Newsletter of the Conservation Paleobiology Network

Issue #13
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CPN Newsletter

Conservation Paleobiology Network

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Diversity, Equity, and Inclusion Statement:

The CPN upholds a commitment to diversity, equity, and inclusion as a core value. We seek to build on this commitment by striving to create an inclusive community whose members represent diverse cultures, backgrounds, career stages, and life experiences. This commitment is critical to strengthening our relevance, credibility, and effectiveness within the field of conservation paleobiology and broader STEM community. Through these efforts, we strive to transform the field in practice, while diversifying the face of conservation paleobiology for the future.

Supported by RCN-NSF Award: EAR-1922562

Introducing Working Group: **Integrating Historical Data and Approaches into Oyster Management**

Principal Investigators: ***Gregory Dietl & Stephen Durham***

In the United States, the eastern oyster (*Crassostrea virginica*) is an economically, culturally, and ecologically important oyster species that ranges from Maine to Texas. Eastern oyster populations are managed by a variety of federal, state, and local governments as well as nongovernmental organizations. The history of oyster harvesting, coastal land use and other pressures, combined with scarce historical monitoring, have caused challenges for over a century. Studies have demonstrated the utility of historical data (*e.g.*, maps, fisheries records, archaeological middens, fossils) to inform oyster management. However, actual use of historical data to support oyster conservation and resource management decisions is still rare.

This working group brings together academic researchers and applied professionals tasked with conserving, managing, and/or restoring oysters to: 1) identify priority research directions by evaluating the information needs among applied professionals and the types of information from the past that may be able to address them; and 2) build trust and commitment to promote long-lasting and sustained collaboration between academic researchers and applied professionals.

More info and updates: https://conservationpaleorcn.org/oyster-management-working-group/

Image caption: *Intertidal oyster reefs at low tide in the Guana River Marsh Aquatic Preserve, north of St. Augustine, Florida (photo credit: Florida Department of Environmental Protection).*

What are CPN Working Groups?
The network sponsors Working Groups focused on research questions that integrate conservation paleobiologists, academic partners, wildlife managers, and stakeholders to develop effective strategies for translating products of historical research into conservation and management actions. The Working Group panel oversees solicitation, selection, development, and assessment of Working Groups.

Conservation Paleobiology Research Highlight #1

By Dr. Andrew Kemp, Tufts University, USA

Fecal sterols as a new proxy for Holocene changes in East African megafauna populations

In the arid tropics of East Africa, the seasonal and geographic availability of water is a key factor controlling the distribution and health of the region's iconic megafauna. Predicting how these populations will respond to hydrological changes for the 21st century and beyond is important for ensuring their conservation.

Populations of East African megafauna likely changed during the Holocene (past ~12,000 years) in response to trends and events in the regional hydroclimate, but reconstructing these populations is challenging because large animals are poorly preserved in the stratigraphic record. We aimed to develop a new proxy (sediment-hosted fecal steroids) to quantitatively reconstruct how megafauna populations shifted in response to hydrological changes during the Holocene. Since the animals themselves are poorly preserved, we examined if diagnostic chemical fingerprints in their dung could be a viable proxy. Fecal steroids reflect diet and its subsequent biochemical modification during digestion by the gut microbiome. These studies showed that in some instances the make-up of fecal steroids is unique to the species level. Furthermore, fecal steroids are well preserved in aquatic sediment (lakes, pools, and wetlands). Therefore, fecal steroids accumulating in these depositional environments likely reflect the megafauna living in the catchment at the time of sediment accumulation.

"Our results suggest that fecal steroids may have utility in reconstructing the time-evolving composition megafauna populations in East Africa."

We first developed a modern analogue dataset by measuring the concentration of 11 different fecal steroids in 87 fresh dung samples representing 22 species of megafauna (e.g., lions, hippos, zebra) in the Maasai Mara National Reserve (Kenya) and a further seven samples from captive animals. The sampling of dung from multiple individuals enabled us to evaluate within-species variability, and the comparison between captive and wild animals offered insight into the role of diet.

Using our reference library, we statistically identified four distinctive groups of megafauna. Fecal steroids in carnivore dung are principally cholesterol, and primate dung includes uniquely high proportions of coprostanol. Two groups of herbivore are distinguished by their differing proportions of phytosterols that are consumed by eating plants and 5β-stanols produced during digestion. Under cross validation a random forests statistical model accurately classified 72% of dung samples to the species level using fecal steroids. Our results suggest that fecal steroids may have utility in reconstructing the time-evolving composition megafauna populations in East Africa, and will be useful for future examination of whether historic changes in populations are faithfully recorded in sediment cores.

Image caption: *The team behind the research paper on fieldwork in the Maasai Mara Nature Reserve in Kenya, collecting dung for analysis.*

This study was published in Biodiversity and Conservation and supported by a grant from the National Geographic Society. For more details see https://doi.org/10.1007/s10531-021-02328-y

Conservation Paleobiology Research Highlight #2

By Dr. Yuri Kimura, National Museum of Nature and Science, Japan

Quietly gone: Anthropogenic extinction of cave-dwelling bats on a tropical island in Japan

"This tells us that the Daito Islands used to not only be a home for three bat species, but also that a significant biodiversity loss is invisibly happening near human activities."

The Daito Islands in Japan are tropical oceanic islands, and just like the Hawaiian Islands, they are separated from the closest landmass since their emergence, and have faced anthropogenic stresses since the first exploitation of early human settlers over 120 years ago. From the 1900s onward, the island's native C_3 forests were irreversibly and rapidly changed into C_4 sugarcane plantation. Presently, the islands harbor the Daito fruit bat (*Pteropus dasymallus daitoensis*), which is the only known mammal species on the islands. Ecological management of the islands is currently of high concern, especially for endangered species. However, it was recently discovered that this flying fox is the sole survivor of the anthropogenic disturbance from over a century ago. In 2016-2018, we found skeletons of the cave-dwelling bat *Miniopterus* sp. and *Rhinolophus* sp. on the floor of two caves on Minami-Daito Island, one of the Daito Islands.

Age determination of the eradicated species is essential for linking the extirpation event to humans. However, bone collagen was not preserved for direct radiocarbon dating, which is a common problem for bone samples found in tropical wet caves. Therefore, a multidisciplinary approach frequently adopted in conservation paleontology was used to bracket the estimated chronological age of the bats.

The most significant signal was obtained by stable carbon analysis on bone apatite. Analyzed individuals revealed C_4 signals in various degrees up to ~50%, which can be interpreted that the bats coexisted with humans because C_4 grasses (sugarcane) were not native on the island and were only introduced by the settlers' economic activities. This tells us that the Daito Islands used to not only be a home for three bat species, but also that a significant biodiversity loss is invisibly happening near human activities.

This study is just the beginning of the conservation paleontological work to be done on the Daito Islands, and with further advancement of paleontological techniques, more will be understood about sensitive insular fauna.

Image caption: *A skeleton of Miniopterus sp., covered by flowstone, from a cave on Minami-Daito Island.*

For more details see article by Kimura et al. (2022) in Paleontology and Evolutionary Science https://doi.org/10.7717/peerj.12702

Student Section

Early career panel bridging science and practice

Earlier this month, the Student Panel hosted two virtual discussions entitled "Conservation connections: Bridging science and practice through conservation paleobiology research." The event highlighted the perspectives of early career CPN community members who are working to bridge the divide between paleontological research and conservation practice. By showcasing their work, we hope the event provided greater exposure to examples of how geohistorical data can (and can't) influence conservation and society. The sessions also created space for participants to discuss how to build partnerships and communicate the value of the fossil record to resource managers and the public.

We'd like to extend a huge thank you to the four panelists—Drs. Stephen Durham, Ryan Mohammed, Alexis Mychajliw, and Matthew Ryan—who shared their experiences and advice. It was enriching to learn how each panelist has been "putting the dead to work" in different contexts. Additionally, thanks to all the participants for contributing your questions and ideas during the Q&A sessions.

If you weren't able to attend the event live, recordings and visual summaries will be posted on the CPN website in late May or early June.

Network Updates and Reminders

The 2nd Conservation Paleobiology Symposium will be held Feb 16-19, 2023 in Gainesville, Florida. More information about abstract deadlines and registration will be forthcoming.

Welcome Olivia Olson!

Olivia Olson (she/her) is a post-baccalaureate research associate in the HEDGE (Holocene Ecology, Diversity, and Global Extinctions) lab at Middlebury College, she will be joining the CPN newsletter team this summer. Her undergraduate work culminated in an interdisciplinary senior thesis which was awarded High Honors in Biology: “Sea minks (*Neovison macrodon*) in context: ecology, phylogeny, and extinction.” She enjoys communicating science with adults and children alike and is eager to begin working with the CPN Newsletter team. You can read more about her work in Middlebury’s Student Research Spotlight and on the Nature Ecology & Evolution Community website (Sea Mink Stories). In her free time she enjoys playing her guitar and spending time outside. Olivia is from Islesboro, Maine.

Paleo Proxy Spotlight – Dendrochronology *by Laura Hemmingham*

What is dendrochronology?

Dendrochronology is the use of tree rings for dating, where scientists use the characteristics of tree cores to understand past environments, including past climates and atmospheric conditions. The characteristics of tree-rings used for dendrochronology include variation in the measure of ring thickness, and the number of rings within the tree core.

How are tree rings produced?

During their life, various seasonal environmental factors can affect the growth of a tree. The seasons are recorded in the tree by deposition of layers of bark, which produce internal rings within the tree trunk upon several layers of accumulation year after year (see image). The innermost ring is the tree's first year, with newer layers being deposited on the outside of the ring group, as each layer of outer bark overlays the previous. When a tree experiences a period of poorer growing conditions, the nutrients it does absorb will be directed to more important parts of the organism, and therefore the trunk, which is not deemed as important, will develop relatively smaller growth rings.

Image caption: *Annual rings from tree trunk, with light brown and dark brown rings denoting different growing seasons. Photo by Dale Turner.*

How are tree rings used as proxies for palaeoenvironments?

As with all living organisms, for trees, favourable environments encourage growth. A small core can be taken from the tree without permanently damaging it. When examining tree ring cores, the thickness of each ring corresponds to the environmental factors that the tree was subject to as it grew, such as temperature and precipitation. Trees usually grow faster in warm and/or wet conditions, compared to cold and/or dry conditions. When studying the tree trunk, rings of different colors can be observed - a lighter and darker brown - which are different seasons (e.g. spring/early summer and late summer/fall), and one ring corresponds to one growth year of the tree's life. Variations in the thickness of either of these colored rings can indicate relatively better or worse growing conditions that occurred tens or hundreds (or thousands!) of years ago. For example, if the tree experienced drought conditions during the summer, a thinner tree ring would be produced during that time. If we can determine when the tree started growing, we can then calculate which year these less productive growing years occurred.

What else can be told from the tree rings?

In addition to warm, wet, cold and dry conditions, other events may be recorded in the tree ring, such as damage to the bark layers of trees surviving forest fires, and even historical tsunami. Archaeology also implements dendrochronology to help understand dates, events and environments associated to a particular settlement. For example, dendrochronology helped date Sweet Track, nicknamed "The Oldest Footpath in the World" (the oldest *dated* footpath) in the Somerset Levels, England, to almost 6,000 years ago.

Postcards from the Field

In this feature of our newsletter, we showcase members' research in the field, lab, or other settings. Please submit your "postcards" with approximately 100 words of text to us at conservationpaleo@floridamuseum.ufl.edu.

Andrew Ng, Middlebury College, Vermont, USA

I'm Andrew Ng, an undergraduate researcher working in Dr. Alexis Mychajliw's HEDGE (Holocene Ecology, Global Diversity, and Extinctions) Lab at Middlebury College. This semester, I worked towards resolving a human-wildlife conflict regarding a pair of beavers (*Castor canadensis*) who inhabit a stormwater drainage pond that our college is responsible for maintaining. Those on Middlebury's campus enjoy viewing the beavers but the beavers consistently flood the pond, which the college must then unclog. Here I am, along with fellow Middlebury student Jack Cornish. Alongside us is a device we built with longtime beaver-conflict-expert Skip Lisle called a Beaver Deceiver. It allows coexistence with the beavers while eliminating flooding. The device prevents the beavers from reaching the outlet drain they clog and will deceive the beavers to where water is flowing - mitigating damming potential as beavers use water movement to guide their debris placement. This is a more sustainable conflict resolution option than traditional trapping, killing, or relocation methods. Through my work, I gained a further appreciation for the on-campus wildlife supported by the beavers' habitat. The pond holds minks and muskrats, plus gets visits from foxes and even skunks. We hope that sustainable resolutions, such as this, gain greater popularity in managing beaver-human conflicts.

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Postcards from the Field continued

Bora Agbulut from Turkey. Paleontology MSc student at NOVA University of Lisbon and Geologist at Sociedade de Historia Natural

Regarding the importance of Geoheritage, we focus on Mitigation Paleontology in the Lusitanian Basin of Portugal as a member of Sociedade de Historia Natural. The work mainly develops interactive maps and risk models with Geographic Information System tools and database management, combined with field data on the scope of conservation and protection of paleontological heritage. The numerous occurrences of fossils, in particular dinosaurs, in the Upper Jurassic of the Oeste region of Portugal, oblige us to constantly update data. For this purpose the SIGAP (Sistema de Informação Geográfica Aplicado à Paleontologia) Project was created. This helps with georeferencing of the numerous deposits with fossil vertebrates, the future availability within the scope of land management and planning, as well as providing a potential source of data for the creation of taphonomic models. Of the various types of data obtained by the SIGAP Project, the creation of erosive models and impacts of human activity on the respective deposits are included, thus resulting in the planning of safeguards and minimization/mitigation actions due to the landslide and rockfall capacity of the cliffs, which pose a threat to the paleontological heritage. SIGAP has identified 386 deposits with possible safe lithostratigraphic positioning, and about 200 others resulting from cliff collapses. Geolocating everything is the big focus. This work is of great importance for the protection of our paleontological heritage and for spatial planning and to develop a mobile application in the near future.

Photo caption: A) GIS software, data management B) Field prospection in excavation area C) Geocoordinating and survey in the cliffs D) Database of the project

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Are you interested in:

…contributing to **Postcards from the Field**?
…sharing a recent publication as a **Research Highlight**?
…being featured in a **Practitioner's Perspective** piece?
…providing other content suggestions for this newsletter?

If yes, please email us at conservationpaleo@floridamuseum.ufl.edu

Invite Your Colleagues to Join our Network!

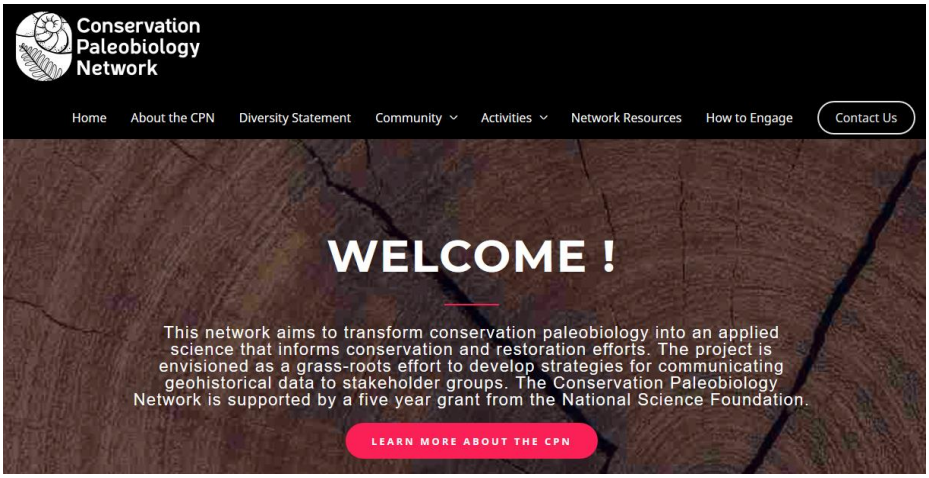
If you know people who might be interested in our network, please invite them to join. You can use the link below to extend your invitation on behalf of our network.

By joining the network, you become a member of our Community of Practice. The membership does not impose any obligations, but enables participants to engage fully in network activities. Members will be able to:

1. Participate in the CPN mailing list
2. Nominate and self-nominate for committees and panels
3. Submit announcements for publication in the CPN Newsletter
4. Apply to participate in the CPN activities such as Field Courses
5. View CPN webinars and submit proposals for webinar modules

To join please go to our website and select "Join the Network".

Visit the website! https://conservationpaleorcn.org/



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