A publication of the Rochester Academy of Science FOSSIL SECTION

The FOSSILETTER

VOL. 41 Number 7 May 2023

May Meeting

The May section meeting is on Tuesday, May 2nd, at **7:30 PM** Eastern Time. We will meet at the Community Meeting Room at the NEQALS (North East Quadrant Advanced Life Support) building at 1030 Jackson Rd, Webster, 14580.

Dan Krisher will kick off with a brief business meeting. Then our guest speaker is Dr. Jennifer Olori, Associate Professor in the Biological Sciences Department at SUNY Oswego. Her presentation is entitled, "*Frogamanders, False Signals, and Funky Worms: Are debates over the origins of modern amphibians coming to a close*?"

Dr. Olori's studies focus on the origin of morphological diversity in the vertebrate skeleton and how variation impacts our identification of Neogene amphibians and reptiles, the cranial morphology of miniaturized and burrowing vertebrates, and the evolutionary relationships of Paleozoic tetrapods and modern amphibians.

Dr. Jennifer Olori, holding the massive skull of an extant Green Sea Turtle from the SUNY Oswego natural history collection. Photo provided by SUNY Oswego.

Dr. Olori has published several research papers on early tetrapod evolution and the origin of amphibians in the Carboniferous and Permian, and more recently has been involved in research with micro-vertebrate fossils at the famous Late Triassic Ghost Ranch sites and the Late Pleistocene Cathedral Cave site in Nevada.

The most significant problem in resolving modern amphibian evolutionary relationships is in fitting in the caecilians. Most of us are very familiar with frogs and salamanders, but few of us has seen a caecilian. [From Wikipedia] "Caecilians are limbless, worm-shaped (vermiform) or snake-shaped (serpentine) amphibians. They mostly live hidden in soil or in streambeds, and this cryptic lifestyle renders caecilians among the least familiar amphibians. Modern caecilians live in the tropics of South and Central America, Africa, and southern Asia." In other words, unless in a zoo, you will never see one around here. One was recently found in Florida, though. It is not native there.

Florida biologists netted a 2-foot-long Rio Cauca caecilian, Typhlonectes natans*, a native of Venezuela during a survey of the Tamiami Canal in 2019. Photo: Florida Museum of Natural History*

Temnospondyls & Lepospondyls

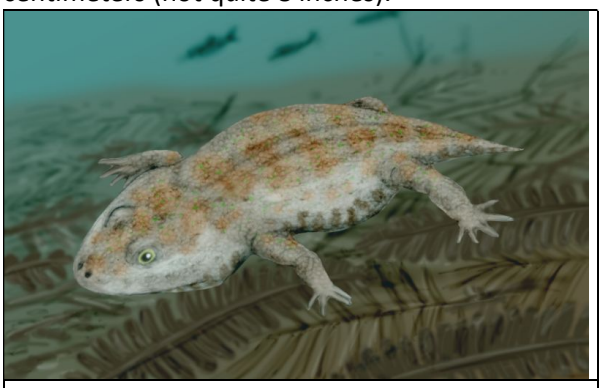
[All Material from Wikipedia]

Temnospondyls is a diverse order of small to giant tetrapods—often considered primitive

amphibians—that flourished worldwide during the Carboniferous, Permian, and Triassic periods. A few species continued into the Jurassic and Cretaceous periods. Fossils have been found on every continent.

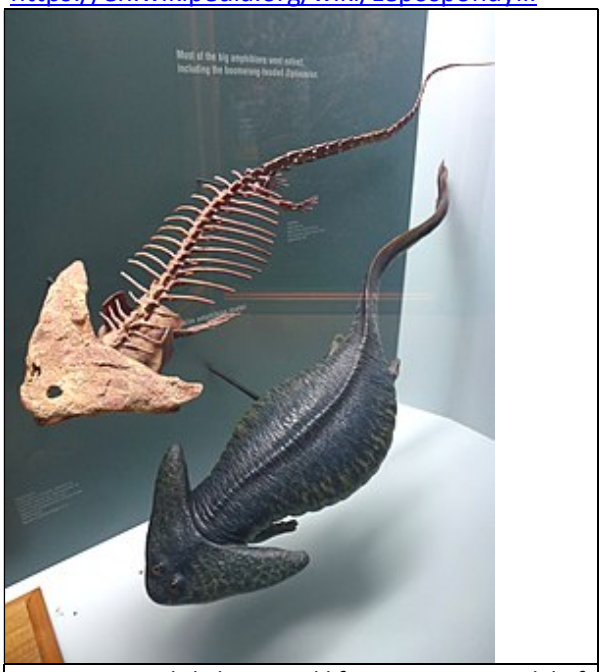
During about 210 million years of evolutionary history, they adapted to a wide range of habitats, including freshwater, terrestrial, and even coastal marine environments. Their life history is well understood, with fossils known from the larval stage, metamorphosis, and maturity. Most temnospondyls were semiaquatic. Some however were almost fully terrestrial, returning to the water only to breed and these were some of the first vertebrates fully adapted to life on land. Although temnospondyls are considered amphibians, many had characteristics, such as scales and armour-like bony plates, that distinguish them from modern amphibians (lissamphibians). For more, see https://en.wikipedia.org/wiki/Temnospondyli

One group of temnospondyls includes *Amphibamus grandiceps* from the Carboniferous (middle Pennsylvanian) of North America. Hence, the group is called *amphibamiforms*. This animal is considered to have been close to the ancestry of modern amphibians. Its length was about 20 centimeters (not quite 8 inches).



Amphibamus grandiceps. *Art by Nobu Tamura*, http://spinops.blogspot.com/.

Lepospondyls are a diverse taxon of early tetrapods. With the exception of one late-surviving lepospondyl from the Late Permian of Morocco (*Diplocaulus minumus*), lepospondyls lived from the Early Carboniferous (Mississippian) to the Early Permian and were geographically restricted to what is now Europe and North America. For more, see https://en.wikipedia.org/wiki/Lepospondyli.



Reconstructed skeleton and life restoration model of Diplocaulus *at the Denver Museum of Nature and Science*

The Origins of Modern Amphibians

by Jennifer Olori

The origins of modern amphibians (frogs, salamanders, and caecilians) from among Paleozoic tetrapods have been debated for two centuries. The oldest hypotheses focused on polyphyletic ancestry, splitting up living amphibians across separate extinct Paleozoic groups. The Polyphyletic Hypothesis (PH) clashes with two competing concepts, both of which predict amphibians to be monophyletic (sharing a common ancestor) but disagreeing on the group from which they arose. Under the Temnospondyl Hypothesis (TH), salamanders, caecilians, and frogs are derived from Paleozoic temnospondyls, whereas the Lepospondyl Hypothesis (LH) views all three as descended from lepospondyls, together more closely related to amniotes (reptiles and mammals) than to temnospondyls.

Over the past 10-15 years, an abundance of well-preserved temnospondyl, salamander, and frog fossils has led to a strong consensus that the latter two emerged from amphibamiform temnospondyls, leaving behind a 'caecilian problem' that was potentially resolved with the

discovery of the enigmatic Late Triassic temnospondyl *Chinlestegophis* in 2017. Although seemingly supporting the TH, *Chinlestegophis* controversially linked caecilians to the Permo-Triassic stereospondyl ('toilet-seat headed') temnospondyls rather than to *amphibamiforms*, creating a new caecilian problem! Detailed investigation of the description and characters associated with *Chinlestegophis*, however, revealed major issues with the resulting phylogenetic analyses.

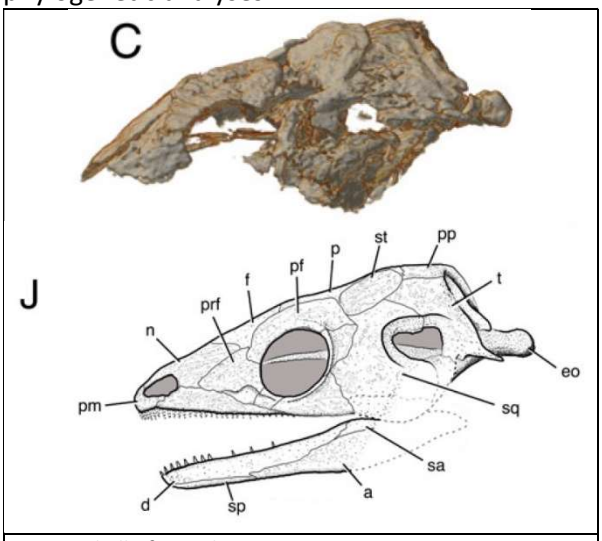


Fig. 1. Skull of C. jenkinsi*., DMNH 56658. Specimen is shown in lateral view (C). A reconstruction of the skull based on the two specimens is shown in left lateral (J) view. From Pardo, J.D., Small, B.J. and Huttenlocker, A.K., 2017. Stem caecilian from the Triassic of Colorado sheds light on the origins of Lissamphibia.* Proceedings of the National Academy of Sciences*, 114(27), pp.E5389-E5395.*

My collaborators and I found that most of the features previously interpreted to be shared by caecilians, *Chinlestegophis* and/or other stereospondyls are unsubstantiated, including the original report that *Chinlestegophis* had boney features associated with a tentacle, a uniquely caecilian sense organ among tetrapods. Additionally, the original matrices used for the phylogenetic analysis contain mis-scores that have piled up uncorrected for over a decade, biasing the resulting relationships.

We concluded that *Chinlestegophis* is not the oldest caecilian, a point punctuated with even more emphasis by the very recent discovery of *Funcuvermis* by colleagues at Petrified Forest National Park. As data from that 'new' oldest caecilian is integrated with carefully revised and corrected character scores for early tetrapods, frogs, and salamanders, an *amphibamiform* temnospondyl origin is supported for all three amphibian groups.

First Field Trips of 2023

by Dan Krisher

The first field trip of 2023 will be on Saturday, May 6th at The Gulf at Lockport. This trip will visit several sites in the Lockport area. The first is located on the west side of the town of Lockport. The site is a railroad cut a few yards off the road and it exposes the Silurian Rochester Shale Formation. This is a family friendly site with no hazards, plenty of room to spread out, and many fossils. The fossils are relatively small but can be found lying loose on the hillside. The material consists primarily of brachiopods and bryozoan with some trilobites, corals, and cystoids as well as other rarer material. Another stop is a road cut nearby at Hickory Corners. This site exposes the Silurian Reynales Formation and the fauna consists of bryozoa, brachiopods, and the occasional gastropod.

The second field trip will be on 5/27 to work several road cuts near Waverly, NY. These expose Upper Devonian strata of the Frasnian West Falls Group containing fauna of brachiopods, bivalves, and rare Upper Devonian rugose corals.

Fossil Section Election – Need Volunteers

The section will elect officers at our June picnic for the 2023-2024 year. PLEASE consider helping and nominate yourself to a position. We promise that it is not much work! If you might be interested but want more information on duties and time involved, please contact one of the current Officers or Board members. The finalized ballot will appear in the June newsletter. Current RAS Fossil Section Officers are listed on last page.

North American Paleontology Convention

By John Handley

As many of you know, the 2024 North American Paleontological Convention (NAPC) takes place at the University of Michigan. I received the email

below. Long story short, the organizers are assessing interest in funding avocational paleontologists to attend the meeting. If you have any interest in attending or presenting as an avocational paleontologist and have no other travel support, please read on.

"Greetings! The 2024 North American Paleontological Convention (NAPC) will take place in Ann Arbor, Michigan, June 17-24, 2024, hosted by the University of Michigan. The Friends of the University of Michigan, Museum of Paleontology (FUMMP) have been tasked with coordinating events and participation by Avocational Paleontologists. This will be an excellent opportunity to not only explore Paleontology generally, but an opportunity to interact with the professionals and share the significance of our contributions to the Science. In particular, we are looking for avocational paleontologists who are interested in presenting their collecting and research activities as well as network with professionals and participate in field trips.

"The conference, of course, is not free to attendees and so it is important to secure funding to assist avocational participants. Thus, we really need your feedback on who would be interested in attending generally, and specifically, who would be interested in presenting at a session to explore the interaction between Vocational and Avocational Paleontologists. This will be a great opportunity to demonstrate our important contributions.

"We are not looking for firm commitments at this time but rather a general sense of interest as we understand that without financial assistance many who would like to attend and participate would not be able to. That said, the University of Michigan must submit its funding proposal a year in advance of the Conference. Thus, time is of the essence and all those interested must respond before the end of May 2023.

"You may respond to this email and/or feel free to contact either of the undersigned directly for more information. Thank you for your assistance in this important project!

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Website:
https://lsa.umich.edu/paleontology/friends-of-the-museum.html

RAS Annual Spring Lecture Video On-Line

Since many of our members are also interested in wildlife, you might want to know that we have a new lecture up on the RAS website. Dr. Paul D. Curtis of Cornell University was the keynote speaker at the 2023 Annual Meeting of Members of the Rochester Academy of Science on April 26. He gave a lecture on "Living with Black Bears in New York State," discussing bear biology, behavior, and ways to reduce potential human-bear conflicts. This fascinating lecture is on the RAS website publications page at https://rasny.org/publications.

June Picnic Meeting with Mineral Section

We will be holding our June 6 Picnic returning to the Marian and Max Farash Center for Observational Astronomy operated by the Astronomy Section of the RAS. This is located in Ionia, NY, just south of Mendon at 8355 County Road 14, Ionia, NY 14475. We will have a tour of the observatory, the largest in upstate NY. We will use the large deck and gas grill attached to the Louis Wolk Education Center building for our picnic. This has a large classroom to which we can retreat if weather is bad as well as indoor restrooms. The section provides the grill items and everyone brings something to share. More details will appear in next month's issue.

Outreach Event

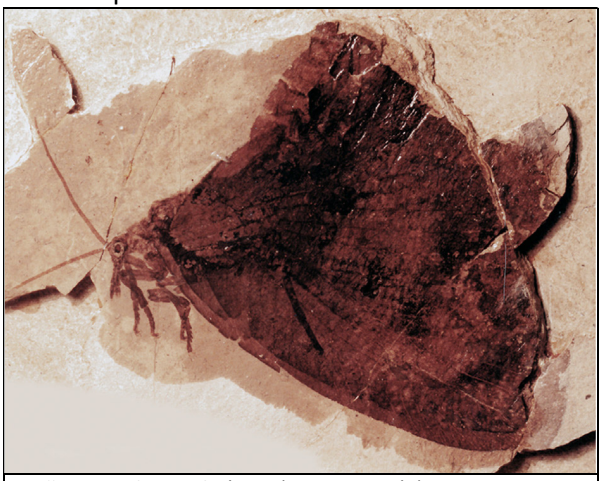
On Saturday June 10, the Fossil Section will be participating with other RAS sections in the 24th Annual Adirondack Mountain Club Outdoor Expo at Mendon Ponds Park Beach Area from 9:30AM until 3:30PM. We will be set up at our outdoor tables again under our tarp. Lots to see and do, as there are over 30 workshops and displays besides ours, plus petting zoo for kids, live music from Golden Link Folk Singing Society, and food/ice cream for purchase from Dave's

Sidewalk Café and Molly V's. See www.adk-gvc.org/expo for more info. This event is free, open to the public, and fun for the entire family. *Get Outside… It's for Everyone!*

If you can come and help out for a while, please contact Dan Krisher at DLKFossil@gmail.com.

Fossil News *edited by Michael Grenier*

How can a pollinating insect be recognized in the fossil record? University of Barcelona press release April 17. 2023.



Peña-Kairath et al. (2023) Figure 2B(a). Meioneurites spectabilis *from the extinct family* Kalligrammatidae / Neuroptera *(Middle–Late Jurassic, Karatau, Kazakhstan). Image: Xavier Delclòs, UB-IRBi.*

Insect pollination is a decisive process for the survival and evolution of angiosperm (flowering) plants and, to a lesser extent, gymnosperms (without visible flower or fruit). There is a growing interest in studies on the origins of the relationship between insects and plants, especially in the current context of the progressive decline of pollinating insects on a global scale and its impact on food production. Pollinating insects can be recognized in the fossil record, although to date, there has been no protocol for their differentiation. Fossil pollinators have been found in both rock and amber deposits, and it is in rock deposits that the first evidence of plant pollination by insects is being studied across the globe. But how can we determine which was a true insect pollinator in the past?

A new study determines the criteria for differentiating a pollinating insect from a presumed pollinator in the fossil record and will facilitate the correct analysis of the origin and evolution of insect pollination.

Today, angiosperms dominate most of the planet's terrestrial ecosystems, but this has not always been the case: flowering plants appeared during the Lower Cretaceous and diversified during the Upper Cretaceous, about 100 million years ago, replacing forests dominated by "gymnosperms" (conifers, ginkgoes, cycads, etc.).

Angiosperms likely interacted with pollinating insects since they appeared on the planet. Their first pollinators were probably generalist insects (beetles, thrips, flies, etc.) that had previously pollinated 'gymnosperms'. Several fossils are known in Cretaceous amber in which pollinating agents were probably already present.

Studying such a complex process as insect pollination through the fossil record is a challenge in paleontology. The study identified 193 insect families from ten different orders considered to be pollinators of angiosperms and "gymnosperms". The authors have also established when they appear in the fossil record and have produced a classification of the fossil insects that have been described as pollinators to date.

By combining these scientific data, the team has developed a key to differentiate fossil insects into two categories —pollinator and presumed pollinator— and thus rule out those that do not show enough evidence of this type of mutualism with plants. Thus, in order to classify a fossil insect as a pollinator, the arthropod must have pollen grains attached to its body and belong to a group of present-day insects considered pollinators, among other characteristics.

Using the analysis of the entire fossil record, it is clear that all current insect orders with some pollinator species existed before the appearance of angiosperms in the Lower Cretaceous. There are even examples of insect groups that were pollinators during the Cretaceous —such as the *Mecoptera* or scorpionflies— but that no longer have pollinating species today. The conclusions of the study suggest that the earliest record of the mutualistic relationship involving insect pollination relates to an extinct group of *Neuroptera* insects and it originated at least in the

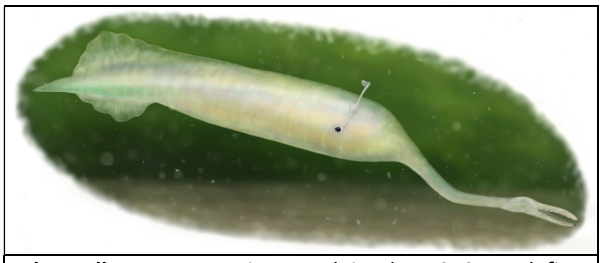
Late Jurassic —some 163 million years ago— long before the emergence of the first flowering plants.

Peña-Kairath et al. (2023) Figure 2B(b). Thysanoptera: Melanthripidae (Early Cretaceous, Peñacerrada I, Spain); *2B(c): Diptera: †Zhangsolvidae (Early Cretaceous, El Soplao, Spain); Image: Xavier Delclòs, UB-IRBi.*

This paper (Peña-Kairath, C., Delclòs, X., Álvarez-Parra, S., Peñalver, E., Engel, M.S., Ollerton, J., Peris, D. "Insect pollination in deep time". *Trends in Ecology & Evolution*, April 2023. Doi: 10.1016/j.tree.2023.03.008), is available from the editor.

New details of Tully monster revealed. 3D scanning of enigmatic fossil may have brought an end to debate about whether it is a vertebrate or invertebrate. **University of Tokyo** press release April 17. 2023.

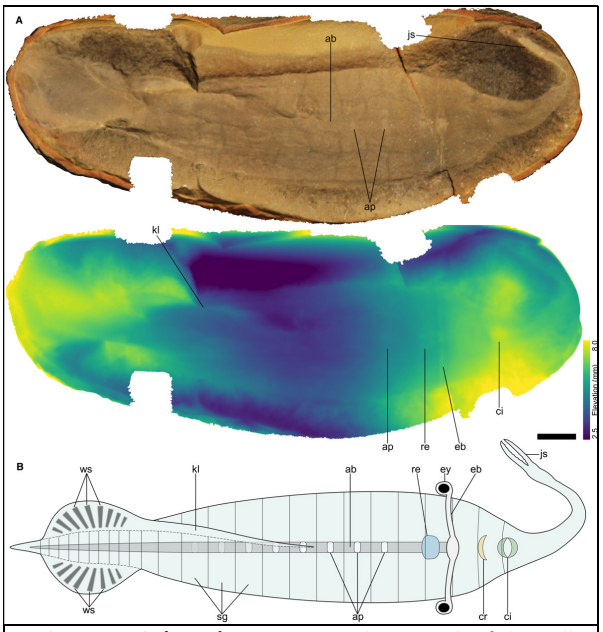
For more than half a century, the Tully monster (*Tullimonstrum gregarium*), an enigmatic animal that lived about 300 million years ago, has confounded paleontologists, with its strange anatomy making it difficult to classify. Recently, a group of researchers proposed a hypothesis that *Tullimonstrum* was a vertebrate similar to cyclostomes (jawless fish like lamprey and hagfish, as was reported in the December 2019 *FossiLetter*. If it was, then the Tully monster would potentially fill a gap in the evolutionary history of early vertebrates. Now, using 3D imaging technology, a team in Japan believes it has found the answer after uncovering detailed characteristics of the Tully monster which strongly suggest that it was not a vertebrate. However, what type of invertebrate it was and its exact classification is still to be determined.



***The Tully monster**. Discovered in the 1950s and first described in a paper in 1966, the Tully monster, with its stalked eyes and long proboscis, is difficult to compare to all other known animal groups. Unique to Illinois in the U.S., it became its state fossil in 1989. © 2023 T. Sakono*

In the 1950s, Francis Tully was enjoying his hobby fossil hunting in a site known as Mazon Creek Lagerstätte in the U.S. state of Illinois, when he discovered what would later become known as the Tully monster. This 15-centimeter (on average), 300-million-year-old marine "monster" turned out to be an enigma, as ever since its discovery researchers have debated where it fits in the classification of living things (its taxonomic position). Unlike dinosaur bones and hard-shelled creatures that are often found as fossils, the Tully monster was soft-bodied. The Mazon Creek Lagerstätte is one of the few places in the world where the conditions were just right for imprints of these marine animals to be captured in detail in the underwater mud, before they could decay. In 2016, a group of scientists in the US proposed a hypothesis that the Tully monster was a vertebrate. If this was the case, then it could be a missing piece of the puzzle on how vertebrates evolved.

Despite considerable effort, studies both supporting and rejecting this hypothesis have been published in recent years, and so a consensus had not been reached. However, new research by a team from the University of Tokyo and Nagoya University may have finally brought an end to the debate. "We believe that the mystery of it being an invertebrate or vertebrate has been solved," said lead author Tomoyuki Mikami. "Based on multiple lines of evidence, the vertebrate hypothesis of the Tully monster is untenable. The most important point is that the Tully monster had segmentation in its head region that extended from its body. This characteristic is not known in any vertebrate lineage, suggesting a nonvertebrate affinity."



Mikami et al. (2023) Figure 1. *A photograph of the Tully monster fossil compared with a 3D color coded scan. For morphological features of* Tullimonstrum, see the paper. *Scale bar represents 10 mm. © 2023 Tomoyuki Mikami*

The team studied more than 150 fossilized Tully monsters and over 70 other varied animal fossils from Mazon Creek. With the aid of a 3D laser scanner, they created color-coded, three-dimensional maps of the fossils which showed the tiny irregularities which existed on their surface through color variation. X-ray micro-computed tomography (which uses X-rays to create cross sections of an object so that a 3D model can be created), was also used to look at its proboscis (an elongated organ located in the head). This 3D data showed that features previously used to identify the Tully monster as a vertebrate were not actually consistent with those of vertebrates.

Although the researchers are confident from this study that the Tully monster was not a vertebrate, the next step of the investigation will be to answer what group of organisms it does belong to, possibly a nonvertebrate chordate (like a fishlike animal known as a lancelet) or some sort of protostome (a diverse group of animals containing, for example, insects, roundworms, earthworms and snails) with radically modified morphology.

This paper (Tomoyuki Mikami, Takafumi Ikeda, Yusuke Muramiya, Tatsuya Hirasawa, Wataru Iwasaki, "Three-dimensional anatomy of the Tully monster casts doubt on its presumed vertebrate affinities," *Palaeontology*: April 17, 2023, doi:10.1111/pala.12646.), is available from the editor.

Ancient giant amphibians swam like crocodiles 250 million years ago

A South African fossil site preserves trace evidence of large amphibian locomotion long before true crocodiles existed.

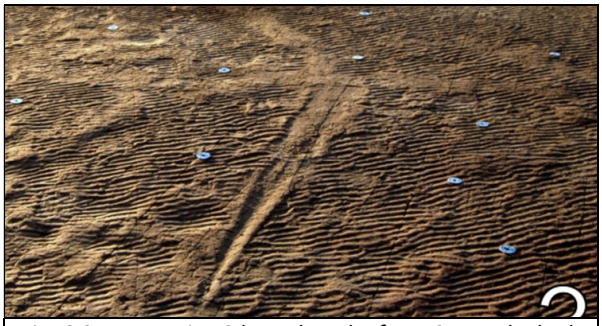


Fig. 6-3. Impression 3 has a length of ~1.59 m and a body width of 180 - 210 mm. A low ridge is present in the centre of the expanded intermediate section and near the point where the tail and intermediate portions join. Impression 3 leads into a smooth trace and is cut by a second smooth trace which crosses in front of impression 3.

The fossils were found on a rock surface that was once the floor of a tidal flat or lagoon of the ancient Karoo Sea of South Africa. Researchers analyzed seven body impressions (resting traces) and a number of tail-marks (swimming traces) inferred to have been made by a rhinesuchid temnospondyl 2 meters long. The researchers interpret them to have been made by one or two animals swimming between resting spots.

The sinuous shape of the tail-marks suggests these animals propelled themselves through the water with continuous side-to-side tail motions like modern crocodiles and salamanders. The shape of the body impressions, as well as a relative lack of footprints alongside the traces, suggests these amphibians tucked their legs against their bodies while swimming, also similar to crocodiles.

For more, see https://www.sciencedaily.com/releases/2023/03/230330102222.htm, or get the original paper at https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0282354

CALENDAR OF EVENTS

May
Tuesday, May 2, FOSSIL MEETING 7:30 PM. LOCATION: NEQALS Community Meeting Room, 1030 Jackson Rd, Webster, 14580. Speaker Dr. Jennifer Olori, SUNY Oswego on amphibian evolution. Visitors welcome.
Saturday, May 6, FIELD TRIP: The Gulf at Lockport
Saturday, May 27, FIELD TRIP: Near Waverly, NY

June
Tuesday June 6, FOSSIL ANNUAL PICNIC 6:00 PM Location: Farash Center for Observational Astronomy, Ionia, NY.
Saturday, June 17, FIELD TRIP: Little Beard's Creek

Visitors are welcome to all Fossil Section meetings! For more information and the latest updates check the RAS Website (**www.RASNY.org**). You can also contact Dan Krisher at DLKFossil@gmail.com or John Handley at jhandley@rochester.rr.com for further information.

ROCHESTER ACADEMY OF SCIENCE FOSSIL SECTION
Monthly meetings are now held as hybrid meetings, live but also broadcast on Zoom. Meetings are held the first Tuesday of each month from October to December and from February to May at 7:30 pm. In person meetings are now held at the NEQALS Community Meeting Room, 1030 Jackson Rd, Webster, NY 14580 unless otherwise listed.

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The FossiLetter is published before each meeting month of the year. Please send submissions to mgrenier@frontiernet.net or by U.S. Postal Service mail to 692 Maple Drive, Webster, NY 14580. Deadline for submissions to the Fossiletter is the 15th of the month.

For scheduling changes and the latest updates please check the RAS Website (www.rasny.org) and click on the Fossil Section link. Last minute updates can also be found on the *General Announcements* page of the Academy Website.

Are you ready for a field trip?