Trigonotarbid Diversity of North America

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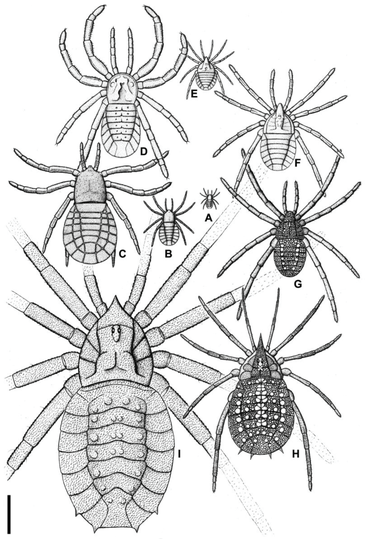
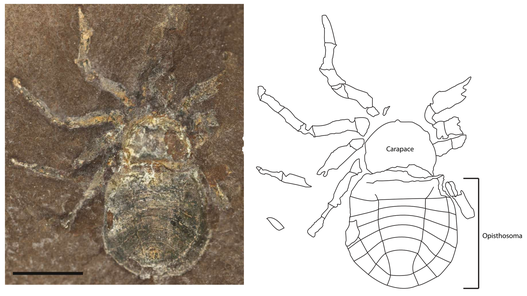
Introduction and Background

Members of the ancient arachnid order Trigonotarbida are spider-like in appearance and represent some of the earliest fully terrestrial animals. Their fossils are found in late Silurian to early Permian deposits (419 mya to 290 mya) (Garwood & Dunlop 2010) and occur in both North America and Europe. Many trigonotarbid fossils from North America have either not been described fully or remain undescribed. Examination of North American trigonotarbid specimens in museum collections has shown the high likelihood of trigonotarbid species that have yet to be described in North American. There are currently over a dozen specimens from multiple localities that have only been described down to their order, yet many likely have sufficient diagnostic characters to be identified further. The lack of research on North American trigonotarbids presents a great potential for expanding our understanding of Trigonotarbida with respect to biogeography, taxonomy, and phylogenetics. Currently there are significantly more families and nearly three times as many genera of trigonotarbids represented in Europe compared to North America.

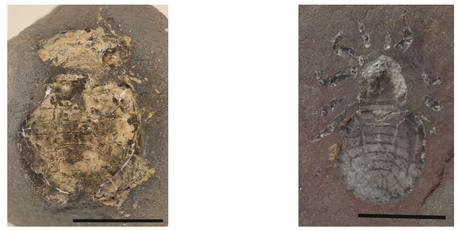


Reconstructions of representatives of nine trigonotarbid families, shown to scale. A, Palaeocharinus rhyniensis (Palaeocharinidae). B, Archaeomartus levis (Archaeomartidae). C, Anthracomartus hindi (Anthracomartidae). D, Anthracosiro woodwardi (Anthracosironidae). E, Trigonotarbus johnsoni (Trigonotarbidae). F, Lissomartus schucherti (Lissomartidae). G, Aphantomartus pustulatus (Aphantomartidae). H, Eophrynus prestvicii (Eophrynidae). I, Kreischeria wiedei (Kreischeriidae). Scale bar = 10 mm. (Figure and caption from Jones et al. 2014).

This project seeks to revise previous descriptions, describe new specimens, and compile information on trigonotarbids from the various North American localities in order to explore the evolutionary history and diversity of the group and identify the potential impacts on phylogenetic reconstructions of Trigonotarbida. I hypothesize that the diversity of North American Trigonotarbida is more similar to Europe than it currently appears in terms of species richness and abundance since they shared similar stratigraphic occurrences and would have been in relatively close geographic proximity to each other during the Devonian and Carboniferous, when both continents combined to form the minor supercontinent Euramerica (Sahney et al. 2010). Trigonotarbids are crucial to both understanding the origins of terrestrial arthropods and expanding our knowledge on the overall evolutionary history of life. The implications from this project include remedying a major gap in the arachnid fossil record, revealing patterns in diversity after the colonization of land, improving phylogentic trees, and possibly showing the impact mass extinctions had on early terrestrial animals.



Anthracomartus sp. trigonotarbid (KUMIP 156097) (member of the family Anthracomarthidae) with illustration showing the opisthosomal tergites divided into five plates per segment. Scale: 10 mm. (Illustration modified from Wright & Selden 2011).

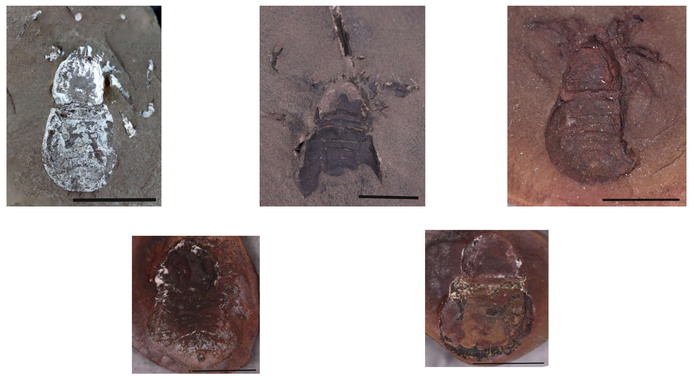


KUMIP 273081 - "indeterminate trigonotarbid" (left) and FMNH 45035 - "undetermined anthracomartid" (right): Potentially identifed to the family Anthracomartidae by the characteristic of opisthosomal tergites divided into five plates per segment (Jones et al. 2014). Scale: 10 mm.

FMNH 9940 - "undetermined trigonotarbid" (middle): Potentially identified to either Kreischeriidae or Eophrynidae because of heavy tuberculation on the opisthosoma. As found in Eophrynidae and Kreischeriidae, specimen has backwards-directed spines on the posterior opisthosomal margin (which I believe sets them apart from Aphantomartidae which possess a heavy tuberculated opisthosoma as well but no spines). There are minor differences in opisthosomal segmentation as well as the pattern of tubercles that serve to distinguish kreischeriids from the likely closely related eophrynids, which might identify this specimen to the family Kreischeriidae, but more detailed analysis is needed (Jones et al. 2014). Scale: 10 mm.

FMNH 56932 - "Trigonotarbida" (left): Potentially identified to Aphantomartidae because of the heavy turberculation on the opisthosoma but apparent lack of spines on the posterior opisthosomal margin (Jones et al. 2014). Scale: 10 mm.

FMNH 32226 - "undetermined trigonotarbid" (left): Potentially identifed to the 'eophrynid assemblage' (Aphantomartidae, Kreicheriidae, or Eophrynidae) because of the seemingly fairly heavily tuburculated opisthosoma (Dunlop & Rößler 2013). Scale: 10 mm.



FMNH 32156 - "undetermined anthracomartid" (top left), FMNH 56955 - "Anthracomartida" (top, middle), FMNH 30323 - "undetermined anthracomartid" (top right), FMNH 32239 - "undetermined anthracomartid" (bottom left), and FMNH 52255 - "undetermined anthracomartid" (bottom right): All can potentially be determined to not belong to the families Trigonotarbidae, Lissomartidae, Aphantomartidae, Kreicheriidae, or Eophrynidae because of their lack of a triangular (Dunlop, 1995) and/or lobed carapace (Jones et al. 2014). These five trigonotarbid specimens can also potentially be determined to not belong to the family Anthracosironidae since they appear to lack the characteristic rounded prosoma and long and fairly narrow opisthosoma (Jones et al. 2014). All scale bars: 10 mm.

References

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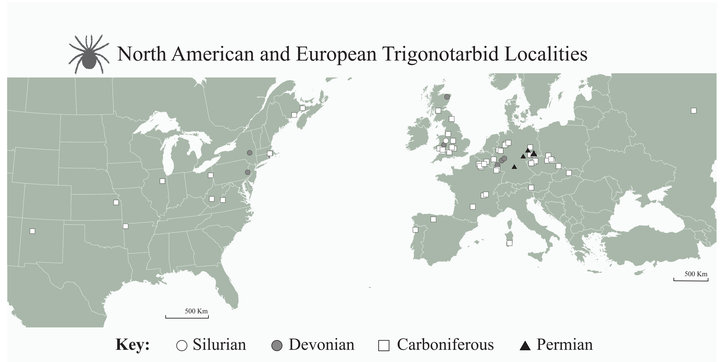
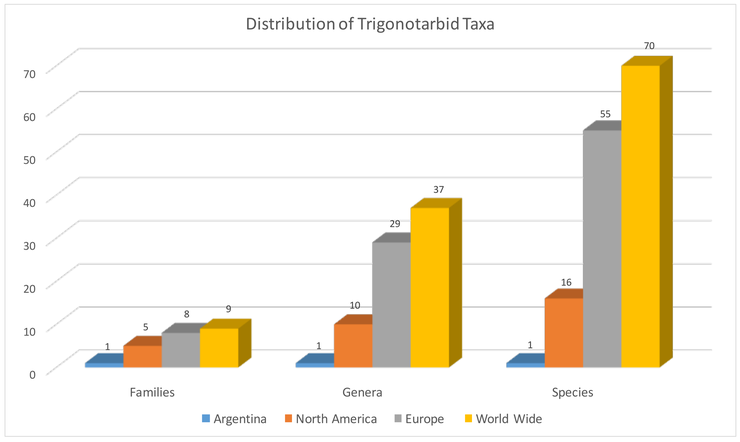


In North America, trigonotarbids have been found at in Lawrence, Kansas; Kinney Brick Quarry, New Mexico; Pawtucket, Rhode Island; Mazon Creek, Illinois; 7-11 Mine, Ohio; Cotton Hill, West Virginia; Fern Ledges, Saint John, New Brunswick; Joggins Fossil Cliffs, Nova Scotia; Fayetteville, Arkansas; Alleghany Tunnel, Virginia; Red Hill, Pennsylvania; and Gilboa, New York.

Geographic distribution of North American trigonotarbid localities (Dunlop et al. 2014). (North America with US States and Canadian Provinces – Single Color by FreeVectorMaps.com). Geographic distribution of European trigonotarbid localities. (Dunlop & Rößler 2013). (Europe with Countries – Single Color by FreeVectorM aps.com).



Future Research Plans and Goals

I will continue to analyzing and describing/redescribing the key morphological features of the North American trigonotarbid specimens for use in taxonomic classification. Particularly well-preserved specimens may be scanned under a Heliscan MicroCT scanner for 3-D modeling of the trigonotarbids. Key features that may be difficult to distinguish from photographs alone will be clarified through illustrations. Phylogenetic software such as PAUP* or Mesquite will then be used to create matrices of morphological features to be used for reconstructing the phylogenetics of North American trigonotarbids.

My prediction is that diversity of North American trigonotarbids will be similar to that of European trigonotarbids. Information on North American trigonotarbid specimens comprising their locality information, morphological descriptions/revised morphological descriptions (with accompanying photos and illustrations), and species classifications based on those morphological descriptions will be added to databases like the World Spider Catalog and Paleobiology Database. Matrices of morphological features to be used for reconstructing North American trigonotarbid phylogeny will also be created and uploaded to Morphobank.

Acknowledgments

I would like to thank the Paleontological Soceity, Paleontological Research Instution, and the KU Geology Department for funding this ongoing research.

I would like to thank Paul Mayer at the Field Museum of Natural History, Mark Florence, Finnegan Marsh, and Conrad Labandeira at the National Museum of Natural History, Bushra Hussaini, Neil Landman, and Mariah Slovacek at the American Museum of Natural History, Matt Stimson at the New Brunswick Museum, and Julien Kimmig at the KU Museum of Invertebrate Paleontology for their help with collection visits and obtaining specimen photos and loans.

I would also like to give a special thank you to my advisor, Paul Selden; comittee members, Deborah Smith and Alison Olcott-Marshall; my parents, Randy and Cheryl Shanks; and Matt Downen and other colleagues for their input and assistance with this research.