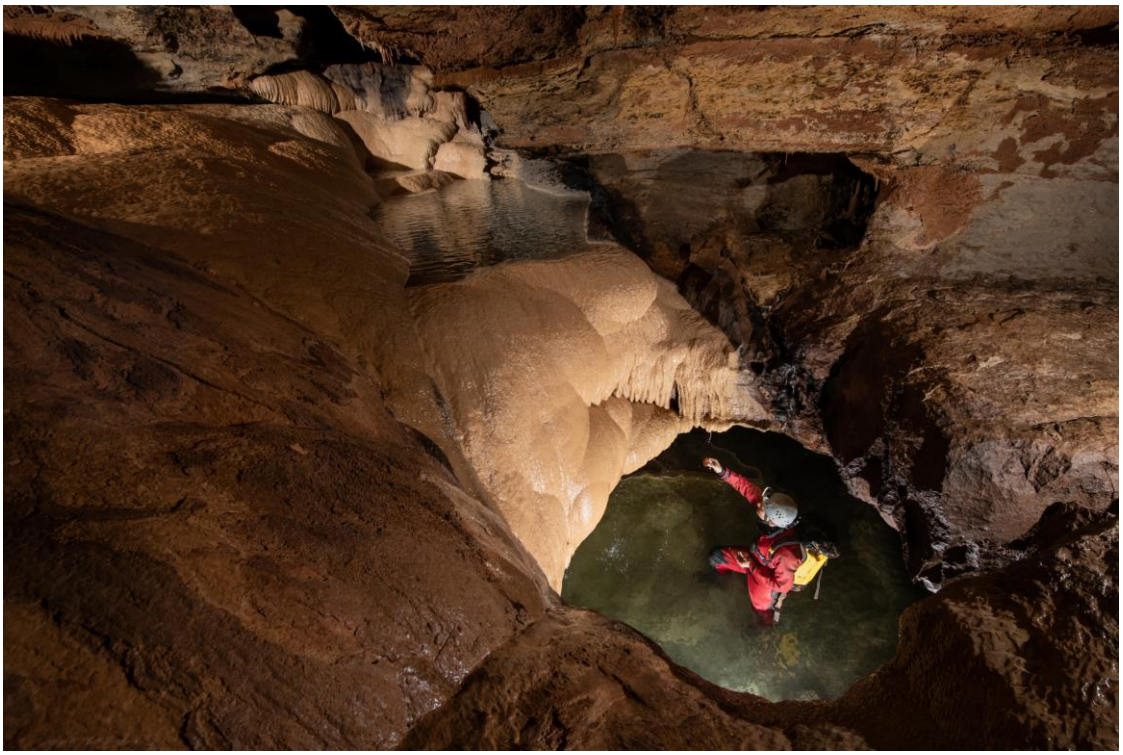

BCRA

British Cave Research Association

31st Cave Science Symposium

Saturday 12th November, 2020

A zoom meeting hosted by Northumbria University and the British Geological Survey

Northumbria University NEWCASTLE

BGS British Geological Survey

Photo c. Robbie Shone

WELCOME FROM THE BCRA CHAIRMAN

On behalf of the Council and Trustees of the British Cave Research Association (BCRA) I am pleased to welcome members and speleologists from (literally!) around the world to the 31st BCRA Cave Science Symposium. The first Symposium was held at the University of Sheffield in 1984 and it was followed by annual meetings until 1987 when it became biannual (1987 and 1991). There was then a four year hiatus before the meetings resumed in 1996 since when they have been held annually. The 30 Symposia to date have been held at 14 individual institutions with the Universities of Bristol and Leeds tying for most popular with five meetings at each. In 2020 the global pandemic has prevented us from meeting in person but 'every cloud has a silver lining' and in our case moving to a virtual meeting has made it possible for us to welcome speakers and guests who would not otherwise have been able to be present. As I type this welcome we have over 100 registered attendees which makes this by far our largest science symposium

The objective of the BCRA is "*to promote the study of caves and associated phenomena wherever they may be situated, for the benefit of the public*" and the Annual Symposium is one of the ways that this objective is fulfilled. The *associated phenomena* include karst landforms on the surface, and this aspect is reflected in the title of the Association's scientific journal, *Cave and Karst Science*. The BCRA Cave Science policy focuses on four major themes: speleogenesis, archaeology/palaeontology, biology and technology. Speleogenesis is interpreted broadly, including those aspects of geomorphology, geology and hydrogeology that impinge on the development of conduits and ultimately caves. Studies of present cave climates and reconstruction of paleoclimates and paleoenvironments using cave sediments (speleothems and clastic deposits) are also considered under the speleogenesis heading. We are very pleased that the programme for the 31st Symposium includes representatives of the first three themes and although there is no specific talk on technology this theme underpins several presentations.

The BCRA AGM is held during the Symposium. Administrative matters are kept to a minimum, the primary objectives being to provide BCRA members with a succinct summary of Association activity during 2020 and to seek views on what should be done in 2021 and beyond. Interested non-members are welcome to attend the AGM and to contribute to the discussion but not to vote.

As with all BCRA events this Symposium was made possible by the commitment of volunteers and I would particularly like to thank Professor Mike Rogerson of Northumbria University for acting as lecture secretary and programme organiser and Dr Andi Smith from the BGS for organising the Zoom meeting.

Finally, and as we have many non-BCRA members attending as Guests, it is important to note that BCRA is a Charity that is run by volunteers and relies on income from membership fees and donations. If you have enjoyed this meeting and would like to join BCRA we would be pleased to welcome you (go to http://bcra.org.uk/detail/fees.html) and if you are willing to provide a donation to assist us then please do so via http://bcra.org.uk/donate

Professor John Gunn, BCRA Chairman

Joining instructions

Thank you for registering for the 2020 BCRA Science Symposium. We have an exciting group of international speakers, and a full programme for you. There will be some complexities from being online, and we will all miss talking to people in person, and continuing conversations. We hope you find ways to do those conversations by other means. However, we can provide some stimulating talks, some good discussions and a more international flavour than our meetings usually provide.

The meeting will be on Zoom, which will be accessed via this link:-

https://ukri.zoom.us/j/98187290719?pwd=TFpFNmRIaVB0dmxLTTZ0MFZCc1VxZz09

We will begin the meeting around 9.00 on the 14th, but the programme will not begin until 9.30. The gap is there to allow you to get into the meeting, and sort out any technical issues you have. We recommend you also turn off your own video, as uploading your data is more likely to slow your connection than downloading ours.

The rules of the meeting are simple:

- Stay on mute to prevent incidental noise and echos
    - Except when invited to thank speakers.
- Ask questions via the chat function
- Join the AGM if you are interested
    - But only vote if you are a member

The AGM is planned to be in a breakout room, and if you are a BCRA member you will be automatically invited. If you would like to attend but are not a member, contact Mike Rogerson via the chat function (you can send the message just to him rather than to everyone by changing the chat recipient). Voting will be also be via direct chat messages to Mike Rogerson – please give your vote (yes or no) and your BCRA membership number. Only votes with a membership number will be counted. This will take a little time, so please bear with us – we promise to do better than Georgia….

We look forward to welcoming you to the meeting!

Mike Rogerson & Andi Smith

BCRA Science Meeting, 2020 Schedule

Time	Activity	Speaker	**Affiliation**	**Title**
9.30-9.45	Introduction, sorting connections and housekeeping	MR / JG		
9.45-10.15	Seminar	Andy Baker	University of New South Wales	The ACKMA Cave Climate Project
10.15-10.45	Seminar	Andi Smith	**British Geological Survey**	**Exploring the impact of tourists on the cave environment: A COVID 19 case study from Poole's Cavern, Derbyshire, UK.**
10.45-11.00	COFFEE			
11.00-11.30	Seminar	Carole Nehme	**University of Rouen**	**The story behind the Chalk karst networks in Normandy (France) and their relation to the incision of the Seine valley during the Quaternary**
11.30-12.00	Seminar	Agni Prijatelj	**Durham University**	**Sediment micromorphology and site formation processes at Chechem Ha Cave, western Belize**
12.00-13:00	BCRA AGM	JG		
13:00-13.30	LUNCH			
13.30-14.00	Seminar	Annabel Wolf	**Northumbria University**	**Caves in central Vietnam and what they tell us about past tropical cyclones**
14.00-14.30	Seminar	Sebastian Breitenbach	**Northumbria University**	**A stalagmite-based multi-proxy reconstruction of Glacial-Holocene climate variability from Sarma Cave in the Caucasus Mountains (Georgia)**
14.30-15.00	Seminar	Paul Toechterle	University of Innsbruck	A cave-based reconstruction of permafrost dynamics during the last glacial period: from the Peak District, UK
15.00-15.15	COFFEE			
15.15-15:45	Seminar	Lucas Godinho	**Sao Paolo University**	**Fluvial erosion rates at the São Desidério river, central Brazil, based on cave deposits dating**
15.45-16.15	Seminar	Tom Thomson	Natural History Museum	Speleobiology in Northern Spain: The Work of the Matienzo Karst Entomology Project.
16.15-16:45	Closing comments, and discussion	MR / JG		

The ACKMA Cave Climate Project

The ACKMA Cave Climate Team

corresponding author: Andy Baker (a.baker@unsw.edu.au)

Not long after the Covid-19 virus closed all Australian and New Zealand show caves, the Australasian Cave and Karst Management Association (ACKMA) took the opportunity to establish baseline show cave climate conditions in the absence of visitors. Fifty QP 6013 temperature and relative humidity loggers were cross-calibrated, including temperature calibration against a Fluke reference standard thermocouple. Temperature precision was < 0.1 °C and accuracy < 0.2 °C; relative humidity precision was <0.5% (at 60%) and manufacturer quoted accuracy in the range 3 - 5%. The project was enthusiastically embraced by the Australasian show cave community, with loggers shipped to 17 participating cave and karst management organisations across Australia and New Zealand. Since June 2020, forty-four loggers have been collecting climate data at 10 minute intervals in 27 caves: one logger is placed outside the cave or caves to collect local external climate data, and other loggers placed inside each cave to assess natural cave climate variability and the potential effect of tour groups. The caves being monitored are, in Australia: Calgardup Cave, Jewel Cave, Mammoth Cave, Ngilgi Cave, Lake Cave, Crystal Cave, Yonderup Cave (WA); Capricorn Caves, Donna Cave, Trezkinn Cave (Queensland); Careys Cave, Jersey Cave, Jillabenan Cave, Gaden Cave, Cathedral Cave, Phosphate Mine (NSW); Gunns Plains, Marakoopa and King Solomons (TAS); Kelly Hill (SA); Shades of Death Cave (VIC). And in New Zealand: Footwhistle, NgaRua, Nikau, Mangawhitikau and Te Anau caves. In this presentation we will present the results to date, which highlights the natural variability of cave climate of these Australasian show caves, and some initial results related to the return of a limited number of visitors to many of the caves in recent months.

Exploring the impact of tourists on the cave environment: A COVID 19 case study from Poole's Cavern, Derbyshire, UK.

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Cave systems normally offer some of the most unimpacted and stable environments on earth. Suffering little from the attention of humans or the extreme impacts of weather, most caves have an annual temperature range of only 1˚C. However, show caves are an anomaly to this norm. With large numbers of tourists routinely entering the cave and artificial lighting and ventilation being used, there can often be a marked impact on the natural cycle of these underground worlds. Much research has been undertaken into the impact of tourism in caves. It is rare however, that researchers can ever really explore the true impact of underground tourism, due to the annual operation of most show caves and a lack of long closedown periods. In early 2020 the UK wide shutdown of all tourism and travel due to the Coronavirus pandemic forced closure of all UK show caves. Poole's Cavern has, since 2018, been operating as one of the worlds best monitored show caves, under the banner of the British Cave Science Centre (BCSC). Here we present some unique cave temperature data that highlights the impact of closing the show cave on temperature cycles and how re-opening has once more resulted in tourist driven temperature variations. This unprecedented period of closure has given us a glimpse into the natural temperature cycle in Poole's Cavern and a baseline from which to assess the impacts of future tourist activities.

The story behind the Chalk karst networks in Normandy (France) and their relation to the incision of the Seine valley during the Quaternary

Carole Nehme[1,4], Andrew Farrant[2], Daniel Ballesteros[1], Dominique Todisco[1], Joel Rodet[3,4], Diana Sahy[2], J. Michael Grappone[5], Jean-Claude Staigre[4], Damase Mouralis[1].

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Caves in the Upper Cretaceous Chalk limestone are generally rare, but more common in the Normandy (France), with several hundred recorded sites. Most occur in the Seine valley. Few caves are several km long with few active streamways; others are relict systems, sometimes preserved up to 90 m above sea level (asl). Many caves are infilled with sediment, sometimes totally and often display a paragenetic morphology. The sediments include reworked loessic material, clay, sand and flint derived from Palaeogene and Quaternary Clay-with-Flint and loess deposits that overlie the Chalk. The spatial and vertical distribution of caves suggest a link between cave elevation, Chalk stratigraphy and the river's incision. Where valleys are incised through karst areas, caves and sediments can be used to reconstruct the landscape evolution because they can record the elevation of paleo-water tables, and contain preserved datable material.

In Normandy (Northern France), the River Seine is entrenched into an extensive karstic Chalk plateau. Previous estimates of valley incision were hampered by the lack of preserved datable fluvial terraces. A stack of abandoned phreatic cave passages preserved in the sides of the Seine valley can be used to reconstruct the landscape evolution of the region. Combining geomorphological observations, paleomagnetic and U/Th dating of speleothem and sediments in eight caves along the Lower Seine valley, we have constructed a new age model for cave development and valley incision. Six identified cave levels up to ~100 m asl were formed during the last ~1 Ma, coeval with the incision of the River Seine. Passage morphologies indicate that the caves formed in a shallow phreatic/epiphreatic setting, and modified by sediment influxes. The valley's maximum age is constrained by the occurrence of late Pliocene marine sand. Paleomagnetic dating of cave infills indicate that the highest-level caves were being infilled prior to 1.1 Ma. The evidence from the studied caves complemented by fluvial terrace sequences indicate rapid river incision occurred during Marine Isotope Stage (MIS) 28 to 20 (0.8-1 Ma), with maximal rates of ~0.30 $m \cdot ka^{-1}$, dropping to ~0.08 $m \cdot ka^{-1}$ between MIS 20-11 (0.8-0.4 Ma), and 0.05 $m \cdot ka^{-1}$ from MIS 5 to the present-time.

Reference

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Acknowledgements

This work was funded by the Institut de Recherches Interdisciplinaire Homme-Société (University of Rouen-Normandy). Financial support for laboratory analysis and uranium series dating was provided by the UK Natural Environment Research Council (NERC).

Sediment micromorphology and site formation processes at Chechem ha cave, western Belize

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This paper presents initial results of an ongoing geoarchaeological investigation of the sedimentary processes at Chechem Ha (Poisonwood Water), a limestone cave in Western Belize, Central America. Chechem Ha is the oldest dated Mayan ritual cave site in the entire Maya region, with dates encompassing the Early Preclassic-Late Classic periods (1100 BCE- 950 CE). Excavations revealed intact sedimentary deposits and excellent stratigraphy. The sediments were characterized as heavy clays with varying amounts of sand and silts, both endogenous and exogenous to the cave. Bat guano, limestone, calcite, aragonite and gypsum are among the most common biogenic and geogenic deposits, while some sands and silts, as well as charcoal and ash, were introduced into the cave by a number of distinct human activities. Here, we report preliminary results of the micromorphological and complementing bulk analyses for the main stratigraphic sequence in Chamber 2 and a selection of locales with a strong anthropogenic signal. We also explore the challenges and opportunities of combining sediment micromorphology with other site-specific ritual indicators, such as spatial and temporal clusters of charcoal and pottery fragments, in order to contribute to the development of geoarchaeological methodologies for more refined interpretations of Mayan ritual cave sites.

Caves in central Vietnam and what they tell us about past tropical cyclones

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Central Vietnam is hit by several tropical cyclones per year and predicting strength and timing of related heavy rainfalls remains a challenge. One way of improving these uncertainties is reconstructing past tropical cyclones. This can be done by using the isotopic signature of stalagmites, which gives insights into hydrological processes in the region. However, the isotopic signature of rainfall can be altered in the epikarst before being deposited in stalagmite carbonate. This alteration needs to be investigated before drawing any conclusions about past climate and the only way to address this problem is cave monitoring.

The Phong Nha-Kẻ Bàng massif in central Vietnam hosts the world's largest caves. Even though most parts of the cave system have been explored for tourism, continuous long-term environmental monitoring is still limited. Therefore, we installed environmental loggers and collected rain and drip water over two years at Soong Cave, which is located about 50 km from Dong Hoi. By analyzing the isotopic composition of the waters, we found that the cave has a residence time of about two months and that the isotopic composition is representing changes in the atmospheric circulation. Thus, stalagmites from central Vietnam have the potential to investigate atmospheric processes, such as heavy rainfalls, in the region. These finding are crucial for palaeoclimate research and help us to understand past and future climate in central Vietnam.

Here, we present cave monitoring data of Soong Cave, collected over two years, and explain implications for palaeoclimate research.

A stalagmite-based multi-proxy reconstruction of Glacial-Holocene climate variability from Sarma Cave in the Caucasus Mountains (Georgia)

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The Western Caucasus region is of great importance for documenting early human dispersals into Eurasia. Much research has been dedicated to elucidating the circumstances of human occupation, as well as the replacement of Neanderthals by modern humans across the Middle to Upper Palaeolithic transition (ca. 45-30 kyrs BP) and into the Last Glacial Maximum (LGM, ca. 24 to 18 kyrs BP) [1, 2, 3]. Although rich in caves, this region's palaeoclimatic evolution remains poorly understood. The most detailed information comes from ^{14}C-anchored pollen records in the context of archaeological excavations [1, 2, 4]. To our knowledge, no regional speleothem-based multi-proxy records are available so far. We present stable isotopes (δ^{18}O, δ^{13}C) and μXRF elemental ratios (Sr/Ca and S/Ca) from a stalagmite from Sarma Cave, Abkhazia—a mountainous karst province in northwestern Georgia. Sarma Cave is located at 2174 m a.s.l., less than 20 km from the Black Sea. The karst plateau is humid subalpine [4] and covered by grassland. At 1830 m depth, Sarma Cave is currently the third deepest cave in the world. The calcitic stalagmite SAR-12-1 was collected at a depth of 100 m below the cave entrance. Seven U/Th dates fix its growth to the LGM (23–21 kyrs BP) and the Holocene (8.5–3 kyrs BP). Stalagmite growth during the LGM indicates the absence of stable permafrost (MAAT > -2°C), despite the high elevation of the cave site. Investigation of layers bracketing the hiatus suggests that the stalagmite had been broken, which precludes attributing the hiatus to climatic or flow path characteristics. The LGM interval is characterized by high δ^{13}C and Sr/Ca values, indicating drier conditions and significant prior calcite precipitation (PCP). High S/Ca values suggest reduced soil development and S retention, or potentially higher sulfur input via limestone weathering in cold conditions. Although LGM δ^{18}O values are lower than in the Holocene, they are higher than in Sofular Cave to the southwest. This puzzling result might be explained by altered precipitation seasonality towards a higher summer rainfall contribution, which can be explained by a southward shifted westerly jet. Unfortunately, kinetic effects affected the LGM portion of the record and hamper reconstruction of past atmospheric dynamics.The Holocene is characterized by, in comparison, much lower δ^{13}C and Sr/Ca values, indicating enhanced soil development and reduced-to-no PCP. Low S/Ca values suggest thicker soil cover and better S retention [5] and support the amelioration of local hydrological balance, consistent with pollen data [4]. Although long-term δ^{18}O in SAR-12-1 tracks that of Sofular Cave, there is a systematic offset between the sites that reverses sign between the LGM and Holocene, which could reflect a fundamental shift in westerly dynamics, lapse rate, and/or seasonality. Our preliminary results confirm the preservation of climate signals in Sarma Cave speleothems, which may be used to constrain paleoclimatic evolution with exceptionally high sampling resolution and age control.

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A CAVE-BASED RECONSTRUCTION OF PERMAFROST DYNAMICS DURING THE LAST GLACIAL PERIOD: EVIDENCE FROM THE PEAK DISTRICT (UK)

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Permafrost is ground that remains at or below 0°C for at least two consecutive years. The history of permafrost in the karst terrains of the British Isles, however, is known in only broad terms for the late Quaternary, with limited data available to constrain millennial changes in past permafrost conditions. We present preliminary results on the spatio–temporal evolution of permafrost in the Peak District (UK) during the last glacial period (~119–11.7 ka BP). Cryogenic cave carbonates (CCCs), secondary cave mineral deposits that are associated with perennial cave ice, were found in Water Icicle Close Cavern and Bagshaw Cavern (Peak District, UK). U/Th disequilibrium dating of CCCs yielded two age clusters: 1) from 48.1 to 33.0 ka BP and 2) from 16.6 to 11.6 ka BP.

Monitoring of modern cave microclimate indicate that the reported CCCs formed during times of warm permafrost temperatures, allowing for episodic infiltration of liquid water into the frozen karst system. Permafrost in the Peak District was likely emplaced during or before Greenland stadial (GS)-13 (~48.3–46.8 ka BP). Warm permafrost conditions with bedrock temperatures only slightly below freezing persisted at least until GS-8 (36.6–35.5 ka BP). During the last glacial maximum, permafrost was widespread, and its temperature dropped, inhibiting water infiltration and causing a hiatus in CCC formation. CCCs that formed during the deglaciation indicate that warm permafrost conditions persisted throughout the Bølling-Alleröd and Younger Dryas (14.7 to 11.7 ka BP).

Acknowledgements

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FLUVIAL EROSION RATES AT THE SÃO DESIDÉRIO RIVER, CENTRAL BRAZIL, BASED ON CAVE DEPOSITS DATING

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Cave fluvial terraces distributed at different elevations and lateral positions along local base level tributaries can give valuable information on the pace of landscape evolution by erosion. In this study, cave passage morphology and cave sediment dating methods (cosmogenic ^{26}Al and ^{10}Be, OSL and U-Th) were performed in order to determine fluvial erosion rates and stages of karst landscape evolution at the São Desidério river watershed, São Francisco craton, central Brazil. The caves develop at neoproterozoic limestones of the Bambuí Gr., which are overlain by cretaceous sandstones of the Urucuia Gr., in a plateau margin geomorphologic context. Three different cave alignments were studied, named as João Rodrigues, Manoel Lopes and Cânion da Beleza, were two main cave levels occur (555 and 525 m.a.s.l.). The minimum age for the oldest cave passages at each cave alignment gets progressively younger to the upstream direction along the São Desidério river, suggesting that the headward migration of this river's main knickpoint controls the development of the cave systems. Minimum ages for the formation of the João Rodrigues, Manoel Lopes and Cânion da Beleza cave alignments are respectively 3.23 ± 0.19 My, 2.20 ± 0.21 My and 0.97 ± 0.3 My. The erosive retreat rate calculated for the main nickpoints of the São Desidério river and its surface tributary, the Nado river, are respectively 4,155.5 m/My and 1,662.4 m/My. The vertical fluvial erosion rates determined for a rocky channel bed and an unconsolidated sediment channel bed were respectively 54.3 m/My and 522.2 m/My.

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Acknowledgements

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Speleobiology in Northern Spain: The Work of the Matienzo Karst Entomology Project.

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The Matienzo Karst Entomology Project (MKEP) is an independent research initiative that has worked within the international caving and academic communities to study the fauna of the caves in the Matienzo depression and the surrounding Cantabrian karst of Northern Spain. Prior to MKEP, virtually no formal scientific work had been carried out to study this specific karst massif to identify or collect species data. The first phase of the project began in 2014 with the support of the British Cave Research Association (BCRA) with the aim to build an initial overview of the ecological and geographic significance of the area. This has since progressed to several targeted field seasons investigating specific cave sites and species communities via both short and long term trapping of fauna underground. Gathering of environmental data, recording behavioural observations and habitats traits have also greatly added to the ecology context of the species discovered and their place in the trophic structure. Sub-projects to study specific species started in 2018, and now include in-depth observations of individual taxa via electron microscopy, defining micro habitats within key cave sites, and classification of cohabitation ranges by cave topography, illumination variance, and environmental factors such as of airflow, temperature, and humidity.

Acknowledgments:
MKEP has been a large collaboration and the authors would like to thank the following for research collation and identification of taxa: Pete Smithers and Jane Ackerman of Plymouth University, Max Barclay of the Natural History Museum (BMNH); for the funding, material, and support from the British Entomology & Natural History Society (BENHS), British Cave Research Association (BCRA), and Oxford University Department of Zoology. In addition, MKEP would like to thank the members of Matienzo Caves Project for their support.