was (and still is) the person everyone turned to for advice and help, as I also do even now. I try to apply this kind of mentoring to my own students and postdocs.

What has been your biggest mistake…? I have taken some risks along the way that could have turned into big mistakes, starting with dropping out of law school without first securing an alternative path, as well as leaving a tenure track job in the USA to move to Germany without having prior experience in the European academic system. In retrospect, these choices were all for the best: dropping out of law school is what led me to human evolution in the first place and, while at first difficult to navigate, being in Germany and Europe has offered me opportunities and resources that would otherwise not be available. If I had to do it all over, I would probably try to hedge my bets a bit better, but while a lot could have gone wrong in the end these risks were worth taking.

What is your greatest research ambition? My research aims at developing new approaches to better understand the paleobiology of extinct hominins through the study of fossils. Such fossils can provide a wealth of information, which can be used not only to help reconstruct phylogeny but also to understand life history, health, and behavior in the past. There is something almost spiritual in trying to glimpse the lives of extinct species. A major research goal of mine is to further our understanding of even fragmentary and distorted fossils through the application and development of new methods, including high-resolution imaging and computer-assisted analyses.

However, perhaps my greatest long-standing ambition is to help put Greece (my home country), and by extension South-East Europe, on the map of Paleolithic Europe. And I mean that quite literally! Paleoanthropological research in Greece and in many neighboring countries has been relatively neglected until recently, mainly due to research priorities focusing on later archaeological periods. The resulting research gap manifested as empty space in the maps of Paleolithic Europe in the textbooks I studied at university. But this empty space covers a region with an important biogeographic role — as a dispersal corridor, as well as a potential glacial refugium — for human populations in the Pleistocene, and is crucial for our understanding of human evolution and dispersals. This research ambition was already formed in my days as a PhD student and has been driving my research in Greece, conducted in collaboration with the Universities of Athens and Thessaloniki and the Greek Ministry of Culture and Sports, and funded over the last eight years by the European Research Council. It has led to important results, such as the discovery of the oldest currently known archaeological site in the country, dating to ca. 450 thousand years ago, as well as the identification of an early migration of *Homo sapiens* to Europe more than 200 thousand years before the present. These results are very exciting for me, but I hope that they are only the beginning. There is much more to be done, and I hope to continue working toward fulfilling this goal for a long time to come!

Do you believe that there is a need for more crosstalk between disciplines? Yes, absolutely! In fact, the study of human evolution is by definition cross-disciplinary, drawing not only from biology (e.g. evolutionary biology, primate ecology and behavior, genetics) but also geology (e.g. paleontology) and the humanities (e.g. archaeology, linguistics, ethnography). While such an interdisciplinary outlook is not always easy, limiting one's perspective to only one of these components risks missing out on important insights and is bound to lead to an incomplete understanding of how humanity — in all its complexity — came to be. It is my strong belief that only through interdisciplinary work can we hope to answer big questions.

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Quick guide

Conifer bark beetles

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What are bark beetles? Bark beetles (Coleoptera: Curculionidae, Scolytinae) are small, cylindrical beetles ranging from ~1 mm-long *Hypothenemus* spp. to ~8 mm-long red turpentine beetles (*Dendroctonus valens*). They comprise a large and diverse group of insects consisting of >6,000 species worldwide. About 25 species are commonly recognized as important disturbance agents in conifer forests, particularly in North America and Europe. Bark beetles spend most of their lives within a host tree, feeding and reproducing within the bark. Trees of all species, ages, and sizes may be colonized and killed by bark beetles, but each bark-beetle species exhibits unique host preferences, life history traits, and impacts (Figure 1A).

How do bark beetles locate and colonize host trees? Adult bark beetles have very limited energy reserves, and are highly susceptible to predation, starvation, and adverse abiotic conditions while searching for hosts. Therefore, they must efficiently locate the correct habitat and host tree species, as well as the most suitable hosts, using a variety of visual and olfactory cues. Once a host is selected, pioneering beetles bore into and through the outer bark and initiate gallery construction in the phloem (that is, the innermost layer of bark that transports photosynthates). Once inside, many bark-beetle species release aggregation pheromones that enhance attraction of conspecifics. In response to this wounding, conifers release oleoresin, which exudes from the entrance hole and may encapsulate and kill pioneering beetles (Figure 1B); this response may be sufficient to thwart the attack. Successful host colonization requires overcoming these and other tree defenses, and generally requires large numbers (several hundreds to thousands) of beetles to 'mass attack' the tree over the course of several days; the healthier the tree the more beetles are required to overwhelm its defenses.

Following mating, eggs are laid along the edges of galleries. Upon eclosion, larvae excavate feeding tunnels in the phloem and/or the outer bark (Figure 1C). Bark beetles carry a variety of phoretic organisms that may be introduced into the tree as well. The best studied are the symbiotic blue-stain fungal associates in the family Ophiostomataceae, which serve as important food sources for larvae and adults and may negatively impact tree health. However, tree mortality occurs primarily by girdling of the phloem during gallery construction and larval feeding. Following pupation, adult beetles of the next generation tunnel outward through the bark and initiate flight in search of new hosts. Voltinism varies with some species, such as the southern pine beetle (*Dendroctonus frontalis*), completing several generations per year whereas others, such as the spruce beetle (*Dendroctonus rufipennis*), take up to three years to complete a generation.

Under what conditions do bark beetle epidemics occur? Mechanisms contributing to bark beetle epidemics are complex and include density-dependent and density-independent factors. However, two requirements must be met: first, there must be favorable weather conducive to beetle survival and population growth; and second, there must be an abundance of susceptible host trees. Climate change is exacerbating some epidemics due to shifts in temperature and precipitation that influence bark beetles, their hosts, and community associates. Forest densification (for example, due to fire suppression) has also contributed to some epidemics due to increased competition among trees for water, nutrients and growing space thereby increasing their susceptibility. Bark beetles have many natural enemies, including invertebrates (such as predatory beetles, snakeflies and parasitoid wasps) and vertebrates (for example, woodpeckers), but these likely have a very limited role in regulating epidemics.

What impacts do bark beetles have on forests? Tree mortality attributed to bark beetles can influence the