myFOSSIL

News from the FOSSIL Project Vol. 6, Issue 1, Spring 2019

Amateur Spotlight: Linda McCall

Editor's note: This issue, Jennifer Bauer interviews Linda McCall. Linda serves on Paleontological Society's Ad Hoc Committee on Government Affairs and the myFOSSIL Steering Committee. Linda is a member of numerous fossil organizations.

Linda McCall at Beef Creek, Jasper, TX surrounded by petrified wood.

Tell us a little about yourself.

Thank you for this opportunity. I am an avocational paleontologist first and foremost but have always been a naturalist at heart – just as willing to pick up an abandoned bird or wasp nest or bird egg or bleached out modern bone or sparkly crystal as I am a fossil. (And photograph them all as well!) During my early college years I worked with the local Science Center to foster rescued injured animals – ask me about the fawn I kept in my apartment for 3 weeks… or the sparrow who didn't leave once it recovered.

How and when did you first get interested in collecting fossils?

My mother always referred to me as an "active" child – which was a kind way of saying I sometimes drove her to distraction. We were living in Columbus, Ohio when I was about 6 (my father was a pilot in the Air Force, so we moved around a bit), and attended the local Methodist Church. I would get bored waiting for church to open and my mother would send me out into the limestone gravel parking lot to find whatever took my fancy. I would bring her back bits of sparkly crystal or broken crinoid stems and she

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would tell me what they were (my mother had been a chemistry major at college in the mid-to late forties, which was unusual in and of itself.) We moved to Texas when I was twelve and fossils were EVERYWHERE and I was hooked. Collecting started in earnest and I wanted to grow up to be a paleontologist!

Why didn't you go on to be a professional paleontologist?

My career as a professional paleontologist showed initial promise. In high school I displayed my collection at the school library and gave talks to fellow students. I enrolled at the University of Texas as a Geology major and was privileged to work at the J J Pickle Research Center in the Vertebrate Paleo Lab under Dr. Wann Langston and Dr. Ernie Lundelius as a freshman – the only freshman there. I wanted to grow up to be just like them – digging in the field and making exciting discoveries and publishing them to increase our knowledge of the world. This was in 1976.

I soon learned that while some members of the paleo world were welcoming and accepting of a woman (like Wann and Ernie and the rest of the folks at the lab) others were not – mainly my school counselors. They convinced me that the only job I would have in paleontology was working in oil and gas with microfossils in an office somewhere. Bummer that! I'm out. So, I dropped out, got married went to work at an insurance stat gathering agency (I do like math), had children and joined a local fossil club – pursuing fossil collecting as a hobby.

I understand you have been the lead author in several peer reviewed published paleontological papers. How long have you been involved in paleontological research? I know you have collected early echinoderms with Dr. Jim Sprinkle! Can you tell us about your experience working with professional scientists?

In the early '80s, on a field trip to Oklahoma with the Austin fossil club (Dr. Sprinkle was along as science advisor for the club). I found a nearly complete specimen of a new echinoderm that Jim had been researching (he had a couple partial specimens of it already). He suggested that our fossil club take on the project of writing the new species up, so we did, and in 1985, with his guidance and mentoring, it was published. My last name was Henry back then.... I was 28 at the time.[1]

Then there is a big gap of child-raising and just collecting on the side. I've always been something of a "super collector" and I never really abandoned the dream of doing something with the fossils I found to increase our knowledge of the natural world in some way. In 2006, my "super-collecting" came to good use. Interstate 35 was being widened in Georgetown, Texas (just north of Austin) and the Austin Gem and Mineral Club folks (of which I was also a member) said to go check it out because there were some awesome calcite crystals and some cool speleothems (cave formations) coming out of some of the small voids they were exposing on a 13ft high limestone wall they were cutting through. I went to look and found instead one small crystallized fossil! I kept watch on the site for a month and when they finally reached the fossil layer again, I collected it like crazy.

Ann Molineux and Linda receiving the Grover E. Murray Award for Best Published Paper

I wanted to do something with all that material and I wanted to figure out what it said about the site and the environment back then, but didn't know where to start. I showed some of the material to Dr. Sprinkle and Dr. Ann Molineux (the fossil club science advisors at the time) and they said, "Why don't we write a paper about this?" I said, "Wonderful!" They said, "Why don't you be lead author." I said, "Are you crazy? I don't have any idea how to do that!" And they said, "It's fine, we'll help you" – so they gave me an outline and I wrote the paper in layman language and they helped me upscale it into scientific language and taught me the terminology and off we went. The paper was written, accepted and I did my first presentation at a professional conference in 2008 at age 51. The paper won the second place Grover E. Murray Best Published Paper Award at the conference (which I credit entirely to my professional co-authors), and has since been reprinted in the South Texas Geological Society Bulletin.[2]

We teamed up again for two more papers, and added another avocational published author Chris Garvie for one. [3,4]:

Working with these professionals has been wonderful. They are warm and open, helpful, and nurturing – guiding and mentoring me through the maze of abstract writing, technical writing, convention attendance and oral presentations, and introduced me to an entirely different world.

I have since gone out on my own, and though I haven't published solo yet, I have done numerous abstracts and a like amount of oral presentations at professional conferences on topics as varied as the color on echinoderms to Paleontological Resources Preservation Act (PRPA) impacts on amateur paleontological publishing and the value of amateur/avocational paleontologists to the field of paleontology (see list under **Learn More** below). In April 2018 I co-chaired my first session at the Southeastern section meeting of the Geological Society of America in Knoxville, Tennessee.

I saw your talk on coloration patterns in fossil echinoids at the Geological Society of America meeting this year. What caused you to pursue that project? Are you teamed up with other local scientists?

One of our club members tipped us off that they were replenishing the sand on North Topsail Beach and that the new sand had fossils in it, so I went down to check. Indeed there were, and for a long time I was collecting them without noticing the color – after all 30 million year old fossils shouldn't still have any color or color patterns on them so I wasn't looking for it. But, being a super collector, when you've picked up a bazillion of them, you can't help but notice when there are replicating color patterns on them, different from random mineral color staining. So then I started looking for it, and the more I looked, the more I found. There are color patterns on specimens from at least 6 different species from 3 different phyla. For the presentation you mentioned I focused on the color and color patterns on the echinoderm (irregular sea urchin) Hemipatagus carolinensis. After 5 years of trying to convince the professional community that I do indeed have original color patterns, if not color, well known echinoderm expert Lou Zachos at the University of Mississippi has agreed to work with me and get these findings published. Yay!

Linda at North Topsail Beach

I notice you work on many types of echinoderms - are they your favorite group or do you have a favorite fossil?

I guess I would have to say I am a generalist and like different things on different days. I do favor invertebrates though – all invertebrates. Teeth and bones, not so much.

I understand you have a sizable personal collection. Can you tell us about it?

Just in the last year we have moved into a house that allows me to really let my collection shine. I love having the space to display and have easy access to my collection, and love to have folks over to share it with. Come visit me! I don't live near a museum or university, so it is also handy to have my own research material close by.

I also understand you have donated many specimens over the years. What is that like?

Well, after collecting sporadically since age 12 and pretty continuously for the last 20 years, the amount of material can get a little out of hand. When my husband mentioned that he thought I had finally tipped over into fossil hoarding, I stepped back and took a second look. Though I would still like to save every fossil I see from eroding away and all that data being lost forever, I really can't save them all… So, I'm deciding what in my collections I can conceivably research and work on and what I need to get somewhere else where someone else can work on them. To that end, I have donated tens of thousands of specimens to the University of Texas, and many specimens to the Aurora Fossil Museum, North Carolina Museum of Natural

Sciences, to Dave Bohaska at the Smithsonian, North Carolina State, Roger Portell at the University of Florida, George Phillips at the Mississippi Museum of Natural Science and Lou Zachos of the University of Mississippi. I intend to donate the bulk of my collection in the next couple of years and only keep what I am displaying and what I am working on. Although, my favorite saying is: "It's not really hoarding if your stuff is cool."

Small fossil storage in Linda's home curated by locality and type of fossil.

Linda's home office with large displays of fossils, annotated images frame, and drawers of fossils.

Do you have a favorite collection location?

That too changes frequently. Currently, probably North Topsail Beach.

Is there a dream collection locality you are looking to get to over the next few years?

Hmmm… nothing that would be legal to collect. Though I've always wanted some of those opalized fossils from Australia…

Crystalline fossils from the Edwards Formation, Cretaceous, Georgetown, TX. Linda's 1st and 2nd published papers were on these fossils.

Do you have any future paleontology goals?

I want to continue to be an advocate for the amateur/avocational community. To educate the professional community and legislators everywhere what a valuable resource we are and what spectacular things we could accomplish together. Are there bad apples? Sure – but far more wonderful ones that could help move paleontology forward in ways we can only dream about currently – should we ever bond and work together on a large scale.

To that end, I serve on the Paleontological Society's Ad Hoc Committee on Government Affairs, remain active in following the PRPA progress, serve on the myFOSSIL Steering Committee and remain a member of various Clubs, Societies and organizations (PS (Paleontological Society), NCFC (North Carolina Fossil Club), PoSA (Paleontological Society of Austin), DPS (Dallas Paleontological Society), FPS (Florida Paleontological Society), SoCal Paleontological Society, Friends of Aurora, Dry Dredgers, GSA (Geological Society of America) AAAS (American Association for the Advancement of Science), and AAPS (Association of Applied Paleontological Sciences) and am friends with many professionals at various universities and museums.

I also continue my research into preserved fossil color and preserved fossil ligaments in bivalves.

And when I'm not doing that you will find me in the field collecting – my absolute favorite place to be.

References

[1] Sprinkle, J., Henry, L., Zimmer, F. S., Kelley, L. S., Whiteley, J. 1985. New Pleurocystites from the Bromide Formation of Oklahoma. *Journal of Paleontology. Vol. 59, No. 6, pp. 1476-1480.*

[2] McCall, L.J., Sprinkle, J., and Molineux, A.M. 2008. Spectacularly preserved, Mollusc-Dominated Fauna from a Cavity Layer in the Lower Cretaceous Edwards Formation, Central Texas. *Gulf Coast Association of Geological Societies Transactions V. 58, pp. 683-694.*

[3] McCall, L.J., Sprinkle, J., and Molineux, A.M. 2010. Comparison of Two Mollusc-Dominated Faunas from Cavity Layers in the Lower Cretaceous Edwards Formation of Central Texas. *Gulf Coast Association of Geological Societies Transactions V. 60, pp.487-502.*

[4] McCall, L.J., Molineux, A.M., and Sprinkle, J., Garvie, C. 2012. An Undescribed Fauna from the Upper Cretaceous 'Pyroclastic Zone' of the Austin Group at Pilot Knob, Central, Texas. *Gulf Coast Association of Geological Societies Transactions V. 62, pp. 287-301.*

To learn more:

View this interview with Linda: **http://www.daringtodig.com/linda-mccall**

Abstracts and oral presentations:

McCall, L.J. 2014. The purpose and function of fossil clubs: a personal perspective. 10th North American Paleontological Convention, The Paleontological Society Special Publications, v. 13, p. 106.

McCall, L.J. 2016. Amateur/Avocational Contributions to Paleontology – The Big Picture. Southeast Geological Society of America. March 2016.

McCall, L. J. 2017. PRPA Repercussions & Implications for Real World Study by Citizen Scientist Avocational Paleontologists. Joint 52nd Northeastern Annual Section / 51st North-Central Annual Section Meeting. March 2017 Oral Presentation

McCall, L.J. 2017. Citizen Scientist Publishing. Harnessing Paleontological Knowledge – North Carolina Fossil Club's Four Part Series. Geological Society of America Abstracts with Programs. October 2017.

McCall, L. J. 2018. Exceptional Color/Color Pattern Retention in Thirty Million Year Old Oligocene, River Bend Formation Invertebrate Specimens from North Topsail Beach, NC. Southeastern Section - 67th Annual Meeting. April 2018. Oral Presentation

McCall, L. J., Zachos, L.2018. Residual Color Patterns in the Echinoid Hemipatagus carolinensis from the North Carolina Oligocene. Geological Society of America Abstracts with Programs. November 2018. Oral Presentation.

Featured Professional: Steven Manchester

Editor's note: This issue we feature Steven Manchester (https://www.floridamuseum.ufl.edu/museum-voices/steven-manchester/), Curator of Paleobotany at the Florida Museum of Natural History and Affiliate Professor in the Departments of Biology and Geology at the University of Florida. Steven has been in the news recently because of his discovery of Central America's oldest marine mammal (https://www.floridamuseum.ufl.edu/science/sea-cow-is-central-americas-oldest-marine-mammal/), but he has a long-standing interest in petrified woods, fossil leaves, and seeds.

Steven Manchester Photo credit Jeff Gage FLMNH

I loved rocks from an early age. While on long family drives my parents would stop at my request to visit interesting road cuts. There was a lot of fresh road construction activity back then when the interstate highway system was still under development. At age 10, I attended an Oregon Museum of Science and Industry (OMSI) summer camp near Fossil, Oregon. There I maintained my interest in agates and crystals, but became more interested in the petrified woods, fossil leaves and seeds found on short hikes from the camp which is now a part of John Day Fossil Beds National Monument. After the first summer I was hooked, and with the help of scholarship from Oregon Agate and Mineral Society I was able to return the following years. Eventually OMSI elevated me to camp counselor and in 1976 the museum hired me to lead a 5-week summer paleobotany program for high school students, which I continued to run through my graduate school days. The students helped me assemble collections of fossil plants from various locations in north central Oregon and these collections have remained an important resource for continuing research.

I am interested in the changing patterns of plant distribution over geologic time. For example, Ginkgo, now native to China, was formerly distributed throughout the northern hemisphere and in South America as confirmed by their distinctive fan-shaped leaves and associated seeds. Similar scenarios are revealed by the fossil record of many flowering plant families, including members of the walnut family, the elm family and many others. Sequoia, now confined to western North America, is found as fossils in Europe and Asia. This kind of information is crucial for discerning the history of plant groups when DNA cannot help us due to extinctions that have greatly reduced geographic ranges of plants from which we can harvest generic material. I also find it interesting to apply information from the fossil plant record to infer past climate change. It still seems amazing to dig up remains of subtropical forest in places that are now semi-desert, like eastern Oregon and central Wyoming.

I have been saddened by the recent closure of public lands to serious amateur collecting with passage of the "Paleontological Resources Preservation Act (PRPA)", aimed at criminalizing fossil collecting on public lands by the public which, in a twisted way, is referred to as "theft." In my view this is an unconstitutional infringement on our right to pursue happiness. By restricting the collection of nearly all fossils (plants, invertebrates, etc.) in an attempt to protect some rare vertebrate fossils, we have cut off a major citizen scientist avenue, and without children being introduced to the fun of collecting fossils, I wonder if we will have a next generation of paleontologists.

I now do more of my collecting in other countries like India and China, which do not require bureaucratic permits for collecting fossils. In the United States, collecting of fossils on private land is still OK, if permission is granted by the owner. Building good relationships with land owners and those operating quarries and mines may be the best way to gain access for collecting fossils going forward.

SEND FEEDBACK

Myself, Steve Manchester, (left) and Thomas Bones (right) in the field preparing to collect fossil nuts at the Clarno Nut Beds, 1976.

Tom Bones in his basement museum, Vancouver, Washington. Many of these specimens are now curated at the Florida Museum.

Over the years, I have enjoyed working with many volunteers, and have benefited greatly from the kindly donations of specimens and locality information. One of the most amazing of these friends, Thomas J. Bones (1892-1990), began collecting agatized nuts and seeds in the Eocene Clarno Formation of Oregon in the 1930s and continued doing so through the 1980s, amassing a huge personal collection that included fossil walnuts, acorns, moonseeds, palm seeds and numerous other kinds of subtropical plants. These fossils have been important in documenting the history of many different plant families, and in showing strong similarities with the Eocene forests of Europe. Mr. Bones transferred the majority of this collection, consisting of thousands of specimens, to the paleobotanical collections at Smithsonian and University of Florida, and this was the basis of my 1994 book on the fossil fruits and seeds of the Clarno Nut Beds. Several of the new species were named in honor of Tom Bones. Mr. Bones' collecting of this site "put it on the map" as an important paleontological site. Ironically, it is now part of John Day Fossil Beds National Monument, where amateur collecting is now

prohibited. You can see some of his spectacular specimens on display at John Day Fossil Beds National Monument. A major part of his collection is also housed at the Florida Museum and can be viewed on request– simply make an advance appointment with me: steven@flmnh.ufl.edu

Tom's nut bowl, filled with silicified fruits and seeds, including Eocene walnuts, hazelnut relatives, and pitted seeds of the tropical vine family, Icacinaceae collected at what has since become John Day Fossil Beds National Monument in central Oregon.

To learn more:

Manchester, S. R., Dilcher, D. L., Judd, W. S., Corder, B., & Basinger, J. F. (2018). Early Eudicot flower and fruit: Dakotanthus gen. nov. from the Cretaceous Dakota Formation of Kansas and Nebraska, USA. *Acta palaeobotanica*, *58*(1), 27-40 (https://doi.org/10.2478/acpa-2018-0006).

Manchester, S. R., & Balmaki, B. (2018). Spiny fruits revealed by nano-CT scanning: Pseudoanacardium peruvianum (Berry) gen. et comb. nov. from the early Oligocene Belén flora of Peru. *Acta palaeobotanica*, *58*(1), 41-48 (https://doi.org/10.2478/acpa-2018-0005).

Manchester, S. R., Pigg, K. B., & Devore, M. L. (2018). Trochodendraceous fruits and foliage in the Miocene of western North America. *Fossil Imprint*, *74*(1-2), 45-54 (https://doi.org/10.2478/if-2018-0004).

Li, L., Jin, J. H., & Manchester, S. R. (2018). Cupressaceae fossil remains from the Paleocene of Carneyville, Wyoming. *Review of Palaeobotany and Palynology*, *251*, 1-13. (https://doi.org/10.1016/j.revpalbo.2017.12.003)

Han, M., Manchester, S. R., Fu, Q. Y., Jin, J. H., & Quan, C. (2018). Paleogene fossil fruits of stephania (menispermaceae) from North America and East Asia. *Journal of Systematics and Evolution*, *56*(2), 81-91 (https://doi.org/10.1111/jse.12288).

Read some Science Stories (https://www.floridamuseum.ufl.edu/museum-voices/steven-manchester/) about Steven's research.

Learn more about the Paleobotany & Palynology Collection (https://www.floridamuseum.ufl.edu/paleobotany/) at the Florida Museum.

Featured Fossil: Dedicated Volunteer Discovers New Shark Species While Microsorting Through Matrix of SUE the T. rex

By Peter Makovicky, Field Museum

Peter Makovicky (Curator, Earth Sciences) coauthored a paper with Field Museum Research Associates Terry "Bucky" Gates (lead author) and Eric Gorscak on the chondrichthyan (sharks and rays) fauna of the SUE locality in the *Journal of Paleontology*. Based on fossil teeth and fin spines, the authors showed that at least one species of ray and three species of shark lived in SUE's environment. One of these sharks represents a new species of carpet shark, the group that includes bottom dwelling species like wobbegongs and bamboo sharks, but also the pelagic whale shark.

Life reconstruction of Galagadon nordquistae. © Velizar Simeonovski

The new discovery owes much to the foresight of Bill Simpson, the Museum's Collection Manager of Fossil Vertebrates and leader of the team that prepared SUE, who saved the sediment that accumulated during the preparation process. About a decade later, Terry "Bucky" Gates joined the Makovicky lab as a research associate and began a project to screen the sediments to look for microvertebrate fossils – teeth, scales, and bones of small animals – to build a better picture of what lived in the environment with SUE. This involved suspending the sediment in water and then running the slurry through a set of connected sieves, each with a finer mesh than the preceding one. Once the sediment was screened and the sand and silt washed away, the remaining concentrate was carefully picked through. Karen Nordquist, a steadfast and dedicated Field Museum volunteer for over three decades, spent hours peering through a microscope meticulously picking tiny fossils out of screen-washed sediments, including more than two dozen minute teeth that turned out to be a new species of carpet shark. The teeth are tiny – only a millimeter across and have an unusual shape with three unequal points and a wide apron at the root perforated by small canal. Some of the teeth bear an uncanny resemblance to the spaceship in the 80's arcade game Galaga, which inspired the genus name, while Karen's crucial role in this discovery is honored by having the species named for her: *Galagadon nordquistae. Galagadon* would likely have been a very small, bottom-dwelling shark between one and two feet long with barbels by its mouth and a diet of small invertebrates. Any interactions with *T. rex* were likely incidental and more likely than not, the two species would have been largely oblivious of each other.

Karen Nordquist, Field Museum, photo by Karen Bean

The classification of fossil shark teeth has long been dominated by traditional taxonomic practices (i.e. expert opinion). The authors took a more modern approach to deciphering the relationships of *Galagadon* by expanding a cladistic study of living carpet sharks to include several Cretaceous species. Depending on which phylogenetic methodology was employed, *Galagadon* is either a member of the wobbegongs, or an archaic relative of living bamboo sharks, although the latter result is more consistent with molecular results which find living wobbegongs to represent a more recent radiation.

All living carpet sharks are marine and most, including wobbegongs and bamboo sharks, live in the Indopacific region. So finding a carpet shark in the SUE quarry shows not only that ancient carpet sharks could live at least intermittently in fresh water habitats, but that they also had a different geographic distribution in the Mesozoic. The authors used current model-based methods to examine how the evolutionary history of carpet sharks may explain biogeographic distribution of *Galagadon* and other fossil and living carpet sharks. While the most favored results suggest that random, long range dispersals could account for the patchy distribution of these sharks through space and time (i.e. a 'Sharknado' effect), this runs counter to paleogeography and aspects of the shark fossil record. Rather, as supported by the next-most favored results, carpet sharks were likely globally widespread when warm, shallow seas covered parts of many continents in the hot-house world of the Cretaceous and Paleogene, and their present day range represents a relict of that range. This is a wonderful case study of how fossils can provide a fuller picture of how the evolutionary history of living lineages has changed dramatically over the course of Earth history.

A tooth of *Galagadon* is on display in the new SUE hall, but bring a loupe – it's the smallest fossil there. And if you see Karen, please congratulate her on the species named for her and thank her for all that she does for the Museum!

A tooth of Galagadon nordquistae. The folds and wrinkles in the enamel are diagnostic of the new species. Scale bar is 1 mm. © Terry A.Gates

To learn more:

Fossil shark teeth discovered in leftover rock that contained SUE the T. rex (https://www.eurekalert.org/pub_releases/2019-01/fm-fst011519.php)

Prehistoric Shark Named After Videogame (https://blog.everythingdinosaur.co.uk/blog/_archives/2019/01/23) (and volunteer)

Research: Megalodon Evolution along the Calvert Cliffs of Maryland

By Victor Perez, Florida Museum of Natural History

At the early age of 6, I visited the Calvert Marine Museum in Solomons, Maryland and received my first shark tooth from their "Discovery Room" exhibit. The staff at the exhibit told me I could find my own shark teeth along the beaches in the nearby Calvert Cliffs and I quickly started to accumulate my own personal collection. Fifteen years later, I got the opportunity to work as a vertebrate paleontology intern at the Calvert Marine Museum, during which I began a research project on the evolution of *Carcharocles megalodon* and the loss of lateral cusplets.

The Calvert Cliffs extend for 25 miles along the Chesapeake Bay and are comprised of nearly continuous stratigraphic layers ranging from roughly 21 to 7.5 million years old (Ma). Experienced collectors had anecdotally reported that *Carcharocles* teeth with lateral cusplets become less common as one ascends in time from the oldest sediments at the north end of the cliffs to the younger sediments at the south end. We decided to test this observation by analyzing all *Carcharocles* teeth from the Chesapeake Bay region in the collections of the Calvert Marine Museum and the National Museum of Natural History of the Smithsonian Institution in Washington D.C.

In the oldest stratigraphic layers (~20.2 to 17.6 Ma) 87% of the *Carcharocles* teeth had lateral cusplets, whereas *Carcharocles* teeth in the youngest layers (~8.5 to 7.6 Ma) lacked lateral cusplets entirely (Figure 1). Our study found that over this roughly 12.5-million-year period lateral cusplets were gradually lost, rather than an abrupt transition from teeth with lateral cusplets to teeth without lateral cusplets. So the question then becomes "why were lateral cusplets lost?".

(http://www.myfossil.org/wp-content/uploads/2019/03/tooth.png)

Figure 1. Carcharocles chubutensis with lateral cusplets (left) and Carcharocles megalodon without lateral cusplets (right). Scale bar represents 2 cm.

If we look back to one of megalodon's early ancestors, *Otodus obliquus*, roughly 60 million years ago, we can see a very different tooth morphology: lacking serrations, large triangular lateral cusplets, and a robust root. This tooth morphology would have a tearing-grasping function that would be ideal for feeding on fast swimming prey. In stark contrast, teeth of *C. megalodon* are uniformly serrated, lack lateral cusplets, and have broadly flattened triangular shape. This tooth morphology would be ideal for cutting and feeding on larger bodied prey.

As these features are developed in the *Carcharocles* lineage, whales and dolphins first appear and increase in abundance and size. While the immediate explanation is that megalodon developed cutting teeth to feed on large marine mammals, the question remains as to why this transition took so long. If there was a strong selective pressure towards teeth without lateral cusplets, you might expect that this transition would happen much faster. Consequently, the actual reason for why lateral cusplets were lost remains speculative.

Among the thousands of *Carcharocles* teeth from the Chesapeake Bay region in these museum collections, over 90% were donated by amateur/avocational paleontologists. In short, this study would not be possible without the efforts of the public, and their willingness to share their discoveries. In fact, roughly two dozen teeth used in this study were posted to the myFOSSIL database that would have otherwise not been known. With that in mind, I encourage everyone to share their discoveries with the world to support new collaborations and future research endeavors!

To learn more:

See more images in the Florida Museum press release "How Megalodon's Teeth Evolved Into the Ultimate Cutting Machine" (https://www.floridamuseum.ufl.edu/science/megalodons-teeth-evolved-into-the-ultimate-cutting-tools/)

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Education: Thinking Outside the (Specimen) Box

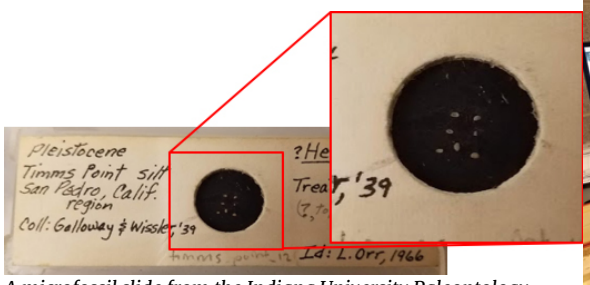
By Jess Miller-Camp, Paleontology Collections Manager, Indiana University

The Indiana Geological & Water Survey (IGWS) and Indiana University Paleontology Collection (IUPC) held an all-day workshop on March 9th in Bloomington, Indiana on digital paleontology for educators and avocational paleontologists. The workshop was free to all attendees, having been fully funded as part of IUPC's Paleoniches project, an NSF grant focused on digitizing the Ordovician holdings of the IUPC.

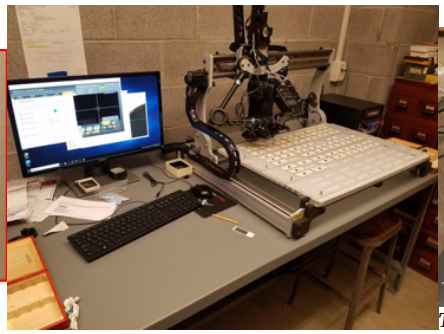
Snails from the Stotter Collection in the Indiana University Paleontology Collections

Many museum-made outreach activities are unfortunately not easily integrated into K–12 classrooms since access to physical specimens is limited and teachers have to follow such tight curricula. A survey participants took during registration reflected a similar problem, with lack of access to paleontological resources being the main barrier to their use in classrooms. The purpose of this workshop was to help teachers learn how to access paleontological resources from their computers and be able to use them in their classrooms.

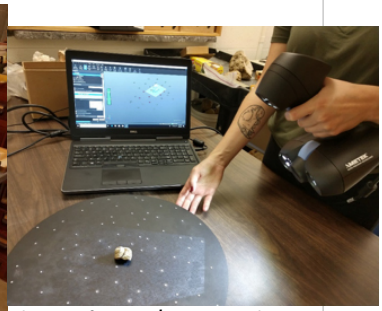
The day was a mix of presentations, hand-on activities, and a tour of the IUPC provided by established professionals and graduate students in paleontology, education, and information science. The presentations provided a background for understanding natural history museums and how fossils are turned into digital data. This includes scanning technologies that are used to create digital 3D models and physical 3D prints, as well as the creation of high-quality digital databases and 2D images of specimens.



A microfossil slide from the Indiana University Paleontology Collection



The GIGAmacro imaging station for high-resolution specimen photography in the Indiana University Paleontology Collection



The Creaform Go!SCAN, used to create 3D files of fossils for on-screen viewing and 3D prints

The hands-on activities will included telling stories with specimens; understanding and interpreting information on museum labels; learning about and running through the uses of 3D prints of fossils, online label transcription and other community science activities, and online educational resources for paleontology; discussing how fossils fit into state educational standards; and breaking into groups to create lesson plans incorporating the day's activities that will then be shared by everyone.

The workshop wrapped up with a group discussion on how to continue conversations between teachers and avocational paleontologists and professional paleontologists and museum workers. A detailed follow-up report documenting the results of the workshop and feedback gathered before and after will be presented in a forthcoming iDigBio (https://www.idigbio.org/) newsletter.

Workshop facilitators:

Gary Motz
Assistant Director for Information Services
Indiana Geological & Water Survey
Affiliate of the Center for Biological Research Collections

Polly Sturgeon
Outreach Coordinator
Indiana Geological & Water Survey

Jess Miller-Camp
Paleontology Collections Manager
Dept. of Earth and Atmospheric Sciences
Digital Projects Coordinator
Center for Biological Research

Alex Zimmermann
Ph.D. candidate
Dept. of Earth & Atmospheric Sciences

Kimberly Cook
M.L.S. student
Dept. of Library and Information Science

Emily Thorpe
M.S student
Dept. of Earth & Atmospheric Sciences

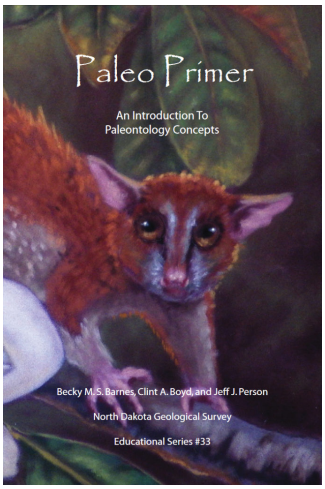
Edit (https://www.myfossil.org/wp-admin/post.php?post=46840&action=edit)

The Paleo Primer Series: Bringing Local Prehistory to the Public

By Becky Barnes, North Dakota Geological Survey

Editor's note: Becky Barnes was hired by the North Dakota Geological Survey in 2008 as the Johnsrud Paleontology Laboratory manager. Her summers are spent working at various fossil sites across North Dakota. Her winters are split between restoring fossils in the lab, managing the volunteer program, illustrating, and creating new outreach programs. She earned her Bachelor's degree from Concordia College in Moorhead, MN, and her Master's degree from North Dakota State University, in Fargo, ND.

Fossils and dinosaurs are unique in how they interest people from a wide range of ages and backgrounds. They can bring together grandparents and children, educators, scientists, and the public. In the paleontology program of the North Dakota Geological Survey (NDGS), we continuously heard the same request year after year: we want more books on paleontology! Many states have had books created that feature their specific paleontological prehistory, but North Dakota was lacking. In 2006, Dr. John Hoganson created a book titled "Dinosaurs, Sharks, and Woolly Mammoths: Glimpses of Life in North Dakota's Prehistoric Past" which provided an overview of the state's prehistory. This quieted the public for a while, but in the end it only made people hungry for MORE information. This was a fantastic problem to have.

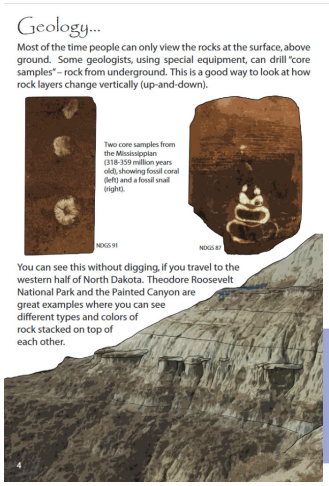


After seasons of writing and designing, we came up with a series we dubbed the "Paleo Primer." It needed to be an introduction to paleontology for those that were new, while still being informative to those who had a basic understanding. It had to be useful for teachers and educators, and have relevant topics and comparisons to keep people engaged. We broke it down into sections, with each book encompassing a general time period in North Dakota. The first book, "Paleo Primer: An Introduction to Paleontology Concepts" includes some general history of paleontology, terms, definitions, and a number of experiments to tie everything together.

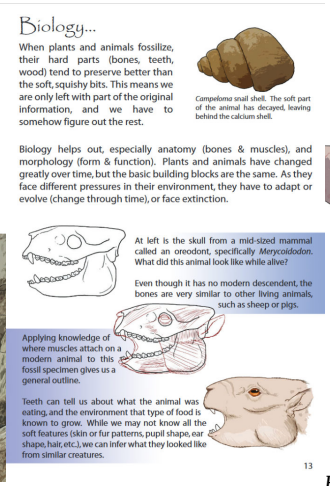
As the main author, and illustrator, I wanted a uniform feel to each of the books. A problem with paleontology is it is difficult to go back in time to photograph the plants and animals. Instead, we resort to drawings of creatures and photographs of fossils. So rather than having a hodgepodge assortment of modern photography, drawings, and illustrations, we settled on a block-color style for everything. Following this color theme, text containing terms or ideas was isolated with color backgrounds.

The publication starts off by explaining what paleontology is, as well as the sciences that help support it. Geology and Biology, the building-blocks of paleontology, are explored briefly. Common ideas and principles are explained for each, including the Law of Superposition, the Principle of Original Horizontality, homologous and analogous structures, and again, plenty of experiments that make the concepts easier to understand.

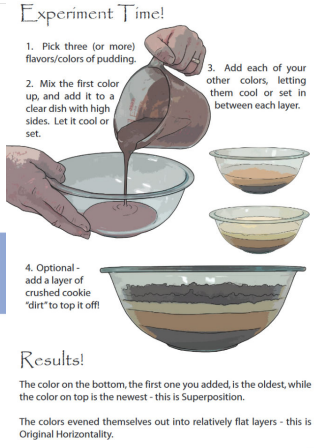
It continues with how things can become a fossil, what the fossil may be made out of, and the people who dig them up: paleontologists! The goal is not to answer every question out there, but to offer a resource to help guide people on their quest for more information. They can use the terms found within the book to search elsewhere online or in other books.



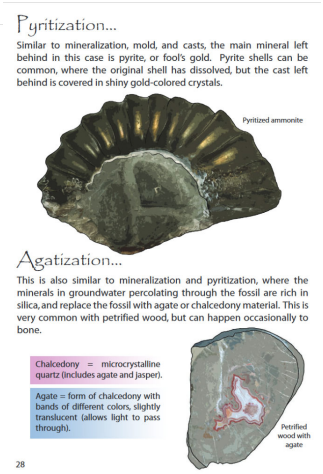
Introduction to geology



Introduction to Biology



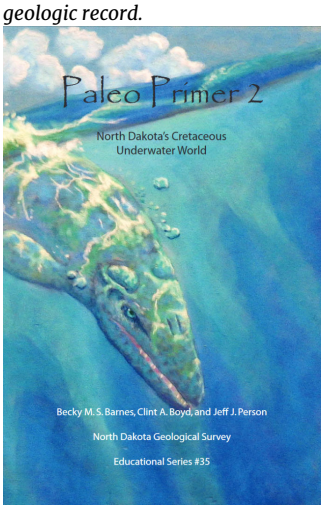
Exploring the geologic principle of Superposition.



An example of an explanatory page on how fossils preserve in the geologic record.

The publication needed to be available to as many people as possible, which is one of the reasons we chose a digital format. The size and quality of the pages work wonderfully on tablets or iPads, and the PDF can be accessed or downloaded from any computer with internet access for free.

The remaining Paleo Primers will each focus on a main period of time in North Dakota's history – specifically what we can learn from fossils at the surface. We will not be exploring sub-surface history at this time. Starting with our oldest surface rocks that once lined the bottom of the Western Interior Seaway, the books include: Cretaceous Underwater World (available now), Time of Dinosaurs, ND Everglades, ND Savanna, and Ice Age. Titles of the last four may be subject to change.



Paleo Primer 2: North Dakota's Cretaceous Underwater World

To learn more:

Follow us on Facebook – https://www.facebook.com/NDGSpaleo (https://www.facebook.com/NDGSpaleo)

Instagram – https://www.instagram.com/ndgspaleo (https://www.instagram.com/ndgspaleo)

Twitter – https://www.twitter.com/ndgspaleo (https://www.twitter.com/ndgspaleo)

Download the Paleo Primers here: https://www.dmr.nd.gov/ndfossil/paleo_primer/ (https://www.dmr.nd.gov/ndfossil/paleo_primer/)

Edit (https://www.myfossil.org/wp-admin/post.php?post=46857&action=edit)

Paleoart: Raven Amos

Raven Amos is a digital artist and illustrator living, working, and playing in the wilds of Alaska. Born in the era of far flung fantasy films and cheesy animation, Amos developed a love of reading, art, and dinosaurs at a very young age. She spent the majority of her primary education expanding her artistic talents and exploring many different artistic mediums, winning several ribbon awards for her watercolor illustrations and ceramic sculptural works at the Alaska State Fair in 1997 and 1998. She immediately enrolled in the Art Institute of Seattle in the Graphic Design and Animation Arts programs after graduating high school, and upon returning to her home state, continued to pursue a career in Graphic Design, where she met her future husband, Scott Elyard, while working at a press in Wasilla. In the years that followed, Amos and Elyard have collaborated on many projects together, including museum display pieces, art shows, and murals. Amos' work appears in the e-book "All Your Yesterdays" by Dr. Darren Naish, John Conway, and Memo Kosemen (Irregular Books, 2013), the scientific paper "A Ceratopsian Dinosaur from the Lower Cretaceous of Western North America, and the Biogeography of Neoceratopsia" by Andrew Farke, et al (PLOSOne 2014), and "The Palaeoartists' Handbook" by Dr. Mark Witton (The Crowood Press, 2018).

Describe your path to paleoart. Have you always been interested in ancient life? Did you come upon it randomly? Do you have science and/or art training?

Ichthyovenator laosensis cruises the coastal swamps, catching an unlucky courting male Siamamia fish in this speculative reconstruction of behavior, environment, and species in Early Cretaceous Laos. © Raven Amos

My path to paleoart began very shortly after I started reading spontaneously at age 4. I remember my brother and I sitting down to draw together and enjoying the results of our collaborations – he would draw *Triceratops* heads and I would draw the bodies and the background. When "The Land Before Time" came out in theaters, my mom took me to see it and immediately upon returning home, I wrote a very long letter to Don Bluth talking about how much I loved the movie and how I wanted to become an artist someday, adding some sketches for emphasis. I received a huge packet in reply, filled to bursting with production stills from the movie and a signed letter. After that, I became obsessed with dinosaurs– really, all things reptilian. My whole family, especially my grandmother, auntie, and mother, were very supportive and encouraged my insanity. Around age 10 or so, I got into the habit of tracing skeletons from my copies of "Dinosaurs and Other Archosaurs" by Zallinger, "Illustrated Encyclopedia of Dinosaurs", both Dr. David Norman and Dougal Dixon's versions, and any other dinosaur books I could get my hands on – I would use those traced skeleton drawings as the basis for my early dinosaur art, tracing over the top on another sheet of paper and adding muscles, skin and details. I'd been studying the Walter-Foster published animation books of Preston Blair at this time and was looking toward attending art college after I graduated high school. I ended up attending the Art Institute for a little over 2 years. I don't have formal science training (outside of my primary education), but I do have an insatiable curiosity – I love to read and learn about the world around me, and I have always enjoyed being out in nature observing the plants and animals that surround my home. It wasn't until I attended my first Society of Vertebrate Paleontology meeting in 2009 that I became more actively involved in the scientific community.

Where do you draw much of your artistic inspiration from? Does living in Alaska help provide content inspiration and creativity?

I would definitely say living in Alaska provides inspiration – I live in an area dominated by forests and mountains, which seem to be a feature in lot of my work. The rest of my inspiration is varied, numerous, and ever-changing – as a kid, I grew up surrounded by art books of varying subject matters, chief among them the works of Brian Froud, the Stephen Cosgrove "Serendipity" books illustrated by Robin James, James Gurney's "Dinotopia" book, in addition to the aforementioned Walter Foster animation books. I job shadowed under the late landscape painter and family friend Otis "Scott" McDaniel sometime around the age of 14, who instilled some important lessons in deriving inspiration and implementing compositions in paintings. At the same time, my brother had a friend who was attending art college and was willing and gracious enough to give me constructive criticism and advice. Possibly as a side-effect of wanting to dip my toes into animation, in high school I became interested in furry art, anime, manga, and Japanese video games, especially the character design aspects. I was also introduced to William Stout and Wayne Douglas Barlow in high school, thanks to what proved to be an exceedingly well-stocked school library. During and after college, I grew into Art Nouveau, especially the works of M.P. Verneuil and the Detmold Brothers.

A speculative look at the behaviors and habits of long-gone creatures, submitted for Irregular Books All Yesterdays contest. Gorgosaurus libratus the lesser bowertyrant courts a potential mate by constructing bowers of bone and driftwood and offering trophies of previous hunts or scavenging expeditions while displaying his iridescent feathers. © Raven Amos

What form of media do you use, most frequently, to create your art? Was this the same as when you first started as an artist? Do you have a favorite media?

© Raven Amos

I got my start as a kid sketching with mechanical pencils on copy paper or legal pads – all of which were in ample supply when I was growing up as both of my parents worked in office settings. I never felt confident with paint, so I would use ink pens, colored pencil and markers for most of my early works. I was introduced to the concept of using a computer to scan and enhance my artwork when my dad purchased a scanner that came bundled with Ulead Photoimpact in the mid-1990s (after much cajoling and wheedling on my part). Most of my work following college involved scanning inked outlines and using a mouse to fill in color and make cel-style shading. Even after purchasing my first used Wacom Intuos tablet in the mid 2000's, it wasn't until I met my husband, Scott Elyard, that I realized the benefits of creating from start to finish on the computer – fewer steps involved, easier to edit or correct if I get something wrong, and best of all, no more smudged ink or pencil. While digital is what I tend to gravitate towards nowadays, my favorite media is probably cheap Bic pens on paper – I always have one in my travel kit, and the loose, messy nature of the Bic pen is the best for getting down quick ideas. It's also the most "Zen" media to work with – you learn very fast exactly how to work with "happy accidents" of splotches and broken lines.

I found some of your work online, much of it surrounds dinosaurs or large ancient life. Have you ever been interested in the small shelly extinct creatures or are you more intrigued by the larger forms of extinct life?

I admit that my interests have mainly skewed toward large, charismatic animals like dinosaurs. Especially after the discovery of the incredibly bizarre crustacean relative *Dollocaris*, I'd like to make a more concerted effort to emulate art noveau artist M.P. Verneuil's approach, wherein he depicted what Victorian-era folk saw as typically "disgusting" and "vile" creatures such as mice, bats, and insects in as much lovingly rendered detail as any drawings he did of more traditionally "beautiful" animals like swan or deer. Creepy-crawly, fluttering, and "shelly" critters are just as important to understanding an extinct ecosystem as the charismatic megafauna and deserve to share the spotlight.

What are the most rewarding and challenging aspects about being a paleoartist?

Probably the most challenging aspect (apart from the inevitable "work/personal life" time struggles) is the countless hours of research and dead ends that can go into creating paleoart. Sometimes, you spend more time and energy on researching a particular animal (or plant) in a particular environment in a particular era than you do actually creating the work itself – one piece in particular, "Flower Dance", took me months to finish, but only a fraction of that time was actually spent painting, with the rest occupied by 20 or more paleobotany papers and the several hundred browser tabs open to pictures of different flowering plants. The most rewarding aspects are the input I receive from scientists and other artists whose work I admire and introducing people to the unique natural history of Alaska and beyond.

To learn more:

Web: http://cubelight.graphics (http://cubelight.graphics/)Twitter: http://www.twitter.com/cubelight (http://www.twitter.com/cubelight)Print Store: http://gumroad.com/cubelight (http://gumroad.com/cubelight)Shirt Shops

http://www.neatoshop.com/artist/Raven-Amos (http://www.neatoshop.com/artist/Raven-Amos)

http://www.redbubble.com/people/alaskanime/shop (http://www.redbubble.com/people/alaskanime/shop)

http://www.designbyhumans.com/shop/alaskanime/ (http://www.designbyhumans.com/shop/alaskanime/)

© *Raven Amos*

Edit (https://www.myfossil.org/wp-admin/post.php?post=46858&action=edit)

Valentine's Day Challenge

By Jennifer Bauer and Mary Jane Hughes

The initial challenge prompted by Sadie.

For this year's Valentine's Day, the FOSSIL Project's social media team held a competition to see who could produce a Valentine that garnered the broadest reach and highest engagement on our social media platforms (Facebook (https://www.facebook.com/TheFossilProject/), Twitter (https://twitter.com/projectfossil), Instagram (https://www.instagram.com/thefossilproject/?hl=en)).

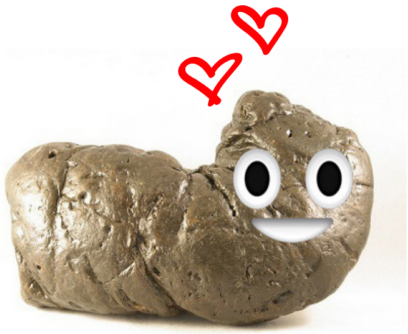
The social media team includes Sam Ocon, Mary Jane Hughes, Rich Bex, MacKenzie Smith, Jen Bauer, and Sadie Mills. Each team member was invited to participate in their platform of choice, so not all Valentines were shared across our social media channels. We have since collected them all into a Facebook album, which you can click here (https://www.facebook.com/pg/TheFossilProject/photos/?tab=album&album_id=9713107064050 05) to explore.

Sadie's paleobotany poem won the greatest reach of all our Valentines. This tweet was seen by 22,972 people and had 402 engagements (clicks, likes, shares).

Rich's 'copro-lite of my life' post on Facebook had the greatest engagement rate. His post reached 5,426 people and had 326 engagements – indicating an engagement rate of just over 6%. This means that 6% of the people that saw the post interacted with it!

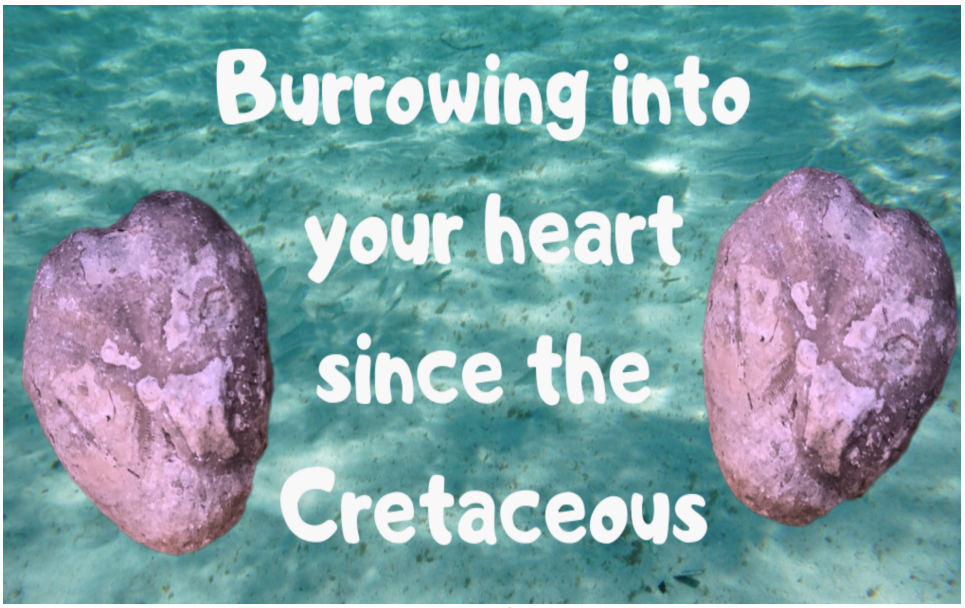
A paleobotany valentine:
Roses are brown
Violets are brown
They're all brown
They are fossil flowers

YOU ARE THE COPRO-LIGHT OF MY LIFE



We hope your Valentine's Day didn't stink!
And remember that there's no such thing as a crappy fossil! Check out the myFOSSIL App or https://www.myfossil.org/ to share your fossil finds or see what other people are finding.

Thank you to all of our followers who helped make this contest so much fun!



FOSSIL Project Updates Spring 2019

By Jennifer Bauer & Sadie Mills

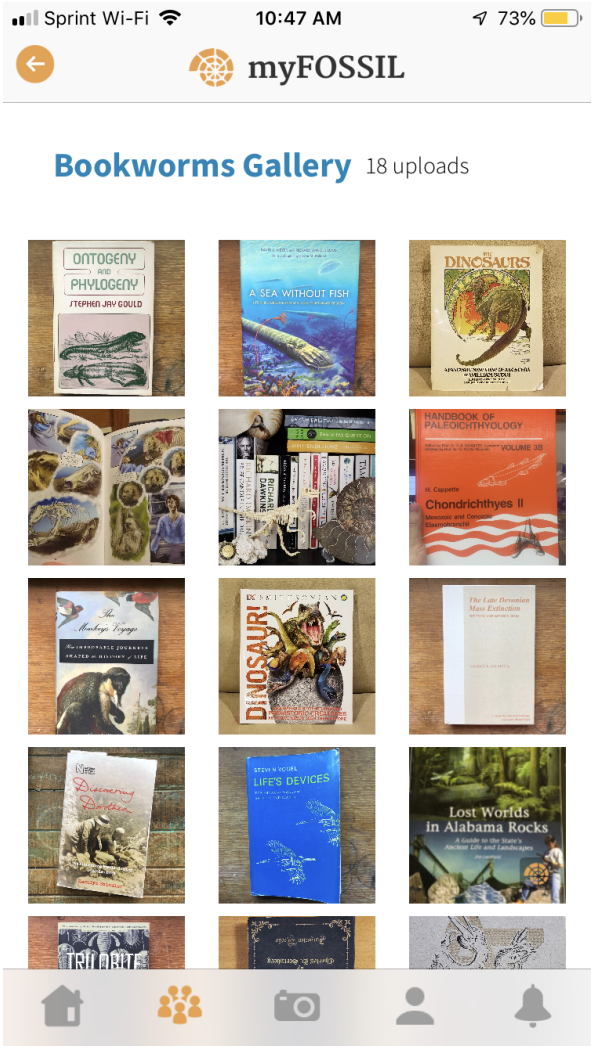
myFOSSIL Web-Page Updates

FOSSIL Project intern, Mary Jane Hughes, has been busy making our Destinations page more user friendly. She created large click through icons for our resources: Collecting Sites; Museums, Parks, and Attractions; Field Opportunities, Organizations and Societies; Professional Organizations and; Join the Discussion – which takes you to our Vacation Explorers group. Many of these pages now include an interactive map for you to easily access information in areas of your choosing.

FOSSIL Project postdoc, Jen Bauer, has updated our Publications (https://www.myfossil.org/publications/) page with our most recent publications and conference presentations. If you have recently presented and want us to add your conference presentation to the website please let us know and we can add it to our members' section.

Mobile App

We have had several new groups created since our last newsletter issue, including: Mollusc Mania, Astonishing Arthropods, Bookworms, What is it?, and Virginia and West Virginia Fossil Collecting. This issue we will feature the Bookworms group! This group is meant to share literature, websites, and other resources related to paleontology. So far there are 44 members and 18 posts. Do you have a favorite paleontology resource? Head to the Bookworms group to share it with the community!



Visit https://www.myfossil.org/resources/mobile-app/ (https://www.myfossil.org/resources/mobile-app/) for details on how to get started on the myFOSSIL mobile app.

Citizen Science Conference

FOSSIL Project graduate student, Rich Bex, will be attending the Citizen Science Conference (CitSci (https://www.citizenscience.org/association/conferences/citsci2019/)) March 13th-March 15th in Raleigh, NC. CitSci2019 is a conference that brings together researchers, practitioners, and participants from around the citizen science community to share their ideas and practices. Rich will be testing the myFOSSIL app with experts who are involved in a variety of Citizen Science projects. Their feedback will be used to improve the effectiveness of the myFOSSIL App.

Society for Information Technology and Teacher Education Conference

Rich Bex will also be attending the Society for Information Technology and Teacher Education (SITE) 2019 Conference in Las Vegas, NV from March 18-22nd to present a paper about the usability of the myFOSSIL App. The study was conducted in two parts. Part one involved testing the app with high school students and part two included K-12 teachers. Findings from the study revealed that the App was perceived to be usable and users showed high satisfaction.

Southeastern Geological Society of America

The FOSSIL Project has several accepted abstracts to The Southeastern Geological Society of America (https://www.geosociety.org/GSA/Events/Section_Meetings/GSA/Sections/se/2019mtg/home.aspx) meeting in Charleston, South Carolina on March 27-29th, 2019. The FOSSIL Project interns, Mary Jane Hughes and Sam Ocon, have been working hard on their posters that explain how we use of Instagram as an engaging educational tool. Their work dissects how to extract participation and engagement through Instagram posts and stories. MacKenzie Smith, a UF graduate student, will present on his work examining FOSSIL YouTube content and how to best understand the different materials presented on this social media platform. Fauve Wilson, a UF volunteer, will be sharing results from the shark teeth collected at the FOSSIL Belgrade event.

The abstracts and presentation times are available online, please click the title links below to learn more. If you are attending SE GSA please stop by our presentations to say hello!

- Hughes, M.J., Ocon, S.B., Mills, S.M., Bauer, J.E., Crippen, K.J., Lundgren, L.M., Bex II, R.T., and MacFadden, B.J. 2019. Engaging in social paleontology: A case study of Instagram. Southeastern Geological Society of America Meeting, Abstracts with Programs, doi: 10.1130/abs/2019SE-327118
- Ocon, S.B., Hughes, M.J., Mills, S.M., Bauer, J.E., Crippen, K.J., Lundgren, L.M., Bex II, R.T., and MacFadden, B.J. 2019. Measuring success: Evaluating paleontology Instagram stories. Southeastern Geological Society of America Meeting, Abstracts with Programs, doi: 10.1130/abs/2019SE-327109
- Smith, M.A. 2019. Science Communication through Engaging and Educational Youtube Content. Southeastern Geological Society of America Meeting, Abstracts with Programs, doi: 10.1130/abs/2019SE-327357
- Wilson, F., Perez, V.J., Magallanes, I., and MacFadden, B.J. 2019. Diversity and Paleoecology of Early Miocene Chondrichthyans from the Belgrade Quarry (Maysville, North Carolina). Southeastern Geological Society of America Meeting, Abstracts with Programs, doi: 10.1130/abs/2019SE-327185

North American Paleontological Convention

The 11th North American Paleontological Convention (NAPC) (https://napc2019.ucr.edu/) will be held June 23 to June 27 in Riverside, California. The FOSSIL team will host a symposium summarizing the accomplishments of the FOSSIL project and will discuss the future of the social paleontology platform. This symposium will be split into four 'theme' blocks where we will have a 15 minute 'spark' to engage the session, a 15 minute panel discussion, and finally a 15 minute discussion with the entire room. Our themes are as follows: (1) Building the Community of Practice via Social Paleontology; (2) Community Connections: Strengthening Professional-Avocational Partnerships for the Future of Paleontology; (3) Accomplishments and Outcomes: Harnessing digital platforms and in-person events to foster community relationships and; (4) Future and Sustainability: myFOSSIL eMuseum and Mobile App.

FOSSIL and iDigBio are hosting workshop for local California K-12 educators called, "Digital Resources in Paleontology, Professional Development Workshop (https://www.myfossil.org/digital-resources-in-paleontology-professional-development-workshop/)." We are still looking for applicants for this free program, so if you have local contacts in California K-12 schools please send along the link! There is a stipend to aid in offsetting any travel expenses and/or pay for professional development credits.

Upcoming Events

March 23
Paleo 2019 (Alberta, Canada)

March 23 - March 24
ESCONI Gem, Mineral, and Fossil Show (Wheaton, IL)
WIPS: Lagerstätten: Exceptional preservation. Extraordinary fossils (Denver, CO)

March 27 - March 29
Southeastern Geological Society of America (Charleston, SC)

March 29 - March 31
MAPS 41st National Fossil Expo (Iowa City, Iowa)

April 12
Central Florida Mineral, Gem, Jewelry & Fossil Show (Orlando, FL)

April 12 - 14
Shark's Tooth Festival 2019 (Venice, FL)

May 4 - May 5
GeoFair 2019 (Sharonville, OH)

May 24 - May 25
26th Anniversary Aurora Fossil Festival (Aurora, NC)

June 23 - June 27
11th North American Paleontological Convention (Riverside, CA)

Click here for more information and events.

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