PALÆO VERTEBRATA

SHORT COMMUNICATION

Designating a lectotype for *Mesacanthus pusillus* (Gnathostomata: Acanthodii)

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Abstract: The early gnathostome genus *Mesacanthus* is well represented in both Lower Old Red Sandstone and Middle Old Red Sandstone assemblages of northern and central Scotland. This 'acanthodian' taxon is currently thought to comprise two valid species: *M. mitchelli* and *M. pusillus*. Although the whereabouts of the holotype of *M. mitchelli* (NHMUK PV P560) is known, the syntype material for *M. pusillus* has long been thought lost. Here we identify at least one specimen that formed part of the original syntype material for *M. pusillus*, albeit in a slightly different condition than when it was originally figured. This specimen is ROM 25872, which is here designated as the lectotype. A second specimen – ELGNM 1978.191.1 – could represent another of the syntype specimens, but poor preservation quality makes it impossible to be certain.

Keywords: Devonian, Orcadian Basin, Midland Valley, Chordata, acanthodians

Submitted 12 October 2020, Accepted 20 January 2021
Published Online 03 March 2021, doi: 10.18563/pv.44.1.e2

INTRODUCTION

The acanthodians (or 'spiny sharks') were a globally distributed assemblage of early gnathostomes, currently considered to be all chondrichthyans rather than a mix of osteichthyans and chondrichthyans (Denison, 1979; Zhu *et al*., 2013; Dupret *et al*., 2014; Brazeau & Friedman, 2015; Giles *et al*., 2015; Burrow *et al*., 2011, 2016, 2020a,b). Within this broad set of taxa is the Devonian genus *Mesacanthus*, which was first erected by Traquair (1888). *Mesacanthus* is a relatively common fossil in the rocks of Northern and Central Scotland, appearing in both the Lower Old Red Sandstone and the Middle Old Red Sandstone, which correspond to the Lower Devonian and Middle Devonian respectively (Trewin & Davidson, 1995, 1999; Newman and Trewin, 2008). The genus comprises two distinct species: *M. mitchelli*, from the Lower Devonian strata; and *M. pusillus*, from the Middle Devonian strata (Baron, 2015). The two valid taxa did not overlap in time, with each being uniquely associated with a particular stratum (Trewin & Davidson, 1995, 1999).

One factor complicating specific identification within *Mesacanthus* is the apparent loss of the type material. In a thorough review of fossil fishes discovered in Scotland to 1845, Andrews (1982, p.47) noted that the syntype specimens of *M. pusillus* were possibly lost, despite the author's attempt to compile a 'checklist' for all of Louis Agassiz's figured specimens (Figure 1a, b), but nominated two specimens that might be from the type species. Following a more recent large-scale search of collections known to house specimens of *Mesacanthus* and a comprehensive literature review, Baron (2015) was only able to identify three specimens that could be missing syntypes of *M. pusillus*. However, he went on to say that in the absence of a more comprehensive search it was not possible at that time to have full confidence in confirming or refuting the status of any of the three specimens. He stated that "this study will not designate a neotype at this time in order to avoid future taxonomic confusion should the holotype ever re-[e]merge" (Baron, 2015, p. 19). This comment is misleading as the type material for *M. pusillus* contained syntypes rather than a single holotype, and as such any later identification of a specimen belonging to the syntypes should become a lectotype, rather than a neotype.

In this study we conclude that no other new candidate specimens that could represent part of the lost syntype material for *Mesacanthus pusillus* are known, and those identified by Andrews (1982) and Baron (2015) are the only likely candidates (Figure 2a, b). Between the current two authors, over two hundred specimens of *M. pusillus* have been studied first-hand, with these specimens showing a wide range of preservation quality and anatomical detail. One of the assessed specimens, ROM 25872, is considered to be convincing enough a candidate to be proposed as the lectotype.

Specimens studied first-hand were housed in the following collections: University of Aberdeen (ABDUG), the National Museum of Scotland (NMS), the Natural History Museum, London (NHMUK), the Hunterian Museum (GLAHM), the Sedgwick Museum, Cambridge (SDGM) and the Royal Ontario Museum, Canada (ROM). In addition, the authors studied photographs of specimens from the Elgin Museum (ELGNM) and the collections of the British Geological Survey (GSM).

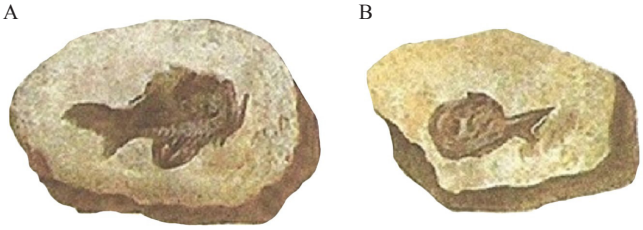

Figure 1. The two specimens figured by Agassiz (1844-1845 pl. 28, Figs. 8–10) in the original description of *Mesacanthus pusillus*. **A**, the larger specimen; **B**, the smaller specimen. Adapted from Agassiz (1844-1845).

DISCUSSION

Of the specimens originally figured by Agassiz (1844-1845, pl. 28 figs. 8-10), the two that are thought to represent the syntypes of *Mesacanthus pusillus* will, for convenience, be referred to in this work as the larger and the smaller specimens (although no scale bar was provided in the original image for either) (Figure 1a, b). Both the larger and smaller specimens appear to have been deformed after death and in both the head has been displaced from its life position (see supplementary file). Frustratingly, neither Agassiz (1844-1845) nor Egerton (1861) stated which, if any, of the specimens that they figured and described represented syntype or holotype specimens. In spite of this, given that these plates and figures were the only images provided by the authors in their original descriptions, it has to be inferred that the specimens figured by them are the type specimens.

It is clear from the comparisons that ROM 25872 (Figure 2b) is most likely of all the specimens considered to be the match for the smaller specimen figured by Agassiz (1844-1845, pl. 28 fig. 10) and that, depending on how the original image was reproduced, it represents the same specimen, or the counterpart to it. The overall shape and pattern of deformation indicate that ROM 25872 is one of the original syntypes, despite the clear differences in the way in which the surrounding matrix was depicted.

It is also known that in 1968 the Royal Ontario Museum (ROM) made a purchase of a collection of 88 Scottish fossil fish specimens from a company called Portsoy Minerals, based in Portsoy, Scotland. This collection contained historically-collected specimens primarily from localities that were no longer available for sampling. One specimen, now listed as ROM 25859, but originally numbered as ROM 87, was noted as being the "reputed counterpart of an Agassiz type specimen" in the collection documents (Figure 2c). Although this specimen is very difficult to interpret and likely does not represent *Mesacanthus* (pers. comm. Carole Burrow, 11.2020) and hence is not specifically relevant to the discussion on the

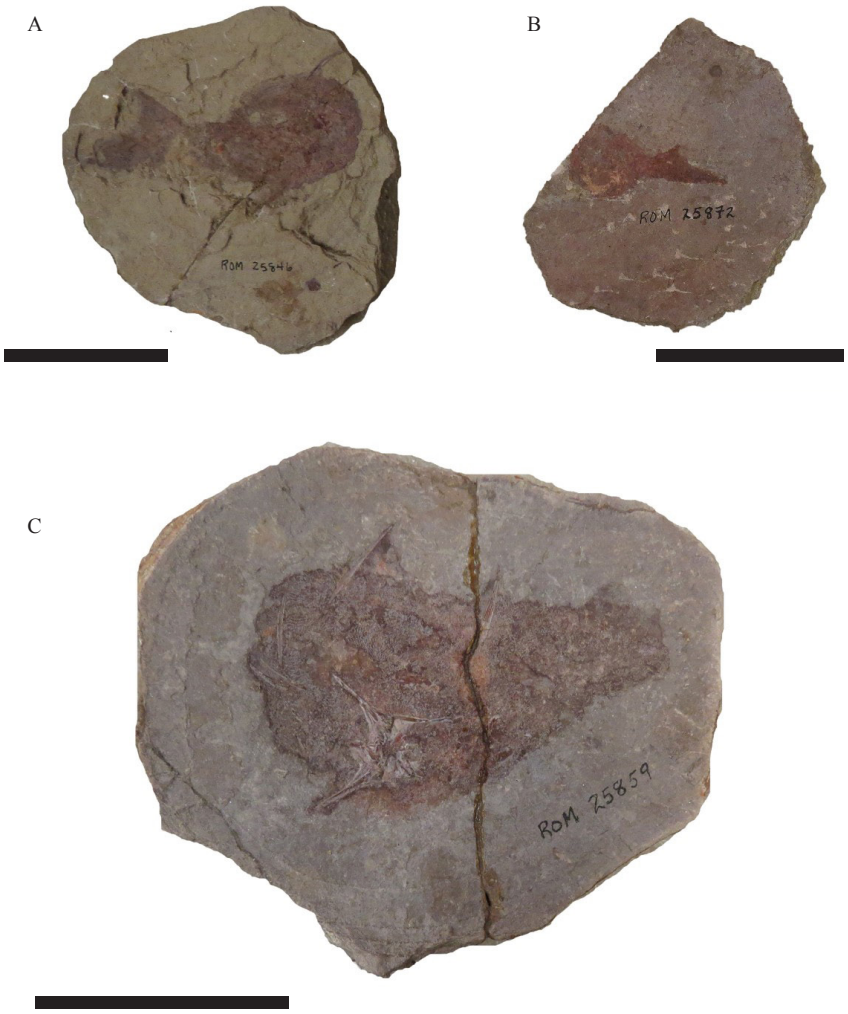

Figure 2. Candidate specimens for the missing types of *Mesacanthus pusillus*. A, ROM 25846; B, ROM 25872 (the new lectotype); C, Specimen thought to also be possibly part of the type series by Andrews (1982), originally listed as ROM 87 and now as ROM 25859, but more likely represents a specimen of *Diplacanthus crassimus*. scale bar = 50 mm.

types of *M. pusillus* (for more information on this specimen, see supplementary file), it does demonstrate the historical nature of at least some of these specimens and opens up the possibility that other Agassiz specimens may have been unknowingly included within this collection.

While another specimen, still housed in Scotland, ELGNM 1978.191.1, also has a similar overall form to one of the specimens figured by Agassiz (1844-1845, pl. 28 fig. 8), the overall poor quality of preservation and high level of damage and deformation of the specimen means that it cannot be said to be part of an original syntype of *Mesacanthus pusillus* (or possible counterpart) with as much confidence as for ROM 25872. In fact, there is nothing about this specimen that allows it to be confidently assigned to the genus *Mesacanthus* at all. This is more problematic, as the specimen could turn out to belong to a different genus of acanthodian from the same time period – for example, it may represent a small specimen of *Cheiracanthus*. The fin spines are not preserved, and therefore the relative position of the dorsal and anal spines cannot be discerned. Scale morphology is also not observable in this specimen, due to the very poor preservation quality. For all of these reasons, while it seems by far the most convincing candidate for the largest of the syntypes of *M. pusillus*, it does not seem appropriate for this specimen to be a name-bearing type. By making ROM 25872 the sole name-bearing specimen, this study seeks to reduce any future taxonomic confusion that might arise.

CONCLUSIONS

After a thorough review of the literature and a search of each collection known to contain specimens of *Mesacanthus pusillus*, this study has been able to identify with confidence at least one of the specimens that formed part of the original, and for many years lost, syntype series. ROM 25872 is now designated as the name-bearing lectotype.

A designated lectotype provides a basis for future studies of *Mesacanthus*, and this is important particularly if new species of *Mesacanthus* are later discovered, named or revised, as is regularly occurring for other contemporaneous acanthodian taxa (see, for example, Newman and Dean, 2005; den Blaauwen *et al*., 2019; Newman *et al*., 2019; Burrow *et al.*, 2020b). Moreover, should any study find evidence for the need to resurrect older taxonomic names such as *M. 'peachi'* and *M. 'coriaceus'*, this lectotype specimen will be important for providing anatomical information for comparisons and for providing a referable datapoint for future morphometric studies.

ACKNOWLEDGEMENTS

We are very grateful to Carole Burrows and to one anonymous reviewer for their helpful comments and suggestions. These comments and suggestions have helped to improve the overall quality of the manuscript and to further cement in the authors' minds the conclusions that can be drawn from the available data.

We dedicate this paper to the late Professor Nigel Trewin; MGB would specifically like to share his own personal appreciation for the help, support and supervision given to him by Prof. Trewin back when he was an undergraduate student at the University of Aberdeen. Prof. Trewin helped to start MGB's career in palaeontology and for that the author is extremely grateful.

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