

CRESWELL CRAGS FOSSIL MATERIAL IN THE NOTTINGHAM NATURAL HISTORY MUSEUM, WOLLATON HALL, UK

by Jordan Bestwick and Adam S. Smith



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The Creswell Crags gorge on the Nottinghamshire-Derbyshire border contains a series of caves in which Holocene and Late Pleistocene deposits accumulated. Fossils from these deposits were acquired by the Nottingham Natural History Museum, Wollaton Hall (NOTNH), during the late 19th century and early 20th century. This study provides the first published review of the entire NOTNH Creswell Crags collection. Overall, there are 274 fossil specimens from Creswell Crags consisting of 466 individual elements. However, only 11.7% of specimens can be attributed to specific caves and none retain any detailed stratigraphic data. This compromises the scientific value of the collection. The collection contains a total of 160 attached labels (on 146 individual elements) comprising ten different types. An assessment of the faunal abundances was conducted to compare with historical excavations. 61% of the NOTNH elements have been identified to genus level and the collection consists of 17 genera from six orders: Carnivora, Artiodactyla, Perissodactyla, Proboscidea, Lagomorpha and Primates. The NOTNH collection contains proportionately more woolly rhinoceros (*Coelodonta*) elements than the 1870s excavations but fewer hyaena (*Crocota*), reindeer (*Rangifer*), and woolly mammoth (*Mammuthus*). We attribute these discrepancies to a possible 'donation bias'.

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Introduction

Creswell Crags on the border between Derbyshire and Nottinghamshire consists of a 450m long Early Permian Magnesian Limestone gorge with cliff faces up to 19m high (Mello 1875; Charles and Jacobi 1994; Jacobi *et al.* 1998; Stewart and Jacobi 2015). The walls of the gorge contain a system of caves, fashioned by a vertically shifting fault scarp along the western edge of the site, in which Holocene and Late Pleistocene deposits accumulated (Jacobi *et al.* 1998; Stewart and Jacobi 2015).

There are 21 caves and fissures distributed across the Creswell Limestone Heritage Area that are associated with Pleistocene material (Wall and Jacobi 2000). At Creswell Crags there are ~23 caves, some of which have yielded fossil material including a diverse fauna of large Pleistocene mammals such as spotted hyaena (*Crocota crocuta*), woolly rhinoceros (*Coelodonta antiquitatis*), giant Irish deer (*Megaloceros giganteus*) and humans (*Homo*

sapiens) (Currant and Jacobi 2001). In addition, numerous flint, quartzite and bone artefacts (Mello 1875, 1876, 1877; Dawkins 1877; Armstrong 1925, 1930, 1932a; Jenkinson 1984), and occurrences of cave art, have also been found within the caves (Pike *et al.* 2005). Independent radiometric dating studies on fossil and human-modified material from Pin Hole Cave and Robin Hood Cave in Creswell Crags dated the Pleistocene fauna, and human-related activities to around 31,000-59,000 and 23,000-53,000 years old respectively (Jacobi *et al.* 1998; 2006). These age ranges have become established as the Pin-Hole Mammal Assemblage Zone (MAZ), named after the first excavated Creswell Crags cave in the 1870s, Pin Hole Cave (Currant and Jacobi 2001; Jacobi *et al.* 2006), and falls within the Middle Devensian (Jenkinson 1984; Jenkinson and Gilbertson 1984; Jacobi *et al.* 1998). Evidence suggests that at this time a fauna of large mammals, including humans, had recently returned to Britain following the end of the previous glacial maximum

(Currant and Jacobi 2001). In contrast, the Creswell Crag cave known as Mother Grundy's Parlour contains a different fauna. Although no quantitative dating studies have currently been conducted on the Mother Grundy's parlour material, this cave is the only one from Creswell Crag which has yielded conclusive evidence of hippopotamus (*Hippopotamus amphibius*) and the narrow-nosed rhinoceros (*Dicerorhinus hemitoechus*) (Dawkins and Mello 1879; Armstrong 1925). These animals are believed to have been present in the UK during the Ipswichian interglacial stage which spanned ~130,000-80,000 years ago (Jenkinson and Gilbertson 1984; van Kolfschoten 1992). Fully understanding the relative abundances of Pleistocene species at Creswell Crag is therefore important for determining temporal and spatial faunal movements across the UK and Europe during glacial and interglacial periods (Jacobi *et al.* 1998; Wall and Jacobi 2000; Currant and Jacobi 2001).

The palaeontological significance of Creswell Crag was first elucidated by Reverend John Mogens Mello (1836-1914) who led the initial explorations of the caves from 1874-1876 with assistance from Thomas Heath and William Boyd Dawkins (Jenkinson and Gilbertson 1984). A range of mammalian fauna and human implements from several caves were excavated and identified during this time (Busk 1875; Mello 1875, 1876, 1877; Dawkins 1877). The initial explorations involved eight caves at Creswell Crag but focused primarily on the first 12-15m from each cave entrance (Mello 1875). This early excavation work was continued in the 1880s by the enigmatic Dr Robert Laing, but little is known of the man or his work (Jenkinson and Gilbertson 1984; Charles and Jacobi 1994; Wall and Jacobi 2000). It was not until 50 years later that deeper excavations led by Albert Leslie Armstrong uncovered more animal remains, increasing known abundances of fauna in the Pin Hole MAZ (Armstrong 1925, 1929, 1930, 1931, 1932a, 1932b; Jenkinson and Gilbertson 1984). Excavations were also undertaken by John Campbell and Simon Colcutt in the 1970s in an attempt to explain the stratigraphy of Creswell Crag and changes in faunal assemblages and human activities across finer time-scales (Jenkinson and Gilbertson 1984). Further work on the cave fauna was carried out by Rogan Jenkinson and others in the 1970s-80s (Jenkinson 1984), however, much of this is unpublished (Wall and Jacobi 2000).

Material from Creswell Crag is distributed across dozens of institutions across the UK and beyond (Wall and Jacobi 2000), including Nottingham

Natural History Museum, Wollaton Hall (NOTNH) (Turner 2000; Wall and Jacobi 2000). This 'distributed collection' is summarised broadly on the 'Creswell Crag Distributed Collections Portal' (<http://www.creswell-crag.org.uk/learning-resources/distributed.aspx>). The main aim of this paper is therefore to provide a history and detailed account of the Creswell Crag fossil material (Pleistocene and Holocene) held at NOTNH, to increase awareness of the collection, place it in its historical context, and provide an itemised account for inclusion in the portal. Turner (2000) listed a small amount of previously cited and figured Creswell Crag material at NOTNH (see below), and Wall and Jacobi (2000) also provided a brief summary of the collection. However, to our knowledge, the majority of the fossil specimens have not been listed or figured in the literature, so their potential for contributing to our understanding of Creswell Crag and Pleistocene Britain remains unclear.

In addition, we assess the relative faunal abundances within the NOTNH collections compared to those listed from the 1870s and 1920s excavations, to determine whether the NOTNH collection is representative or subject to collecting bias.

History of the collection

The NOTNH Creswell Crag material is part of a larger collection of approximately 40,000 individual fossils from various horizons from all over the UK (Turner 2000; Smith 2015). Most of the Creswell Crag material originated from Reverend John Mogens Mello, who donated, sold and bequeathed a large number of specimens to the NOTNH in a series of acquisitions towards the end of the 19th century and the early 20th century. The first group of specimens was donated to the NOTNH in 1876 (NH Acq. Ref: 1875.01), when the museum and its collections were located at Wheeler Gate in central Nottingham (under the name of Nottingham Free Museum; Turner 1993; 2000). Acquisition records state that specimens within this donation included *Coelodonta antiquitatis*, *Crocota crocota* and wild horse (*Equus caballus*) along with other large mammals. The majority of these specimens were collected in 1875, with a small remainder collected in 1876.

A second acquisition (NH Acq. Ref: 1887.16) of specimens was received a decade later in 1887, purchased from Mello for £5, by which time the museum had relocated to Nottingham University College (Turner 1993; 2000). Most of the specimens

in this acquisition, listed as a "large number of Fossil Specimens from Creswell Crags", were also collected in 1875.

The third and final acquisition (NH Acq. Ref: 1914.10) from Mello was bequeathed by his solicitors following his death in 1914 (Turner 1993). This acquisition, listed in the register as a "collection of fossils and implements", included some human artefacts such as flint and quartzite tools collected by Mello. These are probably the implements transferred to the Nottingham Castle Museum and Art Gallery in 1972 (NCM Day Book F, p. 205) and accessioned as NCM 1994-20/1-148. The third acquisition also included a small collection of rocks and minerals, unrelated to Creswell Crags. The focus of this study is on the Creswell Crags fossil material, so a review of the human implements and the other rocks and minerals bequeathed by Mello is beyond the scope of this paper.

The entire natural history collection, including the Creswell Crags material, was moved to Wollaton Hall in 1926 where it remains today (Smith 2015). It is worth noting that not all of the Creswell Crags material at the NOTNH was necessarily acquired from Mello. Only one other 'acquisition' of fossil material from Creswell Crags is listed in the register (NH Acq. Ref: 1882.12). This consisted of a woolly mammoth (*Mammuthus primigenius*) milk tooth, discussed by Metcalfe (1885) and Owen (1885), temporarily loaned from the British Museum. However, the register is incomplete, and does not account for all of the material in the NOTNH. Some of the Creswell Crags and possible Creswell Crags material is unlabelled, so other donations may have been received but not recorded.

Turner (2000) previously catalogued all cited and figured Creswell Crags material within the NOTNH. This material comprises 21 specimens collected by Mello, and includes carnivores *Crocota* and *Ursus*, artiodactyls *Megaloceros* and *Rangifer*, and perissodactyls *Coelodonta* and *Equus*. Two of these specimens were discussed by Mello (1876) and are present in the collection today (Figure 1). In the early 1990s several NOTNH specimens were recognised by Roger Jacobi in an historical photograph of some of the material excavated by Mello (Turner 1993). This photograph, taken some time prior to the NOTNH acquisitions, shows a selection of specimens pinned to a display board propped on a chair, and was subsequently published by Mello in 1891 (Mello 1891). The Nottingham City Museums and Galleries (NCMG) archive holds an original



Figure 1. Photographs of specimens previously cited or illustrated by Mello (1876). A-B. NOTNH FS4339, tooth fragment originally regarded by Mello (1876) as a human made implement, according to Turner (2000). C. NOTNH FS4353, fragment of ivory illustrated by Mello (1876, fig 1) and originally thought to be a piece of antler worked into a point, now thought to be naturally-shaped (Turner 2000). Scale bars = 10 mm.

annotated print of this photo (NCMG 2015-53), reproduced here in Figure 2 with the NOTNH material indicated. The 19 specimens in this photograph are present and in good condition in the NOTNH today (Figure 3). Turner (2000) cites the numbers annotated on the photograph in Mello (1891). However, we identified some minor corrections (Table 1). To our knowledge, the majority of the NOTNH Creswell Crags fossil specimens have not been figured in the literature.

The material

Storage conditions

The NOTNH Creswell Crags collection is stored in a wooden cabinet with removable glass-topped drawers (Figure 4). This cabinet also contains Quaternary material from Nottinghamshire and other UK sites. The Creswell Crags specimens are distributed among 14 drawers and small elements are housed in cardboard trays to prevent damage from them moving around. Wall and Jacobi (2000) noted that some of the Creswell Crags material was beginning to dry out and crack. During this study we noted some of the larger specimens such as the *Coelodonta* and *Bison* limb bones were cracking and several vertebrae, including those of *Megaloceros*, among other bones were abrading against the wooden drawers and cardboard trays. An ongoing collection care project involving volunteers at the NOTNH is improving storage conditions of the entire fossil collection. This is achieved by padding elements with acid-free paper and/or Plastazote®, a light, non-toxic foam formed from nitrogen expanded closed-cell cross-linked polyethylene

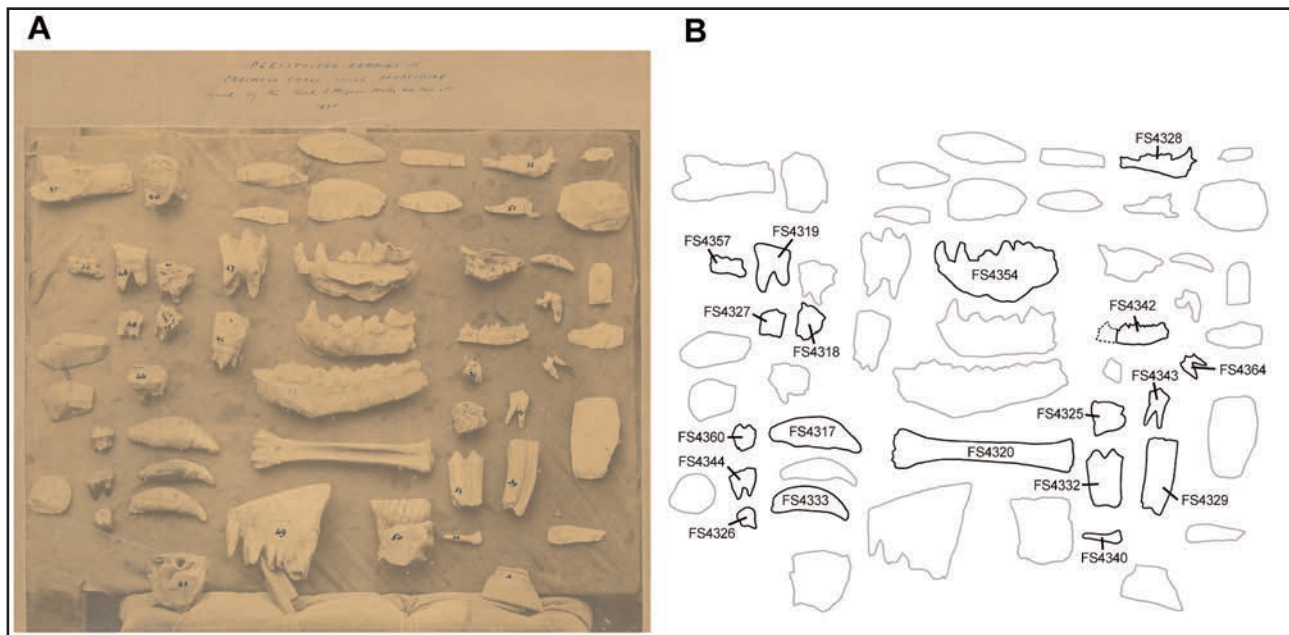


Figure 2. Scan of a photograph mounted on cardboard showing fossils and pieces of human made implements found at Creswell Crags by Mello, 1875. **A.** scanned photograph. **B.** Interpretation. The hand-written text in the photograph caption reads "PLEISTOCENE REMAINS etc Creswell Crags CAVES, DERBYSHIRE Found by the Revd J. Magens Mello MA, FGS, etc. 1875". Each specimen in the photograph (**A**) is annotated with a hand-written number. This photograph is held in the Nottingham Natural History Museum, Wollaton Hall (NCMG 2015-53). A version of this photograph was figured and annotated by Mello (1891). The sequence of annotated numbers in this photograph does not match the sequence in Mello (1891). 19 of the specimens are housed in the NOTNH today, as indicated in **B**. The dotted line in NOTNH FS4342 indicates a broken and missing portion of this specimen.

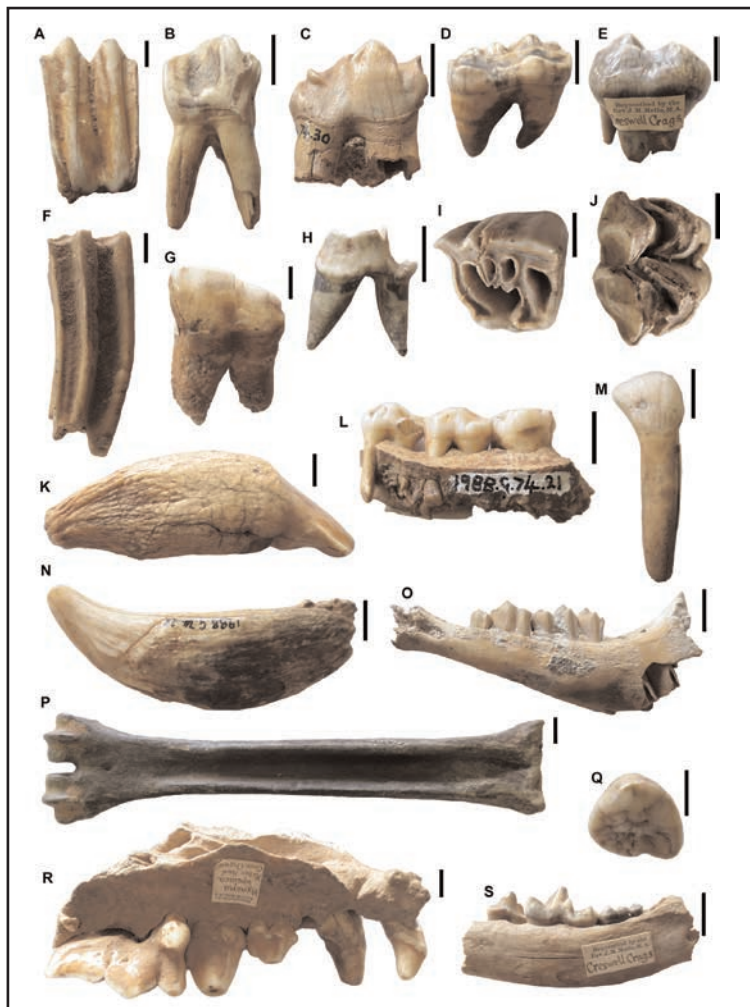


Figure 3. Photographs of 19 NOTNH Creswell Crags specimens previously figured in an historical photograph (NCMG 2015-53; see Figure 2). The following identifications are taken from the NOTNH database. **A.** NOTNH FS4332, *Bison priscus*, a 'cheek tooth'. **B.** NOTNH FS4343, *Bos longifrons*, molar or premolar. **C.** NOTNH FS4327, *Coelodonta antiquitatis*, molar. **D.** NOTNH FS4344, *Ursus* sp., molar or premolar. **E.** NOTNH FS4360, *Ursus* sp., molar or premolar. **F.** NOTNH FS4329, *Equus* sp., molar. **G.** NOTNH FS4319, *Coelodonta antiquitatis*, 'cheek tooth'. **H.** NOTNH FS4364, *Crocota crocuta*, DM4 tooth. **I.** NOTNH FS4318, *Coelodonta antiquitatis*, upper molar. **J.** NOTNH FS4325, *Megaloceros* (in database as 'Megaceros'), molar. **K.** NOTNH FS4317, *Ursus* sp., canine. **L.** NOTNH FS4357, *Sus scrofa*, part of lower jaw. **M.** NOTNH FS4340, *Bovid* incisor. **N.** NOTNH FS4333, *Ursus* sp., canine; **O.** NOTNH FS4328, *Ovis* sp. half of a lower jaw. **P.** NOTNH FS4320, *Rangifer tarandus*, metapodial, probably a metacarpal. **Q.** NOTNH FS4326, *Ursus* sp. premolar or molar. **R.** NOTNH FS4354, *Crocota crocuta*, left upper jaw. **S.** NOTNH FS4342, *Vulpes vulpes*, partial right mandible. Scale bars = 10 mm.



Figure 4. Cabinet housing the Creswell Crags collection (and other Pleistocene material) at the Nottingham Natural History Museum, Wollaton Hall.

(Larkin 2013). The Creswell Crags material will receive this treatment in due course to preserve the future integrity of the collection. A few Creswell Crags fossil specimens are on public display in the NOTNH, and one specimen (NOTNH FS4545) is on loan to Creswell Crags Museum and Heritage Centre where it is on display.

Provenance data and historical labels

Hunt *et al.* (2015) noted that "the excavations at Creswell Crags by Dawkins...were truly groundbreaking at the time" (p.110) but also acknowledged they were severely limited by contemporary knowledge. Jenkinson and Gilbertson (1984) went so far as to say that Dawkins and Mello rushed the excavations, using dynamite and workmen to clear large chambers over a short period of time. This may be backed up by the lack of provenance data associated with the NOTNH Creswell Crags collection. Wall and Jacobi (2000) calculated that 12% of the NOTNH Creswell Crags "finds" were

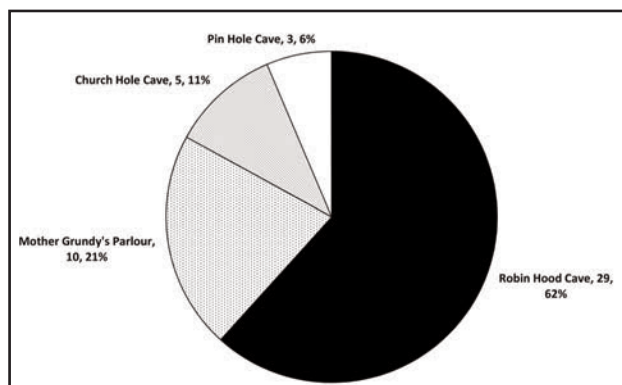


Figure 5. Summary of known provenance data for elements for which specific cave of origin is known (10.1% of the NOTNH Creswell Crags collection).

provenanced to a specific cave. Today, 32 specimens, consisting of 47 elements, retain information regarding the specific cave they were excavated from (Figure 5). This corresponds to 11.7% of specimens (with at least one element with cave information), but only 10.1% of total individual fossil elements (Figure 5). Specimens that retain specific locality information originate from one of four caves: Church Hole Cave (CHC), Mother Grundy's Parlour (MGP), Pin Hole Cave (PHC) and Robin Hood Cave (RHC). The largest percentage of these specimens (62%) comes from Robin Hood Cave (Figure 5).

The stratigraphic data associated with the specimens is also poor, possibly due to the haste with which the specimens were removed (Jenkinson and Gilbertson 1984), although it is possible that provenance data was recorded and has since been lost. Whatever the reason, the general lack of provenance data limits the scientific value of the collection. Dawkins personal papers are housed at Buxton Museum and may contain notes on these excavations.

In total there are 160 historical (before ~1960) labels attached to elements. The labels occur in ten types, which provide potential information on the collector, excavation, etc. (Figure 6). 110 specimens (which may include one or more elements) include at least one element with a label attached. In total, 146 elements have at least one type of label attached. 14 elements have two different types of label attached. The most common type of label designates specimens that were "Bequeathed by the Rev. J. M. Mello, M.A." (in printed lettering) with specific details added by hand (type A, Figure 6A). This label (or slight variants of it) is associated with 98 specimens (131 elements). The remaining nine label types are far fewer, together comprising just 18% of all recorded attached labels (Figure 6B-J). A white rectangular label with serrated edges, a narrow coloured bar (sometimes red, sometimes green), and handwritten text, occurs on seven elements (type B, Figure 6B). One variant of this type has four green striped bars (Figure 6B). These appear to be the edges from perforated sheets of stamps (or press sheets) that have been used as convenient self-adhesive labels. The significance of label type B is otherwise unknown to us, but some of them are also associated with type A labels. Rectangular white strip-like labels with straight edges and handwritten pencil identifications occur on seven elements (type C, Figure 6C). A blue and white octagonal label occurs on six elements and is known to be associated with the 1870s excavations of Mello (type D, Figure 6D). Some type D labels appear blank while others



Figure 6. Types of labels found attached to NOTNH Creswell Crags material. A. Label type A, "Bequeathed by the Rev. J. M. Mello, M. A.", Three variants, left to right: small version with "Creswell Caves" in handwriting (example NOTNH FS4310), large variant with additional taxon identification in handwriting (example NOTNH FS4308), and large variant with additional cave details (example NOTNH FS4307). B. Label type B, white rectangular label with serrated edges in four variants, left to right: broken red bar variant with additional small red stripe (example NOTNH FS4481), solid red bar variant (example NOTNH FS4371), solid green bar variant (example NOTNH FS4369), and four green striped bars variant (example NOTNH FS4551). C. Label type C, rectangular white strip-like label with straight edges (example NOTNH FS4501). D. Label type D, blue octagonal label in two variants, left to right: thick bordered variant (example NOTNH FS12061), thin bordered variant with central blue line (example NOTNH FS12079). E. Label type E, circular label with jagged edges (example NOTNH FS4491). F. Label type F, large rectangular label with straight edges and typed lettering (example NOTNH FS4550). G. Label type G, rectangular label with straight edges and 'grid' (example NOTNH FS4370). H. Label type H, semi-circular label with serrated curved edge and flat straight edge (example NOTNH FS4359). I. Label type I, large rectangular label with typed identification (example NOTNH FS4308). J. Label type J, circular label with smooth edges (example NOTNH FS4498). Photographs not to scale.

have handwritten text (Figure 6D). Circular labels with jagged edges and pencil handwriting occur on three elements (type E, Figure 6E). Type E labels are never associated with any other labels and their significance is unknown to us. A large rectangular label with straight edges has typed lettering that reads "Genus...Species...Locality...Rock" and spaces for handwritten data (type F, Figure 6F). This type of label is widespread in the general NOTNH fossil collection and was probably applied to the elements after their acquisition. A rectangular label with straight edges, a 'grid', and typed lettering with handwritten taxon identification, occurs on one specimen (type G, Figure 6G) and is associated with label type A. Label type G denotes material from the 1870s excavation. The typed lettering on the single type G label reads "Creswell Cave Churchhole cave Exploration, 1876". A white semicircular label with a serrated curved edge, with identification in handwriting is present on one element (type H, Figure 6H). A large white rectangular label (type I, Figure 6I) is found on one element, and is associated with label type A. The final type of historical label attached to elements is a single circular label with smooth edges (type J, Figure 6J) present on one specimen and unassociated with any other labels.

Some loose labels and notes are also associated with the material (Figure 7). These include scraps of brown paper with rough handwriting in pen (Figure 7A), card with handwriting in pen (Figure 7B), cards and papers with red borders and handwriting in pen (Figures, 7C and D), and loose labels (Figure 7E) that are identical to attached label type F. Some loose labels and notes have become disassociated from their elements. Some elements are also marked with pencil but these are often indecipherable or unclear.

Number of specimens

All of the NOTNH Creswell Crags Pleistocene and Holocene fossil material is listed in catalogue form, available on request from the authors. In total there are 274 fossil specimens comprising 466 elements, of which 283 have been identified to genus level (Figure 8A). These identifications are taken from the museum database, which is based on associated labels and research conducted on the collection by Andrew Carrant, Roger Jacobi, Rosemary Powers and Neil Turner. It is possible that some specimens in the NOTNH may be re-identified in the future. The identified specimens consist of 17 genera from six orders; Carnivora (*Canis*, *Crocota*, *Ursus*, *Vulpes*), Artiodactyla (*Bison*, *Bos*, *Hippopotamus*, *Megaloceros*, *Ovis*, *Rangifer*, *Sus*), Perissodactyla (*Coelodonta*, *Dicerorhinus*, *Equus*), Proboscidea (*Mammuthus*), Lagomorpha (*Lepus*) and Primates (*Homo*) (Figure 8B). The NOTNH collection is dominated by *Coelodonta* (25.5%) and *Equus* (22.0%), while *Crocota* is the most common identified carnivore (12.8%). Proboscidea, Lagomorpha and Primates together comprise less than 8% of the entire identified collection (Figure 8B). Many of the above taxa were common in Britain during the Holocene (e.g. *Bos*, *Ovis*, *Sus*, *Lepus*, *Vulpes*, and others) (Dawkins 1877), so a considerable proportion of the NOTNH fossil collection may be Holocene (rather than Pleistocene). The stratigraphic data is compromised not just due to excavation quality, but also due to rain- and flood-waters entering the caves, and intrusive burials by Neolithic *Homo sapiens* disturbing the stratigraphic integrity (Heath 1879). To resolve this issue, Creswell Crags bones can be subjected to radiocarbon dating techniques to quantify relative ages of particular taxa (Jacobi *et al.*



Figure 7. Types of loose labels and notes associated with the NOTNH Creswell Crags material. A. Scrap of brown paper with rough handwriting in pen. B. Card with handwriting in pen. C. Card with red border and handwriting in pen. D. Paper label with red border and handwriting in pen. E. Rectangular label with typed lettering and handwriting in pen, identical to the attached label type F (see Figure 6F). Photographs not to scale.

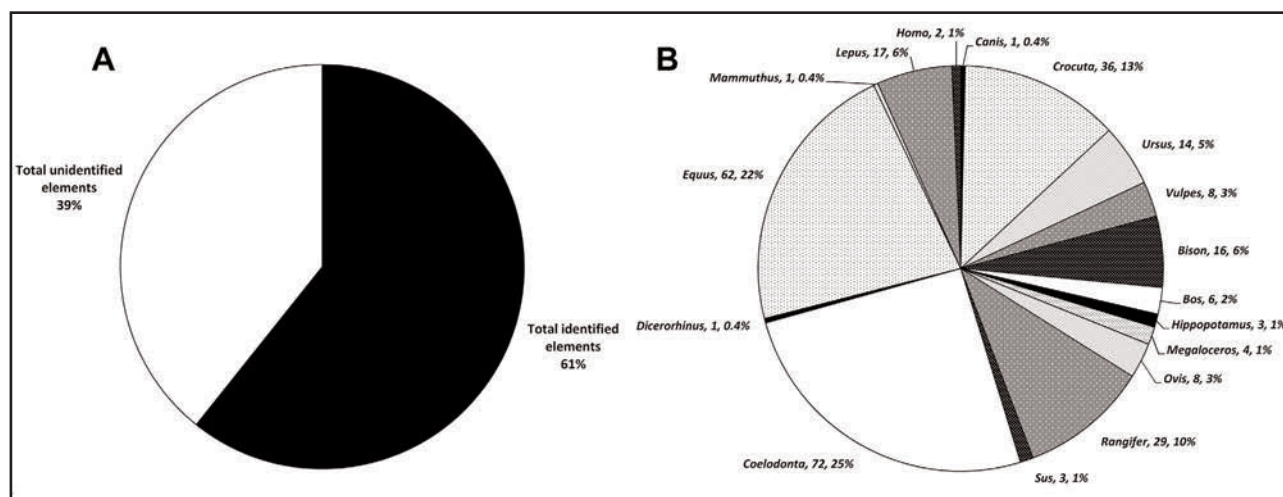


Figure 8. Abundances of faunal elements from Creswell Crags housed at Nottingham Natural History Museum, Wollaton Hall. **A.** Abundances of elements identified to genus level and 'unidentified' elements (some 'unidentified' material is identified to higher taxonomic levels). Identifications were taken from the museum database which is based on associated specimen labels and research by Andrew Carrant, Roger Jacobi, Rosemary Powers and Neil Turner. **B.** Taxonomy of the material identified to genus level (taxa ordered as in Dawkins 1877).

1998; 2006; Pike *et al.* 2005). There is also scope to distinguish between Pleistocene and Holocene material in the future based on assessing preservation, although such an approach is less rigorous and is strongly influenced by the depositional environment.

The collection also contains three specimens (consisting of six elements) which are plaster casts. These include NOTNH FS13716, consisting of a single *Coelodonta* molar, which is a replica of NOTNH FS4960/1. NOTNH FS12386 consists of two *Coelodonta* premolars which are both replicas of NOTNH FS4476/1 and one *Coelodonta* molar which is a replica of NOTNH FS4476/2. The final specimen, NOTNH FS4368, consists of two different *Dicerorhinus* molars which are replicas of a Manchester Museum specimen with the number P1846. These casts were not included in the analyses. Part of a *Rangifer* antler (NOTNH FS12061) joins a specimen in the British Geological Survey (BGS G5 and A85).

Comparison with 1870s excavations

Comparison between the entire NOTNH Creswell Crags collection (Pleistocene and Holocene) and the material listed by Dawkins (1877) (both Pleistocene and Holocene) shows the same four most common genera: *Crocota*, *Equus*, *Rangifer* and *Coelodonta* (Figure 9). However, some differences are still present in the abundances of these four taxa as *Coelodonta* are more abundant in the NOTNH collection, whereas *Crocota* and to a lesser extent *Rangifer*, are less abundant in the NOTNH collection (Figure 9).

Other notable discrepancies include *Bison*, which is twice as abundant in the NOTNH, and *Bos*, which is three times as abundant (Figure 9). In addition, the Ipswichian *Hippopotamus* and *Dicerorhinus* are present in the NOTNH collection, but are not recorded by Dawkins (1877). This discrepancy may be explained because these taxa in the NOTNH are exclusively from Mother Grundy's Parlour, which was excavated by Mello and Dawkins in 1877 (Dawkins and Mello 1879), too late to be published in Dawkins (1877). *Mammuthus* on the other hand is substantially less abundant in the NOTNH collection compared to Dawkins (1877) (Figure 9). One could speculate that this is the result of a 'donation bias,' in which Mello separated out the *Mammuthus* material for other museums/collectors.

Dawkins (1877) recorded the presence of *Panthera* specimens in both Church Hole Cave and Robin Hood Cave. These were believed to belong to the Eurasian cave lion (*Panthera leo spelaea*) and leopard (*Panthera pardus*) (Dawkins 1877). A tooth in the NOTNH collection originally identified as a lion canine was re-identified as a bear in the 1980s/90s by A. Carrant and R. Jacobi (NOTNH FS4308). Conclusive remains of British Pleistocene leopards are restricted to southern England (Diedrich 2013), so their remains could have been brought in by Palaeolithic man from mainland Europe (Freedman and Evans 2015), or could have been misidentified.

The scimitar-toothed cat *Homotherium*, originally named '*Machairodus*' by Dawkins (1877), is absent from the NOTNH collection (or has not been

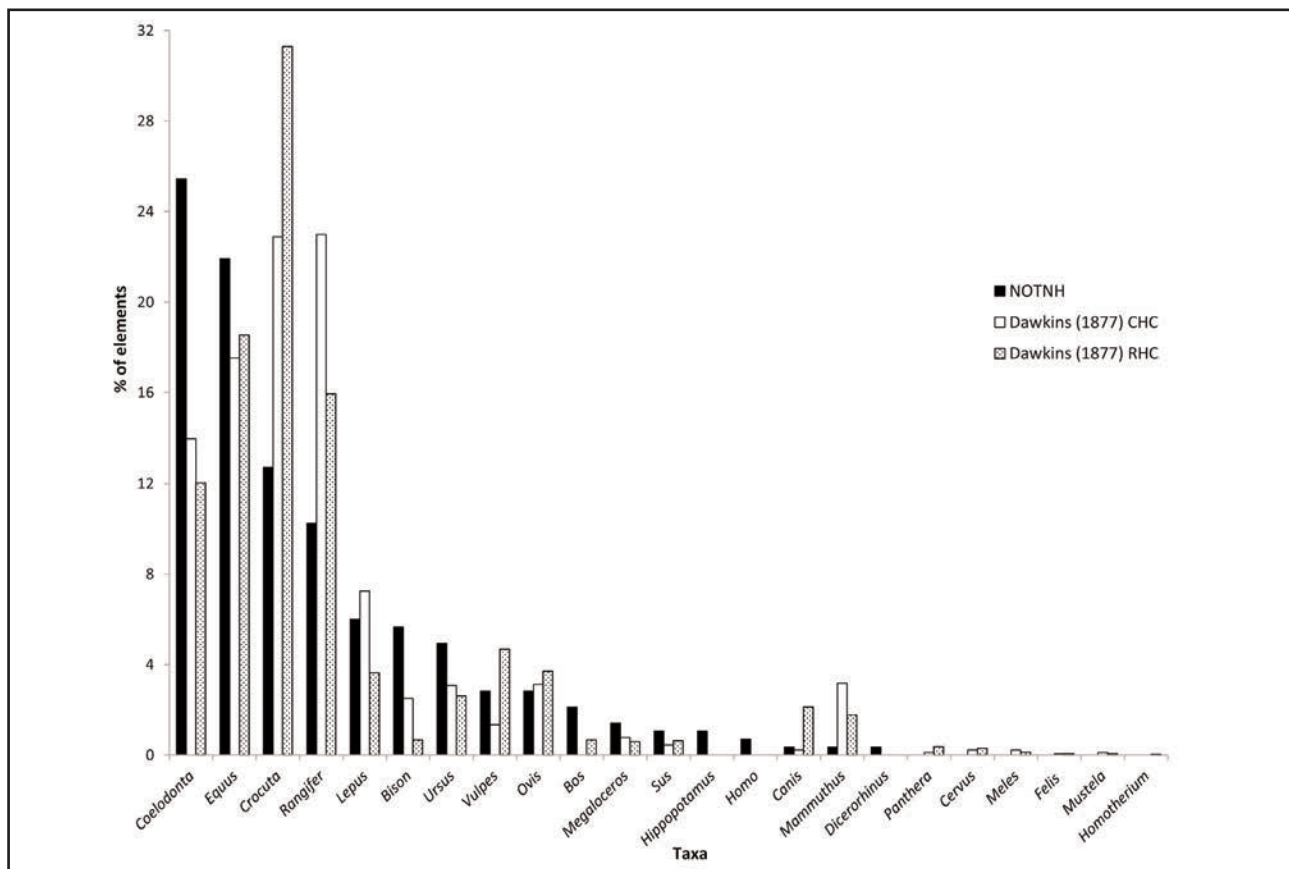


Figure 9. Abundances of identified specimens held at the Nottingham Natural History Museum, Wollaton Hall (NOTNH), compared with abundances of specimens from the initial 1870s excavations of Church Hole Cave (CHC) and Robin Hood Cave (RHC) as reported by Dawkins (1877). N.B. Specimens identified by Dawkins (1877) may have since been re-identified, and specimens in the NOTNH may also be re-identified in the future.

identified), although only one specimen belonging to this taxon has been recorded from Creswell Crags (Dawkins 1877, fig 3; Jenkinson and Gilbertson 1984; Barnett 2014). However, this tooth specimen was originally disputed by Thomas Heath as a deliberate plant (Heath 1880) and this interpretation has since been generally accepted (Jenkinson and Gilbertson 1984). Even if genuine, the tooth would likely have been brought in by Palaeolithic man from mainland Europe (Currant and Jacobi 2001; MacFarlane and Lundberg 2013), and therefore would not be part of the Pin Hole MAZ in Britain.

Limited significance can be attached to the above comparisons because they contain collections of mixed provenance. However, six taxa are exclusively Pleistocene in age in Britain: *Crocuta*, *Bison*, *Coelodonta*, *Mammuthus*, *Hippopotamus* and *Dicerorhinus*, although in Britain the latter two are only found in pre-Devensian deposits. The relative abundances of these taxa may therefore potentially provide a meaningful comparison between Pleistocene Pinhole MAZ collections and/or fauna.

Collecting biases may have arisen in the Creswell Crags caves as Dawkins and Mello were primarily

focused on large, characteristic Pleistocene fauna, so smaller animals may have been less intensively studied or even ignored (Jenkinson and Gilbertson 1984). Later, more detailed excavations certainly found smaller specimens, including Arctic fox (*Vulpes lagopus*), European water voles (*Arvicola terrestris*) and several species of lemming (Armstrong 1929, 1930, 1931, 1932a, 1932b). The lack of such taxa in the NOTNH Creswell Crags collection suggests this may have been the case, further highlighting that the collection does not contain a representative faunal assemblage of Creswell Crags.

Reconciliation of specimens with the database

A database of NOTNH material was compiled as part of a documentation initiative (The Baseline Database Project) in the 1990s. Following this project, as of 01/08/2003, there were 252 fossil records with the 'find spot' listed as Creswell Crags in the database (an additional specimen of cave earth is not a fossil: NOTNH FS12153). 15 of these had no acquisition details. In the current study all 252 of these specimens were accounted for in the collection. The

specimen details in the database were double-checked against the physical labels and updated accordingly. As a result of this project, the details were updated for 127 records.

In addition we identified 26 more specimens (consisting of 73 elements) from Creswell Crags on the basis of; (1) physical labels that had been previously unrecorded (four specimens in total) and (2) data in 'collections note' field of the baseline database (22 in total, plus the four labelled specimens).

There are also 24 specimens (consisting of 192 elements) labelled as "probably from Creswell Crags." The specimen NOTNH FS12380 consists of a small drawer, separate from all other Creswell Crags specimens, containing 75 bones and teeth mounted by nails in the drawer bottom (Figure 10A). This specimen is labelled "?Creswell Crags" in the baseline database but contains no other stratigraphy or acquisition details, so this is presumably just an educated guess by the curator at the time (the handwriting belongs to Jim Owens, Museum Assistant, 1939-1954, and Assistant Curator: Geology, 1954-1984). The remaining 23 specimens (containing 117 elements) are in two drawers in the cabinet (Figure 4), with 11 specimens (containing 75 elements) in Drawer 9 (Figure 10B) and 12 specimens (containing 42 elements) in Drawer 11 (Figure 10C). Both drawers are physically labelled "probably from Creswell Crags" (in Jim Owens' handwriting) but have no other stratigraphy or acquisition details recorded on the labels or in the database. Therefore this is also presumably just an educated guess. Although the taxonomic identities of some probable Creswell Crags specimens had previously been tentatively deduced, their scientific value remains low and have therefore all been excluded from our analyses.

Reconciliation of specimens with the acquisition registers

The NOTNH register of acquisitions was compiled retrospectively as part of a service-wide documentation initiative in the 1990s/2000s immediately preceding the Baseline Database Project (see above). Each Mello acquisition in the register does not include an itemised list of individual Creswell Crags specimens (see 'History of the Collection'). Therefore, there is no way to confidently distinguish between the various bequests, purchases and gifts, so reconciliation of the individual specimens with separate Mello acquisitions is difficult. However, it may be possible to reconcile some specimens with acquisitions on the basis of their labels. Those specimens with type A labels (Figure 6A; 98 specimens in total) might be part of the third acquisition.

Conclusions and future directions

The NOTNH Creswell Crags collection contains a diverse Pleistocene and Holocene mammalian fauna. Although it is not always certain which epoch particular taxa or specimens may belong to, elements could be subjected to radiocarbon dating techniques to quantify relative ages of taxa (Jacobi *et al.* 1998; 2006; Pike *et al.* 2005).

Work is ongoing to classify the unidentified specimens to provide more accurate faunal abundances of the NOTNH collection and Creswell Crags and the Pin Hole MAZ. This can be aided by resolving whether the "probable Creswell Crags" specimens are indeed from these caves. Whilst the NOTNH Creswell Crags collection can be considered important for future palaeontological research, the lack of site provenance and stratigraphic data limits its scientific value. This could in part be rectified by focusing on specimens and elements which retain pencil or pen annotations

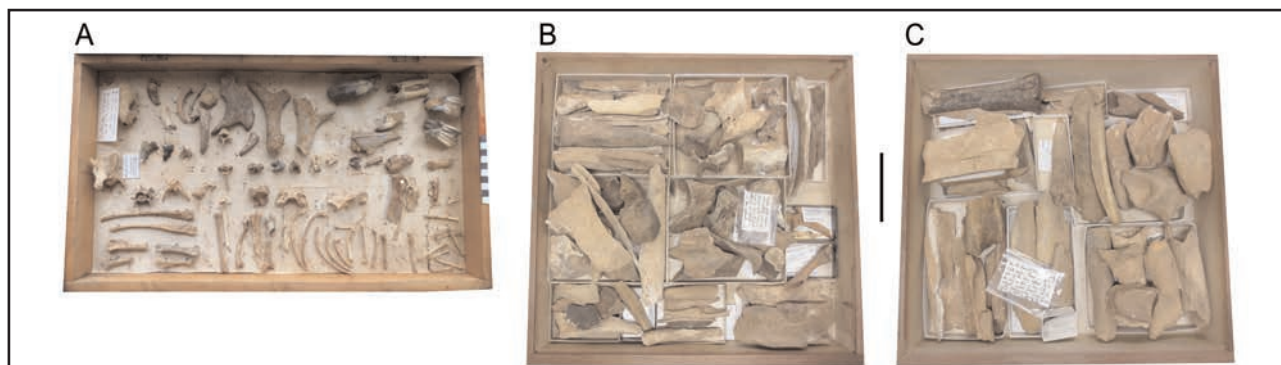


Figure 10. Boxes/drawers of NOTNH material labelled as "Probably from Creswell Crags". A. Box of 75 elements with a single specimen number (NOTNH FS12380). B. Specimens stored in drawer 9. C. Specimens stored in drawer 11. Scale bar 10cm.

Specimen number	Acquisition number	Description	Photograph number given by Turner (2000)	Actual photograph number
NOTNH FS4317	1988.G.74.11	<i>Ursus</i> canine tooth	18	22
NOTNH FS4318	1988.G.74.8	<i>Coelodonta</i> molar tooth	45	42
NOTNH FS4319	1988.G.74.9	<i>Coelodonta</i> molar tooth	46	38
NOTNH FS4329	1988.G.74.6	<i>Equus</i> molar tooth	39	51

Table 1. Corrections to Turner (2000). All other photograph numbers cited by Turner (2000) are correct. Note that specimen numbers have taken precedence over acquisition numbers in the NOTNH for identification purposes since 2000.

on the fossils themselves and/or their associated loose notes. Deciphering these marks could potentially uncover the person or persons who originally wrote them and consequently from when and where they were excavated.

Projects such as this one will hopefully encourage other museums with Creswell Crags material to document and publish their collections in more detail. This may help deduce whether museums that received donations of Creswell Crags material were indeed subjected to 'donation biases' with respect to specific taxa being acquired, and might provide more data for understanding spatial and temporal faunal movements during the Ice Age (Wall and Jacobi 2000; Currant and Jacobi 2001).

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