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RAPID COMMUNICATION

THE FIRST GRAVID ICHTHYOSAUR FROM THE HAUTERIVIAN (EARLY CRETACEOUS): A COMPLETE *MYOBRADYPTERYGIUS HAUTHALI* VON HUENE, 1927 EXCAVATED FROM THE BORDER OF THE TYNDALL GLACIER, TORRES DEL PAINE NATIONAL PARK, SOUTHERNMOST CHILE

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ABSTRACT—Ichthyosaurs were pelagic marine reptiles with a global distribution through most of the Mesozoic. Cretaceous Ichthyosauria are mostly known from the northern hemisphere, although findings from the southern hemisphere have been reported from Australia, Argentina, Chile, and New Zealand. Despite these findings that have contributed to knowledge of the clade, there is still a dearth of information about the evolution, phylogenetics, and ecology of Cretaceous ichthyosaurs from the Southernmost Pacific margin of Gondwana. A Lower Cretaceous locality next to the Tyndall Glacier, inside Torres del Paine National Park, southernmost Chile, has yielded 87 ichthyosaur skeletons to date. Most of the specimens recorded from this area are complete and articulated, however, they are affected by recent weathering and the constant erosion. Here we describe a complete platypterygiine ichthyosaur, which we provisionally assign to *Myobradypterygius hauthali* von Huene, 1927. The specimen was excavated from the border of the glacier in Patagonia during March and April 2022 and corresponds to the first complete excavated ichthyosaur from Chile. This specimen additionally preserves gastrointestinal contents and is the only Hauterivian (131 Ma) ichthyosaur documented to date containing the articulated skeleton of a preserved fetus. This research increases the knowledge of the paleobiology of the species. In addition to morphology, it contributes information regarding paleoecology and paleopathology, diet, and reproduction in *M. hauthali*, a taxon potentially restricted to the Pacific margin of Gondwana.

SUPPLEMENTARY FILE(S)—Supplementary file(s) are available for this article for free at www.tandfonline.com/UJVP

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INTRODUCTION

This work presents the preliminary results of the excavation of a complete and articulated gravid ichthyosaur (MHNRS-Pa-1) from the Early Cretaceous of Torres del Paine National Park, southernmost Chile (Figs. S1 and S2, Supplementary File 1). The fossil had been exposed on the border of the Tyndall Glacier after the continuous ice recession and was initially discovered by the main author in 2009. The Tyndall fossil locality is a rich Lagerstätte deposit (Stinnesbeck et al., 2014). The associated invertebrate fossils found in the area (i.e., ammonites, belemnites, and inoceramids) suggested that the locality is Valanginian to Hauterivian in age (Stinnesbeck et al., 2014), however recent U-Pb CA-TIMS analyses position the unit at 131.07 ± 0.07 Ma (M. Malkowski,

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This new specimen complements the record of Early Cretaceous ichthyosaurs from the southern hemisphere, which records include ophthalmosaurians from Australia (Kear, 2003; 2005), Argentina (Campos et al., 2024; Fernández & Aguirre-Urreta, 2005; Fernández, 2007; Lazo et al., 2018; von Huene, 1925, 1927), Chile (Pardo-Pérez et al., 2012, 2015, 2024; Pardo-Pérez, 2015; Schultz et al., 2003; Stinnesbeck et al., 2014), and New Zealand (Sachs & Grant-Mackie, 2003).

MHNRS-Pa-1 corresponds to the first completely exposed, articulated, and excavated specimen from Chile and the most complete specimen of *Myobradypterygius hauthali* recorded to date. It is also unique in representing the first gravid ichthyosaur recovered to date from Hauterivian sediments (reviewed in Miedema et al., 2023). This research will contribute to a better understanding of the taxon, and also to the diversity and distribution of ichthyosaurs through the southern paleo-Pacific margin of Gondwana.

MATERIAL AND METHODS

Material

MHNRS-Pa-1—A complete and articulated skeleton 3.50 m in length (estimated), preserving cranial and articulated postcranial bones (Fig. 1; Supplementary File 2). This specimen arrived head-first to the sea floor; the snout penetrated about 10 cm into the sediment. Subsequently, the entire skeleton shifted towards the left side, resulting in its exposure in right lateral view. The combination of rapid sedimentation and benthic hypoxia, inferred by the thin layers of pyrite intercalations, hindered scavengers and allowed the complete and articulated preservation of this specimen. The specimen was excavated in 2022 and is currently under preparation in the Natural History Museum Río Seco in Punta Arenas.

Methods

The excavation was performed during a 31-day field campaign on the border of Tyndall Glacier. Before starting the excavation, the specimen was drawn 1:1 on site on a plastic acetate foil and photographed to create a photogrammetric model. The specimen was excavated in five blocks and transported by helicopter to the next ranger station (see more details in the Supplementary File 1).

Institutional Abbreviations—MHNRS, Museo de Historia Natural Río Seco, Punta Arenas, Chile. **TY**, is the abbreviation used for the Tyndall glacier specimens that remain on site.

RESULTS AND DISCUSSION

Taxonomic Referral

MHNRS-Pa-1 was previously cited as '*Platypterygius*' *hauthali* in Stinnesbeck et al. (2014) with the acronym TY56, however, no anatomical description or taxonomic discussion was provided. Most of the skull elements are still under the sediment and the specimen is currently under preparation; however, the shape of the anterior external naris can be discerned. Three distal facets on the humerus for articulation with the ulna, radius, and an anterior extrazeugopodial element, a forefin with rectangular tightly packed phalanges, and a hexagonal intermedium supporting two distal digits are all characteristic of *Myobradypterygius hauthali* von Huene (1927) (see also Pardo-Pérez, 2015; Pardo-Pérez et al., 2024) (Fig. 1E, F). Following this, we provisionally refer MHNRS-Pa-1 to this taxon.

Description

The exposed skeleton comprises the posterior skull, postcranial axial skeleton, pectoral and pelvic girdles, and forefins (Fig. 1). Bone interpretations were assessed by direct comparison to *Platypterygius australis* skull AM F98273 (see Kear, 2005), based on similarities in the shape of the nares.

Maxilla—The maxilla is well-exposed anterior to the posterior narial opening (Fig. S2C, D). A robust ascending process contacts the nasal. The maxilla forms the anterior and ventral edges of the circular posterior narial opening. The lack of a posterior ascending process forming the posterior wall of the posterior narial opening appears to be genuine. Posteriorly, prominent grooves are interpreted as remnants of the jugal facet.

Nasal—A portion of the right nasal is recognized in MHNRS-Pa-1. The ventral margin of the lateral nasal contacts the ascending process of the maxilla over a broad contact, and posteriorly participates in the formation of the dorsal border of the posterior narial opening. The posterodorsal portion of the lateral nasal forms the ventral edge of a bilobate structure, likely foramina located dorsal to the narial opening. The contact between the nasal and lacrimal is not clear.

Lacrimal—The lacrimal is extensively eroded laterally, and its contacts with the nasal and maxilla are not clear. The lacrimal appears to contact the external narial opening in lateral view, and potentially forms its posterior edge. The circumorbital edge of the lacrimal is made of much denser bone than the anterior portion of the element.

Naris—The naris is not completely preserved but the posterior external narial opening can be discerned by the shape of the maxilla, which at this level forms the anterior and ventral edges of a concave opening 34 mm in depth. The posterior edge of the posterior external narial opening is not preserved, but appears to have been formed by the lacrimal. The anterior narial opening is not exposed.

The narial region is also exposed in another specimen from the Tyndall fossil locality, TY61, also referred to *M. hauthali* (Pardo-Pérez et al., 2024). Both specimens support the existence of a deep maxilla with a robust nasomaxillary pillar dividing the external nares into anterior and posterior parts (Fig. S2C, D).

Postcranial Axial Skeleton—The vertebral column is almost completely exposed in right lateral to anterolateral and posterolateral views, except for two portions of the presacral series and neural arches that are embedded in the sediment (Table S1 and additional text in Supplementary File 1).

Forefin—The forefin of *Myobradypterygius hauthali* has been described in detail elsewhere (see Campos et al., 2024; Pardo-Pérez et al., 2012, 2024; Pardo-Pérez, 2015). Only morphology not described elsewhere is detailed in the Supplementary File (Fig. S2E, F; Table S2, Supplementary File 1).

Fetus—A fetus was identified within the body cavity of MHNRS-Pa-1 based on a 150 mm-long section of 15 articulated vertebrae in lateral exposure, and one in articular view. Vertebral centra are ~15 mm high and 8.5 mm in length. A small notochordal foramen is preserved in the centrum in articular view. This vertebral section likely corresponds to the caudal portion of the fetus, according to the dorsoventral reduction of the height of the vertebrae in a posterior direction (Fig. 1G; Fig. S4A, Supplementary File 1). No neural arches or spines are observed. The remainder of the fetal skeleton is probably embedded in the sediment.

To date, only two ophthalmosaurian ichthyosaur taxa preserving fetuses have been described, both from the Albian (Early Cretaceous): *Maiaspondylus lindoei* (Maxwell & Caldwell, 2003) and *Platypterygius australis* (Kear & Zammit, 2014). The fetus associated with MHNRS-Pa-1 thus contributes to filling an important gap in the fossil record of ichthyosaurian reproductive biology (Toarcian Albian). The preserved fetuses of *Maiaspondylus lindoei* are very small and poorly ossified. However, those of *Platypterygius australis*

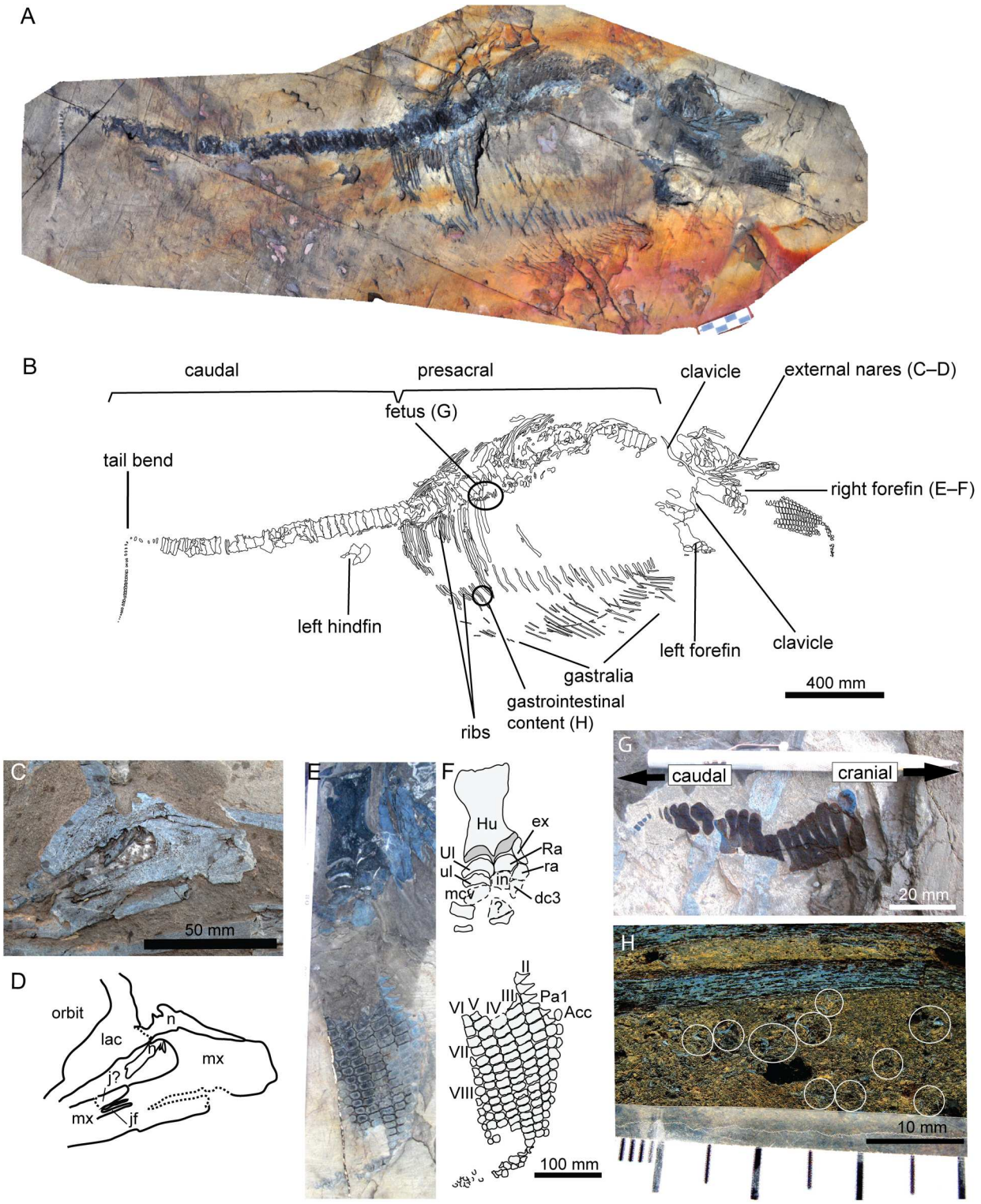

FIGURE 1. Skeleton of *Myobradypterygius hauthali* von Huene, 1927 (MHNRS-Pa-1). **A**, orthogonal image of MHNRS-Pa-1. Scale equals 20 cm. **B**, interpretative drawing of the complete skeleton of MHNRS-Pa-1, indicating its most relevant preserved sections. **C**, a close-up of the narial aperture. **D**, interpretative drawing of its shape and surrounding preserved bones. **E**, photograph of the exposed right forefin. **F**, interpretative drawing of the forefin. **G**, image showing part of the preserved fetus with the vertebrae outlined in a black line. **H**, image showing some of the exposed gastrointestinal content of MHNRS-Pa-1. Small teleostean vertebrae are outlined in white circles. **Abbreviations**: **Acc**, anterior accessory phalanges; **dc3**, distal carpal three; **ex**, extrazeugopodial element; **Hu**, humerus; **in**, intermedium; **j**, jugal; **jf**, jugal facet; **lac**, lacrimal; **mx**, maxilla; **mcV**, metacarpal five; **n**, nasal; **Pa1**, preaxial digit one; **Ra**, radius; **ra**, radiale; **Ul**, ulna, **ul**, ulnare; **II**, digit two; **III**, digit three; **IV**, digit four; **V**, digit five; **VI**, digit six; **VII**, digit seven; **VIII**, digit eight.

are comparably well ossified, assumed to be a later developmental stage. At 15 mm in height, the fetal centrum of *Myobradypterygius hauthali* for an adult 3.5 m in length is surprisingly large, considering that the fetal centrum figured by Kear and Zammit (2014) measured approximately 24 mm in height for an adult up to 7 m in length (Kear et al., 2003), and might reflect proportionately larger young in *M. hauthali*, or be related to an advanced developmental stage. The fetus of *M. hauthali* is positioned with the skull oriented toward the female skull; this is consistent with the observation that tail-first parturition is the most prevalent birth orientation in merriamosaurian ichthyosaurs (Miedema et al., 2023).

Intestinal Contents—A dense accumulation of unevenly compacted phosphatic material is preserved in the posterior rib cage and is interpreted as potential intestinal contents. Disarticulated vertebrae of small teleostean fishes can be recognized (Fig. 1H; Fig. S4B, Supplementary File 1).

Direct evidence of diet is uncommon in Cretaceous ichthyosaurs, thus far only having been documented from *Platypterygius australis*, a much larger ichthyosaurian taxon with a generalist diet apparently including turtles, birds, and fishes (Kear et al., 2003). The small fish bones constituting the intestinal contents documented in MHNRS-Pa-1 are consistent with both its relatively small adult size and the local fauna, where the largest fishes appear to be only 30–40 cm maximum length (Stinnesbeck et al., 2014). The record of coprolites containing fish remains in another ichthyosaur from the Tyndall fossil locality provides evidence that fish were a regular part of the ichthyosaur diet in this area (Stinnesbeck et al., 2024).

Taphonomy—The interpretation of a head-first landing into the sediment is supported by the position of the anterior skull of MHNRS-Pa-1 being embedded on a deeper sedimentary layer than the postcranium. The embedded rostrum is clearly visible from the lateral side of the rock block containing the skull (see Fig. S3 in Supplementary File 1). While we cannot confirm whether the landing was caused by a turbidite mass flow, as proposed by Stinnesbeck et al. (2014), or by other mechanisms, the matrix of the layer in which MHNRS-Pa-1 was found is composed by turbidite deposits (see additional supplementary text in Supplementary Files).

CONCLUSION

This communication documents some preliminary observations on the anatomy of MHNRS-Pa-1. This specimen corresponds to the first complete ichthyosaur excavated from Chile, as well as only the third instance of a gravid Cretaceous ichthyosaur (the first from the Hauterivian) and the second instance of direct dietary evidence in a Cretaceous ichthyosaur. MHNRS-Pa-1 is referred to *Myobradypterygius hauthali*, named based on a partial forefin, and some vertebrae from the Berriasian Río Belgrano Formation in Argentina, but apparently abundant in the Eastern Pacific region during the Early Cretaceous (Pardo-Pérez et al., 2024). Further studies of the ichthyosaurian material from southern Chile will greatly enhance our understanding of its anatomy, paleobiology, and paleoecology, as well as the life history of ichthyosaurs from the Pacific margin of southernmost Gondwana.

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AUTHOR CONTRIBUTIONS

JP-P designed the project, JP-P and EEM collected the data, MM, PZ, and AP provided geological and stratigraphic information, JP-P, CGM, and EEM took photographs and did the photogrammetry, JP-P, EEM, and FS prepared the figures, CGM, JL, and HO excavated the specimen, AP and CGM prepared the specimen, JP-P and JD prepared the tables, all the authors contributed in the preparation of the manuscript.

DATA AVAILABILITY STATEMENT

The authors confirm that the data supporting the findings of this study are available within Supplementary Files 1 and 2. In addition, photogrammetry 3D model of MHNRS-Pa-1 is deposited on Figshare and can be downloaded using the following DOI: 10.6084/m9.figshare.26065444

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the author(s).

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SUPPLEMENTARY FILES

Supplementary File 1. docx. Additional descriptions on the geological setting of the fossil locality, the anatomy of MHNRS-Pa-1 and paleobiology.

Supplementary File 2. Obj. 3D Photogrammetric reconstruction of MHNRS-Pa-1.

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