

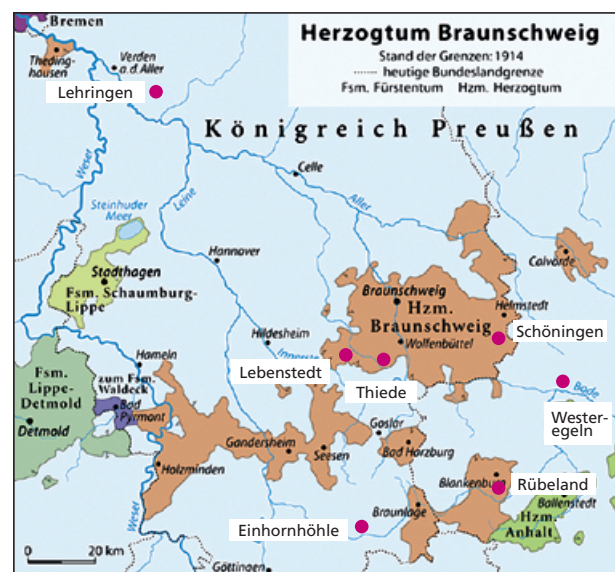
## ICE AGE FAUNA IN THE BRAUNSCHWEIG REGION, WITH A FOCUS ON THE CARNIVORES

Braunschweig used to be an independent duchy for more than 1000 years. It included territories at the River Weser in the West as well as territories which are now part of Saxony-Anhalt in the East. Parts of the geologically important Harz Mountains used to be territory of Braunschweig, too. However, the territory as a whole was not contiguous but consisted of many isolated spots which were separated by Hanoverian or Prussian territory in between (fig. 1). Therefore, it appears logical to define the »Braunschweig region« as the area which encompasses all these separate Brunsvigian parts, as well as the area in between. Nowadays, the central and eastern parts of the area form part of Germany's largest National Geopark »Harz – Braunschweiger Land – Ostfalen« which is also recognized as a UNESCO Geopark.

Geologically the area is rich in Mesozoic sediments (Triassic, Jurassic, and Cretaceous), and important fossil sites such as Cremlingen (Lkr. Wolfenbüttel/D) and Langenberg (Lkr. Gütersloh/D) have yielded vertebrate fossils such as ichthyosaurs, pterosaurs and dinosaurs (Fischer et al. 2012; Hauff et al. 2014; Sander et al. 2006).

As far as Pleistocene localities are concerned, the majority of them are Late Pleistocene, but three important Middle Pleistocene localities are also known (tab. 1).

|   |                     |
|---|---------------------|
| Rübeland Caves – 10000-45000 BP                 |                     |
| Salzgitter-Lebenstedt – 55000-50000 BP          |                     |
| Salzgitter-Thiede (Gypsum)                      | } Upper Pleistocene |
| Peine-Förste (Gypsum)                           |                     |
| Westeregeln                                     |                     |
| Walkenried (Gypsum)                             |                     |
| Osterode-Düna                                   |                     |
| Unicorn Cave Scharzfeld – 35000-170000 BP       |                     |
| Lehringen near Verden (out of area) – 124000 BP |                     |
| Gröbern (out of area) – 120000-125000 BP        |                     |
| Neumark-Nord (out of area) – c. 200000 BP       |                     |
| Schöningen – c. 300000 BP                       |                     |
| Bilzingsleben (out of area) – 350000-420000 BP  |                     |



**Tab. 1** Principle Pleistocene localities in the Braunschweig region (dating of Middle Pleistocene localities under debate; see text).

**Fig. 1** Historical borders of the Duchy of Braunschweig and localities mentioned. – (SNHM Archives, modified).



Fig. 2 Historical sketch of a fossil assemblage from a gypsum layer at Salzgitter-Thiede (1818). – (Courtesy University Library Göttingen).

**LATE PLEISTOCENE LOCALITIES**

Fossil bones from the Late Pleistocene are numerous in the Braunschweig region. Historically, four localities stand out, as they have been known and documented for centuries: Bone materials from the first two localities are stored in the State Natural History Museum (SNHM) in Braunschweig.

**Fig. 3** Entrance of Baumann's Cave. – (After C. Bruno in: Merian 1654; Collection Stephan Kempe).



### Salzgitter-Thiede

In his posthumously published book »Protogaea« (1749), the famous G. W. Leibniz (1646-1716) depicted a molar of a mammoth from »Tida« (now Salzgitter-Thiede) which he interpreted as a tooth of a marine animal. Historical mammoth molars from that locality (a gypsum quarry) have been deposited in the Geoscience Museum of the University of Göttingen and in the State Natural History Museum in Braunschweig. The latter were recovered in the years 1810-1818 by Carl Bieling and J. G. J. Ballenstedt (fig. 2). Ballenstedt was among the first German palaeontologists. In 1817 he published a book called »Beweis von dem Daseyn und Untergange von mehr als einer Vorwelt« (Joger 2005).

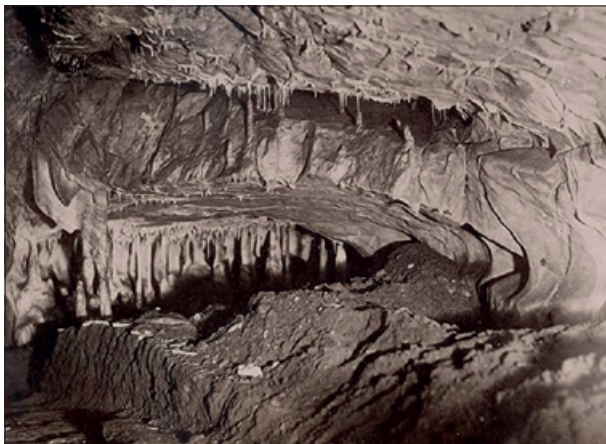
The fossils from Thiede have not yet been radiocarbon dated, but they are probably Late Pleistocene in age. Apart from woolly mammoth (*Mammuthus primigenius*) and diverse small mammals (Nehring 1878), they comprise of woolly rhinoceros (*Coelodonta antiquitatis*), horse (*Equus* sp.), reindeer (*Rangifer tarandus*), deer (*Cervus* sp.), steppe bison (*Bison priscus*), badger (*Meles meles*), polecat (*Mustela putorius*), polar fox (*Alopex lagopus*), wolf (*Canis lupus*), cave lion (*Panthera leo spelaea*), and hyena (*Crocuta crocuta spelaea*), respectively their bite marks on other bones. Diedrich (2007) classifies the bone assemblages at Thiede, Osterode (Lkr. Göttingen/D), and Westeregeln (Salzlandkreis/D) near Magdeburg as hyena dens, and he also reports that hyenas were frequently scavenging on lion bones (Diedrich 2011).

### The Rübeland Caves

Baumann's and Hermann's Caves, also known as the Rübeland Caves, are situated in the Bode Valley near Wernigerode (Lkr. Harz/D) in Saxony-Anhalt. Historically, they were part of the Blankenburg exclave of the Duchy of Braunschweig. The caves are situated in Middle Devonian limestone and the formation of the caves is thought to have started in the Neogene. In connection with the Neogene-Quaternary development of the Bode River Valley, many vertically connected horizontal levels emerged. The latest and deepest is a phreatic zone in today's karst water level.



**Fig. 4** Wilhelm Blasius (1845-1912), director of the State National History Museum in Brunswick. – (SNHM Archives).



**Fig. 5** Fossil-rich fluviatile sediment (unstratified) in Hermann's Cave. – (SNHM Archives).

First mentioning of speleothem formations and bone finds in Baumann's Cave dates back to the 16<sup>th</sup> century (Kempe et al. 2004). Due to the richness in bones, then interpreted as remains of the unicorn *Unicornu fossile*, the cave gained the attention of numerous historical authors, for example G. Agricola (1546), C. Gessner (1565), M. Merian (1654; **fig. 3**), G. W. Leibniz (1749), and C. Linnaeus (1779). Already in 1665 the first map of Baumann's Cave was published. The stalagmites, but also bones and teeth of »enormous and terrible animals« or »giants« found in that cave were harvested and sold as remedies. To regulate that trade, Duke Rudolf August of Braunschweig and Lüneburg issued the world's first cave protection order for this cave in 1668, and employed the first official cave warden. In the 18<sup>th</sup> century, bones from the cave were still sold as remnants of the mythical unicorn. J. F. Zückert (1763) interpreted them as relicts of the great flood of the bible. In 1789 the first correct interpretation of the fossil bones found as remains of bears was published (Lassius 1789). This was a few years before the formal description of the cave bear as *Ursus spelaeus*. Yet even William Buckland (1824) still used Baumann's Cave as an example for the great flood.

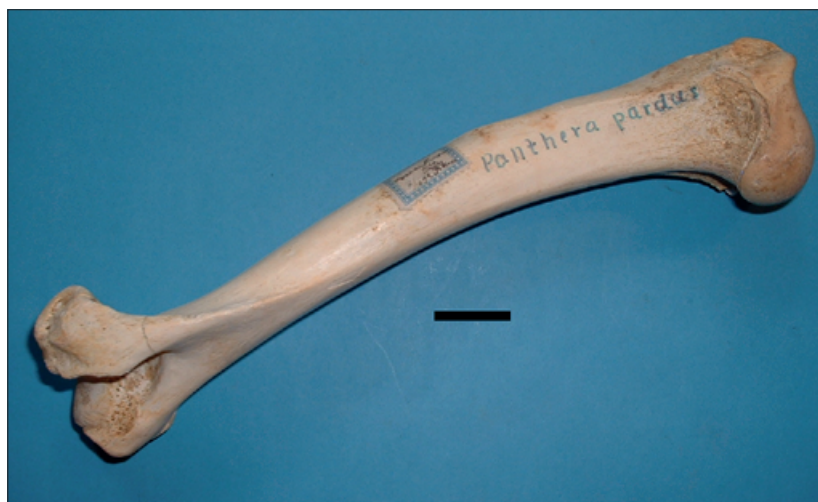
Survey works in 1888 discovered important and bone-rich new parts of the cave. Thereafter, the State National History Museum in Brunswick conducted palaeontological excavations from 1889 until 1902.

Hermann's Cave was found during road construction works in 1866. First palaeontological excavations took place in 1875 (Grotrian 1878) and continued until 1897 by the Technical University of Braunschweig and the State National History Museum in Brunswick under J. H. Kloos and W. Blasius (**fig. 4**). Kloos and Müller (1889) published a description of the caves' interior and their sediments (**fig. 5**). Further excavations by the State Museum of Prehistory in Halle took

place in 1954 and 1962, as well as by the Karstmuseum in Uftrungen (Völker 1998).

The caves' fauna is highly diverse. Bird and mammal bones dominate, the majority of the latter belong to cave bears (*Ursus spelaeus*). The presence of cave lion (*Panthera leo spelaea*), leopard (*Panthera pardus*; **fig. 6**), cave hyena (*Crocota crocota spelaea*), wolf (*Canis lupus*), red fox (*Vulpes vulpes*), arctic fox (*Alopex lagopus*), marten (*Martes sp.*), stoat (*Mustela erminea*), wolverine (*Gulo gulo*), and wildcat (*Felis silvestris*) is also documented; presumed skull material of dhole (*Cuon alpinus*) is under study.

**Fig. 6** A well-preserved leopard humerus from Baumann's Cave at Rübeland. – (Courtesy W. Rosendahl, Mannheim).



The oldest radiocarbon datings (44-46 ka uncalibrated) were obtained in *Ursus spelaeus* and *Rangifer tarandus*, whereas bones of *Canis lupus*, *Panthera pardus* and *P. leo spelaea* were dated between 31 and 37 ka (Joger/Rosendahl 2012). This period (OIS 3) is characterized by frequent oscillations of mean temperature, and even interstadial-like »warm« phases (Dansgaard et al. 1993). Only a chamois (*Rupicapra rupicapra*) was estimated uppermost Pleistocene ( $10218 \pm 71$  years BP) (Joger/Rosendahl 2012).

Ecologically, the fauna includes five different elements: arctic fauna (e. g. *Alopex lagopus*, *Rangifer tarandus*, *Ovibos moschatus*, *Gulo gulo*); steppe fauna (e. g. *Allactaga major*, *Bison priscus*); alpine fauna (e. g. *Capra ibex*, *Rupicapra rupicapra*); temperate fauna (e. g. *Capreolus capreolus*, *Cervus elaphus*, *Vulpes vulpes*) and widespread carnivores (e. g. *Canis lupus*, *Panthera leo spelaea*, *P. pardus*, *Crocuta crocuta spelaea*). It is uncertain whether all of these species existed contemporaneously or in subsequent periods.

Blasius (1898) reported Neanderthal-type artefacts from Baumann's Cave. Among them were stone tools, but also a number of broken and modified bones. In his view, they had been handled by humans. Yet some of these bones could have been chewed by hyenas.

The Unicorn Cave (**Einhornhöhle**) near Scharzfeld/Harz (Lkr. Göttingen/D) is peculiar in preserving sediments representing an enormous time span, ranging from 10 000 to 200 000 years of age, hence incorporating both Late and Middle Pleistocene (Saale complex, Eem). However, although the cave has been known for a long time (Agricola 1546; Buckland 1824), there have only been small-scaled excavations (profiles of up to 14 m in depth). Carnivore bones found represent *Ursus spelaeus*, *Panthera leo spelaea*, *Felis sylvestris*, *Canis lupus*, *Crocuta crocuta spelaea*, *Meles meles*, and *Gulo gulo* (Nielbock 2010). The Middle Pleistocene (lower) layers in the cave are yet to be uncovered.

Another Late Pleistocene locality, **Salzgitter-Lebenstedt**, has become famous because of the Neanderthal skull elements found there in 1952 and in 1976/1977, together with stone tools, worked bones and antlers, and remains of the following megafauna: *Panthera leo spelaea*, *P. pardus* (not confirmed), *Canis lupus*, *Mammuthus primigenius*, *Coelodonta antiquitatis*, *Bison priscus*, *Rangifer tarandus*, *Equus sp.*, *Megaloceros giganteus* (Grote/Thieme 1985). The assemblage is dated to the interstadial of Oerel (59 000-55 000 years BP); it is interpreted as a Neanderthal campsite (Steinmetz 2005a). A botanical analysis revealed a cool-temperate herbal steppe with dwarfed *Betulus*, *Juniperus* and *Salix*, in a river valley with some semi-aquatic vegetation. Finds of a Russian Jerboa (*Allactaga major*) indicate a steppic vegetation. Most finds from Salzgitter-Lebenstedt are stored in the Braunschweigisches Landesmuseum (see Ludovici/Pöppelmann 2017).

## MIDDLE PLEISTOCENE LOCALITIES

**Lehringen** (between Verden and Bremen [Lkr. Verden/D]) is far to the West of our region, but this interglacial locality (Eem, pollen zone IIIc, dated 124 000 years BP) represents another Middle Pleistocene hunting site in Lower Saxony with well-preserved wooden tools. Bones of a forest elephant (*Palaeoloxodon antiquus*) with a wooden lancet among them were found at Lehringen in 1948 (Adam 1951). With it, bones of *Ursus cf. arctos*, *Canis lupus*, *Lutra lutra*, *Felis sylvestris*, *Bos primigenius*, *Capreolus capreolus*, *Megaloceros giganteus*, *Dama dama*, *Cervus elaphus*, *Equus sp.*, and *Stephanorhinus hemitoechus* were recovered (Houben 2003). This is a typical interglacial fauna. The warm temperate climate is also evidenced by a complete shell of a pond turtle, *Emys orbicularis*. The locality was probably a lakeshore, comparable with the older Schöningen site or with Neumark-Nord, which may be roughly contemporaneous (see below).

**Gröbern** (near Bitterfeld in Saxony-Anhalt [Lkr. Anhalt-Bitterfeld/D]) to the Southeast of our region (pollen zone IIIb) was nearly contemporaneous with Lehringen. An adult *Palaeoloxodon antiquus* had been butchered there by early Neanderthals (Steinmetz 2005b). Bones of *Dama dama* and *Capreolus capreolus* were also found at Gröbern, but no carnivore remains.

The nearby site **Neumark-Nord** (Saalekreis/D) revealed, according to Mania (2010), an interglacial fauna within the Saale complex (roughly 200 000 years BP), whereas tooth enamel ESR dating gave a younger, Eemian age (Schüler 2010). *Palaeoloxodon antiquus* was abundant at Neumark-Nord, but a nearly complete skeleton of a lioness (*Panthera leo spelaea*) was also found (Diedrich 2010; Fischer 2010). Good overviews and detailed descriptions of the locality and its fauna are given in the recent publications edited by Meller (2010a; 2010b).

Like Gröbern and Neumark-Nord, the famous hominid locality **Bilzingsleben** (Lkr. Sömmerda/D) lies outside the Braunschweig area which is the scope of this article, but it is of similar age or even slightly older than Schöningen. The absolute age is estimated between 420 000–350 000 years BP (Mania/Mai 2001), but an alternative dating ranges between only 250 000–200 000 years BP (Eissmann/Litt 1994). Among the human remains belonging to several individuals, bones of *Palaeoloxodon antiquus*, *Stephanorhinus kirchbergensis/hemitoechus*, *Bos primigenius*, *Bison sp.*, *Equus mosbachensis*, *Capreolus suessenbornensis*, *Megaloceros sp.*, *Dama dama*, *Cervus elaphus*, *Sus scrofa*, *Ursus cf. deningeri*, *Panthera leo spelaea*, *Felis silvestris*, *Vulpes vulpes*, *Meles meles*, *Martes sp.*, *Lutra lutra*, *Crocota crocuta spelaea*, *Canis lupus*, the primate *Macaca floreana*, and the beaver *Trogontherium cuvieri* were found (Müller/Pasda 2011). Fauna and flora are evidence for a comparatively warm climate. Oak forests were dominant.

**Schöningen** (Lkr. Helmstedt/D) – like Neumark-Nord an Eocene open-air lignite mine with a series of Pleistocene layers filling a depression on top – is the focus of this volume and a comprehensive list of the large mammalian fauna secured there so far shall therefore be enough for this overview. The exact age and stratigraphy have been under debate until recently. Current thermoluminescence dating has reduced the estimated age of the Middle Pleistocene »spear horizon« from 400 000 to approximately 300 000 years BP (MIS 9; Richter/Krbetschek 2015).

For the mammal faunal assemblages, I am referring here to van Kolfschoten et al. (2007), as well as van Kolfschoten (2014), who differentiate three main strata:

|                   | early Middle Pleistocene<br>780 000-300 000 years BP        | late Middle Pleistocene<br>300 000-126 000 years BP | Late Pleistocene<br>126 000-11 700 years BP             |
|-------------------|---|---|---|
| lion              | <i>Panthera leo fossilis</i><br>(= <i>P. mosbachensis</i> ) | <i>Panthera leo spelaea</i><br>(since 370 000 BP)   | <i>Panthera leo spelaea</i>                             |
| leopard           | <i>Panthera pardus sickenbergi</i>                          | <i>Panthera pardus antiqua</i>                      | <i>Panthera pardus spelaea</i>                          |
| jaguar            | <i>Panthera onca gombaszogensis</i>                         |   |   |
| sabre-toothed cat | <i>Homotherium crenatidens</i>                              | <i>Homotherium latidens</i>                         | <i>Homotherium latidens</i> (?) –<br>North Sea specimen |
| lynx              | <i>Lynx issiodorensis</i>                                   | <i>Lynx issiodorensis</i>                           | <i>Lynx lynx</i>  |
| cheetah           | <i>Acinonyx pardinensis</i>                                 |   |   |
| cougar            | <i>Puma pardoides</i><br>(= <i>Panthera schaubi</i> )       |   |   |
| hyena             | <i>Crocuta crocuta</i> ssp.                                 | <i>Crocuta crocuta spelaea</i>                      | <i>Crocuta crocuta spelaea</i>                          |

**Tab. 2** Fossil Felidae in Central Europe (including Hyaenidae).

- Schöningen 12II («Reinsdorf-Interglacial», MIS 9): *Palaeoloxodon antiquus*, *Dicerorhinus* (*Stephanorhinus*) *kirchbergensis*, *Bos primigenius*, *Bison* sp., *Equus mosbachensis*, *Capreolus capreolus*, *Cervus elaphus*, *Sus scrofa*, *Ursus spelaeus*, *U. thibetanus*, *Martes* sp., *Crocuta crocuta spelaea*, *Canis lupus*.
- Schöningen 13I (probably the oldest stratum; may be «Holstein-Interglacial», MIS 11: *Mammuthus trogontherii* (probably misidentified *Palaeoloxodon antiquus*), *Equus mosbachensis*, *Cervus elaphus*, *Bison* sp.
- Schöningen 13II («Reinsdorf-Interglacial», MIS 9): *Palaeoloxodon antiquus*, *Bos primigenius*, *Bison priscus*, *Equus mosbachensis*, *Cervus elaphus*, *Megaloceros giganteus*, *Canis lupus*, *Vulpes vulpes*, *Mustela erminea*, *M. nivalis*. Among the smaller mammals, bones of a Desman (*Desmana* sp.) are a very remarkable find (van Kolfschoten/van Asperen/Voormolen 2007). The list was recently complimented by the rhinoceros species *Stephanorhinus kirchbergensis* and *S. hemitoechus*, by *Equus hydruntinus* and by the saber-toothed cat *Homotherium latidens* (van Kolfschoten/Buhrs/Verheijen 2015).

The Holsteinian fauna of Schöningen 13I is considered to be older (MIS 11 according to van Kolfschoten 2014) than the »spear horizon« (MIS 9), but thermoluminescence data (Richter/Krbetschek 2015) resulted in just a slightly older age for Schöningen 13I.

The faunal difference between Schöningen 12II (with forest species like *Capreolus capreolus* and *Sus scrofa*) as well as the thermophilic *Bubalus murrensis* (Serangeli et al. 2015a) on one side, and Schöningen 13II (with a dominance of steppe species) on the other side, is interpreted as an effect of climatic cooling.

However, Heinrich/van Kolfschoten (2007) also report the tertiary relict species *Trogontherium cuvieri* from Schöningen 13II, pointing to a temperate climate with trees. Another, much more spectacular tertiary relict found was the saber-toothed cat *Homotherium latidens* (Serangeli et al. 2015b).

## DISTRIBUTION AND ABUNDANCE OF CARNIVORES

While the smaller carnivores (Mustelidae, foxes, lynx and wildcat) are represented in Pleistocene localities of the region with the same species as today, there is a marked faunal change within the large mammals. For example, the cave bear was present in the Harz Mountains in great numbers until about 30 000 years BP, but died out soon afterwards. As the Middle Pleistocene localities reported here are not caves (with exception of deep layers of the Einhornhöhle), it is not surprising that normally no cave bears were found there. Yet among the bones from Schöningen 12II, with a more forested environment than Schöningen 13II, even two bear species (*Ursus spelaeus* und *U. thibetanus*) could be distinguished (van Kolfschoten 2014).

Three large carnivores are abundant in most Pleistocene localities: Lion (*Panthera leo*), wolf (*Canis lupus*) and hyena (*Crocuta crocuta*). The latter is often represented in the fossil record – not necessarily by its own bones, but rather by its characteristic bitemarks, engraved in other species' bones, or by traces left by its habit of chewing at the end of those bones. Some Late Pleistocene localities are even interpreted as hyena dens – the bones found there were accumulated by foraging hyenas (Diedrich 2007). Much less abundant is the leopard (*Panthera pardus*), and the leopard bones from Rübeland and Salzgitter-Lebenstedt are amongst the northernmost records of this species in the world (Probst 2011; Pajmians et al. 2018). This fact probably indicates that leopards were absent from our region during cold periods of the Pleistocene.

Cheetah (*Acinonyx* sp.), cougar (*Puma pardoides*) and jaguar (*Panthera onca gombaszoegensis*) were present in the early Middle Pleistocene Mosbach sands near Wiesbaden as well as at Untermaßfeld (Lkr. Schmalkalden-Meiningen/D) in Thuringia (Hemmer 1971; Hemmer/Schütt 1970; Hemmer et al. 2003). Up to now, they have not been recorded from sites younger than the early Middle Pleistocene (tab. 2). However, as witnessed by the discovery of saber-toothed cat remains (*Homotherium* was thought to have become extinct around the border between early and late Middle Pleistocene), an extension of a stratigraphic range of a species is always possible. Only the isolated North Sea specimen of *Homotherium latidens* (see contribution Mol and Langeveld in this volume) was dated younger than the one from Schöningen (even Late Pleistocene, but lacking any stratigraphic context).

## REFERENCES

- Adam 1951: L. D. Adam, Der Waldelefant von Lehringen – eine Jagdbeute des diluvialen Menschen. Quartär 5, 1951, 79-92.
- Agricola 1546: G. Agricola, De natura fossilium. De ortu et causis subterraneorum (Basel 1546).
- Blasius 1898: W. Blasius, Die anthropologisch wichtigen Funde in den Höhlen bei Rübeland a/H. Correspondenz-Blatt der Deutschen anthropologischen Gesellschaft 10, 1898, 109-113.
- Buckland 1824: W. Buckland, Reliquiae Diluvianae; or, Observations on the organic remains contained in caves, fissures, and diluvial gravel, and on other geological phenomena, attesting the action of an universal deluge (London 1824).
- Dansgaard et al. 1993: W. Dansgaard / S. J. Johnsen / H. B. Clausen / D. Dahl-Jensen / N. S. Gundestrup / C. U. Hammer / C. S. Hvidberg / J. P. Steffensen / A. E. Sveinbjörnsdottir / J. Jouzel / G. Bond, Evidence for general instability of past climate from a 250-kyr ice-core record. Nature 364, 1993, 218-220.
- Diedrich 2007: C. G. Diedrich, The Upper Pleistocene *Crocuta crocuta spelaea* (Goldfuss 1823) population and its prey from the gypsum karst den site Westeregeln near Magdeburg (Middle Germany). Abhandlungen und Berichte für Natukunde 30, 2007, 57-83.
- 2010: C. G. Diedrich, A diseased *Panthera leo spelaea* (Goldfuss 1810) lioness from a forest elephant graveyard in the Late Pleistocene (Eemian) interglacial lake at Neumark-Nord, central Germany. Historical Biology Online 2010, 1-23.
- 2011: C. G. Diedrich, Late Pleistocene steppe lion *Panthera leo spelaea* (Goldfuss, 1810) footprints and bone records from open air sites in northern Germany – Evidence of hyena-lion antagonism and scavenging in Europe. Quaternary Science Reviews 30, 2011, 1883-1906.
- Eissmann/Litt 1994: L. Eissmann / T. Litt (eds), Das Quartär Mitteldeutschlands. Ein Leitfaden und Exkursionsführer; mit einer Übersicht über das Präquartär des Saale-Elbe-Gebietes. Altenburger Naturwissenschaftliche Forschungen 7 (Altenburg 1994).



- Fischer 2010: K. Fischer, Ein Löwenskelett (*Panthera spelaea*, GOLD-FUSS, 1810) aus interglazialen Seesedimenten der Saalezeit von Neumark-Nord bei Merseburg. In: Meller 2010b, 339-360.
- Fischer et al. 2012: V. Fischer / M. W. Maisch / D. Naish / R. Kosma / J. Liston / U. Joger / F. J. Krüger / J. Pardo Pérez / J. Tainsh / R. M. Appleby, New ophthalmosaurid ichthyosaurs from the European Lower Cretaceous demonstrate extensive ichthyosaur survival across the Jurassic-Cretaceous boundary. PLoS ONE 7/1, 2012, e29234. DOI: 10.1371/journal.pone.0029234.
- Gessner 1565: C. Gessner, De Omni Rerum Fossilium Genere, Gemmis, Lapidibus, Metallis, Et Hivismodi (Zürich 1565).
- Grote/Thieme 1985: K. Grote / H. Thieme, Eiszeitliche Jagdtiere und Jäger der mittleren Altsteinzeit am Beispiel der Freilandstation Salzgitter-Lebenstedt. In: K. Wilhelmi (ed.), Ausgrabungen in Niedersachsen. Archäologische Denkmalpflege 1979-1984. Berichte zur Denkmalpflege in Niedersachsen, Beiheft 1 (Stuttgart 1985) 51-57.
- Hauff et al. 2014: R. B. Hauff / C. Heunisch / U. Hochsprung / J.-M. Ilger / U. Joger / M. Klopchar / R. Kosma / F.-J. Krüger / D. Thies / H. Zellmer, Jurameer. Niedersachsens versunkene Umwelt (München 2014).
- Heinrich/van Kolfschoten 2007: W.-D. Heinrich / T. van Kolfschoten, Erster Skelettfund von *Trogotherium cuvieri* (Altbiber). In: H. Thieme (ed.), Die Schöninger Speere – Mensch und Jagd vor 400.000 Jahren (Stuttgart 2007) 116-123.
- Hemmer 1971: H. Hemmer, Zur Kenntnis pleistozäner mitteleuropäischer Pantherkatzen (Pantherinae). Veröffentlichungen der Zoologischen Staatssammlung München 1, 1971, 15-36.
- Hemmer/Schütt 1970: H. Hemmer / G. Schütt, Ein Gepardenfund aus den Mosbacher Sanden (Altpleistozän, Wiesbaden). Mainzer Naturwissenschaftliches Archiv 9, 1970, 118-131.
- Hemmer et al. 2003: H. Hemmer / R. D. Kahlke / T. Keller, *Panthera onca gombaszoegensis* (KRETZOL, 1938) aus den frühmittelpleistozänen Mosbach-Sanden (Wiesbaden, Hessen, Deutschland). Ein Beitrag zur Kenntnis der Variabilität und Verbreitungsgeschichte des Jaguars. Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen 229, 2003, 31-60.
- Houben 2003: C. Houben, Die Wirbeltierfauna aus dem letzten Interglazial von Lehringen (Niedersachsen, Deutschland). Eiszeitalter und Gegenwart 52, 2003, 25-39.
- Joger 2005: U. Joger, Johann Justus Ballenstedt und die Anfänge der Paläontologie. Braunschweigischer Kalender 2005, 98-99.
- Joger/Rosendahl 2012: U. Joger / W. Rosendahl, The Rübeland Caves (Harz Mts.) – Historical excavations and modern analyses. Braunschweiger Naturkundliche Schriften 11, 2012, 55-68.
- Kempe et al. 2004: S. Kempe / B. Dunsch / K. Fetkenheuer / G. Naumann / F. Reinboth, Die Baumannshöhle bei Rübeland/Harz im Spiegel der wissenschaftlichen Literatur vom 16. bis zum 18. Jahrhundert: Lateinische Quellentexte. Braunschweiger Naturkundliche Schriften 1/7, 2004, 171-215.
- Kloos/Müller 1889: J. H. Kloos / M. Müller, Die Hermannshöhle bei Rübeland (Weimar 1889).
- van Kolfschoten 2007: T. van Kolfschoten, Die Kleinsäugerreste aus dem Reinsdorf-Interglazial von Schöningen. In: H. Thieme (ed.), Die Schöninger Speere – Mensch und Jagd vor 400.000 Jahren (Stuttgart 2007) 112-115.
- 2014: T. van Kolfschoten, The Palaeolithic locality Schöningen (Germany): A review of the mammalian record. Quaternary International 326-327, 2014, 469-480.
- van Kolfschoten/van Asperen/Voormolen 2007: T. van Kolfschoten / E. van Asperen / B. Voormolen, Die Großsäugerfauna von Schöningen. In: H. Thieme (ed.), Die Schöninger Speere – Mensch und Jagd vor 400.000 Jahren (Stuttgart 2007) 76-86.
- van Kolfschoten/Buhrs/Verheijen 2015: T. van Kolfschoten / E. Buhrs / I. Verheijen, The larger mammal fauna from the Lower Paleolithic Schöningen spear site and its contribution to hominin subsistence. Journal of Human Evolution 89, 2015, 138-153.
- Leibniz 1749: G. W. Leibniz, Protogaea (Göttingen 1749).
- Linnaeus 1779: C. von Linnaeus/Linné, Vollständiges Natursystem des Mineralreichs; nach der 12. lat. Ausgabe in einer freyen und vermehrten Uebersetzung von J. F. Gmelin (Nürnberg 1779).
- Lasius 1789: G. S. O. Lasius, Beobachtungen über die Harzgebirge, nebst einem Profilrisse, als ein Beytrag zur mineralogischen Naturkunde (Hannover 1789).
- Ludovici/Pöppelmann 2017: B. Ludovici / H. Pöppelmann (eds), Die Tierknochenfunde der mittelpaläolithischen Jägerstation von Salzgitter-Lebenstedt. Forschungen und Berichte des Braunschweigischen Landesmuseums N. F. 1 (Braunschweig 2017).
- Mania 2010: D. Mania, Zur Einordnung der Warmzeit von Neumark-Nord und ihrer Elefanten-Fauna in den Ablauf der Erdgeschichte. In: Meller 2010a, 64-70.
- Mania/Mai 2001: D. Mania / H.-D. Mai, Molluskenfaunen und Floren im Elbe-Saalegebiet während des mittleren Eiszeitalters. Praehistoria Thuringica 6/7, 2001, 46-91.
- Meller 2010a: H. Meller (ed.), Elefantenreich – eine Fossilwelt in Europa [exhibition catalogue] (Halle [Saale] 2010).
- 2010b: H. Meller (ed.), Neumark-Nord – Ein interglaziales Ökosystem des mittelpaläolithischen Menschen. Veröffentlichungen des Landesamtes für Denkmalpflege und Archäologie Sachsen-Anhalt. Landesmuseum für Vorgeschichte 62 (Halle [Saale] 2010).
- Merian 1654: M. Merian, Topographia und eigentliche Beschreibung der vornembsten Stäte, Schlösser auch andere Plätze und Örter in den Herzogthümern Braunschweig und Lüneburg, und denen dazu gehörenden Grafschafften und Landen (Frankfurt 1654).
- Müller/Pasda 2011: W. Müller / C. Pasda, Site formation and faunal remains of the Middle Pleistocene site Bilzingsleben. Quartär 58, 2011, 25-49.
- Nehring 1878: A. Nehring, Die quaternen Faunen von Thiede und Westeregeln nebst Spuren des vorgeschichtlichen Menschen II. Archiv des Anthropologischen Organs der Deutschen Gesellschaft für Anthropologie, Ethnologie und Urgeschichte 11, 1878, 1-64.
- Nielbock 2010: R. Nielbock, Die Einhornhöhle. Die Welt der Einhorn, Höhlenbären und Neandertaler (München 2010).
- Pajmans et al. 2018: J. L. A. Paymans / A. Barlow / D. W. G. Foerster / K. Henneberger / M. Meyer / G. F. Baryshnikov / U. Joger / W. Rosendahl / D. Nagel / R. G. Havmøller / M. T. P. Gilbert / M. Hofreiter, Historical biogeography of the leopard (*Panthera pardus*) and its extinct European populations. BMC Evolutionary Biology 18/156, 2018. DOI: 10.1186/s12862-018-1268-0.
- Probst 2011: E. Probst, Eiszeitliche Leoparden in Deutschland (München 2011).

- Richter/Krbetschek 2015: D. Richter / M. Krbetschek, The age of the Lower Paleolithic occupation at Schöningen. *Journal of Human Evolution* 89, 2015, 46-56.
- Sander et al. 2006: P. M. Sander / O. Mateus / T. Laven / N. Knötschke, Bone histology indicates insular dwarfism in a new Late Jurassic sauropod dinosaur. *Nature* 441, 2006, 739-741.
- Schüler 2010: T. Schüler, ESR-Datierung von Zahnschmelzproben der archäologischen Fundhorizonte von Neumark-Nord. In: *Mel-ler* 2010a, 71-74.
- Serangeli et al. 2015a: J. Serangeli / U. Böhner / T. van Kolfschoten / N. J. Conard, Overview and new results from large-scale excavations in Schöningen. *Journal of Human Evolution* 89, 2015, 27-45.
- 2015b: J. Serangeli / T. van Kolfschoten / B. Starkovitch / I. Verheijen, The European Saber-toothed cat (*Homotherium latidens*) found in the »Spear Horizon« at Schöningen (Germany). *Journal of Human Evolution* 89, 2015, 172-180.
- Steinmetz 2005a: W.-D. Steinmetz, Das Jägerlager der Neandertaler von Lebenstedt. In: U. Joger / C. Kamcke (eds), *Mammut – Elefanten der Eiszeit* [exhibition catalogue] (Braunschweig 2005) 74-75.
- 2005b: W.-D. Steinmetz, Der Elefantenschlachtplatz von Gröbern. In: U. Joger / C. Kamcke (eds), *Mammut – Elefanten der Eiszeit* [exhibition catalogue] (Braunschweig 2005) 82-83.
- Völker 1998: R. Völker, Hundert Jahre wissenschaftliche Grabungen in Rübeler Höhlen. *Berichte des Landesamts für Umweltschutz Sachsen-Anhalt* 3, 1998, 36-38.
- Zückert 1763: J. F. Zückert, Die Naturgeschichte einiger Provinzen des Unterharzes, nebst einem Anhang von den Mannsfeldischen Kupferschiefern (Berlin 1763).

## SUMMARY / ZUSAMMENFASSUNG

### Ice Age Fauna in the Braunschweig Region, with a Focus on the Carnivores

The Braunschweig region locates many Late Pleistocene localities (including the famous caves of the Harz Mountains and the Neanderthal site Salzgitter-Lebenstedt), but besides Schöningen, only few Middle Pleistocene sites are known in the wider area. Of these, Lehringen near Bremen, although much younger than the horse butchering site at Schöningen 13II, witnessed a comparable big game slaughter (victim: *Palaeoloxodon antiquus*). Comparable younger sites are Gröbern and Neumark-Nord in Saxony-Anhalt. Bilzingsleben in Thuringia may be slightly older than Schöningen. As far as large carnivores are concerned, bones of cave bear *Ursus spelaeus* (in the Harz Mountains), wolf (*Canis lupus*) and lion (*Panthera leo spelaeus*) are most abundant in numerous localities. Hyena (*Crocuta crocuta spelaea*) was omnipresent too, but many records refer to biting or gnawing marks on bones of other species. Among the Upper Pleistocene localities, Hyena dens are often the origin of bone assemblages. Among the rarer species, the leopard (*Panthera pardus*) is recorded here in some of its northernmost points of occurrence worldwide. The recent finds of *Homotherium latidens* at Schöningen add another large carnivorous species to the Pleistocene fauna of the region.

### Eiszeitliche Fauna im Braunschweiger Land, mit Schwerpunkt auf den Fleischfressern

Die Braunschweiger Region beherbergt zahlreiche spätpleistozäne Fundstellen (u. a. die berühmten Höhlen des Harzes und die Neandertaler-Fundstelle Salzgitter-Lebenstedt), aber außer Schöningen sind nur wenige mittelpleistozäne Fundstellen im weiteren Umkreis bekannt. Davon ist Lehringen bei Bremen, obwohl viel jünger als der Pferdeschlachtplatz in Schöningen 13II, Zeuge einer vergleichbaren Großwildschlachtung (Beute: *Palaeoloxodon antiquus*). Vergleichbare jüngere Fundstellen sind Gröbern und Neumark-Nord in Sachsen-Anhalt. Bilzingsleben in Thüringen ist möglicherweise etwas älter als Schöningen.

Bei den Großraubtieren sind Knochen von Höhlenbär (*Ursus spelaeus*) (im Harz), Wolf (*Canis lupus*) und Löwe (*Panthera leo spelaeus*) in zahlreichen Fundorten am häufigsten vertreten. Auch die Hyäne (*Crocuta crocuta spelaea*) war allgegenwärtig, aber viele Berichte beziehen sich auf Biss- oder Nagespuren an Knochen anderer Arten. Bei den oberpleistozänen Fundorten sind Hyänenhöhlen oft der Ursprung der Knochenansammlungen.

Zu den selteneren Arten gehört der Leopard (*Panthera pardus*), der hier an einigen seiner nördlichsten Fundorte weltweit nachgewiesen wurde. Die jüngsten Funde von *Homotherium latidens* bei Schöningen ergänzen die pleistozäne Fauna der Region um eine weitere große fleischfressende Art.