New ichthyosaur remains from the Turmiel Formation (Lower Jurassic) of Ariño (Teruel, Spain)

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Introduction

Ichthyosaurs were a group of fully aquatic marine reptiles that lived from the Early Triassic to the Late Cretaceous, spanning a temporal range of approximately 145 million years and achieving a wide global distribution.

Despite their cosmopolitan distribution and abundance in Jurassic localities across Europe (often with exceptional preservation), the ichthyosaur record in the Iberian Peninsula, and especially in Spain, is generally scarce, isolated, and fragmentary. However, the southern paleogeographic position of Iberia relative to other European sites enhances the value of these discoveries. These findings extend and broaden the presence of this group of marine reptiles in the western Tethys region, reaching areas much farther south than their main areas of diversity and abundance, such as Central Europe.

Ichthyosaur remains in the Iberian Peninsula have been primarily found in Lower Jurassic deposits across several localities on the Portuguese Atlantic coast and in northern Spain, specifically in Asturias (Ruiz-Omeñaca et al., 2006; Pereda-Suberbiola et al., 2010; Pratas e Sousa et al., 2025). Several significant discoveries stand out, contributing to our understanding of the evolution and distribution of these marine reptiles in the proto-European Atlantic Ocean. These include *Gadusaurus aqualigneus*, a Neoichthyosaurian thunnosaurian from the Sinemurian (Pratas e Sousa et al., 2025), and the remains of a partial *Leptonectes* sp. skeleton found in the Pliensbachian of the Rodiles Formation, Asturias (Fernández et al., 2018). In addition, Triassic remains of an ichthyosauriform have been described in the Balearic Islands (Matamales-Andreu et al., 2020), an ichthyosaur in Manzanera, Teruel (Aragon) (de Miguel Chaves et al., 2015), and several vertebrae in the Toarcian of Alòs de Balaguer (Catalonia) (Chambers et al., 2012).

In this context, we present the first Jurassic ichthyosaur remains found in Aragon, significantly expanding the Iberian fossil record.

Geographical and Geological Setting

The remains came from two sites, Mas del Gato-1 and Mas del Gato-2, situated a few kilometres northwest of the town of Ariño, within the province of Teruel (Aragon, Spain), in the northeastern Iberian Peninsula.

Both localities are found within the Turmiel Formation, as defined by Goy et al. (1976). This formation's stratotype is located in the Mesa River valley in Guadalajara, Spain. The Turmiel Formation extends not only through that area but also into the Iberian Range of Teruel, and, in isolated occurrences, even into the Catalan Coastal Range. Its age is primarily Toarcian, though locally, its lower part can date to the late Pliensbachian,

and its upper part to the early Aalenian. Therefore, it represents the last Lower Jurassic unit present in the study area.

This formation is characterized by an alternation of marls and limestones (predominantly mudstone and, to a lesser extent, wackstone and packstone). It exhibits shallowing and deepening sequences, with sedimentation occurring in an outer shelf environment, below wave base. Occasionally, tempestite levels are observed, which can extend for several tens of kilometres. In the Ariño area, the Turmiel Formation can reach a thickness of up to 40 meters (Goy et al., 1997).

Material and methods

The material from the Mas del Gato-1 locality was recovered in the 1990s by José María Abad and subsequently donated to the Museo de Ciencias Naturales de la Universidad de Zaragoza. The remains, found disarticulated and fragmented, include: an incomplete skull; part of the appendicular skeleton, with several fragments of the pectoral girdle, an incomplete right forefin; a fragment of the left humerus; as well as various rib fragments. Given the preservation state of the remains and the presence of some external molds where the body fossil had been lost, they were scanned at the TESCAN MicroCT CoreTOM at CENIEH (National Center for Research on Human Evolution) in Burgos (Spain).

From the Mas del Gato-2 locality, two large posterior dorsal or anterior caudal vertebrae, a fragment of a third caudal vertebra, a phalanx, and a tooth fragment were recovered. This material was found and donated to the Museo de Ciencias Naturales de la Universidad de Zaragoza by the geologists María José Mayayo and Felipe Barbed.

Results and Discussion

The morphology of the reconstructed skull of Mas del Gato-1 features an elongated, narrow rostrum with numerous small, very similar conical teeth and aulacodont dental implantation. These characteristics allow the specimen to be assigned to an ichthyosaur within the Parvipelvia euichthyosaur clade (Maxwell & Cortés, 2020).

The morphology of the left forefin displays a humerus with only two facets for the radius and ulna, and a phalangeal count between 4 and 5 digits. This is a typical synapomorphy of ichthyosaurs belonging to the Neoichthyosauria clade up to the Middle Jurassic, at which point ichthyosaurs of this clade began to exhibit three facets on the humerus, a distinctive character of the Ophthalmosauridae family (Fischer et al., 2012). Therefore, the Mas del Gato-1 remains belong to a neoichthyosaur, likely from the Eurhinosauria clade or the families Ichthyosauridae or Stenopterygiidae, within Thunnosauria.

As for the remains of the Mas del Gato-2 locality, the vertebrae exhibit the typical biconcave disc morphology, with a length of 6–7 cm and a diameter of approximately 12–13 cm. Regarding the tooth fragment, it shows distinct striations. The material is highly fragmentary and does not present conclusive diagnostic characters. However, the size of the vertebrae and the tooth are comparable to remains described for the neoichthyosaur *Temnodontosaurus*, the only Toarcian genus that reached significantly large body sizes. Furthermore, longitudinal striation on the dental enamel is a character present in Triassic ichthyosaurs, but it tends to be reduced or absent in more derived clades. *Temnodontosaurus* is characterized by having teeth with distinct longitudinal striations.

Conclusions

The ichthyosaur remains from the Turmiel Formation (Toarcian) at the Ariño localities belong to the Neoichthyosauria clade. It is probable that they represent two distinct species: a small-sized thunnosaurian and a large-bodied ichthyosaur, whose remains are comparable to those of the genus *Temnodontosaurus*.

The co-occurrence of these two types of specimens within the same geological formation suggests an ecological niche partitioning, with each species likely exploiting distinct resources or employing varied hunting strategies. These discoveries not only confirm the presence of at least two ichthyosaur species in the Toarcian of the Iberian Range, but also provide crucial evidence for the presence of these Early Jurassic marine reptiles in the northeastern Iberian Peninsula.

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