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Excavating the 'Rutland Sea Dragon': The largest ichthyosaur skeleton ever found in the UK (Whitby Mudstone Formation, Toarcian, Lower Jurassic)

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ABSTRACT

An almost complete ichthyosaur skeleton 10 m long was discovered in January 2021 at the Rutland Water Nature Reserve in the county of Rutland, UK. This was excavated by a small team of palaeontologists in the summer of the same year. Nicknamed 'The Rutland Sea Dragon', this almost fully articulated skeleton is an example of the large-bodied Early Jurassic ichthyosaur *Temnodontosaurus*. The specimen was analysed *in situ*, recorded (including a 3D scan using photogrammetry), excavated and removed from the site in a series of large plaster field jackets to preserve taphonomic information. Significantly, the specimen is the largest ichthyosaur skeleton to have been found in the UK and it may be the first recorded example of *Temnodontosaurus trigonodon* to be found in the country, extending its known geographic range significantly. It also represents the most complete skeleton of a large prehistoric reptile to have been found in the UK. We provide an account of the discovery and describe the methods used for excavating, recording and lifting the large skeleton which will aid palaeontologists facing similar challenges when collecting extensive remains of large and fragile fossil vertebrates. We also discuss the preliminary research findings and the global impact this discovery has had through public engagement.

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1. Introduction

Ichthyosaurs are one of the most iconic prehistoric reptiles. The first specimen to be brought to the attention of science was collected over 200 years ago by Joseph and Mary Anning in Lyme Regis, Dorset, England (Home, 1814; Torrens, 1995). The first complete prehistoric marine reptile to be formally described was an ichthyosaur, probably also collected by Mary Anning (Home, 1819; Lomax and Massare, 2022). Since these early discoveries, thousands of ichthyosaur fossils ranging from isolated vertebrae to complete skeletons have been found across the UK, largely from coastal exposures and quarries but also estuaries, road and rail cuttings *etc.*

Unarguably, the most famous ichthyosaurs from the UK are those collected from the Early Jurassic, specifically from the classic collecting sites along the Lyme Regis stretch of coastline and from the various quarries in the village of Street and surrounding areas in Somerset. Other notable Early Jurassic localities in the UK include the numerous exposures along the Yorkshire Coast and old quarries in Leicestershire and Nottinghamshire (*e.g.*, Martin et al., 1986; Lomax and Gibson, 2015). Based on the most recent taxonomic work, at least nine genera comprising multiple species are currently known from the Early Jurassic of the UK, such as *Ichthyosaurus*, *Temnodontosaurus*, *Leptonectes*, *Protoichthyosaurus* and

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Abbreviations: LEICT, Leicester Museum and Art Gallery, 53 New Walk, Leicester, UK; NHMUK, Natural History Museum, London, UK.

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Stenopterygius (Lomax, 2016; Lomax et al., 2017; Massare and Lomax, 2018; Lomax, 2019; Maxwell and Cortés, 2020; Swaby and Lomax, 2021; Laboury et al., 2022). Most of these genera are small to medium-sized, ranging from about 1.5 m to 6 m or so (McGowan and Motani, 2003; Lomax and Sachs, 2017; Lomax et al., 2019). However, the largest of these by far is *Temnodontosaurus*, known from numerous specimens, including several skeletons representing very large individuals.

Here, we describe the excavation of a practically complete 10 metre-long *Temnodontosaurus* skeleton (Fig. 1) unearthed in 2021 at Rutland Water Nature Reserve, part of a large reservoir complex in the small county of Rutland in the East Midlands of England (Fig. 2).

2. Geographical location

Located just to the east of Rutland's county town, Oakham, Rutland Water comprises 1215 ha of open water and by surface area is the largest reservoir in England. Its construction was completed in 1978 and it provides water to the conurbations of the East of England. A biological Site of Special Scientific Interest (SSSI), it is also a Special Protection Area under the European Union Directive on the Conservation of Wild Birds and a 'Conservation Review' site. An area of 1333 ha is designated a Ramsar Site, an internationally important wetland site and 450 ha at the shallow western end of this is the Rutland Water Nature Reserve, managed by the Leicestershire and Rutland Wildlife Trust (LRWT) although the land is owned by Anglian Water. This area consists of eight shallow lagoons and bunded-off sections of the main water and provides a haven for a broad array of wildlife but is internationally important for wintering wildfowl and regularly attracts over 25,000 wetland birds.

Sixty-four potential sites in and around the Northamptonshire area were investigated for suitability to become the reservoir before the twin valleys of the River Gwash were chosen. The three main reasons for selecting this location were the availability of clay within the area to build the dam, the nearness of the River Welland and the River Nene to supply the water needed, and its central location to the area requiring the water — the expanding population of the East of England (Ovens and Sleath, 2007). In addition, the valleys are underlain by the impervious clay of the Whitby Mudstone Formation (WMF).

3. Geological setting

The geology that surrounds and underlies Rutland Water comprises Jurassic sandstones, mudstones and limestones; the clay-dominated Lias Group (Lower Jurassic) is overlain by the limestone-dominated Inferior Oolite Group (Middle Jurassic). See Figures 2 and 3 for a summary of the geological setting.

When the reservoir dam was constructed using local clay in the 1970s, invertebrate fossils (*e.g.*, ammonites, belemnites, and bivalves; LEICT archives) were found to be abundant and two medium-sized partial ichthyosaur skeletons were discovered and excavated (LEICT G854.1974 & LEICT G1.1977). These specimens are from the Whitby Mudstone Formation (WMF) of the Toarcian Stage of the Lower Jurassic. The WMF is named for the extensive exposures along the Yorkshire coastline near the town of Whitby where numerous marine reptiles have been found (Benton and Taylor, 1984; Lomax, 2019). Descriptions of the two ichthyosaur specimens have yet to be published although there is a brief mention in Benton and Spencer (1995, p. 105). Of the two, LEICT G854.1974 was collected from a known horizon close to the reservoir dam (Figs. 2 and 3), whilst the other (LEICT G1.1977) has limited collection data. Both specimens include approximately 60 vertebrae along with skull and limb material and the finds probably represent two taxa based on differences in vertebral proportions and regional transitions. The two specimens are in the collections of Leicester Museum and Art Gallery and a full study and formal description of them is currently in preparation.

Forrest (2000) described fragmentary material of a large rhomaleosaurid plesiosaur (LEICT G2.1988) found adjacent to Rutland Water and originating from the WMF (Bifrons Chronozone). One other local tetrapod of note was found not far from Rutland Water; a relatively well-preserved partial skeleton referred to the sauropod dinosaur *Cetiosaurus oxoniensis* (LEICT G468.1968, 'The Rutland Dinosaur'). This was discovered in June 1968 at Great Casterton in Rutland (Fig. 2) and was collected by staff of Leicester City Museums. Whilst the original stratigraphical position of the specimen could not be examined directly, it was clearly from Middle Jurassic (Bajocian) sediments at the base of the Rutland Formation (Upchurch and Martin, 2002) so would be approximately 10 to 13 million years younger than the fossils from Rutland Water. Most of the *Cetiosaurus* material is now on display at Leicester Museum and Art Gallery, as a ~15 m long articulated skeleton comprising some real bones and some hand-modelled replicas. This remains one of the most complete sauropods to have been found in the UK (Upchurch and Martin, 2002; Lomax and Tamura, 2014).

4. Discovery of the 'Rutland Sea Dragon'

On January 20th 2021, after water levels had been lowered to undertake maintenance work, Joseph (Joe) Davis – the Conservation Team

Fig. 1. The fully exposed skeleton of the 'Rutland Sea Dragon', a 10-metre-long ichthyosaur. Dean Lomax (6′5″/196 cm) as scale. © Anglian Water.

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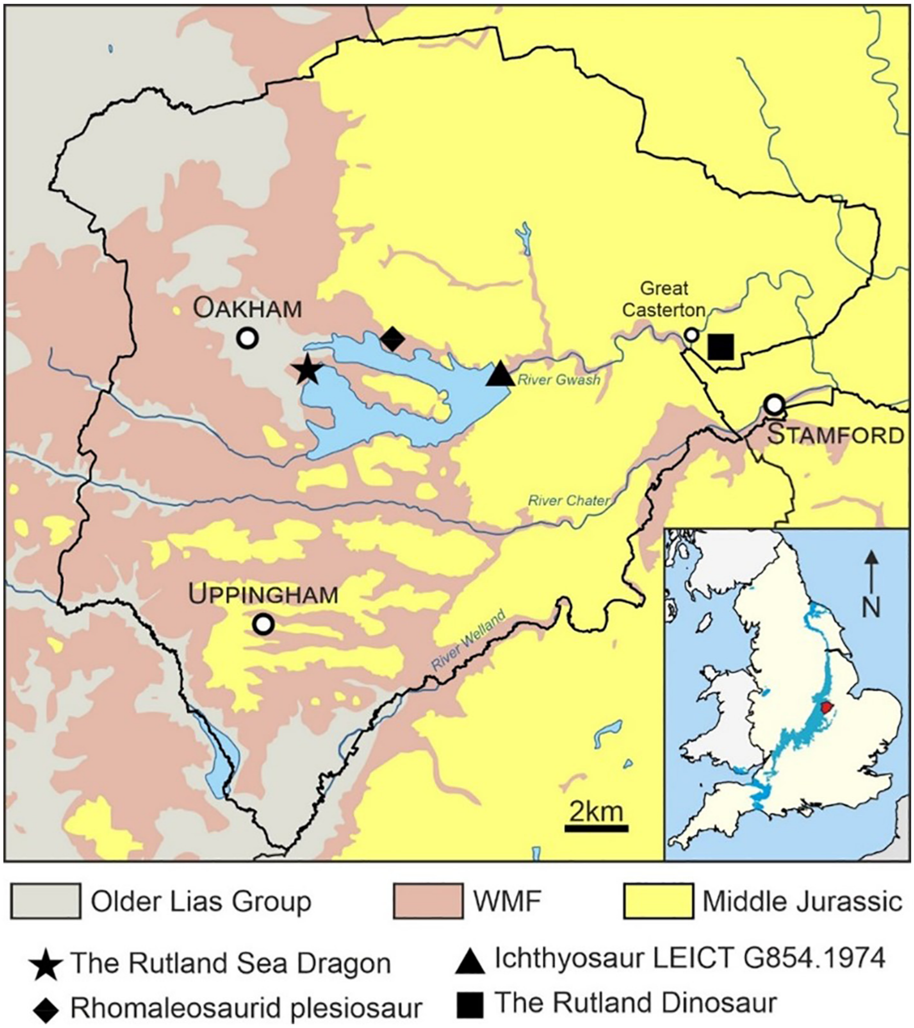

Fig. 2. Map showing the location of Rutland within the UK and Rutland Water in the centre of the county; the star indicates the location of the Rutland ichthyosaur (grid reference: SK 87894 08030; What3Words: waitress.beamed.pizzeria); other symbols represent the location of other significant tetrapod fossils mentioned in the text.

Leader at the Leicestershire and Rutland Wildlife Trust – discovered something unusual in Lagoon 4, part of Rutland Water Nature Reserve (grid reference: SK 87894 08030; Fig. 2). More than a dozen large, semi-articulated vertebrae were standing just proud of the wet clay that had until recently been covered by water. He was not sure what animal they were from or if there were more bones hidden under the mud, but he made sure that they were not damaged whilst he sought relevant specialists to check their significance. His local council correctly directed him to the nearby University of Leicester. A day after Joe had made the find, Vicky Ward, curator in the School of Geography, Geology and the Environment at the university forwarded his query on to Dean Lomax, an expert on marine reptiles and British dinosaurs, and Mark Evans, an expert on marine reptiles who had been the Curator of Natural Sciences at the nearby Leicester Museum & Art Gallery for 21 years until curatorial redundancies in 2019. Joe's enquiry was also passed to Mark *via* Leicestershire County Council's heritage team and John Martin, a former museum colleague, which provided crucial information on the location of the discovery. Dean and Mark discussed the find and how best to assess its significance, considering that the discovery had been made during a lockdown in the COVID-19 pandemic.

After approval of a COVID-19 Risk Assessment, Mark visited the site straight away as he lived locally. Thirty vertebrae could be seen, along with elements from the pectoral girdle and skull, exposed over an extent of almost 5 m. As a result of this, a site visit was made on 15th February 2021 by a small team comprising Dean Lomax, Mark Evans, Nigel Larkin and Darren Withers to assess the specimen as fully as possible and to decide if an excavation was warranted (Fig. 4). Within a few hours' work the soft, wet Jurassic clay had been removed by hands and trowels from almost the whole specimen. This revealed what appeared to be a completely preserved skeleton approximately 10 m long, with an almost fully articulated vertebral column right down to the penny-sized caudal vertebrae at the very tip of the tail. Some bones of the skull were exposed, but it was decided not to expose any more of the skull due to the damp, wintery conditions.

It was obviously a significant find, not only in terms of its size – clearly the largest ichthyosaur fossil to have been found in the UK – but because of the completeness of the skeleton, with large-bodied ichthyosaurs usually being represented by fragments or partial skeletons in the UK. It was also clear that the specimen could have easily been destroyed by heavy excavation equipment during the initial construction of this lagoon and its islands just 10 years previously, or by ploughing before that as the area had previously been farmland and the specimen must have lain less than a metre below the original land surface.

Once the team had exposed as much as they could, a 3D scan was taken of the skeleton using photogrammetry to record its size and the positions of the bones, and so that a digital 3D model of the specimen could be made. Isolated bones which had been fully uncovered and recorded, such as elements from the disarticulated forelimbs, were collected to prevent loss or damage. The skeleton was then carefully covered with thin plastic sheeting, mud and a heavy tarpaulin to protect

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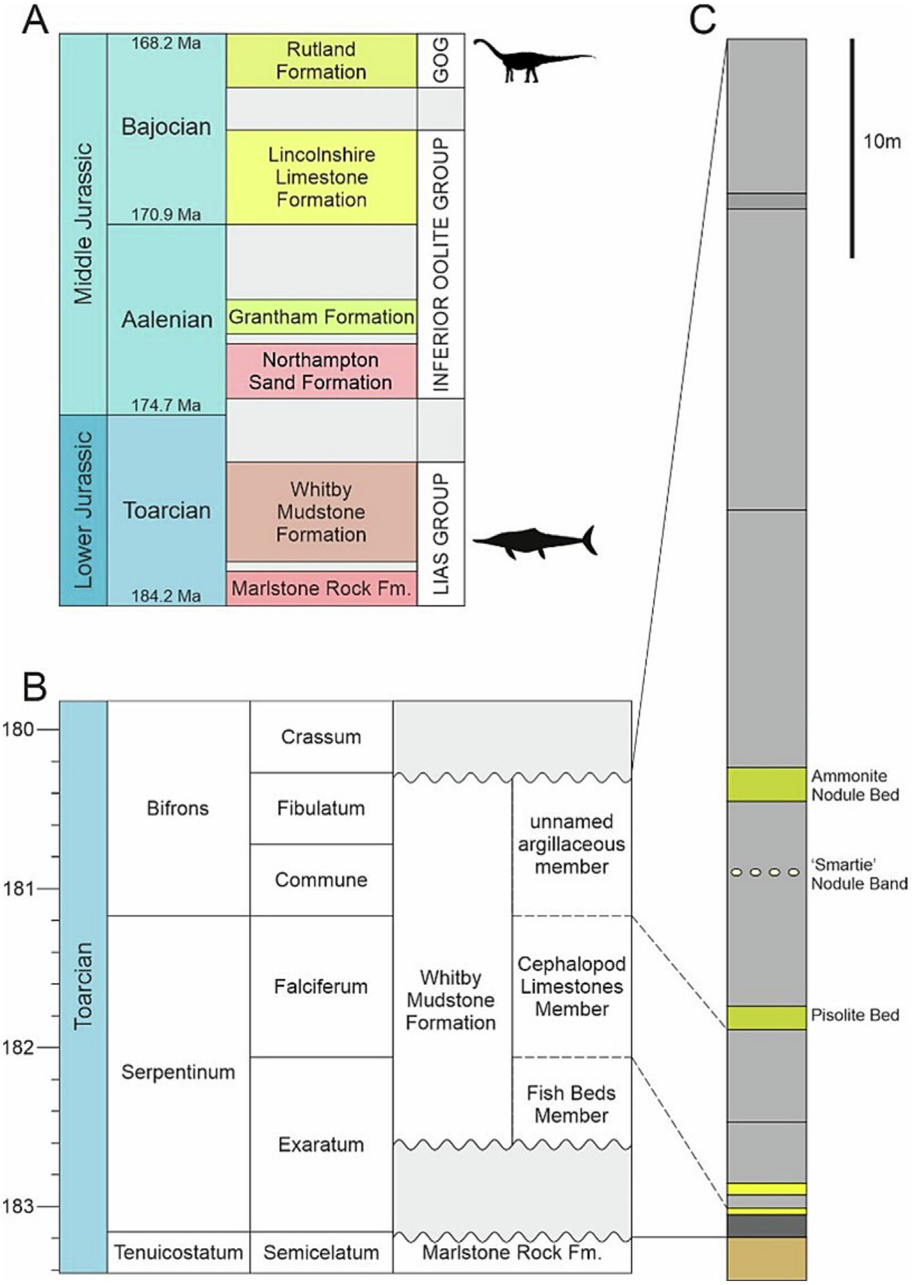

Fig. 3. The geological setting of Rutland Water and the Rutland Sea Dragon. A, General lithostratigraphical framework of the Rutland Water area, silhouettes show the approximate horizons for the 'Rutland Sea Dragon' and 'Rutland Dinosaur'; B, bio- and lithostratigraphy of the Whitby Mudstone at Rutland Water, after Horton and Coleman (1977); C, geological section for the area based on borehole SD6, SK 9472 0737 (after Horswill and Horton, 1976). Abbreviations: GOG, Great Oolite Group.

it from the elements. The water levels would need to be raised soon after the visit (necessary for the lagoon's role as a wetland nature reserve) and the water levels would not be low enough again for an excavation until the following August. This provided six months to organise a full excavation of the large skeleton and to secure appropriate funding to cover the costs.

5. Methods and materials

5.1. Planning the excavation

Although the specimen would be partially protected under water whilst the excavation was being planned, the owners of the site, Anglian Water, were concerned about unauthorised access. Firstly, the potential theft of parts of the specimen was a serious threat despite trespassers facing significant physical risks from deep water and deep mud. In addition, the main reason for the existence of the reserve is the wildlife (and wildlife watchers) which must not be disturbed at certain times of year. This meant that everyone involved in the project had to sign a Non-Disclosure Agreement to keep the find as confidential as possible, although funding had to be secured for the excavation.

Anglian Water (the landowner) were generous hosts and LRWT would provide some on-site accommodation for the excavation, but further funding was required to cover further accommodation and travel costs for the excavation team, essential materials for digging, recording and packing the specimen, and van hire and diesel for transporting the specimen to appropriate storage. Securing funding to excavate the largest ichthyosaur skeleton to be discovered in the UK should have been a relatively easy task. However, having only six months to procure it was problematic as most funders have set deadlines at specific points in the

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Fig. 4. Assessing the newly discovered specimen in Lagoon 4 at Rutland Water, in February 2021. Note the line of vertebrae sticking proud of the mud from bottom left to the centre. Left to right: Darren Withers, Dr Mark Evans, Dr Dean Lomax and Nigel Larkin. © Natalie Turner.

year and either the initial submission deadline had already passed or the decision would be made too late. Despite some disappointing rejections, The Geologists' Association's Curry Fund and The Palaeontographical Society generously helped with the costs, as did Anglian Water, LRWT, Rutland County Council and Museum Development East Midlands either with direct funds or funding in kind.

The health and safety risk assessment for the excavation took place during the COVID-19 pandemic. Although the lockdown had been lifted in England, there were still considerations regarding sharing vehicles, accommodation and tools *etc*. The team took Covid tests before assembling and also regularly throughout the excavation. Even so, facemasks were worn when sharing vehicles and when indoors, food and drink was not shared and hand sanitiser was always available.

Numerous site-specific hazards were included in the Risk Assessment, including avian flu, botulism, tetanus and leptospirosis. The site was surrounded by deep water, deep mud, and shallow water with algal blooms and the excavation site itself was covered in a layer of avian guano. Because of the latter, the site was cleaned with spades before work started, wooden pallets were used to store all tools and materials on to keep them relatively clean, disposable gloves were worn at all times, and no food or drink was consumed on site. The three-page risk assessment had to be signed off by the teams at Anglian Water and LRWT before finally being read, understood and signed by all who would be working on site.

The excavation plan described the stages of the fieldwork and the various roles and skills that would be needed. Because of logistics and funding considerations as well as the risk from COVID-19, only a small team of suitably skilled individuals could be assembled for the excavation. In total, the team comprised 16 people from professional palaeontologists to experienced collectors of fossil marine reptiles but health and safety issues meant that only a set number of individuals were present each day (9, on average), allotted with specific tasks.

5.2. Uncovering the skeleton

The team started work on site on August 23rd, 2021. The site was divided into 2 m squares with upright metal stakes, with a tape running through the long axis (Fig. 5). These stakes also flagged up the extent of the specimen which was a useful guide for keeping site visitors from stepping on the skeleton.

As the water levels had slowly dropped over the preceding few weeks, the Jurassic clay surrounding the skeleton had baked hard in the sun, even under the tarpaulin. The smaller bones, such as the ribs, were often in a fragile state, laying in fairly hard clay. The top surfaces of the bones were carefully cleaned of mud with trowels and small hand tools such as oyster knives, wooden 'lolly sticks' and brushes, but were left sitting proud of the clay, *in situ* (Fig. 5). Where necessary, the bones and teeth were consolidated with Paraloid B72 in acetone (a reversible conservation-grade methacrylate co-polymer). Each evening, after working a 12-hour day, the site was covered with a very light tarpaulin which was carefully weighted down.

5.3. Recording the skeleton

The bones were plotted the traditional way with pencil on a large sheet of graph paper at 1:10 scale. Also, a detailed photographic record was made of the skeleton and of individual bones and interesting taphonomic details for reference. After fieldwork was complete, all the photographs and videos of the project were collected from members of the team and archived online, then backed up onto two external hard drives kept in separate locations.

In addition to this, once the full extent of the specimen had been revealed and cleaned as far as practicable, but before it was encased in the plaster field jackets, the whole *in situ* skeleton was 3D scanned in high definition using photogrammetry. This was vitally important for the project: not only would it provide a permanent digital record in three dimensions of the fossil and its taphonomy whilst it was still lying undisturbed in the ground, but it would also provide information that could be utilised for post-excavation research whilst the specimen remained in its field jackets. In addition, it would act as an important reference when the skeleton came to be removed from the field jackets and cleaned, conserved and prepared. The digital 3D model and associated outputs (Fig. 6) could also be used in publicity, educational work and of course the eventual permanent display.

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Fig. 5. The team cleaning the ichthyosaur skeleton during the first week of the excavation. The skull is in the foreground with the vertebral column stretching away to the distance, with the tape measure along the axis of the skeleton. Yellow flags in the foreground mark where some of the loose ichthyosaur teeth had been found. © Dean Lomax. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

The camera used was the Lumix S5 DSLR from Panasonic. Depth of field issues across such a large specimen were avoided by taking photographs in a mostly perpendicular direction to the surface of the specimen. Conditions for the photography were perfect for scanning, with cloudy but bright conditions creating an ideal diffuse lighting on the specimen (Fig. 5). Bones removed during the February investigation were temporarily replaced so that they could be included. Following the main scan a second scan of the skull was undertaken in similar conditions after more of the bones were uncovered and a third scan was undertaken when more of the abdomen was revealed. The many hundreds of photographs taken were converted into digital 3D models using commercially available photogrammetry software.

5.4. Making field jackets and lifting the skeleton

As the ichthyosaur skeleton was being uncovered, cleaned and recorded it rapidly became apparent that although the bones have good surface preservation, some were quite fragile and not well mineralised. The ribs and skull in particular were heavily cracked (Fig. 7a) and the skeleton was massive and would be heavy. The combination of these facts alone meant that the whole skeleton should be removed from site in a series of plaster of Paris and hessian field jackets, strengthened with splints. This decision was reinforced by the fact that the skeleton was preserved in its entirety, and that it exhibited some interesting taphonomic information including possible evidence of scavenging. Even though the skeleton had been plotted and 3D scanned, removing the bones from site individually would reduce their association with one another. Therefore, apart from a few stray vertebrae and some distal forelimb bones that had been scattered by post-mortem processes, the skeleton had to be lifted in a series of large and heavy plaster field jackets.

Before the field jackets were made to protect and lift sections of the skeleton, relevant bones were measured and observations on the taphonomy and taxonomic details of the skeleton were described in the site logbook. Once the skeleton had been thoroughly recorded, the small individual bones such as the dispersed elements of the forelimbs, the outlying vertebrae and loose teeth, plus molluscs were numbered and removed from site. A unique raffle ticket (in a small ziplock bag of its own) was placed with each item in a larger ziplock bag that had a description written on it in indelible marker, and the details of the numbered find were entered into the site logbook. This prevented inadvertent duplication of specimen numbers. Before each specimen was lifted, a close-up photo was taken of it with its raffle ticket, and another wider angle shot taken to give context. Once the small items had been removed from site, the rest of the skeleton was excavated in sections, each in a numbered plaster field jacket.

A trench was dug around the skeleton, leaving it on a large pedestal of Jurassic clay. It was decided where each jacketed section would begin and end using natural gaps in the skeleton where possible. Where necessary, bone surfaces were consolidated with Paraloid B72 in acetone. Once this had set, a layer of acid-free tissue paper was used in direct

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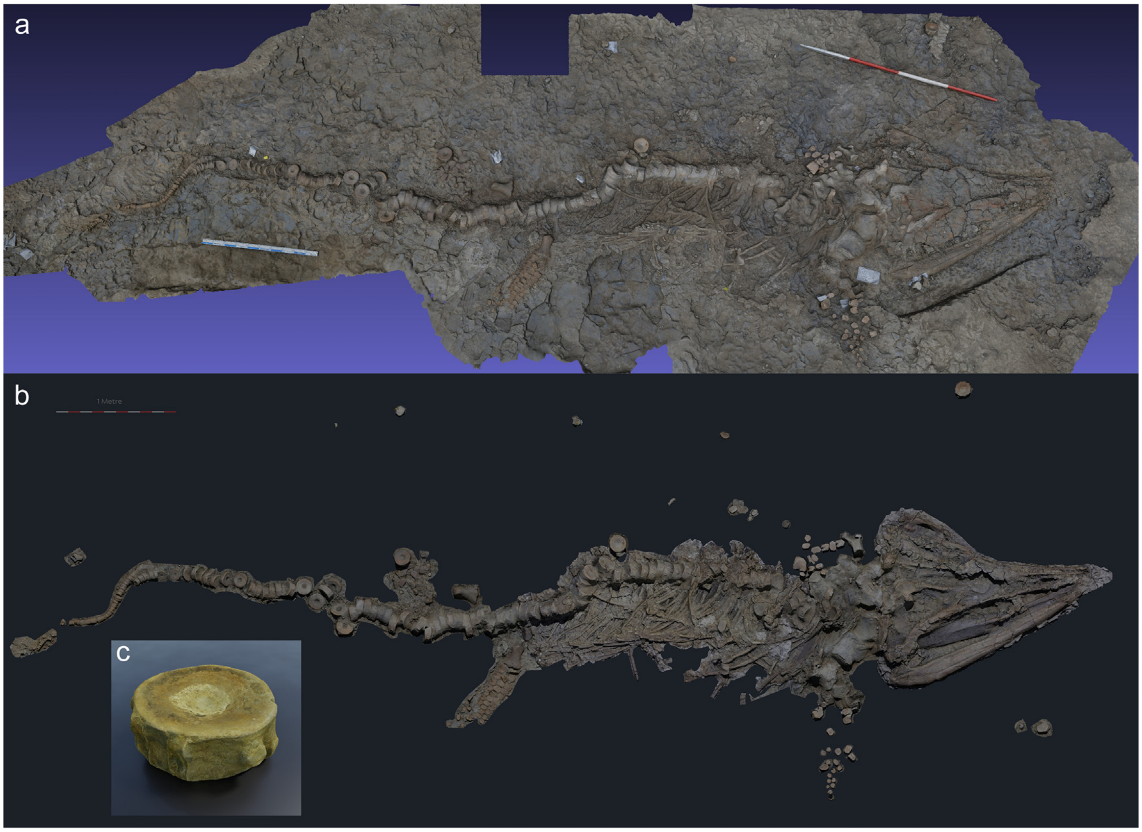

Fig. 6. (a) The initial digital 3D model of the whole ichthyosaur skeleton lying in the ground during the excavation, including the surrounding Jurassic clay in which it was preserved (scale bar 200 cm). (b) The skeleton as a light ray rendered 2D photo-real looking orthographic image created from the digital 3D model — the definitive output of the scanning part of the project. Scale bar 100 cm. (c) A full 360-degree 3D scan of a dorsal vertebra from the ichthyosaur skeleton as a rendered image. © Steven Dey.

contact with the bones, followed by a few layers of dampened tissue paper to infill undercuts and deep hollows. Then, aluminium foil was applied tightly against the contours of the bones and layers of hessian soaked in plaster of Paris were added until a thick plaster jacket covered the top and sides of the skeleton in its matrix (Fig. 7a, b, & c). Then the pedestal of matrix underneath the specimen was reduced and plaster and hessian were added to the undersides (Fig. 7d). For the larger field jackets, wooden splints were added (beams of 3″ × 2″, cut to length) to reinforce the jacket and reduce torsion during lifting and transportation. The largest field jackets required a series of wooden beams securely screwed to one another underneath the specimen and its plaster jacket so that the whole block could be lifted with appropriately rated straps secured to the lowest pieces of wood (Fig. 8a, b, c & d). Getting the wooden beams underneath the skeleton required digging a series of tunnels through the Jurassic clay of the pedestal whilst lying down in the trench alongside the specimen. Using this technique meant that the large, heavy and wide field jackets containing the skull and abdomen (~1 and ~1.5 metric tonnes respectively) did not have to be 'flipped' to be removed from site: they could be lifted straight out of the ground, kept in their original orientation (Fig. 8d). Joe Davis, who discovered the bones, had access to a tractor, telehandler and a large agricultural trailer which made lifting the largest jackets and removing them from site a relatively straightforward process. The excavation was completed on September 12th 2021.

5.5. Sampling

A significant part of the excavation was to understand the palaeoenvironment in which the ichthyosaur had lived and died. The team collected *in situ* invertebrate fossils found in and around the skeleton, within the confines of the excavation. These included numerous molluscs, principally ammonites and belemnites. In some cases, specimens lay directly on the bones. In addition, whilst walking to and from site along a long thin peninsula in the lagoon, the team also collected *ex situ* fossils from the area in general, scattered when the islands and peninsulas were created in 2010/11. This *ex situ* collection comprises ammonites, nautiloids, bivalves, gastropods and belemnites, plus a handful of individual ichthyosaur vertebrae from other specimens. Some of these additional vertebrae were found *in situ* near the full skeleton, almost certainly in the same level but from other individuals. The invertebrate macrofauna from both the excavation and the wider area is currently being assessed by Kevin Page (University of Exeter), Peter Doyle (London South Bank University) and Crispin Little (University of Leeds).

Although the belemnites and ammonites directly associated with the ichthyosaur skeleton provide some environmental and stratigraphical information, the absence of abundant well-preserved ammonites found *in situ* puts greater weight on the biostratigraphical and palaeoenvironmental utility of microfossil assemblages. Samples of matrix from around the skeleton were collected during the excavation and these were subsequently studied for their calcareous microfossil content by a team headed by Ian Boomer (University of Birmingham).

These samples were disaggregated in ~1 % solution of H_2O_2 (hydrogen peroxide) for 30 min, rinsed, dried and sorted under a binocular microscope. The calcareous microfauna were identified, and representative specimens photographed using a Scanning Electron Microscope (SEM). Analyses mainly focused on the foraminifera and ostracods but also included sub-millimetric fragments of larger organisms. Additional subsamples of sediment were sent to Paul Bown (University College London) to establish the calcareous nannofossil composition (mainly coccolithophorid algae) and James B. Riding (British Geological Survey) for analysis of the organic-walled palynomorph assemblages (including marine algae, and terrestrial spores and pollen).

A large sample of matrix from the excavation was also sieved, washed and sorted by David Ward for larger microfossil material and

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Fig. 7. (a) The 2 m-long skull of the ichthyosaur, with obvious cracks, sitting on the pedestal of Jurassic clay, with the field jacket being made. © Dean Lomax. (b) The distal section of the tail has been jacketed and the field jacket for the next section is being made. In the background to the right, a member of Posh Gecko is filming the process. © Dean Lomax. (c) Making plaster field jackets for the proximal section of the tail. © Nigel Larkin. (d) Tunnelling under the 2 m-long skull to get plaster of Paris and hessian right underneath the specimen. © Dean Lomax.

microvertebrate fauna (vertebrate fossils smaller than 5 mm). The sample was oven dried (120 °C), weighed (~25 kg) and then soaked in warm water for about an hour. It was then poured into a bespoke clay washing machine and washed in a 450 micron mesh sieve for 24 h (Ward, 1981). The residue (~1 kg) was rich in iron oxide-stained casts with some gypsum. It was soaked in 5 % potassium carbonate solution and then gently re-sieved, dried and reweighed. It was reduced by 50 %. The carbonate fraction was fairly fragile so no further treatment (*e.g.,* heavy liquid to remove pyrite) was attempted. The residue was sorted under a Meiji binocular microscope (×7.5 %) and listed.

6. Results: dating & environment

Based on previous studies of the geology of Rutland Water (see above), along with the fossils found during the excavation, it was known that this ichthyosaur skeleton would date from approximately 180 million years ago, preserved as it was within the Whitby Mudstone Formation of the Early Jurassic Toarcian Stage. To determine exactly which stratigraphical horizon the skeleton was preserved in and therefore date the specimen more accurately, the invertebrate fossils and microfossils found within the excavation are currently being analysed and some preliminary results are discussed herein.

The discovery of multiple molluscs found in direct association with the ichthyosaur provided some immediate information about the specific horizons. The fossils are typical of the Falciferum Subchronozone (upper Serpentinum Chronozone), or early Bifrons Chrononzone (*i.e.,* Sublevisoni Subchronozone), with numerous small belemnites *Acrocoelites subtenuis* and *Simpsonibelus dorsalis* together with the more robust *Acrocoelites vulgaris*. However, large specimens of the distinctive species *Acrocoelites trisulculosus* have been recovered, being typical of the Exaratum Subchronozone (lower Serpentinum Chronozone) (Peter Doyle, *pers. comm.*; see Doyle, 1990, 1992). Partial harpoceratine ammonites preserved on the dorsal surface of the skeleton display ribbing more similar to that of *Harpoceras* grp *falciferum* (Sowerby) than *H.* grp. *serpentinum* (Schlotheim), suggesting the Falciferum Subchronozone (see Howarth, 1992). This would need confirming when the plaster jackets are removed. The microfossil analysis presented here focuses on a single sample recovered next to the main skeleton and gives insight to both the age and depositional environment of the ichthyosaur.

6.1. Calcareous microfossils (Ian Boomer, Philip Copestake)

Calcareous microfossil residues proved to be well-preserved, containing evidence for ostracods and foraminifera as well as fragments and larval stages of bivalves, brachiopods, gastropods, ammonites, elements of Echinodermata (crinoids, ophiuroids, echinoids, holothurians), remains of shark (dermal denticles) and fish (teeth, otoliths) as well as radiolaria (siliceous microplankton). Taken together, these indicate a rich benthic and planktic ecosystem with a well-oxygenated water column and a good supply of organic matter to the sea floor.

The ostracod and foraminifera assemblages are relatively low diversity for this geological interval but they are moderately abundant and generally well-preserved. Their primary utility in this study is defining the chronostratigraphical age of the ichthyosaur. This approach is aided by the nearby studies by Bate and Coleman (1975) and Horton and Coleman (1977) of microfaunas from 1960s' engineering cores around Empingham (*c.,* 8 km to the east) associated with the original

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Fig. 8. (a) The abdomen: the largest section of the ichthyosaur to be encased in a single plaster field jacket. © Dean Lomax. (b) Making the field jacket for the large abdomen block: applying plaster to the undersides and reducing the size of the pedestal. © Dawn Butler. (c) The field jacket containing the abdomen of the ichthyosaur ready to be lifted from the trench. © Emma Nicholls. (d) The safe removal from the site of the largest field jacket, containing the abdomen. © Emma Nicholls.

construction of Rutland Water. Importantly, the published microfaunas from these boreholes were recorded in association with ammonites enabling the microfaunas to be directly correlated with standard ammonite chronozones, which provide the essential chronostratigraphical subdivision of the Jurassic succession.

Ostracod assemblages are dominated by *Ektyphocythere intrepida* and *Kinkellinella sermoisensis*. The foraminifera are dominated by *Lenticulina muensteri*, *Citharina* cf. *longuemari*, *Citharina* cf. *colliezi* and *Mesodentalina varians haeusleri*. The sample also includes specimens of *Conorboides* sp. 2 (Horton and Coleman, 1977) first recorded from the Empingham boreholes. The overlapping ranges of these taxa in the studied sample, and the short vertical range of *Conorboides* sp. 2 in particular, when correlated with the succession from the Empingham boreholes (Horton and Coleman, 1977, see Fig. 16), allow an indirect inferred correlation to the uppermost part of the Falciferum Subchronozone (upper part of the Serpentinum Chronozone). The significance of the key stratigraphical taxa is illustrated in Figure 9.

6.2. Calcareous nannoplankton (Paul Bown)

Nannofossils are very abundant and relatively high in diversity for this time interval and indicate normal, open marine conditions. The high abundance of small *Biscutum* is believed to represent relatively high-productivity surface waters, supporting abundant, diverse higher trophic levels. Very good preservation reflects the non-indurated, clay-rich lithology, and the nannofossil carbonate fraction is essentially pristine. Stratigraphically, the assemblage is indicative of the uppermost NJ6 to lowermost NJ7 nannofossil biozone (equivalent to the Serpentinum to Bifrons Chronozone boundary interval) based on the absence of *Orthogonoides hamiltoniae* and *Discorhabdus criotus* and continued abundance of *Lotharingius hauffii* (see Bown and Cooper, 1998, Fig. 4.1).

6.3. Palynomorphs (James B. Riding)

The sample yielded a moderately diverse and generally well-preserved assemblage of palynomorphs dominated by terrestrially-sourced gymnosperm pollen, with markedly fewer cryptogam spores and marine palynomorphs. The major pollen taxa are undifferentiated bisaccates, *Classopollis classoides* and *Perinopollenites elatoides*. The cryptogam spores are largely smooth trilete forms assigned to *Cyathidites*. Marine palynomorphs are largely clumps of the small prasinophyte species *Halosphaeropsis liassica*. The presence of the marine dinoflagellate cyst taxa *Nannoceratopsis gracilis* and *Nannoceratopsis senex* is consistent with a Toarcian age for this horizon. More specifically, a monogeneric assemblage of *Nannoceratopsis* is indicative of the Early

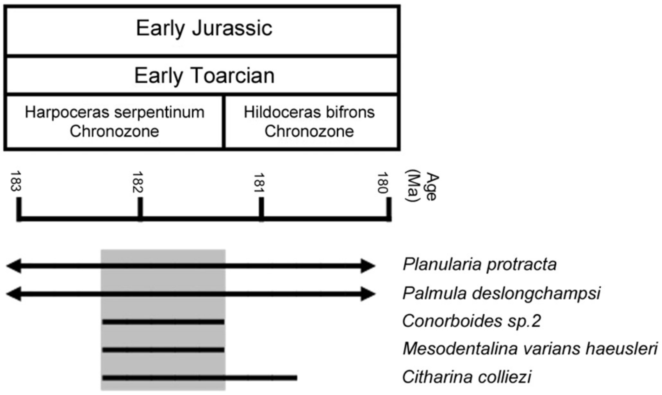

Fig. 9. Known local chronostratigraphical ranges of key foraminifera species associated with the ichthyosaur skeleton. Grey shaded box indicates the only stratigraphical interval within which all taxa co-occur in nearby BGS boreholes from which zonal ammonites occur. This implies an age of late Serpentinum Chronozone for the specimen, approximately 182.3 to 181.3 million years ago. Timescale based on Hesselbo et al. (2020).

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Toarcian (Riding et al., 1999; Bucefalo Palliani and Riding, 2003). The sparsity of dinoflagellate cysts in the sample studied is most suggestive of the interval immediately above the Toarcian Ocean Anoxic Event (T-OAE) (Riding, 1987).

The co-existence of terrestrially-derived miospores and indigenous marine palynomorphs is indicative of an open marine, shelfal setting. A fully aerobic shelfal environment is strongly suggested by the occurrence of *Micrhystridium* spp. and the dinoflagellate cyst genus *Nannoceratopsis* (see Wall, 1965; Wall et al., 1977; Riding, 1983).

Samples of matrix from the excavation prepared and examined by David Ward yielded larger microfossil material that was corroded by decomposed pyrite and distorted. Molluscs included thin shelled *Camptonectes*-like bivalves, the 'Oyster' *Pteria*, also *Liostrea*, *Pseudopecten*, *Entolium*, *Cardinia Pteromya*, the gastropod *Coelodiscus*, numerous tiny cerithiid gastropods cf. *Cryptaulax*, small belemnites and various ammonite nuclei. The Echinodermata include small isolated columnals and ?calyx or cirii attachment (1) of ?*Seirocrinus*. Decapoda finds included a few lobster limbs, possibly *Pseudoglyphea*. The cerithiids may have benefited from the presence of the ichthyosaur carcass.

6.4. Summary of the microfossil analyses

The biostratigraphical evidence indicates that the skeleton was most likely deposited during the interval following the T-OAE. This climatic perturbation occurred during the Exaratum Subchronozone, and is only partially recorded in neighbouring Leicestershire due to the absence of the lower part of the succession (Caswell and Coe, 2012). Subtleties of the biostratigraphical ranges and relative abundances of key taxa suggest an age within the latest part of the Falciferum Subchronozone (upper part of the Serpentinum Chronozone), latest part of the lower Toarcian stage, equivalent to approximately 181.5 to 182.5 million years ago in the geological time scale of Hesselbo et al. (2020) (Fig. 9).

Ammonites and belemnites were nektonic so inform us about that part of the water column in which the ichthyosaur was living. However, the benthos (including the calcareous microfossils and fragments of larger benthic organisms, *etc.*) inform us about the environment into which the remains ultimately sank after death (presumably after some time as a bloated, floating or semi-submerged carcass). Domination of the macrofauna by nekton indicates a deep pelagic environment with few large, complete, invertebrates recovered from the sea floor habitat, and a similar assemblage of nekton/benthos was recorded from contemporaneous environments in Somerset (Boomer et al., 2021), also inferred to be relatively deep water.

7. Discussion

7.1. Plaster field jackets

Plaster jacketing big fossils such as the remains of large fossil vertebrates to enable their safe removal from the field is a procedure that has been used by palaeontologists for over a century. Useful guides to making successful plaster jackets are given in Leiggi and May (1994) and Croucher and Woolley (1982). Correctly made, plaster field jackets provide protection for fossil material uncovered in fieldwork, keeping the weather from damaging the find and protecting the specimen as it is lifted out of the ground and transported. They also keep articulated bones in their exact association, critical for taphonomic studies *etc.* However, the strength and reliability of such field jackets can be adversely affected by the weather, location, substrate and the materials used.

It is worth noting that in a couple of instances during the excavation the plaster did not perform well. The weather was often cold and damp and this, perhaps combined with being downwind from a large reservoir providing a constant stream of very moist air, played a role in the plaster's inability to set properly sometimes. It is possible that the water used also contributed to the poor setting. Although the excavation was surrounded by water in the reservoir, this was a health hazard due to all the bird faeces, algae and occasional bird corpse. It would also have impurities from the clay substrate which would adversely affect the setting of the plaster. Therefore, local tap water was used but this is notoriously 'hard', with a high (natural) mineral content. This combination of factors retarded the setting of the plaster so much on cold and damp days that two of the smaller field jackets (still weighing a quarter of a tonne each) did not set properly for several weeks, even though stored indoors for most of that time. Had this been expected in advance, zinc sulphate would have been brought to site to help improve the setting of the plaster (Croucher and Woolley, 1982). Fortunately, a few days of dry and warm weather towards the end of the excavation coincided with making the largest field jackets for the skull and abdomen and these set successfully.

7.2. 3D scanning

At 10 m long, the main challenge of 3D scanning the specimen was to balance the level of detail against the file size of the resulting digital 3D model. The overall scan area with outlying bones was approximately 20 m^2. The smallest features in this area were teeth and smaller ribs requiring resolution down to 1–2 mm. The chosen scanning method was photogrammetry because it delivers high levels of 3D geometry for textured items, and it works well outdoors and delivers full-colour textured models giving more detail than geometry alone. It was decided to capture as much detail as possible on site and to then scale back the digital models depending on their application.

A number of trial 3D digital models were created including a model of the whole animal. This model (Fig. 6a) was huge in terms of the data it contained but enabled small areas to be examined in great detail. To reduce the file size, areas of matrix not containing bones were removed then a series of digital 3D models were trialled down to a 2.5 million polygon model with a single 8K texture (Fig. 6b). This was uploaded to the 3D model sharing platform Sketchfab to create easy access to the model for colleagues. Earlier concerns about scale of the model proved to be unfounded with enough detail coming out of even the lower-resolution version for online viewing.

This scanning project was unusual in that the process started before the specimen was excavated and was repeated during the excavation and extraction process rather than after the specimen was extracted and conserved. The utility of digital 3D methods became apparent during processing because it was possible to use data from the various digital models to construct a composite of the skeleton and the outlying bones all fully uncovered even though some portions of the specimen were scanned at different points during the excavation process. This view of the specimen was never fully visible all at once in reality due to the timing of the cleaning and excavation processes, demonstrating the unique potential of digital 3D scanning to record context during fieldwork. The final digital 3D model provides the best view possible of the specimen in the ground. It can be viewed both as a digital 3D model and as 2D renders and is metrically scaled so it can also be used to measure any aspect of the specimen. High-resolution photographic images can be rendered from the final digital 3D model meaning that researchers and public engagement professionals are not limited to photographs captured on site or drone photos that only show one point in the excavation. Many public engagement outputs were created from the final digital 3D model: A life-size 1:1 scale, 10 m-long, 2 m-wide physical banner was printed for public engagement events; a 1:33 scale replica of the skeleton in the ground has been 3D printed for outreach use; and an animation was created to show how the original site looked with the digital model emerging from the mudstone for a TEDx talk given by Dean Lomax (see below).

The on-site scan of the specimen does not show individual bones in full 360° because they were still partially buried in the Jurassic clay

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when scanned. Usefully, some of the bones that were collected individually can be 3D scanned separately after cleaning and preparation. They can then be rendered as a digital 3D model (Fig. 6c) and shared for research and public engagement. Physical copies can also be 3D printed in an appropriate medium for handling at outreach events, reducing the risk to the real bones.

7.3. What we know about the ichthyosaur skeleton so far

Of the few large ichthyosaur skeletons previously discovered in the UK, those collected historically have poorly recorded information, with details of where they were found and their geological age often completely unknown. Others were not recorded very scientifically when discovered and often they were collected from coastal localities where a planned and methodical excavation was difficult for logistical reasons or else simply impossible. Therefore, this excavation provided a rare opportunity to study an ichthyosaur of this large size *in situ* and collect all the data possible. Moreover, although most of the large ichthyosaurs found in the UK are from the Early Jurassic like the Rutland specimen, many are known only from partial or fragmentary skeletons, usually comprising large, isolated skulls or series of vertebrae.

7.3.1. Taxonomy

In the UK, large-bodied Lower Jurassic ichthyosaurs are currently represented by a single genus, *Temnodontosaurus*, which has a known stratigraphical range from the Hettangian to Toarcian. At present, seven or eight different species of *Temnodontosaurus* are recognised and include four (or five) known from the UK, *T. platyodon*, *T. eurycephalus*, *T. crassimanus*, *T. zetlandicus* and possibly '*T*. *acutirostris* (Lomax, 2019; Swaby and Lomax, 2021; Laboury et al., 2022). Only *T. crassimanus*, *T. zetlandicus* and '*T*. *acutirostris* are known from the Toarcian and specifically from the Whitby Mudstone Formation, but each is known from a single holotype specimen. Furthermore, '*T*. *acutirostris* may not belong to the genus, as outlined by Swaby and Lomax (2021) and Laboury et al. (2022). As previously pointed out by these authors, the genus *Temnodontosaurus* needs to be critically revised.

Nevertheless, based on current taxonomy, initial assessments in the field suggest that the ichthyosaur is an example of *Temnodontosaurus*. Our early assessment of several features, including the extent of limb element notching and the relative size of the humerus suggests it is not *T. crassimanus*, but instead probably represents the first example found in the UK of *T. trigonodon*, a species that is well-known from similar-aged sites in Germany, the Posidonia Shale of Holzmaden and surrounding areas. If this is correct it would extend the geographic range of the species significantly but a specific determination cannot be confirmed until the skeleton has been fully cleaned, conserved and analysed in detail. As a result, a thorough taxonomic assessment is beyond the scope of the current study.

7.3.2. Size

When the skeleton was fully exposed *in situ*, it was measured from the tip of the skull to the last preserved caudal vertebra. These measurements were repeated multiple times to ensure accuracy. Measuring along the vertebral column and including the skull, the skeleton as preserved measures 9.82 m. However, there is a notable gap in the vertebral column immediately posterior to the skull where the atlas–axis could not be identified. Here, two cervical vertebrae are present near the skull, but then the vertebrae become disarticulated and jumbled, perhaps due to how the individual came to rest on the seabed; there should probably be 13 disarticulated vertebrae in this gap. Some of these vertebrae were found lying flat relative to the column whereas others are buried beneath the pectoral girdle. As a result, this part of the vertebral column (the neck) was shortened. By accounting for the number of missing vertebrae and measuring the lengths of the articulated anterior vertebrae compared to the length of the gap (74 cm), it was deduced that the missing length at this point would have measured approximately 20–30 cm. Additionally, if the entire vertebral column was straightened and measurements could be taken of the atlas–axis, it is estimated this would add an extra 10–15 cm from the back of the skull to the first articulated vertebrae. Likewise, it is possible that more than 10 cm might be missing from the tip of the skull and up to 10 cm might be missing from the end of the tail. The latter two observations can only be assessed and presumably confirmed once the specimen has been fully prepared and examined in detail. Taking into account the extra measurements for the missing vertebrae and the gap, the full length of the entire skeleton is a little over 10 m.

This specimen represents the most complete skeleton of any large ichthyosaur found in the UK. By comparison, notable large and complete British ichthyosaurs include a 6.83 m long skeleton of *Temnodontosaurus platyodon* (NHMUK PV OR2003*, DRL pers. obs.). This was discovered and part-collected by Mary Anning in July 1832 from Lyme Regis, Dorset, and has been proposed as the species neotype (McGowan, 1974). Another skeleton of *T. platyodon* (NHMUK PV OR2918) collected in 1898 from a quarry in Stockton, Warwickshire, measures approximately 6 m (Graham et al., 2020) and is on display at the NHMUK above the aforementioned specimen. With a preserved skeleton measuring 7.3 m, the holotype and only known specimen of *Temnodontosaurus crassimanus*, collected in 1857 from the Yorkshire coast, previously represented the largest almost complete skeleton of an ichthyosaur collected in the UK; the total estimated length, accounting for missing parts of the skull and vertebral column is ~9 m (Swaby and Lomax, 2021). To further highlight the significance and rarity of the Rutland specimen, it is worth pointing out that these individuals were all collected over 125 years ago; the Mary Anning specimen was found almost 200 years ago. The remains of larger ichthyosaurs have subsequently been found in the UK including some from the Early Jurassic that may have been up to 15 m long (McGowan, 1996) and some Late Triassic giants that were possibly in excess of 25 m (Lomax et al., 2018) but these are known only from very fragmentary specimens, sometimes just a single bone.

7.3.3. Taphonomy

The completeness of the specimen combined with the high articulation of the skeleton suggests that the carcass arrived on the seabed relatively soon after death. The ichthyosaur was preserved lying dorsolaterally, in ventrolateral view, with the skull at an angle to provide an intriguing three-dimensional view of various parts, including the left and right lower jaw and braincase elements. The skeleton is almost fully articulated, and although parts of the vertebral column, along with both forefins and one of the hindfins have become slightly detached and disturbed, these remain associated. The left hindfin is well-preserved and is mostly intact. Some of the distal elements of the limb are scattered or missing and this may be due to scavenging of the carcass. There is also evidence of possible scavenging on some of the vertebrae. An ichthyosaur tooth matching that of a *Temnodontosaurus* was found near the distal end of the tail, at the point where part of the vertebral column has been distorted, which may suggest further evidence of scavenging.

7.4. Reaction to the discovery

The importance of the find was obvious right from the beginning and TV production companies were contacted by Dean Lomax even before the initial reconnaissance visit in February 2021. Discussions were held in confidence as the site had to be kept as secret as possible for reasons of security. The production company Rare TV sent a cameraman to the site in February to film the initial one-day dig. Following the success of this, they agreed to send a cameraman for several days of the main excavation in August 2021. Initially, plans were discussed for the excavation to have its own TV programme but because the skeleton was found during a Covid lockdown no TV channel would commit to a

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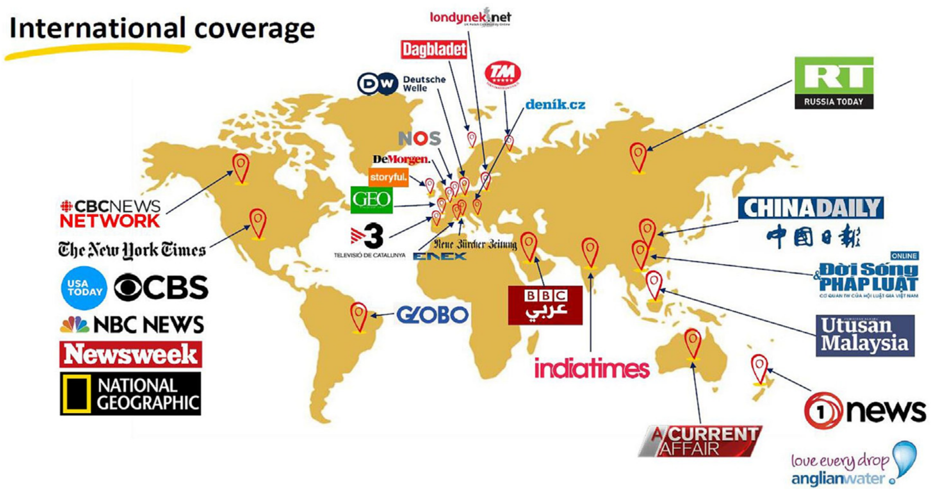

Fig. 10. Just some of the many organisations around the world that covered the discovery and excavation of the Rutland ichthyosaur. © Anglian Water.

full-scale documentary. Fortunately, Rare TV is the producer of the long-running BBC archaeology series, 'Digging for Britain' and it was decided that the excavation would be included as a special feature in an episode to coincide with announcing the discovery publicly. Therefore, the excavation was periodically filmed by the Digging for Britain team. Also, Anglian Water contracted a local production company, 'Posh Gecko', to film the entire excavation. This included footage of the team at work, plus interviews and drone footage to provide a comprehensive archive to be used in due course for television programmes, displays and research *etc*.

Almost one year after Joe Davis initially made the discovery, the specimen was revealed to the public on January 10th 2022 *via* a press release and footage of the excavation was shown on the BBC TV show 'BBC Breakfast', where Dean Lomax and Joe Davis discussed the find. The following evening footage of the excavation was also shown as part of an episode of the ninth series of 'Digging For Britain'. Significantly, this turned out to be the most watched episode in all the nine series of the show — the first time a palaeontological subject, rather than archaeological, had been featured. The discovery became a huge news story, subsequently reported in most of the national papers in the UK and in newspapers, TV news and radio programmes all around the world (Fig. 10).

The 'blog' describing the excavation on the website of the Geological Curators Group reached 3000 reads in the first week of going live (the average is around 200). The full digital 3D model was viewed about 18,000 times online within a couple of weeks of the press release. Statistics compiled by Anglian Water's PR department a couple of weeks after the press release included: over 2000 'mentions' across online, broadcast and in print globally; 738 articles shared 1.3 million times on social media (1.3 million Facebook and 11,300 Twitter); the top 25 articles combined for a total reach of '2 Billion'; and 59 countries are known to have covered the story. Dean Lomax's initial social media posts announcing the discovery also reached a large audience, with his Twitter post earning 2,467,091 impressions as of 03/05/2023. On Instagram, the same announcement reached 356,250, and on Facebook it reached 112,347.

These statistics demonstrate the public's appetite for palaeontological stories in the news and on social media. Since the discovery was announced, there has been a steady stream of interest, with many people asking if a "full documentary" could be made about the excavation and various news outlets regularly ask for updates. Continuing to share the story with the public, members of the team have also delivered multiple public lectures including Dean Lomax delivering a presentation about the discovery for TEDxManchester 2022, in front of an audience of ~3000 people. This talk was selected for the main channel at TED.com where it reached over one million views in less than three months. It currently ranks as the fourth most-viewed TED talk on the subject of palaeontology. The project was even debated, briefly, in the House of Parliament. Alicia Kearns (MP for Rutland and Melton since 2019) asked the then Prime Minister Boris Johnson if he would provide financial support for funding visitor attractions relating to the ichthyosaur skeleton and a newly discovered Roman mosaic in Rutland.

7.5. Post-excavation work

Funding was secured to conserve some particularly fragile parts of the ichthyosaur skeleton immediately after the excavation and to conserve and prepare some of the invertebrate fauna, enabling their identification so that research can continue on the palaeoenvironment of the site. A follow-up one-day field trip took place in August 2022, to look for additional specimens. The team discovered dozens of molluscs (nautiloids, ammonites, belemnites, gastropods *etc.*) along with additional ichthyosaur vertebrae from other individuals and the first remains of a thalattosuchian crocodylomorph (the 'Rutland Crocodile') to be discovered in Rutland, found by Natalie Turner.

The next phase of work is to secure funding for the 24–36-month project to remove the plaster field jackets from the skeleton (Fig. 11) and to prepare and conserve the contents for research and mount the skeleton for display. It is planned that the conserved skeleton and associated fossils will be placed on permanent exhibition in an accredited institution very close to where the fossil was found, in Rutland itself.

The specimen was found on land belonging to Anglian Water. Rutland County Council and Anglian Water are in the process of setting up a Charitable Incorporated Organisation (CIO) that will take care of the specimen and the conservation and display projects. It has been agreed that the specimen will be donated to Rutland County Council and the Rutland County Museum at which point the specimen will be given a formal museum number.

8. Conclusions

In the summer of 2021, the UK's largest ichthyosaur skeleton (a 10 m-long *Temnodontosaurus*) was successfully excavated from Toarcian Lower Jurassic clay deposits in three weeks by (on average) nine people working 12-hour days. This was despite the size of the skeleton, some unexpectedly poor weather and the limitations of the COVID19 pandemic as well as other health and safety considerations.

The project is an excellent example of how professional and 'amateur' palaeontologists can work together with a variety of organisations for the good of science, with this significant specimen being rescued and

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Fig. 11. The ichthyosaur skeleton in its field jackets stored in Nigel Larkin's conservation workshop. On the wall is a life-size 2D print-out of the digital 3D model of the skeleton as it lay in the ground after cleaning. © Nigel Larkin.

secured for future generations to enjoy and for researchers to study. When the find was revealed to the public in January 2022 the project became a huge news story and was reported around the world.

The invertebrate fossils and microfossil fauna analysed so far provide biostratigraphical evidence that the ichthyosaur skeleton was buried during the interval following the T-OAE. Subtleties of the biostratigraphical ranges and relative abundances of key taxa suggest an age within the latest part of the Falciferum Subchronozone (upper part of the Serpentinum Chronozone), latest part of the early Toarcian Stage, equivalent to approximately 182.5 to 181.5 Ma (Fig. 9).

A full study and description of this skeleton, along with an assessment of the other marine reptile material found at the site is currently in preparation, but it is clear that at least three Toarcian species of ichthyosaur are preserved in the Rutland Water area. Once the specimen excavated in 2021 is fully prepared and conserved, the research team will study the skeleton in more detail and publish their findings. However, initial analysis suggests that the skeleton is likely to be an example of the Early Jurassic species *T. trigonodon*, which is well-known from similar aged sites in Germany but has yet to be formally recognised in Britain. Therefore, this would be an important find that would extend the geographic range of the species, provide a unique opportunity to analyse an entire skeleton and compare it with less complete specimens, and such subsequent research will add to wider data about faunal recovery following the T-OAE.

Britain is the 'birthplace of ichthyosaurs', their fossils having been unearthed and scientifically studied here for over 200 years, with the first scientifically described remains dating back to Mary Anning and her early discoveries in Lyme Regis on what is now the 'Jurassic Coast'. Yet, despite the thousands of ichthyosaur remains discovered in Britain, none of them are quite as large as this specimen and no other examples of this genus found in the UK are as complete. Rutland's motto '*Multum in Parvo*' translates as 'Much in Little' so it is fitting that Britain's largest ichthyosaur skeleton has been found in England's smallest county.

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