Newsletter of the Conservation Paleobiology Network

Issue #16
Nov 2022

CPN Newsletter

Conservation Paleobiology Network

INSIDE THIS ISSUE:

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

Student Perspectives – North American Furbearer Workshop

By Sara Williams and Elizabeth Austin

Image caption: *Working Group participants at Shoals Marine Lab, Maine, USA.*

The crystal blue waves lapped against the side of the ferry to Portsmouth, as we (Sara and Elizabeth, undergraduates from Oklahoma University and Middlebury College) watched quintessential lighthouses and ships with billowing sails pass by. We were headed to Shoals Marine Lab on Appledore Island, Maine to participate in the CPN-funded Maine Furbearers Workshop as part of the CPN North American Fur Trade Working Group. We had spent the summer as research interns at the Smithsonian National Museum of Natural History as a part of a multi-institutional NSF-funded project (DISES #2109168) on the socioecological dynamics of the North American fur trade. This CPN Working Group (led by Courtney Hofman, Alexis Mychajliw, Bonnie Newsom, Torben Rick, and Arthur Speiss) works to combine archeological data, present day ecology, and land management to understand our past and present relationships to fur bearing species.

As students, we were excited to share what we had learned about the Smithsonian archeological collections from the coast of Maine that were relevant to the North American fur trade. The project's species of interest are mink (*Neovison* spp.), muskrat (*Ondatra zibethicus*), and beaver (*Castor canadensis*). These animals, vital to ecosystem health and human cultures, were almost hunted to extinction (or in the sea mink's [*Neovison macrodon*] case, were indeed hunted to extinction) due to pressure from the fur trade in the Gulf of Maine and the Northeast. These archaeological collections, as well as historical and modern collections, will be used to evaluate past and present furbearer populations and interactions with humans over time. (Continued on page 10).

Conservation Paleobiology Research Highlight *By Angelina G. Perrotti*

Diverse responses of vegetation and fire after Pleistocene megaherbivore extinction across the Eastern US

"These differences suggest spatial variations in the strength of couplings among late-Quaternary megaherbivore extinctions, vegetation composition and structure, and fire regime"

Megaherbivores are keystone species whose removal from landscapes can cause cascading ecosystem changes, yet the consequences of Late Quaternary extinctions remain uncertain. This work tested the Megaherbivory Release Hypothesis (MRH), which posits that the decline and extinction of megaherbivores (body size >1000 kg) during the end-Pleistocene in eastern North America contributed to the expansion of more palatable hardwood tree taxa, the formation of vegetation assemblages with no modern analogue, and increased fuel load and fire activity. Analyses of coprophilous fungal spores in lake sediment records are essential to testing the MRH as part of multi-proxy analyses of the lead/lag relationships among vegetation composition, megaherbivore abundance, fire, and climate. This research builds on prior analyses of coprophilous fungal spores from individual sites that have supported the MRH using single fungal taxon (*Sporormiella*) abundances, by establishing five new multi-taxon coprophilous fungal spore records alongside existing pollen, spore, and charcoal records from 14 sites across eastern North America (see map image). The MRH was well supported in the northeast and central US, with most sites (5/6) showing a coprophilous spore decline at ~14.6 ka that preceded the rise of hardwood taxa and development of no-analogue vegetation assemblages (~14.4 ka). However, changes in fire regime varied widely among northeast and central US sites and may precede the spore declines, contrary to the predictions of the MRH. The MRH was not well supported in the southeastern US, where a smaller rise in hardwood taxa (~16.1-13.1 ka) generally preceded the decline in coprophilous spores at individual sites (~15.8-12.7 ka).

These differences suggest spatial variations in the strength of couplings among late-Quaternary megaherbivore extinctions, vegetation composition and structure, and fire regime. Possible explanations for the differences between the northern and southeastern US include differences in landscape heterogeneity of canopy openness and palatability, net primary productivity and sensitivity to top-down trophic effects, megaherbivore density, and climate trends and seasonality.

Image caption: *Map of sites. Yellow stars indicate sites where we completed multi-taxa coprophilous spore recounts. Red circles indicate sites where we used existing coprophilous spore counts; these counts are for Sporormiella only, except White Pond, which includes counts for Sporormiella, Coniochaeta, Cercophora, and Podospora. Black triangles indicate sites not included in the time series analyses due to data-quality limitations.*

For more information please see paper by Perrotti *et al*. 2022 in Quaternary Science Reviews: https://doi.org/10.1016/j.quascirev.2022.107696

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Practitioner Perspective *Interview by Olivia Olson*

Featured Practitioner: Summer Praetorius

Summer Praetorius, PhD is a paleoceanographer at the Geology, Minerals, Energy, and Geophysics Science Center at the United States Geological Survey. Dr. Praetorius studies the interactions between ocean dynamics and past climate change by aggregating paleoceanographic records from the North Pacific. Her work on past ocean-climate systems informs strategies for mitigating the effects of future climate change. Her website features not only her research but also her photography and her Twitter (@S_Praetorius) showcases her impressive four-leaf clover finding ability.

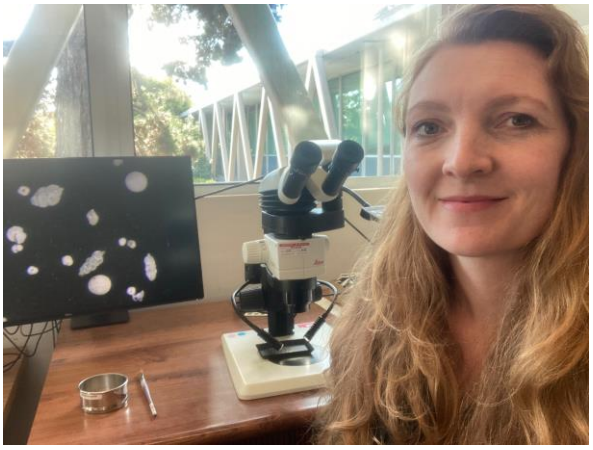

Image caption: *Dr. Praetorius with her favorite fossil: the foram Orbulina universa.*

1. You're a geologist and oceanographer - have you always been interested in this field?

I was always interested in science and archaeology - I thought that archaeology was the path I would go down. I got my Bachelor's degree in both geology and archaeology, but wasn't sure what interested me more. As an undergraduate I saw a flyer for an REU (Research Experience for Undergraduates) at Woods Hole Oceanographic Institute (WHOI) to study paleoclimate and oceanography. That was my light bulb moment - I thought: this was how I could link oceans and climate studies! My advisors (Jerry McManus and Delia Oppo) and I looked at ocean sediments in the North Atlantic to understand changes in deep water currents and how that related to the strength of North Atlantic overturning and rapid swings in temperature. After graduating, I worked at WHOI as a research assistant and eventually went on to get a PhD where I switched to studying the North Pacific.

2. Can you speak more to your interest in archaeology? Have you since revisited that in your work?

Actually, yes. I had always been interested in human migration and wanted to revisit those questions as a researcher. Only now after publishing datasets from the North Pacific, I want to tackle the effects that paleoclimate had on people. We're now aggregating paleoclimate records to contextualize human migration - where people were and when and how that relates to the climate. For example, we can connect the paleoclimate data to paleogenomics to try and see when people moved from Siberia to Beringia and on to North America. We are trying to figure out the environmental conditions along the coasts to assess the most climatically viable times for migration.

3. Do people seem more interested in your work now that you're connecting the paleoclimate work to human stories?

Absolutely. People are naturally interested in those human stories - it allows people to connect more directly to our work. In this research, we're zooming out to look into connections to climate. And I think it's easier to see past humans being affected by climate change than it is to see ourselves as vulnerable to it because it's relegated to the past. So hopefully, lessons about human vulnerability to climate change can therefore come across in a more accessible way.

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Practitioner Perspective continued

4. Geology addresses deep time. As a geologist, how do you convey the importance of your work to people living day to day?

Earth science feels so naturally interesting to me that it's sometimes challenging to realize that others don't always share that same interest or sense of relevancy. One way I get past this is by writing science communication pieces. I feel it's my responsibility as a scientist to translate my work to the public using stories and metaphor. People will often tune out deep time when scientists talk about it. But not only is gradual change seen in paleoceanography, so is abrupt change. These abrupt changes in climate can take place in as little as a year to a decade. For example, ice core records during the last glacial period show very fast swings in temperature that can occur in a few years to decades. You can see these events play out in various records throughout the globe—changes in ocean productivity and oxygen content, and rapid changes in the hydrological cycle on land. It's like the earth reorganizing on fairly short time scales. I'm interested in studying these tipping points, those that occur on more human time scales.

5. Was there a moment when you saw the work you're doing as pertinent?

When I moved to California, a mass of warm water in the North Pacific called "the Blob" had been sitting offshore for a couple years. The Blob was linked to a lot of shifts in the west—it coincided with the worsening drought and uptick in large fires in California, and it wreaked havoc on marine ecosystems up and down the west coast. There was one day in August of 2015 that I'll never forget. There was an atmospheric inversion during a heat wave and the air was smoky from fires that were burning in Napa. We drove to the coast to try and get some fresh air, but when we got to the coast, the Pacific looked like a flat lake: there was no wind, the water was warm, dead fishes were washing up on shore. They were dying from hypoxia because there was also a massive algal bloom across the North Pacific. It felt apocalyptic. I looked around to see if anyone else was noticing or bothered by any of it, but it seemed people were happily sunbathing and enjoying the warm water. I had a paper in press at the time on past ocean hypoxic events in the North Pacific and how they were linked to ocean warming and increases in diatom algae. What was unnerving about the paleo hypoxic events is that they started abruptly but persisted for as long as 1,000 years. I remember feeling deeply uneasy that day as the fish washed ashore, wondering if I was watching the start of a regime shift in the marine ecosystems.

6. Did anything change in your research after that experience?

Yes. I wanted to work on solutions; I felt such a sense of urgency. I wanted people to see the potential for cascades in climate change. I became more interested in trying to understand how past ocean warming impacted coastal ecosystems in the past. I paired up with researchers at Bodega Marine Lab to work on establishing a paleo proxy using modern abalone shells in the hopes I could then use ancient abalone shells to reconstruct past conditions. But around the same time that I started working on that project, there was a major collapse in abalone populations and kelp ecosystems in Northern California. The kelp forests in California are vulnerable to these climatic shifts and are relevant to fishing communities today. I'm hoping to work more on kelp systems. For example, we could possibly look at the interactions between past ocean warming and the effects on kelp ecosystems.

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7. What advice do you have for students interested in research?

Getting involved in research early on is a great way to get your foot in the door. It's really important to have supportive mentors (and it's helpful to talk to their other students already working with those mentors). A good research mentor will both empower you in research and recognize the importance of work-life balance. For me my early-career research led to publications and job opportunities.

8. And finally, what's your favorite fossil?

One of the paleo proxies I use is foraminifera fossils, which indicate temperature changes in the ocean. I love sitting at my microscope and looking at all of them, but my favorite is *Orbulina universa*. It has spines when it's alive but when it's a fossil it looks like a globe. It's easy to identify and is present in subtropical waters so it's a clear indicator of warm water.

Student Section

Conservation Paleobiology at the Geological Society of America annual meeting, Denver

In person again at last! There was a sizable showing of CPN members at the 2022 Geological Society of America annual meeting, which was convened last month in Denver, Colorado. Several sessions were organized by members of our community on topics including conservation paleobiology, taphonomy, ecological niche modeling, paleoecology, and method development. During the conservation paleobiology session, a group of attendees joined the CPN Student Panel for an informally organized conservation paleobiology lunch. It was wonderful to meet so many network members in person and hear about everyone's ongoing research. We hope you'll join us for more peer networking activities at the upcoming Conservation Paleobiology Symposium in February. Details coming soon!

Image caption: *Multiple groups of Conservation Paleobiologists gather at the Geological Society of America in Denver. Images provided by Elizabeth Austin (left), and Erin Dillon (right).*

Paleo Proxy Spotlight – Coloration of Sediments/Fossils

by Darja Dankina

What does sediment and fossil color tell us?

Scientists can obtain indirect (proxy) data about the paleoenvironment and paleoclimate using the preserved records of sediments, among other things. One aspect of sediment that can be useful for understanding past climate is color. Color in sediments can be measured precisely and can indicate the presence or absence of oxygen (red color) or plant life (green chlorophyll), or the sources and formation of such sediment. Thus, this source of information can yield important paleoenvironmental data. Another way that color can be used by geologists is by looking at fossil coloration. Although related more to the conditions that a fossil was exposed to after deposition rather than paleoenvironment, it is nonetheless a useful tool for geologists piecing together the overall tectonic and/or geographical history of a region, which is an important consideration for scientists studying paleoclimate using sedimentary deposits.

Commonly, the data used to reconstruct paleoclimate relies on the study of micro-fossils in oceanic sediments. These studies are often based on microfossil morphological characteristics, such as the outer features, form, size, and microstructure. Usually, detailed analysis of microfossils is done using high-quality micrographs made by a Scanning Electron Microscope (SEM). However, while SEM can capture a lot of valuable information, this method does not capture one important feature: fossil color. The color of some fossils can reveal important information about organic metamorphism. The Color Alteration Index (CAI) is widely used to study microfossils such as conodonts, foraminifera, palynomorphs, etc. The color alteration is directly related to depth and geothermal gradient of the buried material. Below are some examples of how the CAI can be used.

Example 1 - According to McNeil et al. (1996), fossil foraminifera experience color and mineralogical changes with increasing thermal maturity and burial diagenesis (see image below). This makes them useful for understanding burial history of marine sedimentary rocks. Agglutinated foraminifers are usually rich in terrigenous elastic rocks including deltaic deposits, shelf sands, and deep-water turbidites. All these components are typical targets for hydrocarbon investigation (McNeil et al. 1996). Standard geothermal indicators such as vitrinite and palynomorphs are commonly reworked in these sediments. Agglutinated foraminifers are typically *in situ* in these deposits and therefore might provide a better measure of thermal maturity (McNeil et al. 1996).

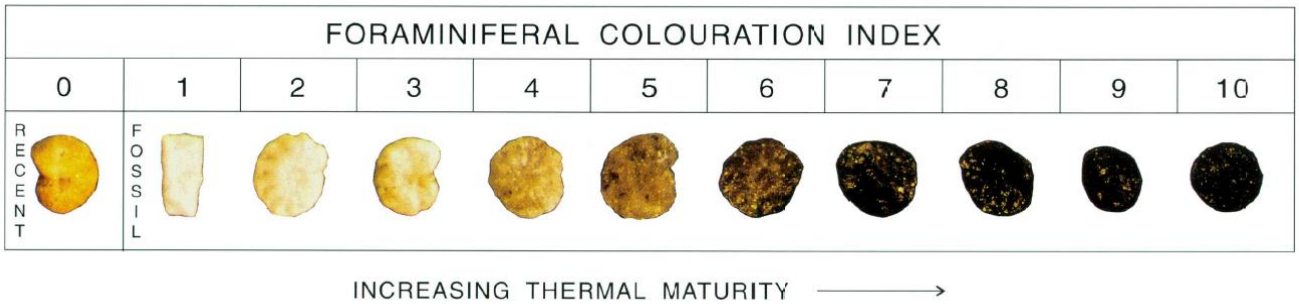

Image caption: *The Foraminiferal Coloration Index chart showing color changes through increasing thermal maturity (McNeil et al. 1996).*

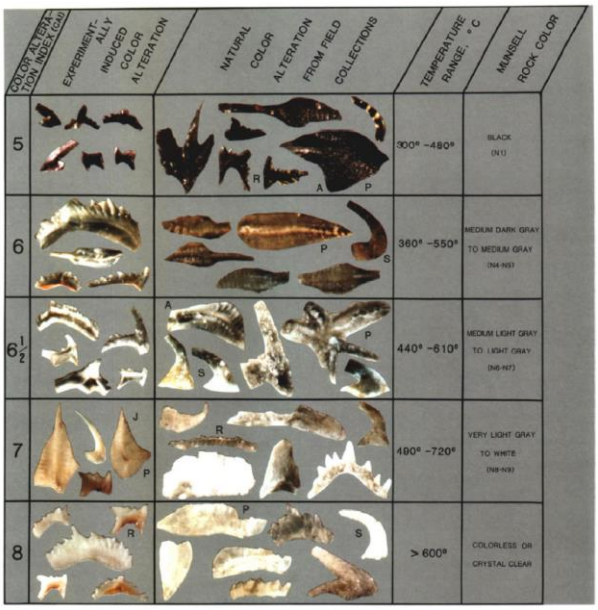

Image caption: *Color standards for altered conodonts of CAI5 through 8. The geologic temperature range for each CAI covers durations of 1,000 yr to 500 m.y. The recognizable conodonts are generally not recovered from regionally metamorphosed rocks above greenschist facies, conodonts having CAI values of greater than 6 usually are found in rocks that have been affected by a relatively high-temperature, short-term metamorphic event. The higher part of the temperature range is thus probably most applicable to contact metamorphic rocks. Munsell rock-color chart designations (Munsell Color Company, 1979) for each index are also provided. P-platform element, R-ramiform element, S-simple-cone element, J-juvenile, A-adult (Rejebian et al. 1987).*

Example 2 - Epstein et al. (1976) explained another use of the CAI based on conodonts, as the CAI is a valuable tool for assessing organic metamorphism (Rejebian et al. 1987). A simple color chart can be used for index determination, or a set of standards can be assembled from field collections or cooked in the laboratory. Thus, standards can be easily assembled and reproduced. Moreover, the conodont color alteration begins near the upper thermal limit for many palynomorphs. The CAI of conodonts provides thermal cutoffs for oil, condensate, and dry gas production. Additionally, the CAI of conodonts is applicable to rocks as old as the Cambrian, whereas reflectance techniques for vitrinite cannot be used for pre-Devonian rocks. Finally, conodonts are most abundant and most easily concentrated from marine carbonate rocks in which palynomorphs are generally poorly preserved and in which vitrinite is least abundant and often absent.

Example 3 - Palynomorphs (sporomorphs and acritarchs) can be used for a wide range of geological studies as sediment origin analysis, structural geology, geo-thermometry, and hydrocarbon source rock potential. Sedimentary organic matter has a high sensitivity to thermal evolution. For example, palynomorphs are composed of resistant organic polymers. These polymers have an important characteristic of the inner reordering of their molecular structure resulting from processes acting during burial (depth and duration, geothermal flux, and fluid geochemistry). In many palynomorphs, these processes result in color alteration that is directly related to the maximum temperature achieved. Nonetheless, post-depositional oxidation due to weathering cannot only corrode or even destroy palynomorphs but can also lighten their color. The characteristic of palynomorphs to change color with increasing temperature has enabled the development of powerful tools for identifying the thermal history of sedimentary basins (Spina et al. 2018).

References:

Epstein, Anita G., Jack Burton Epstein, and Leonard D. Harris. "Conodont color alteration: an index to organic metamorphism." (1976).

McNeil, David Harvey, D. R. Issler, and L. R. Snowdon. Colour alteration, thermal maturity, and burial diagenesis in fossil foraminifers. No. 499. Geological Survey of Canada, 1996.

Rejebian, Vivian A., Anita G. Harris, and J. Stephen Huebner. "Conodont color and textural alteration: An index to regional metamorphism, contact metamorphism, and hydrothermal alteration." Geological Society of America Bulletin 99.4 (1987): 471-479.

Spina, Amalia, et al. "Application of Palynomorph Darkness Index (PDI) to assess the thermal maturity of palynomorphs: A case study from North Africa." International Journal of Coal Geology 188 (2018): 64-78.

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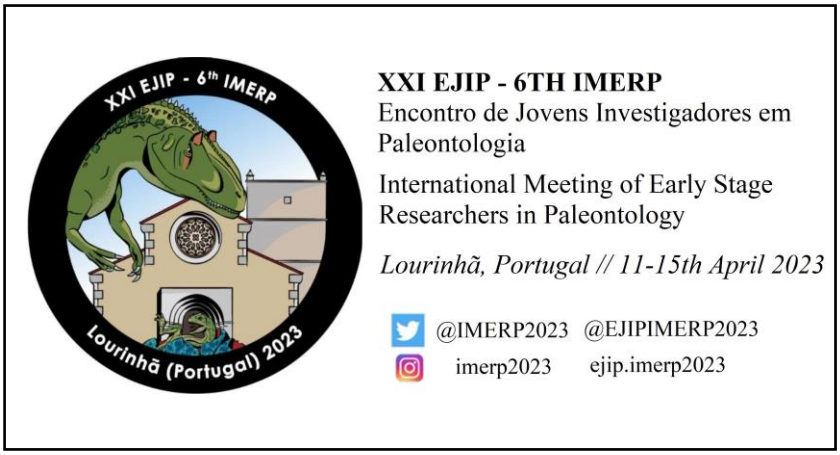
Upcoming Conferences

2ND CONSERVATION PALEOBIOLOGY SYMPOSIUM (FEB 2023, GAINESVILLE, FL) - Registration and abstract submission are now open. Early registration deadline and abstract deadline are Dec 16, 2022. Registration for students and post-docs is FREE!

Website here: https://conservationpaleorcn.org/annual-symposium-conference-page/



INTERNATIONAL MEETING OF EARLY STAGE RESEARCHERS IN PALEONTOLOGY (APRIL 2023, LOURINHA PORTUGAL)

4th PALEONTOLOGICAL VIRTUAL CONGRESS (8-22 MAY, 2023)

Deadline for thematic sessions proposals: February 15, 2023
Deadline for virtual field trips proposals: April 15, 2023
Deadline for abstract submission: March 8, 2023
Deadline for regular registration: No limit

INQUA INTERNATIONAL CONFERENCE (JULY 2023 ROME, ITALY) - International Union for Quaternary Research (INQUA) hosts an international conference for Quaternary scientists once every four years. Next year, the conference will take place at the Sapienza University Rome, Italy, from 13-20 July. The conference theme is 'Time for Change', reflecting the contribution Quaternary research provides to current societal and climate challenges. Early registration is now open and closes 20 Feb 2023. Website here: https://inquaroma2023.org/

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.

Sofia Patrocínio - NOVA School of Science and Technology (Lisbon, Portugal)

My name is Sofia Patrocínio. Currently, I am doing my Master's degree in Paleontology at NOVA School of Science and Technology (Lisbon, Portugal). My degree was in Environmental Education and Nature Tourism at Escola Superior de Educação de Santarém. I have been developing several projects since my entry into my Master's, including a board game on Paleontology (PaleoMasterMinds) and a project to take Paleontology to Portuguese schools (PaleoJúnior). The areas of Paleontology that interest me most are Micropaleontology and Education for Paleontology. In my Master's I am focusing on Mesozoic evolution of mammals. Also, I am collaborating with the project named "The Portuguese Fossil Database", which aims to compile and make available all existing information about fossil occurrences in Portugal. Through this work, we hope to help and enhance paleontological research and education in Portugal.

Continued from front-page (Student Perspective – North American Furbearer Workshop):

By Sara Williams and Elizabeth Austin

(Continued from page 1)

We were excited to share our findings with our collaborators attending the Furbearer Workshop and learn from the diverse views and goals of the many stakeholders in attendance. This workshop was host to archeologists, biologists, land conservationists, Indigenous language keepers, and fur trappers. While some participants were more concerned with historical populations of furbearers, others were more interested in modern furbearer populations. We heard from Tom, a renowned trapper and taxidermist in Maine, speak about his personal interactions with mink. We heard from John, Mi'kmaq language keeper, who spoke about the muskrat stew he and his family enjoy. Bonnie, Penobscot archaeologist, asked questions about deeper timescales and Wabanaki involvement in conservation. And Linda Welch, at the US Fish and Wildlife Service, spoke about the threat minks present to protected seabirds in Maine. The overarching focus of everyone in attendance was conservation, and how we could combine historic and modern data to ensure future ecosystem health and responsible human-furbearer interaction.

Along with learning from the lovely folks in attendance, the physical setting of Shoals Marine Lab provided an appropriate backdrop for what this working group is all about. As we swam, followed muskrat paths, and watched the sunset over the water, it was abundantly clear the importance of conservation. The ability to come together as a group and interact with each other and the environment we are studying would not have been possible without the CPN and the efforts of everyone who participated.

Image caption: *Image of sailboat from the Fur Bearing Workshop in Maine (left), and participants of the workshop Sara Williams and Elizabeth Austin (right).*

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Conservation Paleobiology Network

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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!

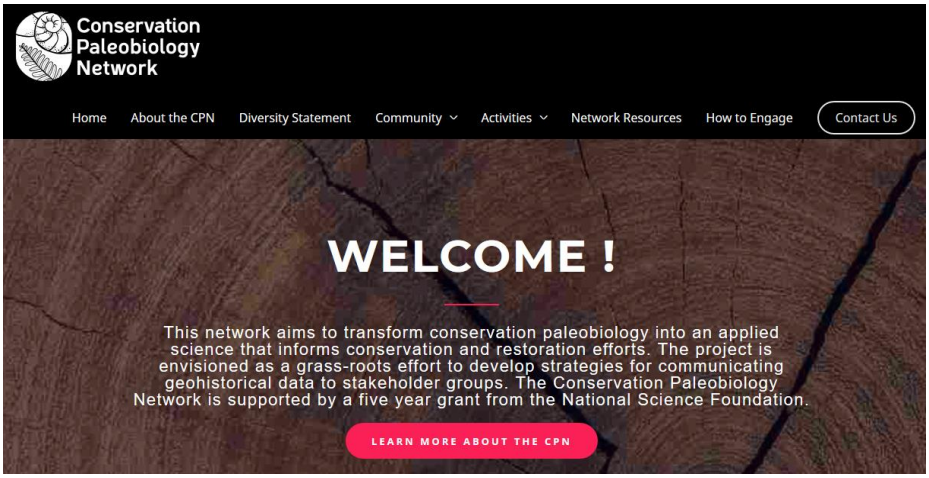
If you know people who might be interested in our network, please invite them to join. You can use the link below to extend your invitation on behalf of our network.

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
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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