

Occurrence of Callianassid Coprolites in the Cretaceous of New Jersey

Carl M. Mehling

Fossil Amphibian, Reptile and Bird Collections
Division of Paleontology
American Museum of Natural History
Central Park West at 79 St.
New York, NY 10024

ABSTRACT - The occurrence of masses of callianassid thalassinidean coprolites in the Cretaceous exposures of Ramanessin Brook and Big Brook, Monmouth Co., New Jersey, is discussed. Comparisons with occurrences of currently recognized ichnospecies show that these recently discovered specimens represent a new temporal occurrence and range extension for callianassid coprolites: the first confirmed Campanian records of this ghost shrimp ichnofossil for North America.

Introduction

The callianassid crustacean *Protocallianassa* has left a rich fossil record in the Cretaceous of New Jersey. Body fossils (mostly pincers and other arm segments) show callianassid shrimp to be one of the most commonly preserved infaunal elements - as well as the most common crustaceans in general - of this Campanian ecosystem. Trace fossils of callianassids in the form of burrows (*Ophiomorpha*) are also common in many local outcrops and are important bioturbation features (Frey *et al.* 1978) of the Cretaceous sediments of Monmouth County. Reported here is the first identification and description of another callianassid trace fossil type: coprolite masses.

Modern and fossil fecal pellets from ghost shrimp are easily identified by the bilaterally symmetrical arrangement of two groups of canals (haemorrhodilates *sensu* Pryor 1975) that run the length of the pellets parallel to the long axis (Moore 1932). These canals derive from projections extending from the posterior margin of the rear gut (Brönnimann 1972, 1976) that leave their mark on the still-fluid feces as it travels past them. These projections likely divert larger particles in the feces, which might irritate the tissues of the shrimp, away from the pellet edges (Pryor 1975). The pattern of canals is species-specific and aids ecologists studying modern ecosystems in identifying the pellet's producers (Bromley 1990).

Localities

The first specimen (AMNH-FI-47145) was collected by Fiona Brady on 6 March 1999 as float on a gravel bar about 1/2km upstream (north) of route 520 and west of Ramanessin Brook Greenway Trail in Holmdel, NJ. The second specimen

(AMNH-FI-50168) was collected by the author on 28 July 2001 as screened float upstream (northwest) of the Boundary Road Bridge between Holmdel and Marlboro, NJ.

Although collected out of stratigraphic context, the specimens likely originated in the Wenonah or Mt. Laurel Fms. *Protocallianassa* occurs throughout the local outcrops, which also include the Navesink, but is most abundant in the Wenonah, and the Mt. Laurel is the most extensively exposed formation at these sites (Ralph Johnson, pers. comm.).

Description

AMNH-FI-47145 is 27.5mm in its longest dimension (Fig. 1). Exposed on its surface are several hundred individual coprolites (or pellets) with little or no visible cementing ground mass (Fig. 2). Each coprolite is about .75mm in diameter and up to 2mm long. Most of the visible coprolites are eroded, show negligible relief, and, owing to their organizational disarray, exhibit a variety of cross-sections. Several of the pellets are sectioned parallel to the long axis and expose the canals along their length (Fig. 3). Those that are sectioned perpendicularly to the long axis display the pattern of canals necessary for identification (Fig. 4).

AMNH-FI-50168 is 15mm in its longest dimension and 1cm in diameter (Fig. 5). The shape of the mass is finger-like and slightly oblong in cross section. Opposite the rounded end, the mass is broken and reveals some unweathered pellets. Otherwise, the preservation of the mass and individual pellets is similar to AMNH-FI-47145.

The canals in the coprolites of both the Ramanessin and Big Brook specimens seem to show a crescent-like cross-section (*sensu* Brönnimann 1972), which would place it in the ichnogenus *Palaxius* (Brönnimann and Norton 1960). There

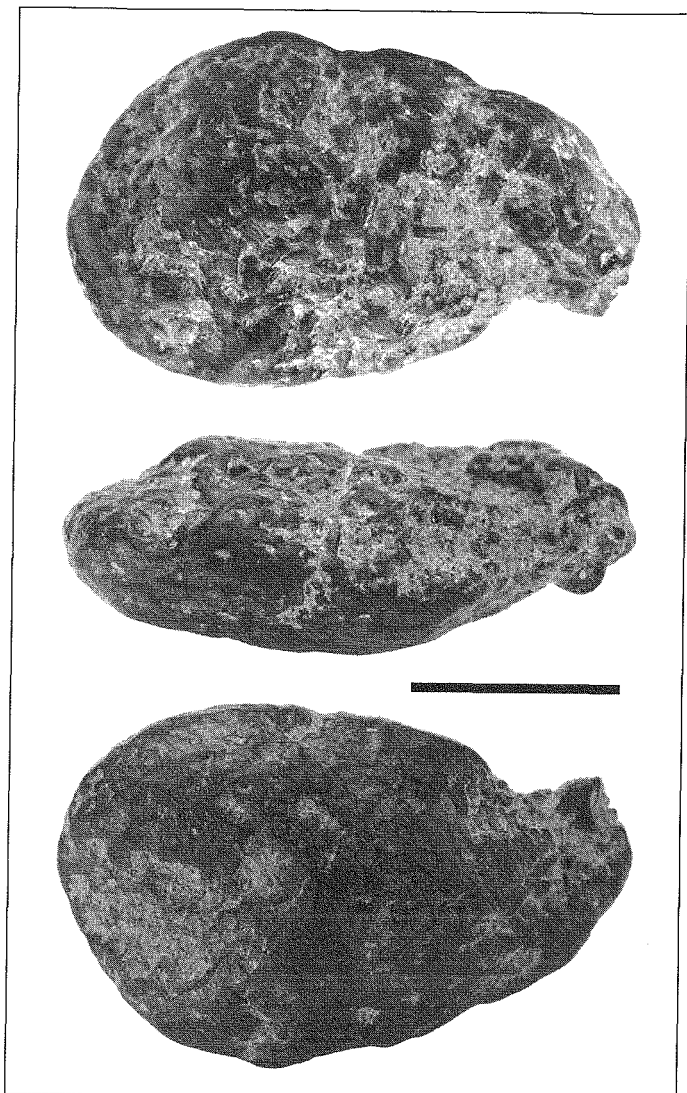


Figure 1. Three views of AMNH-FI-47145. Scale bar equals 1 cm.

appear to be 10 canals in each individual pellet arranged in much the same pattern as the five described 10-canal *Palaxius* ichnospecies (Blau 1993-2000, Blau *et al.* 1993) (Fig. 6). The canal cross-sections also appear to show somewhat expanded ends most similar to the Middle Jurassic to Oligocene *P. decemlunulatus* (Paréjas 1948, Senowbary-Daryan and Kuss 1992), although the pellets of the new specimens are slightly larger than those described by Paréjas.

Discussion

The genus *Palaxius* is known from as far back as the Middle Triassic (Joachim Blau, pers. comm.). Currently, North American *Palaxius* (*P. salataensis* Brönnimann, Cros & Zaninetti 1972) is only described from the Triassic, along with other crustacean coprolites: *Parafavreina thoronetensis*

Brönnimann, Caron & Zaninetti 1972, *Thoronetia quinaria* Brönnimann, Caron & Zaninetti 1972, and *Payandea shastaensis* Kristan-Tollmann & Tollmann 1983 (Blau *et al.* 1993, Kristan-Tollman and Tollman 1983). Brönnimann and Norton (1960) describe *Favreina salevensis* from the Upper Jurassic of Texas and mention thalassinidean-type coprolites from the Upper Jurassic of Alabama and the Lower Cretaceous of Florida. The Jurassic Alabama coprolites (identified as *Parafavreina* and *Palaxius*) are also mentioned by Andrew K. Rindsberg (Uchman and Rindsberg 1999) of the Geological Survey of Alabama as a future investigation by him and his colleague David C. Kopaska-Merkel. To date, the only Late Cretaceous records for *Palaxius* come from Colombia (*P. caucaensis* Blau, Moreno & Senff 1995, Joachim Blau, pers. comm.) and Egypt (*P. decemlunulatus* Senowbary-Daryan and Kuss 1992). Stephenson (1954) figures a mass of pellets from the Raritan Fm. (Cenomanian) of New Jersey. Although only a tentative fecal identification is provided, and no organism is proposed as the coprolite maker, the brief description suggests a callianassid origin for the pellet mass. A similar accumulation from the Campanian of Wyoming is figured by Gill and Cobban (1966) filling the living chamber of a baculite but is described merely as "very small rod-shaped fecal pellets." Lauginiger (1988) states, "coprolites from sharks, bony fish, and arthropods are very common fossil finds in the Cretaceous sediments of Delaware," but does not provide a description or figures of the specimens, nor is any institution mentioned that might hold specimens. Pryor (1975) mentions Atlantic Coastal Plain vermiform glauconite pellets and suggests a decapod fecal pellet origin for them, but the specimens reported here are the first definitive records of thalassinidean coprolites for this time period and area.

The *Palaxius* identification here is tentative as the appear-

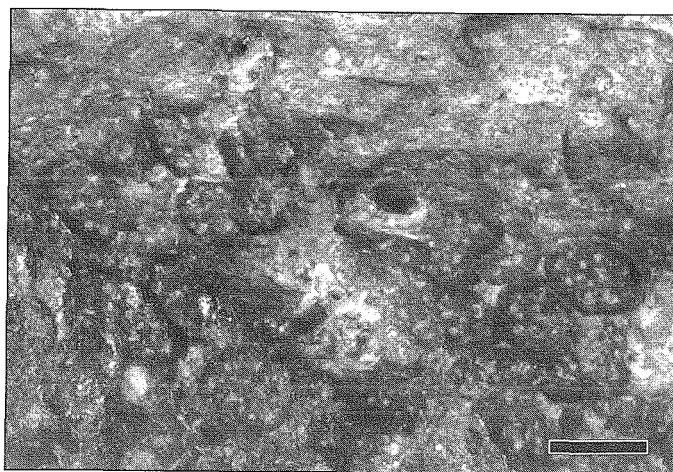


Figure 2. Areas on AMNH-FI-47145 with no adhering matrix show that there is little or no ground mass separating the individual coprolites. Notice that individual pellets abut one another (particularly the two above the scale bar) and that the majority of the photograph shows coprolitic (as opposed to ground mass) material. Scale bar equals 1 mm.

ance of the canals as crescents may be a diagenetic artifact resulting from the coalescence of adjacent rounded canals (Brönnimann 1972, 1976). Due to variations inherent in each pellet, the effects of diagenesis, and the complication of polishing sandy samples, there can be difficulty in obtaining a single cross-section with all the identifying characteristics (Moore 1932). The specimens contain a large number of indi-



Figure 3. Longitudinal canals (arrows) are visible in coprolites of AMNH-FI-47145 that are sectioned lengthwise. Scale bar equals 1 mm.

vidual coprolites, thus increasing the chances of building up a composite image of a representative cross-section. Fine-tuning of the taxonomic identification awaits future laboratory preparation of the specimens.

Protocallianassa is the only thalassinidean in the paleofauna found at Ramanessin Brook (Poore 1994, Rathbun 1935) and the coprolites described here exhibit the very specific characters for thalassinideans, a group to which *Protocallianassa* belongs. Although connection of coprolites to their makers is notoriously unreliable, assignment of the coprolite masses to *Protocallianassa* is currently the most parsimonious explanation. Other varieties of invertebrate coprolite masses are fairly common in these beds, but do not exhibit the thalassinidean coprolite characteristics.

Each coprolite mass is interpreted here as the product of a single individual callianassid. Callianassid shrimp rarely leave

the safety of their burrows (Bromley 1990), and by means of a current created by the beating of their pleopods, the individual shrimp propels waste out of its system of tunnels. These pellets can accumulate at the burrow exit (Bromley 1990). Although tidal currents can transport and concentrate callianassid fecal pellets into beds (Pryor 1975), such beds are not encountered at this site. It therefore seems unlikely that each of these masses represents a random fecal accumulation of more than one individual. However, it is possible that pellets from several individuals, concentrated by currents, filled a cavity creating a discrete mass.

The individual pellets of thalassinideans are very compact and greatly resistant to disintegration (Bromley 1990, Pryor 1975), but it is presently unclear how or why they remained adhered as masses.

Callianassid coprolites offer stratigraphic, morphologic, and possibly even dietary information, but have traditionally been neglected in the literature (Brönnimann 1976). It is hoped that with this report will come a refined search-image in those working in the Cretaceous of New Jersey, as well as recognition by those who work on invertebrate coprolites that the range of deposits producing this type of specimen has been expanded, and a temporal gap filled.

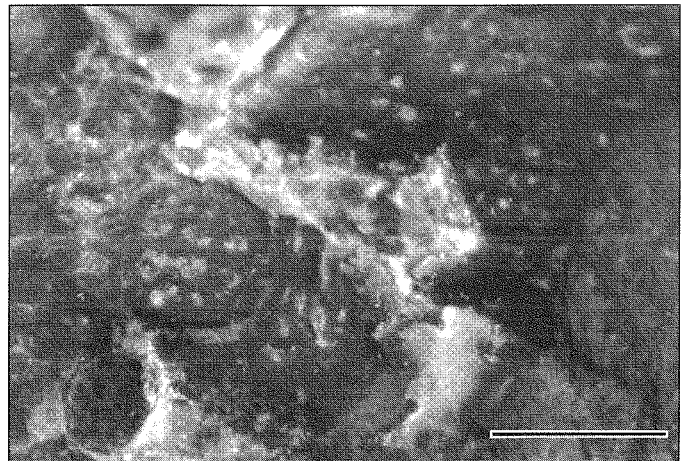


Figure 4. Individual coprolites of AMNH-FI-47145, which have been naturally cross-sectioned, show the pattern of canals necessary for identification (compare to Figure 6.). Scale bar equals 1 mm.

Acknowledgements

I thank my wife Fiona Brady for her discovery and donation of the first specimen, which, upon macroscopic observation, I decided was nothing that would have warranted my attention, and for her constant support. Mary DeJong and Amanda Beilskas of the AMNH library were indispensable aids in the hunt for obscure literature. A special thanks goes to Rick Edwards and Mick Ellison for some of the digital photography of the specimens. I would also like to thank Neil



Figure 5 Four views of AMNH-FI-50168. Scale bar equals 1 cm.

Landman (Division of Paleontology, American Museum of Natural History), Ralph Johnson (Monmouth Amateur Paleontological Society), Joachim Blau (Institut fuer Palaeontologie, University of Erlangen-Nürnberg), and Don Clements and Joseph Collins for their critical reviews of the manuscript. My gratitude goes to Ned Gilmore (Academy of Natural Sciences, Philadelphia) for pointing me in the right direction for reference to arthropod coprolites from Delaware. I also thank Dr. Christopher Tudge (NMNH – Smithsonian Institution), Dr. Michael Tuerkay (Forschungsinstitut Senckenberg, Germany), and Dr. Gary C. B. Poore (Museum Victoria, Australia) for their advice concerning the phylogeny of thalassinideans, and Dr. Guenter Schweigert (Staatliches Museum fuer Naturkunde, Germany) for his advice on the temporal and geographic range of *Palaxius decemlunulatus*.

Literature Cited

- Blau, J. 1993-2000. FAVRIS - The Interactive Database on Structured Crustacean Coprolites. <http://www.uni-giessen.de/~gg13/FAVRIS/FAVRIS.htm>
- Blau, J., B. Grün and M. Senff. 1993. Crustaceen-Koprolithen aus der Trias der Westlichen Tethys (Lienzer Dolomiten, Österreich; Prager Dolomiten, Italien) und vom Gondwana-Westrand (oberes Magdalenatal, Kolumbien, Südamerika). *Paläontologische Zeitschrift*, 67: 193-214.
- Blau, J., M. Moreno and M. Senff. 1995. *Palaxius caucaensis* n. sp., A Crustacean Microcoprolite from the Basal Nogales Formation (Campanian to Maastrichtian) of Colombia. *Micropaleontology*, 41 (1): 85-88.
- Bromley, R. G. 1990. Trace Fossils: Biology and Taphonomy. *Special Topics in Palaeontology*. 280pp.
- Brönnimann, P. 1972. Remarks on the Classification of Fossil Anomuran Coprolites. *Paläontologische Zeitschrift*, 46: 99-103.
- Brönnimann, P. 1976. Revision of the Lectotype of *Favreina salevensis* (Paréjas) (Crustacea, Decapoda) and Description of Favreine Form-Species from the Jurassic and Cretaceous of Scotland, Portugal, Yugoslavia and Pakistan. *Paläontologische Zeitschrift*, 50: 40-56.
- Brönnimann, P., J. P. Caron and L. Zaninetti. 1972. *Parafavreina*, n. gen. n. sp., A New Thalassinid Anomuran (Crustacea, Decapoda) Coprolite Form-Genus from the Triassic and Liassic of Europa and North Africa. *Mitteilungen der Gesellschaft der Geologie und Bergbaustudenten in Wien*, 21: 941-956.
- Brönnimann, P., P. Cros and L. Zaninetti. 1972. New Thalassinid Anomuran (Crustacea, Decapoda) Coprolites from Infraliassic Limestones of the Dolomites, Italy. *Mitteilungen der Gesellschaft der Geologie und Bergbaustudenten in Wien*, 21: 921-928.
- Brönnimann, P. and P. Norton. 1960. On the Classification of Fossil Fecal Pellets and Description of New Forms from Cuba, Guatemala and Libya. *Eclogae Geologicae Helveticae*, 53 (2): 832-842, Basel.
- Frey, R. W., J. D. Howard and W. A. Pryor. 1978. *Ophiomorpha*: Its Morphologic, Taxonomic, and Environmental Significance. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 23 (1978): 199-229.
- Gill, J. R. and W. A. Cobban. 1966. The Red Bird Section of the Upper Cretaceous Pierre Shale in Wyoming. *United States Geological Survey Professional Paper 393-A*: 1-72 plus plates.
- Kristan-Tollman, V. E. and A. Tollman. 1983. Tethys-Faunenelemente in der Trias der USA. *Mitteilungen der Österreichischen Geologischen Gesellschaft*, 76: 213-272.
- Lauginiger, E. M. 1988. Cretaceous Fossils from the Chesapeake and Delaware Canal: A Guide for Students and Collectors. *Delaware Geological Survey, Special Publication No. 18*. 57pp.
- Moore, H. B. 1932. The Faecal Pellets of the Anomura. *Proceedings of the Royal Society of Edinburgh*, 52: 296-308 plus plates.

- Paréjas, E. 1948. Sur Quelques Coprolithes de Crustacés. *Archives des Sciences*, 1 (3): 512-520.
- Poore, G. C. B. 1994. A Phylogeny of the Families of Thalassinidea (Crustacea: Decapoda) with Keys to the Families and Genera. *Memoirs of the Museum of Victoria* 54: 79-120.
- Pryor, W. A. 1975. Biogenic Sedimentation and Alteration of Argillaceous Sediments in Shallow Marine Environments. *Geological Society of America Bulletin*, 86: 1244-1254.
- Rathbun, M. J. 1935. Fossil Crustacea of the Atlantic and Gulf Coastal Plain. *Geological Society of America Special Papers Number 2*. 160pp.
- Senowbary-Daryan, B. and J. Kuss. 1992. Anomuren-Koprolithen aus der Kreide von Ägypten. *Mitteilungen aus dem Geologisch-Paläontologischen Institut der Universität Hamburg*, 73: 129-157.
- Stephenson, L. W. 1954. Additions to the Fauna of the Raritan Formation (Cenomanian) of New Jersey. *United States Geological Survey Professional Paper 264-B*. 25-43 plus plates.
- Uchman, A. and A. K. Rindsberg. 1999. 46 Authors, Current Activities. *Ichnology Newsletter* 21, February 1999. <http://www.emory.edu/COLLEGE/ENVS/research/ichnology/IN99-CURREN%7E1.HTM>.

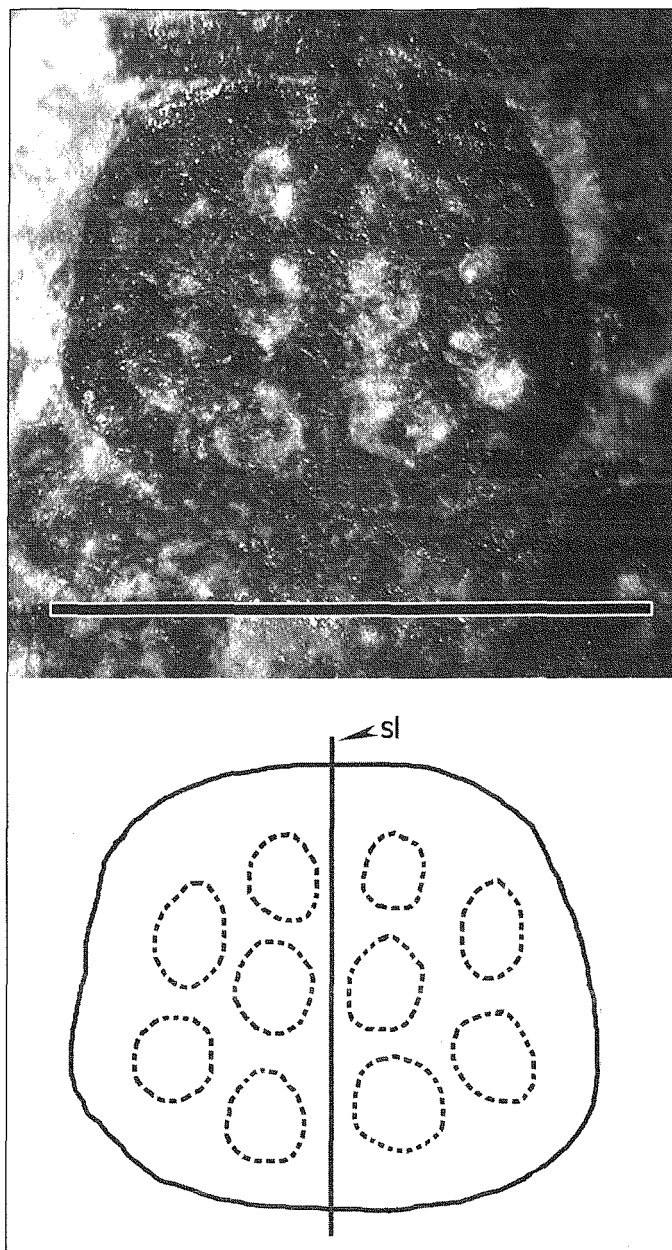


Fig. 6 Natural cross-section of one coprolite of AMNH-FI-47145 showing the sagittal line of symmetry ("sl" in diagram) and the pattern of canals interpreted here as two sets of five crescent-shaped canals (dotted lines in diagram show location of 10 canals). Scale bar equals 1 mm.