

# Roveacrinida (Crinoidea, Articulata) from the upper Maastrichtian Peedee Formation (upper Cretaceous) of North Carolina, USA – The last pelagic microcrinoids

Andrew S. Gale<sup>a,\*</sup>, Eric Sadorf<sup>b</sup>, John W.M. Jagt<sup>c</sup>

<sup>a</sup> School of Earth and Environmental Sciences, University of Portsmouth, Burnaby Building, Burnaby Road, Portsmouth PO1 3QL, UK

<sup>b</sup> 315 Hemlock Street, Cary, NC 27513, USA

<sup>c</sup> Natuurhistorisch Museum Maastricht, de Bosquetplein 6-7, 6211 KJ Maastricht, The Netherlands

## ARTICLE INFO

### Article history:

Received 12 November 2017

Received in revised form

10 January 2018

Accepted in revised form 24 January 2018

### Keywords:

Echinodermata

Applinocrininae

Hessicrininae

Correlations

## ABSTRACT

Microcrinoids belonging to the Order Roveacrinida are described from the Late Maastrichtian Peedee Formation of North Carolina. Five species are present; *Applinocrinus texanus* Peck, 1973, *Lucernocrinus multispinosus* Gale, sp. nov., *Birgenelocrinus degraafi* Jagt, 1999, *B. jagti* Gale, sp. nov. and *Peedeocrinus sadorfi* Gale, gen. et sp. nov. Two of these species (*A. texanus*, *B. degraafi*) and close relatives of two others (*Lucernocrinus*, *Birgenelocrinus jagti*) are known from the upper Maastrichtian (upper Maastricht Formation) of the Netherlands and northeastern Belgium, indicating that the Roveacrinida were flourishing and widespread up to the end of the Cretaceous. It is concluded that Paleogene and Neogene records of Roveacrinidae represent contamination of samples by Cretaceous (Turonian) material.

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## 1. Introduction

Pelagic microcrinoids of the Order Roveacrinida were abundant and diverse in open marine settings through parts of the Triassic, Jurassic and much of the Cretaceous (Hess and Messing, 2011; Hess et al., 2016; Gale, 2016, 2017), and were locally rock-forming in Cretaceous pelagic limestones of the Tethyan region (e.g. Berthou and Bengston, 1988; Ferré et al., 2005, 2017). The order underwent major evolutionary radiations in the Albian-Cenomanian (Hess, 2015) and the early Campanian (Gale, 2016, 2017), and representatives of this last radiation are known from the uppermost Maastrichtian of northwestern Europe (Jagt, 1999, 2005).

Here we describe a new fauna of Roveacrinida, recovered from clays of the upper Maastrichtian Peedee Formation at Wilmington, on the Brunswick River in North Carolina. The material is abundant and very well preserved, and includes four species, three of which are new. Importantly, it also provides new information about the widespread Maastrichtian species *Applinocrinus texanus* Peck, 1973, particularly concerning its ontogeny. The Wilmington fauna has marked similarities with contemporaneous assemblages

described from the upper Maastrichtian of southern Limburg, the Netherlands (Jagt, 1999), and provides a valuable insight into North American microcrinoids from the uppermost Cretaceous.

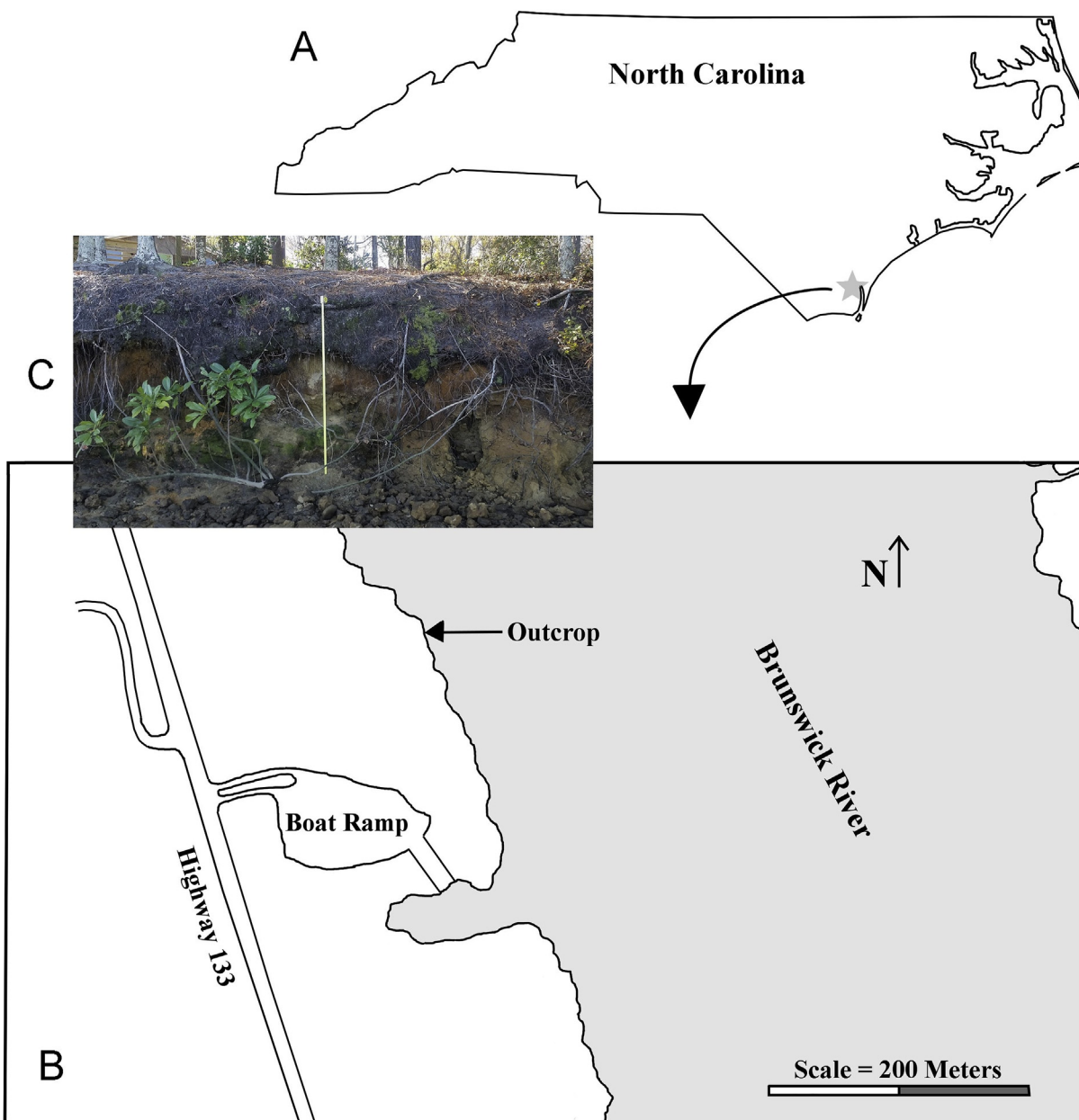
The roveacrinid material from the upper Maastrichtian of Wilmington, NC, represents the youngest certain representatives of the order Roveacrinida known to date. We discuss the supposed Paleocene and Neogene records of the group from Poland (Salamon et al., 2010; Gorzelak et al., 2011), and conclude that they are contaminants of Turonian cc species.

## 2. Locality and geology

The geographical location of the locality is shown in Fig. 1; the co-ordinates for the site are 34° 13' 20.29" N, 77° 58' 52.24" W. The upper Maastrichtian Peedee Formation is a marine sequence composed of dark greenish to gray muddy sands with some mica and glauconite (Sohl and Owens, 1991; Landman et al., 2004). It rests unconformably on top of the Donoho Creek Formation and is unconformably overlain by Paleogene and younger strata. The study area is on a structural high known as the Cape Fear Arch. Cretaceous rocks are exposed along much of the axis of the arch, and Paleogene and younger rocks are exposed along the flanks (Harris et al., 1986; Soller, 1988; Harris and Self-Trail, 2006).

\* Corresponding author.

E-mail address: [andy.gale@port.ac.uk](mailto:andy.gale@port.ac.uk) (A.S. Gale).



**Fig. 1.** A, map of North Carolina to show position of detailed map of outcrop locality C. B, Photograph of Leyland Ramp outcrop of Peedee Formation on the Brunswick River, Wilmington, North Carolina. Scale of tape measure 1 m.

In the study area, approximately 1.7 m of Peedee Formation is exposed, comprising fine grained muddy sand with irregular calcareous cemented concretions. There are areas where the Pleistocene Waccamaw Formation unconformably rests on the Peedee Formation. The base of the Peedee Formation is not visible at the site. The exposed outcrop where samples were collected is weathered to a greenish yellow colour. The Peedee Formation in North Carolina probably belongs to the *Discoscaphites conradi* Zone (Landman et al., 2004) which is of late Maastrichtian (but not latest) age.

### 3. Materials and methods

Bulk samples were collected from the outcrop and later thoroughly dried. Once dried, the bulk samples were soaked in water to break the matrix down enough to wet sieve using a 0.6 mm brass

sieve retaining the fraction that was larger than 0.6 mm. The drying and sieving process was repeated to remove as much of the remaining silt and clay as possible. The residue was dried and then dry sieved using a 0.6 mm brass screen and a 1.0 mm brass screen. The larger fraction material was picked under magnification (reading glasses) while the 0.6–1.0 mm fraction was picked under a binocular microscope.

### 4. Systematic palaeontology (by Andrew S. Gale)

Abbreviations. To denote the repository of material illustrated and/or referred to in the text, the following abbreviations are used: NHMM, Natuurhistorisch Museum Maastricht, Maastricht, the Netherlands; NHMUK, Natural History Museum, Department of Palaeontology, London, United Kingdom; RGM, Naturalis Biodiversity Center, Leiden, the Netherlands (formerly Rijksmuseum van

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