Archaeologia Austriaca, Band 108/2024, I–XXIV
© 2024 by Österreichische Akademie der Wissenschaften, Wien

Exploring the Surrounding of a Gravettian Site. The Case Study Grub-Kranawetberg, Austria

Philip R. Nigst
Walpurga Antl-Weiser
Marjolein D. Bosch

Abstract
In this report we summarize the findings of our fieldwalking survey conducted around the well-known Mid-Upper Palaeolithic (Gravettian) open-air site Grub-Kranawetberg I in Lower Austria, about 40 kilometres northeast of Vienna. In September 2021, we surveyed around 126,000 square metres using GNSS (Global Navigation Satellite System) to piece-plot each find. In total, we recovered 359 finds comprising lithic artefacts and faunal remains. In our analysis we show that the state of the fields did not drive how many finds per cadastral parcel were recovered during our survey and did not bias the find density per cadastral parcel. The majority of finds hint at a Gravettian dating and occur in two concentrations on top of the hill west of the known site Grub-Kranawetberg I.

Keywords
Upper Palaeolithic, Gravettian, fieldwalking, survey, spatial analysis, GIS, Lower Austria

Zusammenfassung – *Erkundung der Umgebung einer gravettienzeitlichen Fundstelle. Die Fallstudie Grub-Kranawetberg, Österreich*

In diesem Bericht fassen wir die Ergebnisse unserer Oberflächenbegehung um die bekannte Freilandfundstelle Grub-Kranawetberg I (mittleres Jungpaläolithikum/Gravettien) in Niederösterreich, etwa 40 Kilometer nordöstlich von Wien, zusammen. Im September 2021 untersuchten wir mehr als 126.000 Quadratmeter; die einzelnen Funde wurden mit der Hilfe von GNSS (Globales Navigationssatellitensystem) eingemessen. Insgesamt haben wir 359 Funde geborgen, darunter Steinartefakte und Faunenreste. In unserer Analyse zeigen wir, dass der Zustand der Felder keinen Einfluss darauf hatte, wie viele Funde pro Katasterparzelle während unserer Begehung geborgen wurden, und die Funddichte pro Katasterparzelle nicht verzerrt hat. Die Mehrzahl der Funde deutet auf das Gravettien hin und tritt in zwei Konzentrationen auf der Hügelkuppe westlich der bekannten Fundstelle Grub-Kranawetberg I auf.

Schlüsselbegriffe
Jungpaläolithikum, Gravettien, Oberflächenbegehung, Prospektion, GIS, Niederösterreich

1. Introduction

The spatio-temporal location of human activities across a landscape is essential for understanding human landscape use and the deep history of human behavioural responses to climate change and variations in resources, nutrients and moisture,[1] both within the same time frame and over time. There is a plethora of approaches that can shed light on human landscape use, regardless of whether they focus on sites as behavioural units, sites as sample locations or an off-site approach, acknowledging the varying density of human activity across landscapes.[2]

Current evidence – even in well-researched site cluster microregions – that could provide answers on human landscape use is limited or very much biased towards a few excavated contexts. Mid-Upper Palaeolithic (Gravettian) sites and site clusters are well known from the Middle Danube region, including the site clusters of Willendorf,[3] Pavlov-Dolní Věstonice,[4] Krems,[5] Moravany[6] or Stillfried-Grub[7] (Fig. 1). At many of those site clusters, large amounts of archaeological material have been collected over extended time periods, including material from surface collections, accidental finds during construction and/or farming, and excavations. However at many of those sites, it is hard to estimate the surroundings and extension of the sites beyond the excavated trenches. Even if we take an iconic site like

1 For a recent discussion, see, e.g., Davies, Nigst 2022.
2 E.g. Foley 1981.
3 Felgenhauer 1959. – Nigst et al. 2008. – Nigst et al. 2014.
4 Svoboda 1994. – Svoboda, Ložek, Vlček 1996. – Svoboda et al. 2016.
5 Neugebauer-Maresch 2001. – Einwögerer et al. 2014.
6 Hromada, Kozlowski 1995. – Kozlowski 1998.
7 Antl-Weiser 1996a. – Antl-Weiser 2008.

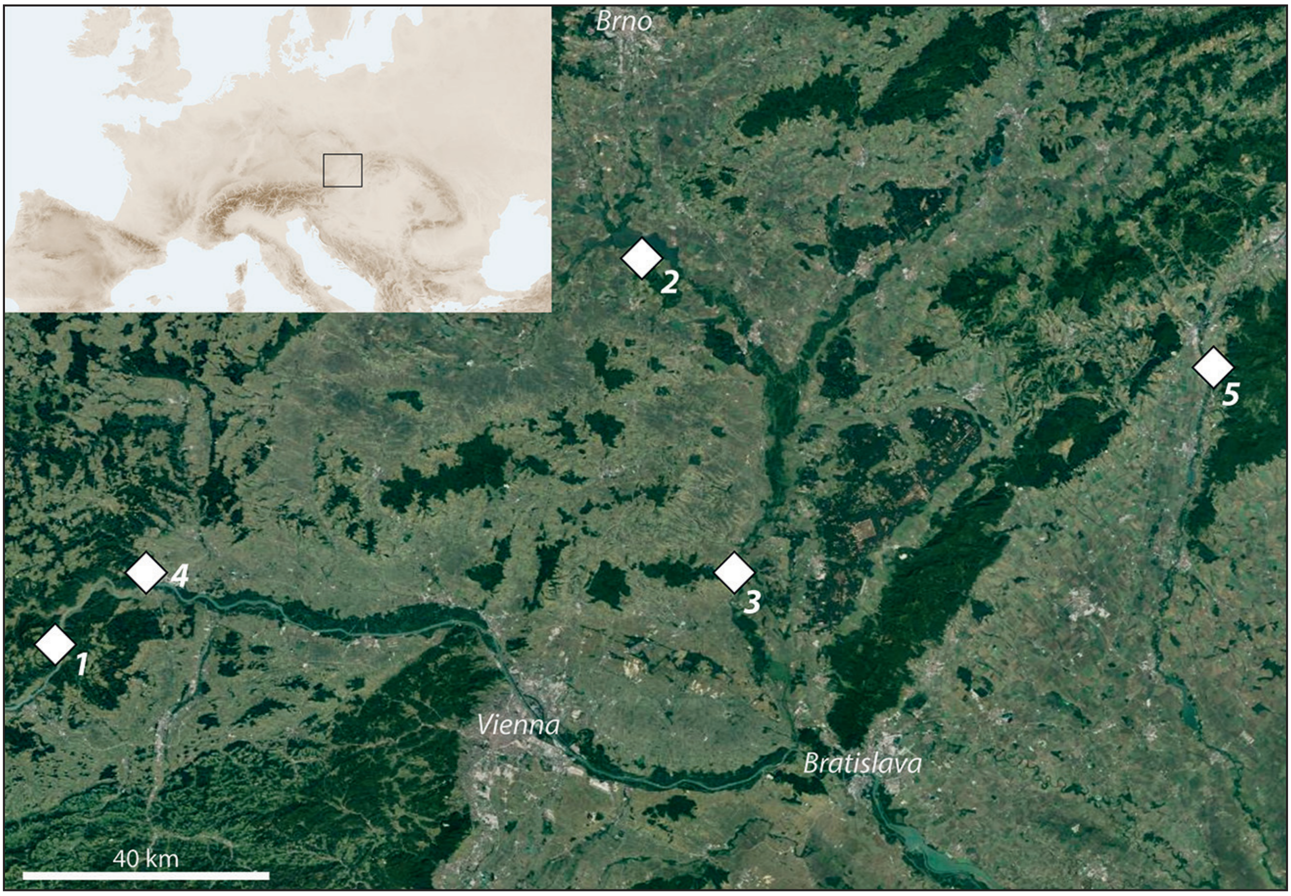

Fig. 1. Map showing the location of the Stillfried-Grub microregion and other microregions mentioned in the text. – 1. Willendorf microregion. – 2. Pavlov-Dolní Věstonice microregion. – 3. Stillfried-Grub microregion. – 4. Krems microregion. – 5. Moravany microregion (Satellite image: Google Maps [https://earth.google.com/web/@48.74355523,16.67867004,341.55509864a,283404.54785664d,35y,0h,0t,0r/data=OgMKATA]; inset: DTM of Europe, using WGS84/UTM grid system [northern hemisphere] [EPSG code 32600] as the coordinate reference system, showing the location of the main map; DTM source: GTOPO30 HYDRO 1k dataset from U.S. Geological Survey Earth Resources Observation and Science [EROS] Center, https://doi.org/10.5066/F77P8WN0; GIS and graphics: P. R. Nigst).

Pavlov I[8] as an example, we know relatively little about the extent of human occupation beyond the limits of the excavation trenches. At some other sites, more work surrounding the trenches has been done, good examples with corings are Krems-Wachtberg[9] or Willendorf II.[10] However even then, there is little data available to estimate the extent of the sites and/or further evidence of human occupation(s) in the immediate surroundings of the sites. Most of those sites are trenches and represent sample locations rather than 'camps' or other activity/settlement localities in an ethnographic sense. Where do those 'sites' end? Does the trench at 100 m distance belong to the same 'camp'? How does the surface scatter a few fields to the east relate to the human occupation in the trench under excavation? These and similar questions are very difficult to answer, but their answers are of interest for an understanding of the spatio-temporal distribution of human activities (and humans) across the landscape.

In an effort to contribute to a better understanding of the surrounding of one large Gravettian site in a cluster of sites in the Stillfried-Grub microregion, we conducted fieldwalking surveys around the excavation site Grub-Kranawetberg. While at this stage our fieldwalking survey cannot answer all questions and cannot provide a completely new view of landscape use by Gravettian humans, even if only in the Stillfried-Grub microregion, we see it as a case study highlighting the potential and problems in such an endeavour.

In a first step towards achieving a better understanding of the landscape behaviour of Gravettian humans, the

8 Svoboda 1994. – Svoboda et al. 2016.
9 Einwögerer et al. 2014.
10 Haesaerts et al. 1996.

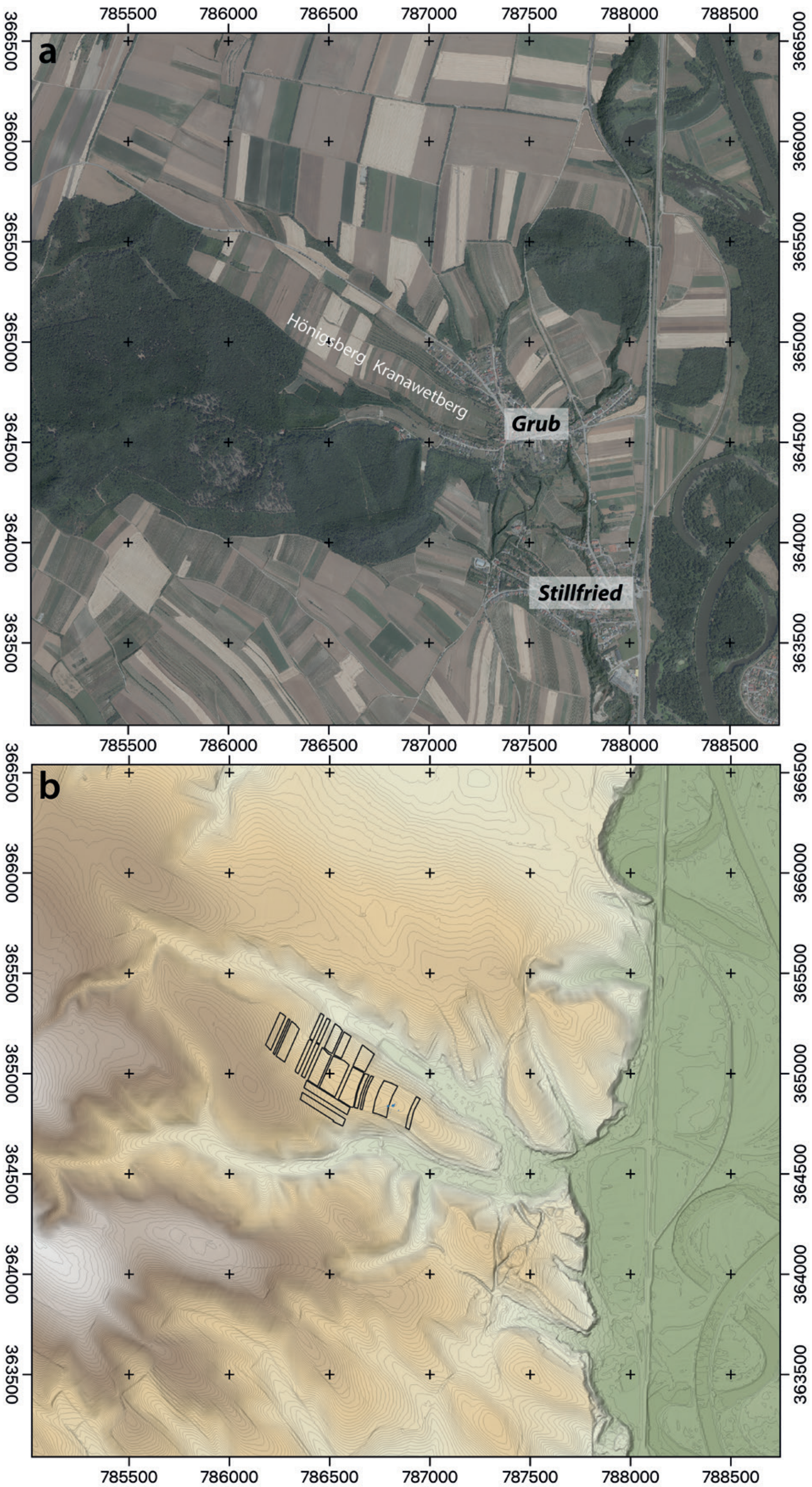

Fig. 2. – a. Map showing the location of the Kranawetberg-Hönigsberg ridge and the villages Grub and Stillfried. – b. Map showing the location of the survey area (black outline) on top of a digital terrain map (Areal images/orthophotos: © Land Niederösterreich; elevation, hillshade and 1 m-contour lines calculated from a digital terrain model with 1 m resolution: © Land Niederösterreich; coordinate reference system: MGI/Austria GK M34 [EPSG code 31259]; GIS and graphics: P. R. Nigst).

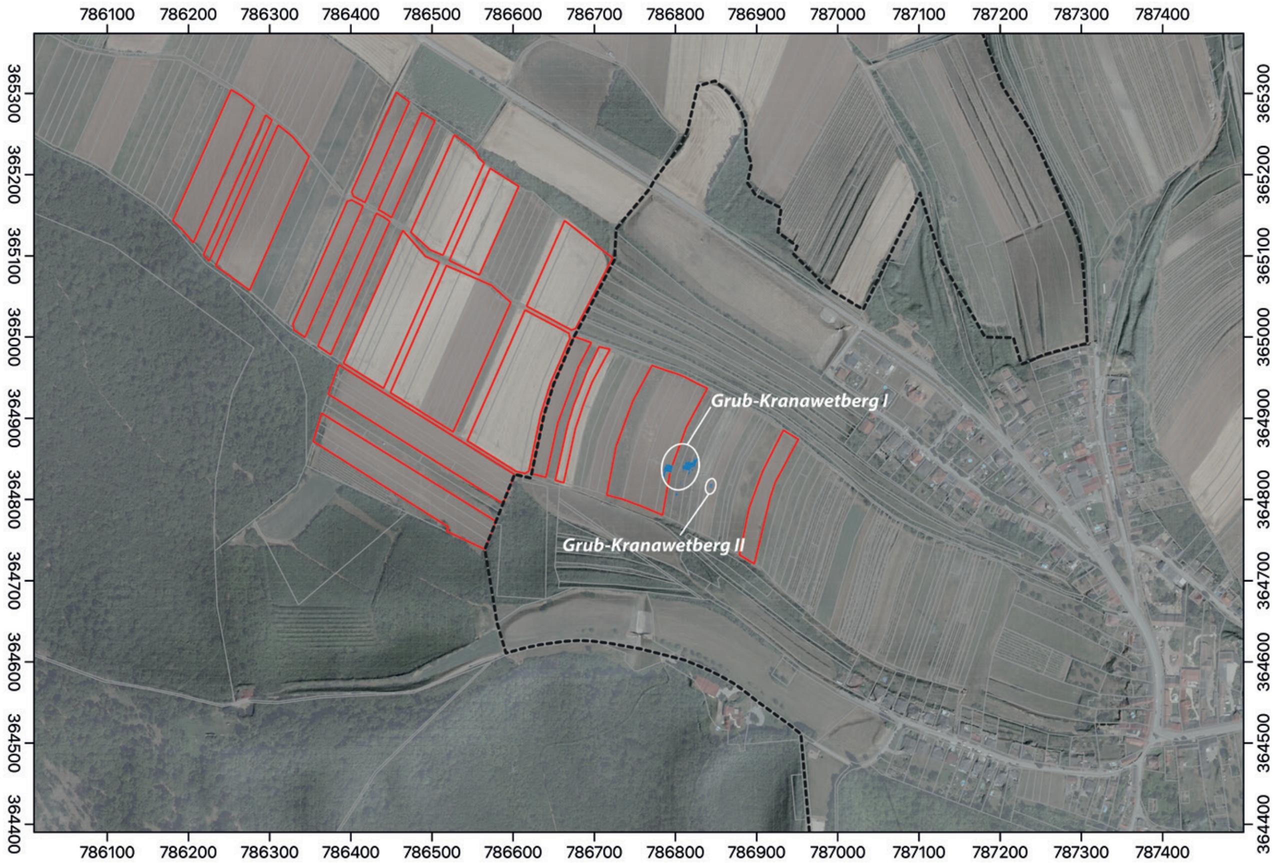

Fig. 3. Map showing the surveyed cadastral parcels (red outline) on top of the orthophoto and cadastral map; excavation trenches of Grub-Kranawetberg I and II are shown for reference (Cadastral map [Digitale Katastralmappe]: © Bundesamt für Eich- und Vermessungswesen; areal images/orthophotos: © Land Niederösterreich; hillshade calculated from a digital terrain model with 1 m resolution: © Land Niederösterreich; coordinate reference system: MGI/Austria GK M34 [EPSG code 31259]; GIS and graphics: P. R. Nigst).

objectives of our 2021 fieldwalking survey were to explore the scattering of surface finds in the region around the well-known site Grub-Kranawetberg I, excavated by Walpurga Antl-Weiser between 1993 and 2011,[11] and to use this information to guide decisions about future fieldwork, both in terms of coring activities and test excavations. Such future fieldwork should provide essential information on the bigger issues of human landscape use mentioned briefly above.

The specific goals of this paper are:

- Careful evaluation of our fieldwalking survey data in the context of field state and potential biases with regard to spatial distribution
- Presentation of the materials recovered and their chronological position
- Presentation of the spatial distribution of the recovered materials
- Use of our results for a first attempt to enhance understanding of the extent and diversity of the find region Kranawetberg, including identifying potential locations for future test trenches and areas to be protected.

2. Site Background

The Stillfried-Grub microregion is rich in prehistoric and especially Upper Palaeolithic sites.[12] Grub-Kranawetberg as a Palaeolithic find-spot itself comprises the excavation site Grub-Kranawetberg I,[13] the excavation site Grub-Kranawetberg II[14] and a scatter of surface finds that stretches over a large part of the ridge.[15] Grub-Kranawetberg I was excavated

11 Antl-Weiser 1996b. – Antl-Weiser et al. 2010. – Nigst, Antl-Weiser 2011. – Bosch et al. 2012. – Nigst, Antl-Weiser 2012. – Antl-Weiser 2016.

12 Weiser 1978. – Antl-Weiser 2008.

13 Antl-Weiser 1995. – Antl-Weiser 1996b. – Antl-Weiser et al. 1997. – Antl-Weiser 2008. – Antl-Weiser et al. 2010.

14 Bosch et al. in press a.

15 Antl-Weiser 1996a.

between 1993 and 2011 by a team led by Antl-Weiser (Natural History Museum Vienna)[16] and new excavations resumed in 2021.[17] The newly discovered site Grub-Kranawetberg II is located to the east of Grub-Kranawetberg I and has been discovered as part of our coring survey in 2022.[18]

Grub-Kranawetberg is located approximately 40 km northeast of Vienna in Lower Austria, close to the Austrian-Slovakian border (Fig. 1). The site complex, west of the village of Grub an der March, is situated on a ridge running west-northwest to east-southeast towards the village of Grub (Fig. 2). Nowadays the valleys to the south and north of the ridge are dry valleys. The ridge is about 1,200 metres long and 180 metres wide and its height varies between ~205 metres (in its west-northwestern part), ~200 metres (in its central part) and ~185 metres (in its east-southeastern part). The eastern half of the ridge is part of the village of Grub (KG Grub an der March, MG Angern an der March, VB Gänserndorf)[19] and has the field name Kranawetberg, while the western part belongs to the village of Stillfried (KG Stillfried, MG Angern an der March, VB Gänserndorf) and is known by the field name Hönigsberg (Fig. 2).

The majority of the ridge is used for agricultural purposes, only small parts along its southern flank are forested and/or disused old field terrace systems, which are nowadays overgrown by vegetation including trees (Fig. 3). The terrace field systems of the northern flank are partly still in use. The top surface of the ridge is used for viniculture and fields for various crops, as well as fallow ground. Vineyards can be found especially on the eastern part of the ridge, while crop cultivation dominates on the western part. Fallow ground can be found on individual fields, especially in the central part of the ridge.

Surface finds dating to the Palaeolithic have been known from the Kranawetberg/Hönigsberg ridge since the 1930s.[20] Since the 1970s, more intense surface collections have been conducted. These activities have been ongoing since then, with phases of more or less (or no) surveying activity. The collections have been conducted by both archaeologists and local collectors. Some of the local collectors active on the ridge have been accumulating rather large collections of surface finds. Those collections are dominated by lithic artefacts but also contain some faunal material. Some are in private possession, while some have recently been donated to the local museum 'Stillfried – Zentrum der Urzeit'.

All surface collections from the 1930s to very recent finds have been unsystematic surface collections, some with a bit more information on which part of the ridge they were collected from but never at the cadastral parcel or subparcel level. Hence, while those collections show the enormous potential of the ridge as an Upper Palaeolithic find-spot, they are of limited use for questions concerning the spatial distribution and especially for locations of potential test trenches to explore if, where, and how much of the eroded Upper Palaeolithic find horizon(s) is(are) still available for excavation and future protection.

3. Methods

3.1. Fieldwork Methods

Fieldwork consisted of fieldwalking in lines with a distance of approximately two metres (Fig. 4), which was partly due to practical reasons, namely that it is easy to spot materials up to a distance of about one metre from survey participants, and partly to the safe working and distance guidelines during the Covid-19 pandemic.

Our collection strategy was geared towards the Palaeolithic, hence we decided to collect the following material categories: lithic artefacts, bone, teeth, antler, ivory and shell, but no other clearly Holocene archaeological material like ceramic or metal objects. Some of the lithic artefacts and the fauna could be of Holocene age, but this was partly hard to assess in the field (mostly due to their unwashed status and – among the fauna – high fragmentation rate). We also did not collect stones, because in several places on the ridge, the plough cuts into Neogene deposits, and hence – depending on the type of Neogene sediments – stones can be rather frequent.

Each individual object was recorded at its find location by a waypoint using handheld Global Navigation Satellite System (GNSS) devices. A similar recording strategy has been applied in the region in fieldwork led by Petr Škrdla, for example,[21] and for a more distant example, in the work by Emily Hallinan[22] in South Africa. Several objects at the same spot were recorded by individual waypoints at the same location. Each object/waypoint was assigned a unique ID comprising the ID of the GNSS unit used and a serial ID number. The format of the unique ID was 'GK-X-YYY', where GK stands for Grub-Kranawetberg and X stands for the ID number of

16 Antl-Weiser 1995. – Antl-Weiser 1996b. – Antl-Weiser et al. 1997. – Antl-Weiser 2008. – Antl-Weiser et al. 2010.

17 Antl-Weiser et al. in press.

18 Bosch et al. in press a. – Bosch et al. in press b.

19 These abbreviations are used in the following: KG = Katastralgemeinde (cadastral municipality), MG = Marktgemeinde (market town), VB = Verwaltungsbezirk (administrative district).

20 Mossler 1935. – Weiser 1978. – Antl-Weiser 1996a.

21 Škrdla 2005. – Škrdla 2017.

22 Hallinan, Parkington 2017. – Hallinan 2022.

Fig. 4. Photos of fieldwalking survey in September 2021 (Photos: P. R. Nigst).

the GNSS unit (e.g. 'GK-1' or 'GK-2'), while YYY represents the serial ID starting with 1. Objects were placed individually in find bags, which were labelled with the unique ID. In some cases, we realised after washing that two or three objects had made it into one find bag; in such cases letters, e.g. a, b, or c, were added to the serial ID. Waypoints for these objects were duplicated with the new unique ID number.

During fieldwalking, we used GNSS equipment to record survey tracks and waypoints. We used the following equipment: Garmin GPSMap65, Garmin etrex30 and Garmin etrex10. All three models used signals from both GPS (Global Positioning System) and GLONASS (Global'naya Navigatsionnaya Sputnikovaya Sistema) satellites, normally with more GPS satellites visible and therefore utilized. Survey track recording was set to maximum detail.

3.2. Laboratory Methods

3.2.1. Field Data Post-Processing

Field data was transferred from the GNSS device using the software BaseCamp by Garmin and saved in the XML-based GPS Exchange Format (GPX). First data control and cleaning (e.g. when tracking mode was not disabled at the end of fieldwalking and hence the car journey back to the dig house was also included) was done within the BaseCamp software. These GPX files were added to our geographic information system (GIS) project in QGIS 3.18-Zürich using the 'Add-Vector-Layer' function. The waypoints were subsequently exported to ESRI shapefile format as point files and merged with database information from lithic and faunal analyses (see below).

3.2.2. Spatial Analysis

For the spatial analysis of our survey data, we built a GIS using QGIS 3.18-Zürich. The final analysis for this publication was carried out using QGIS 3.28.2-Firenze. As the project coordinate reference system, we used the MGI/Austria GK M34 (EPSG code 31259), a static Transverse Mercator system. For kernel density estimates (KDE), we utilized the Density Analysis v2023.9.21 plug-in.[23] For all our KDEs, we used a bandwidth of 15 m, an output cell size of 0.1 m, an Epanechnikov kernel, and linear colour interpolation. Digital terrain models used standard settings for colour ramps and/or hillshade in QGIS 3.28.2-Firenze.

3.2.3. Lithic Analysis

Analysis of lithic artefacts is based on attribute analysis using the variables defined in Philip R. Nigst.[24] This includes qualitative as well as quantitative variables. Categories of attributes include measurements (e.g. length, width, thickness,

23 https://github.com/NationalSecurityAgency/qgis-densityanalysis-plugin/tree/main (last access 21.3.2024).
24 Nigst 2012.

weight, exterior platform angle, platform width, platform thickness/depth, etc.), attributes related to blank production (e.g. platform type, presence/absence of bulb, lip, etc.), blank morphology (e.g. profile, distal shape, etc.), dorsal scar pattern and description of retouch and edge damage, both in terms of the type and location of retouch/damage. Core attributes include the core type, surface and platform management. Length measurements were recorded utilizing a digital calliper in mm (precision: two decimals). Weight is recorded in g with a scale (precision: two decimals); artefacts weighing 100 g or more were recorded with no decimals (on a different scale). We attributed all lithic artefacts to a raw material group based on macroscopic criteria alone. The following eight raw material groups were used in this preliminary assessment of raw materials: (i) fine-grained, beige-translucent chert with white patina (flint?), (ii) radiolarite, (iii) coarse-grained, green-brown chert, (iv) fine-grained, greenish-greyish chert, (v) coarse-grained, greyish chert, (vi) greyish chert with reddish speckles, (vii) quartzite, and (viii) unidentified raw material.

3.2.4. Faunal Analysis

Faunal remains (including shell) were attributed to a species if possible. Otherwise, they were recorded as size classes. For bones we identified the skeletal element and the portion of the bone. Our description of the specimens includes identification of anthropogenic marks (e.g. traces of impact, of percussion or cut-marks) and animal modifications (e.g. chewing). We also recorded other attributes such as alterations, burn marks, decalcification and root etching. Weathering stages utilized the classification by Anna K. Behrensmeyer,[25] while burning stages were classified following the system developed by Mary C. Stiner et al.[26]

3.2.5. Statistical Analysis

All statistical analyses have been conducted in R v4.1.2 'Bird Hippie'[27] and R Studio 2022.07.2 as the user interface. Additionally, the packages dplyr v1.0.9,[28] ggplot2,[29] readxl 1.4.0,[30] and WriteXLS 6.4.0 were used. We use standard descriptive statistics for continuous variables. Relationships between counts of categorical data were tested using Pearson's chi-squared test with Monte Carlo simulation of the p-value[31] to avoid issues with small sample size and issues related to whether one or more expected cell count would be less than five. To analyse the relationship(s) between continuous and categorial data, we employed linear models with fixed effects.[32]

4. Results and Discussion

4.1. The 2021 Fieldwalking Survey: An Overview

Between 1 and 10 September 2021 a team of nine people (six undergraduate students, one master's student, one post-doctoral scientist and one senior academic staff member) surveyed the survey area indicated in Figures 2b, 3 and 5 covering 55 cadastral parcels, of which nine belong to KG Grub an der March and 46 cadastral parcels to the KG Stillfried (see Tab. 1 for a full list of the surveyed cadastral parcels). Cadastral parcels for surveying were selected based on the following criteria: (1) field or fallow land/vineyard (fallow land and vineyards were not selected for survey), (2) type of crop (depending on the type of crop and its harvest time, we excluded/included certain parcels), (3) land owner agreement (for a few potential fieldwalking candidate parcels we were not able to secure permission for fieldwalking in time, mostly due to a lack of response from the land owners or incorrect land owner information in the cadastral database). The fieldwalking was conducted on six days between the dates mentioned above (Tab. 1) and was interrupted by a Covid-19 outbreak in the team and the necessary isolation and testing procedures.

The level of experience of the fieldwalking participants (undergraduate students vs. master's student vs. post-doctoral scientist vs. senior academic) did not result in fewer objects being collected by undergraduate students (Tab. 2). On the contrary, the senior academic collected the fewest objects (n = 41), while the number of objects collected by the three undergraduate student teams ranged from 51 to 81.

Using the GNSS equipment detailed in the methods section above, we tried to maximize use of both GPS and GLONASS satellites leading to a very good satellite coverage. On average, spatial accuracy varied between 0.6 and 1.8 metres; this was established by waypoint averaging over a point with known coordinates, i.e. a cadastral marker stone. Height was recorded automatically by the GNSS equipment but not used in any of the following analyses, as height values using commercial handheld GNSS units are prone to inaccurate measurements. However, if needed in

25 Behrensmeyer 1978.
26 Stiner et al. 1995.
27 R Core Team 2021.
28 Wickham et al. 2022.
29 Wickham 2016.
30 Wickham, Bryan 2023.

31 Patefield 1981.
32 E.g. Chambers 1992. – Gelman, Hill 2007.

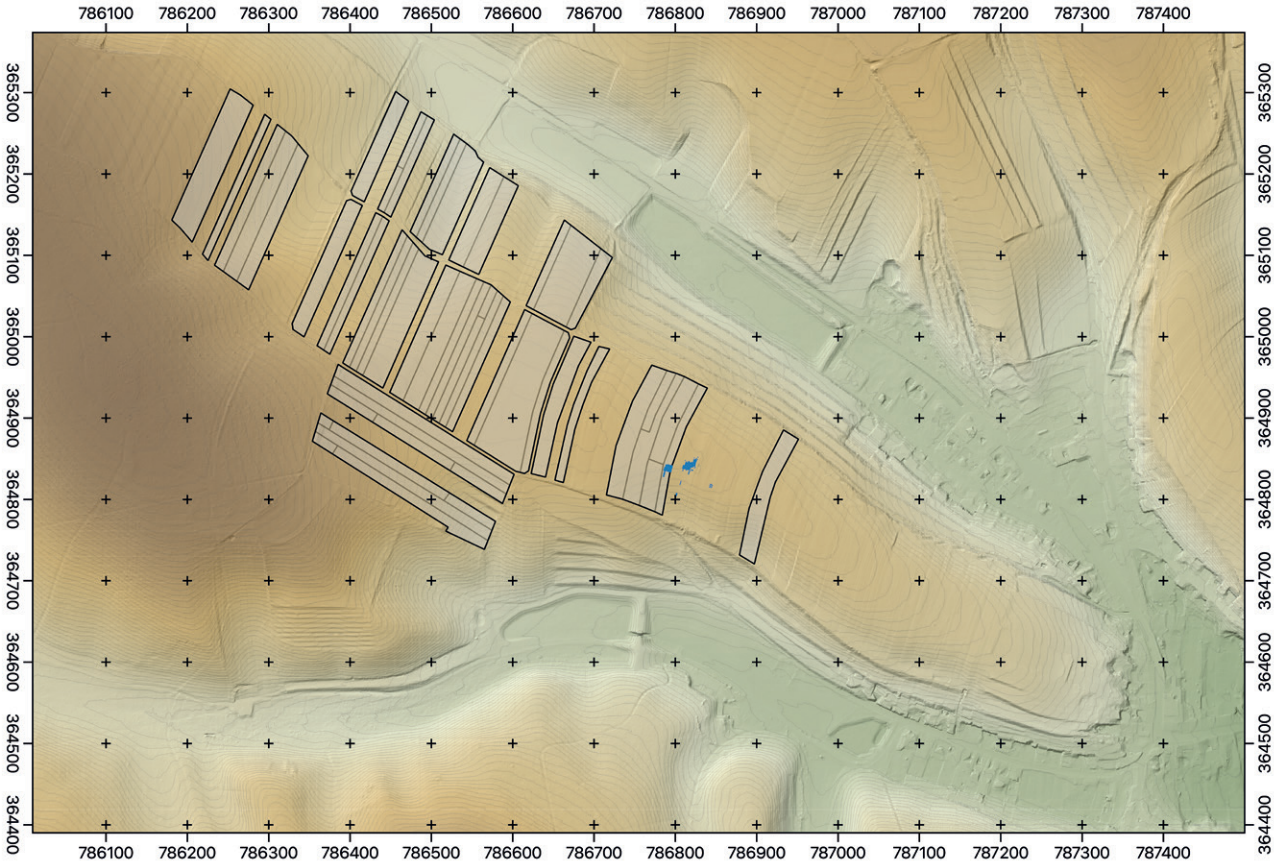

Fig. 5. Map showing the surveyed cadastral parcels (black outline) on top of a digital terrain model. Excavation trenches (blue) of Grub-Kranawetberg I and II are shown for reference (Elevation and hillshade calculated from a digital terrain model with 1 m resolution: © Land Niederösterreich; coordinate reference system: MGI/Austria GK M34 [EPSG code 31259]; GIS and graphics: P. R. Nigst).

KG (cadastral municipality)	Cadastral parcel no.	Area in m²	Date surveyed	State of the field	Finds	Number of finds	Find density per m²	Find density per km²
Grub an der March	125/2	3312	2021-09-10	harrowed	no	0	0.00000	0.00
Grub an der March	135	1859	2021-09-01	harrowed	yes	2	0.00108	1,075.85
Grub an der March	136/1	2194	2021-09-01	harrowed	no	0	0.00000	0.00
Grub an der March	136/2	1186	2021-09-01	harrowed	no	0	0.00000	0.00
Grub an der March	137/1	908	2021-09-01	harrowed	yes	1	0.00110	1,101.32
Grub an der March	137/2	2599	2021-09-01	harrowed	yes	6	0.00231	2,308.58
Grub an der March	138	3633	2021-09-01	harrowed	yes	1	0.00028	275.25
Grub an der March	145	1809	2021-09-02	harrowed (old)	yes	17	0.00940	9,397.46
Grub an der March	147/2	3341	2021-09-10	harrowed (new)	yes	20	0.00599	5,986.23
Stillfried	1679	1738	2021-09-02	harrowed	yes	6	0.00345	3,452.24
Stillfried	1680	1366	2021-09-10	ploughed	no	0	0.00000	0.00
Stillfried	1681	4940	2021-09-10	harrowed	yes	2	0.00040	404.86
Stillfried	1682	9029	2021-09-03	harrowed	yes	41	0.00454	4,540.92
Stillfried	1683	1854	2021-09-03	harrowed	yes	52	0.02805	28,047.46
Stillfried	1684	1166	2021-09-03	harrowed	no	0	0.00000	0.00

KG (cadastral municipality)	Cadastral parcel no.	Area in m²	Date surveyed	State of the field	Finds	Number of finds	Find density per m²	Find density per km²
Stillfried	1690	1847	2021-09-03	harrowed	yes	15	0.00812	8,121.28
Stillfried	1691	1658	2021-09-03	harrowed	yes	8	0.00483	4,825.09
Stillfried	1694	408	2021-09-03	harrowed	yes	2	0.00490	4,901.96
Stillfried	1695	1391	2021-09-03	harrowed	yes	54	0.03882	38,820.99
Stillfried	1696	1693	2021-09-03	harrowed	yes	34	0.02008	20,082.69
Stillfried	1699	1783	2021-09-03	harrowed	yes	8	0.00449	4,486.82
Stillfried	1700	3867	2021-09-03	harrowed (new)	yes	20	0.00517	5,171.97
Stillfried	1701	2526	2021-09-10	harrowed (new)	no	0	0.00000	0.00
Stillfried	1702	2476	2021-09-10	harrowed	yes	1	0.00040	403.88
Stillfried	1703	3309	2021-09-06	harrowed	yes	13	0.00393	3,928.68
Stillfried	1706	3740	2021-09-10	ploughed	no	0	0.00000	0.00
Stillfried	1707	4846	2021-09-06	harrowed (new)	yes	5	0.00103	1,031.78
Stillfried	1708	1632	2021-09-09	harrowed (new)	yes	3	0.00184	1,838.24
Stillfried	1709	1263	2021-09-10	harrowed (new)	no	0	0.00000	0.00
Stillfried	1710	1265	2021-09-10	ploughed	no	0	0.00000	0.00
Stillfried	1711	1679	2021-09-09	harrowed (new)	yes	3	0.00179	1,786.78
Stillfried	1712	1669	2021-09-09	harrowed (new)	yes	1	0.00060	599.16
Stillfried	1718	1299	2021-09-10	ploughed	no	0	0.00000	0.00
Stillfried	1719	1665	2021-09-09	harrowed	yes	5	0.00300	3,003.00
Stillfried	1720	1730	2021-09-09	harrowed	yes	4	0.00231	2,312.14
Stillfried	1721	529	2021-09-10	ploughed	no	0	0.00000	0.00
Stillfried	1722	659	2021-09-10	ploughed	no	0	0.00000	0.00
Stillfried	1725	3507	2021-09-09	ploughed	no	0	0.00000	0.00
Stillfried	1726	2693	2021-09-09	ploughed	no	0	0.00000	0.00
Stillfried	1737	3211	2021-09-10	harrowed	no	0	0.00000	0.00
Stillfried	1738	3754	2021-09-10	ploughed	no	0	0.00000	0.00
Stillfried	1741	2447	2021-09-10	ploughed	no	0	0.00000	0.00
Stillfried	1745	1796	2021-09-10	ploughed	no	0	0.00000	0.00
Stillfried	1749	6129	2021-09-10	ploughed	no	0	0.00000	0.00
Stillfried	769/1	2874	2021-09-02	harrowed (new)	no	0	0.00000	0.00
Stillfried	769/2	360	2021-09-02	harrowed (new)	no	0	0.00000	0.00
Stillfried	770	2863	2021-09-02	harrowed (new)	yes	2	0.00070	698.57
Stillfried	771/1	201	2021-09-02	harrowed (new)	yes	1	0.00498	4,975.12
Stillfried	771/2	1953	2021-09-02	harrowed (new)	yes	14	0.00717	7,168.46
Stillfried	771/3	806	2021-09-02	harrowed (new)	yes	2	0.00248	2,481.39
Stillfried	774/1	1351	2021-09-02	harrowed (old)	yes	1	0.00074	740.19
Stillfried	774/2	818	2021-09-02	harrowed (old)	no	0	0.00000	0.00
Stillfried	774/3	910	2021-09-02	harrowed (old)	yes	1	0.00110	1,098.90
Stillfried	775	2877	2021-09-02	harrowed (old)	yes	2	0.00070	695.17
Stillfried	776	3661	2021-09-02	harrowed (old)	yes	12	0.00328	3,277.79

Tab. 1. List of cadastral parcels.

Team	No finds
1 (UG + UG)	68
2 (UG + UG)	51
3 (UG + UG)	81
4 (MA + PD)	49
5 (SA)	41
Total	**290**

Tab. 2. Table summarizing the number of finds collected per survey team. – Abbreviations: UG = undergraduate student, MA = master student, PD = post-doctoral scientist, SA = senior academic.

Day	Area	Number of finds
2021-09-01	12,379	10
2021-09-02	22,221	58
2021-09-03	24,696	234
2021-09-06	8,155	18
2021-09-09	14,575	16
2021-09-10	44,053	23
Total	**126,079**	**359**

Tab. 4. List of the area surveyed and number of finds collected per day.

State of the field	No finds	Finds	Total
harrowed	5	18	**23**
harrowed (new)	4	10	**14**
harrowed (old)	1	5	**6**
ploughed	12	0	**12**
Total	22	33	55

Tab. 3. Table summarizing the number of cadastral parcels with and without finds for each value of state of field.

Find category	n	%
lithic	290	80.78
fauna	69	19.22
Total	**359**	**100.00**

Tab. 5. Frequency and percentage of lithic artefacts and faunal remains.

future, we can extract height information from high-resolution digital terrain models.

The survey conditions were not very good with regard to two aspects. First, the weather in the second half of August and in September 2021 was rather warm and sunny, resulting in dry conditions and no or minimal precipitation. Second, the fields varied in their state, from newly harrowed to ploughed (see Tab. 3), and we distinguished the following states: harrowed (new), harrowed, harrowed (old) and ploughed. Taking the field state and the lack of rain together, the expected artefact visibility was probably lower than in our original plans. Due to the fact that the fieldwork was part of a fieldwork training course of the University of Vienna, the date of the survey was not flexible.

We surveyed a total of 126,079 square metres, which averages to 21,013.2 per day. The minimum area (8,155 square metres) surveyed per day was on 6 September 2021 due to the Covid-19 outbreak in the team and subsequent cancellation of the day's surveying activity. Also, no surveying was undertaken on the next two days due to isolation requirements by health authorities. On the other days, the area surveyed ranged between 12,379 and 44,053 square metres (Tab. 4).

In total, we collected 359 finds on 33 of the 55 surveyed cadastral parcels (Tab. 3 and Fig. 6a), which represents ~60 % of the cadastral parcels. In these 33 cadastral parcels, the number of finds per parcel ranged from 1 to 54 (Fig. 7a and Tab. 1), while the mean number of finds is 10.88 finds per cadastral parcel (sd = 14.46). The find density in the individual cadastral parcels ranges between 275.22 and 38,820.99 finds per square kilometre (Fig. 7b and Tab. 1). The average find density is 5,425.462 finds per square kilometre (sd = 8,261.665). Our 359 finds comprise 290 lithics artefacts and 69 faunal remains including one *Fissidentalium badense* shell (Tab. 5).

4.2. Did the State of the Field Influence the Survey?

As the fields surveyed during our fieldwork were in quite different states comprising ploughed, harrowed, harrowed (fresh) and harrowed (old) (Tab. 3 and Fig. 6b), we want to explore here whether the state of the field influenced our survey results.

In total, 33 cadastral parcels (~60 %) provided finds, while 22 cadastral parcels (~40 %) provided none (Tab. 3 and Fig. 6a). Table 2 shows that none of the ploughed cadastral parcels provided any finds, while only 10 of the 33 harrowed ones provided no archaeological finds. A Chi-square test with Monte Carlo simulation of the p-value (10,000 replicates) showed that the recovery of archaeological material differs between harrowed and ploughed cadastral parcels (χ^2 = 23.023, p = 9.999e-05). Also, if we break down 'harrowed' into 'harrowed (fresh)', 'harrowed', and 'harrowed (old)' (Tab. 3), a Chi-square test with Monte Carlo simulation of the p-value (10,000 replicates) showed the same result (χ^2 = 23.319, p = 9.999e-05), suggesting that

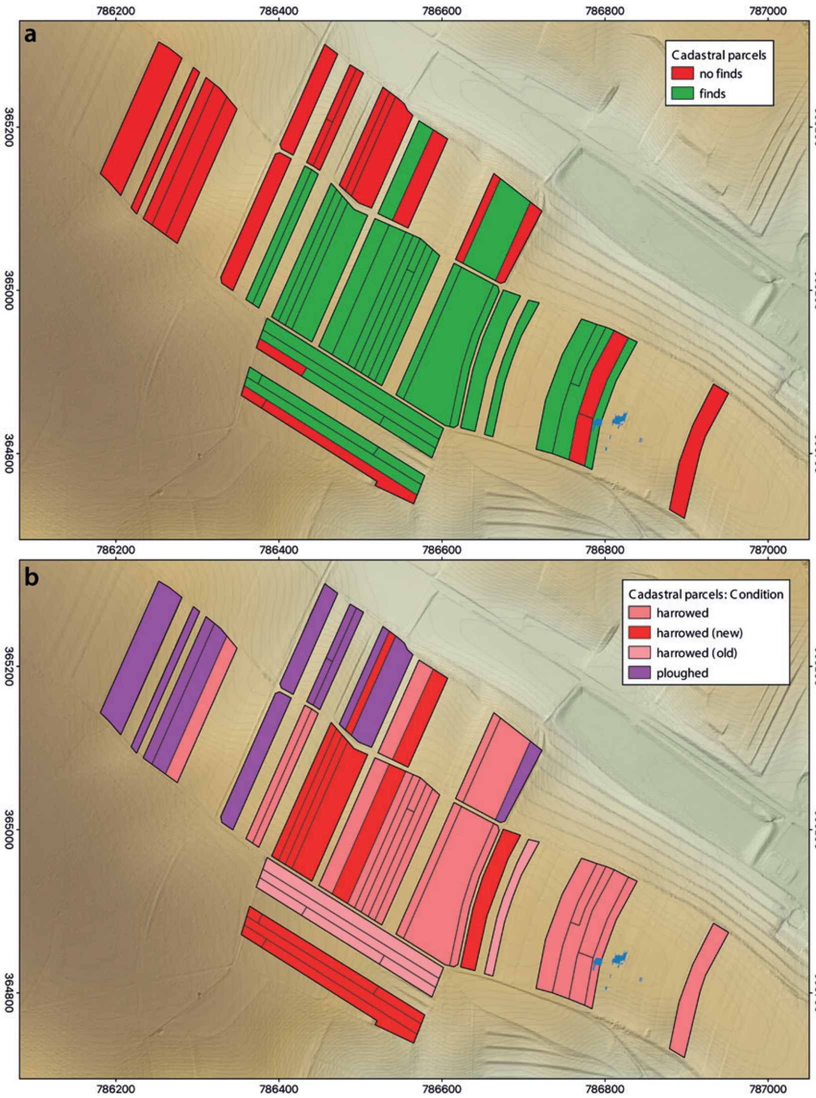

Fig. 6. – a. Map showing the surveyed cadastral parcels with and without finds on top of the digital terrain model. – b. Map showing the state – ploughed, harrowed, harrowed (fresh) and harrowed (old) – of surveyed cadastral parcels on top of the digital terrain model. Excavation trenches (blue) of Grub-Kranawetberg I and II are shown for reference (Elevation and hillshade calculated from a digital terrain model with 1 m resolution: © Land Niederösterreich; coordinate reference system: MGI/Austria GK M34 [EPSG code 31259]; GIS and graphics: P. R. Nigst).

the state of the fields had an influence on whether or not archaeological finds were recovered.

We were also interested in whether the number of finds recovered and the find density are dependent on the state of the cadastral parcel. We constructed a linear model of 'number of finds' as a function of 'state of the field'. This model was not significant at 0.05 level ($F(2,51) = 2.412$, $p = 0.07742$), although there might be a weak trend. When looking at the individual coefficients, the ploughed fields might be driving the weak trend here. However, the variable 'state of the field' explains only 7.28 % of the variability in 'number of finds'. We also constructed a linear model of 'find density' as a function of 'state of the field'. This model again was not significant ($F(2,51) = 2.129$, $p = 0.108$). The variable 'state of the field' explains only 5.9 % (adj. R^2) of the variability in 'find density'.

When looking only at cadastral parcels with finds ($n = 33$), the linear model of 'number of finds' as a function of 'state of the field' was not significant ($F(2,30) = 1.028$, $p = 0.3701$), with 'state of the field' explaining only 0.17 % (adj. R^2) of the variability in 'number of finds'. Similarly, a linear model of 'find density' as a function of 'state of the field' was again not significant ($F(2,30) = 1.066$, $p = 0.3569$). The 'state of the field' explains only 0.41 % (adj. R^2) of the variability in 'find density'.

In sum, our analysis suggests that while ploughed fields result in no finds recovered at all, the number of finds and the find density per cadastral parcel are not driven by the state of the field. This finding allows us to use our survey data presented above to cautiously infer site formation processes, erosion activity and human behaviour.

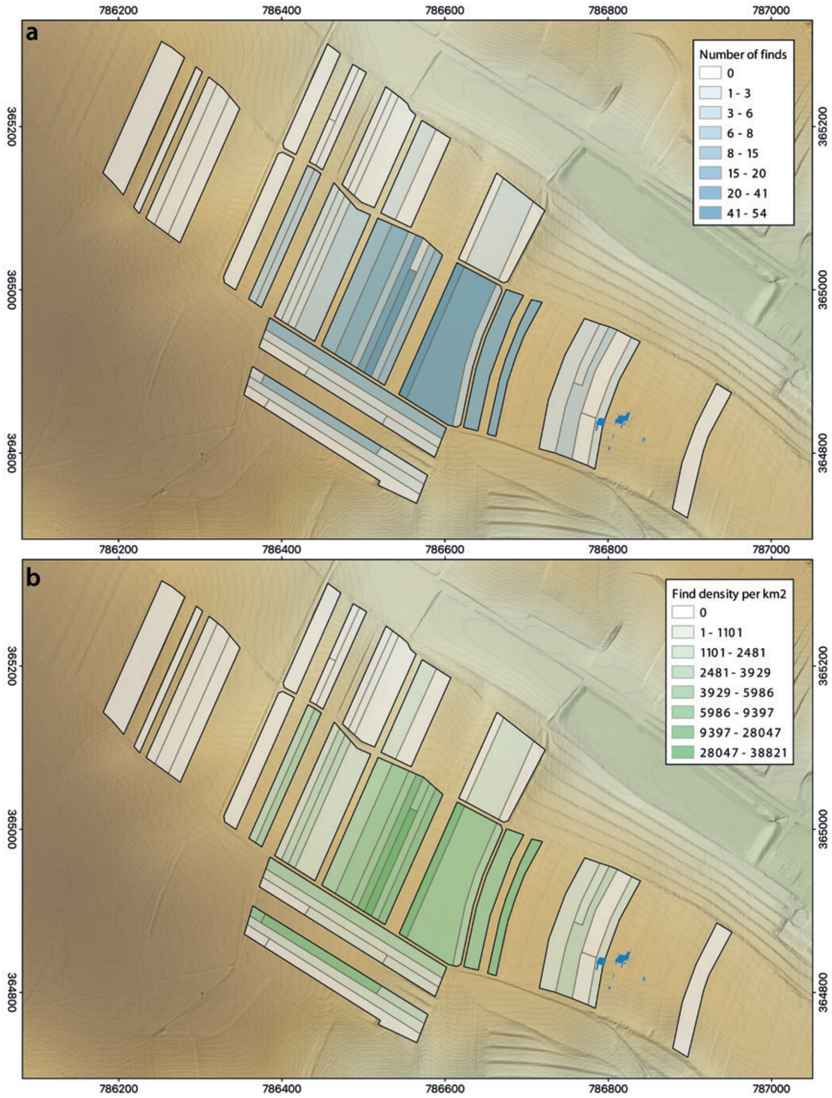

Fig. 7. Maps showing the find number (a) and find density (per km²) (b) per cadastral parcel. Excavation trenches (blue) of Grub-Kranawetberg I and II are shown for reference (Elevation and hillshade calculated from a digital terrain model with 1 m resolution: © Land Niederösterreich; coordinate reference system: MGI/Austria GK M34 [EPSG code 31259]; GIS and graphics: P. R. Nigst).

4.3. Spatial Distribution

The spatial distribution of the finds is shown in Figure 8a with a lot of material stemming from the central part of our survey area. Visual inspection of the spatial distribution of the finds shows two concentrations or areas of higher find density highlighted and labelled A and B in Figure 8b. A kernel density estimation map of the find distribution is shown in Figure 8c.

It is evident from the maps in Figures 9 and 10 that the main pattern is driven by the lithic artefacts rather than the fauna. The faunal remains do not occur at a higher density in the same areas as the lithic artefacts. In addition, we have to keep in mind that the majority of faunal remains are not of Late Pleistocene, i.e. Palaeolithic, age (see section 4.4 for more details), hence we have highlighted the Late Pleistocene fauna in a different colour in Figure 11.

The two higher density areas A and B shown by the point map in Figure 8b are not located at the same microtopographic position with regard to the current terrain. Area A is right on top of the ridge while Area B is on the upper, very shallow slope. However, both are located more or less on top of the ridge – as shown by the slope map, derived from the digital terrain model, in Figure 12 – with no or minimal overlying deposits preserved. This, in turn, allows us to suggest that most probably no archaeological horizons are preserved.

Noteworthy in this context is also the fact that on the surveyed parcels just east of the Grub-Kranawetberg I excavation area, no lithic or Pleistocene faunal remains have been recovered on top of the hill, but – if at all – on the slope to the south. This is congruent with observations by Antl-Weiser during the 1993–2011 excavations at the site.

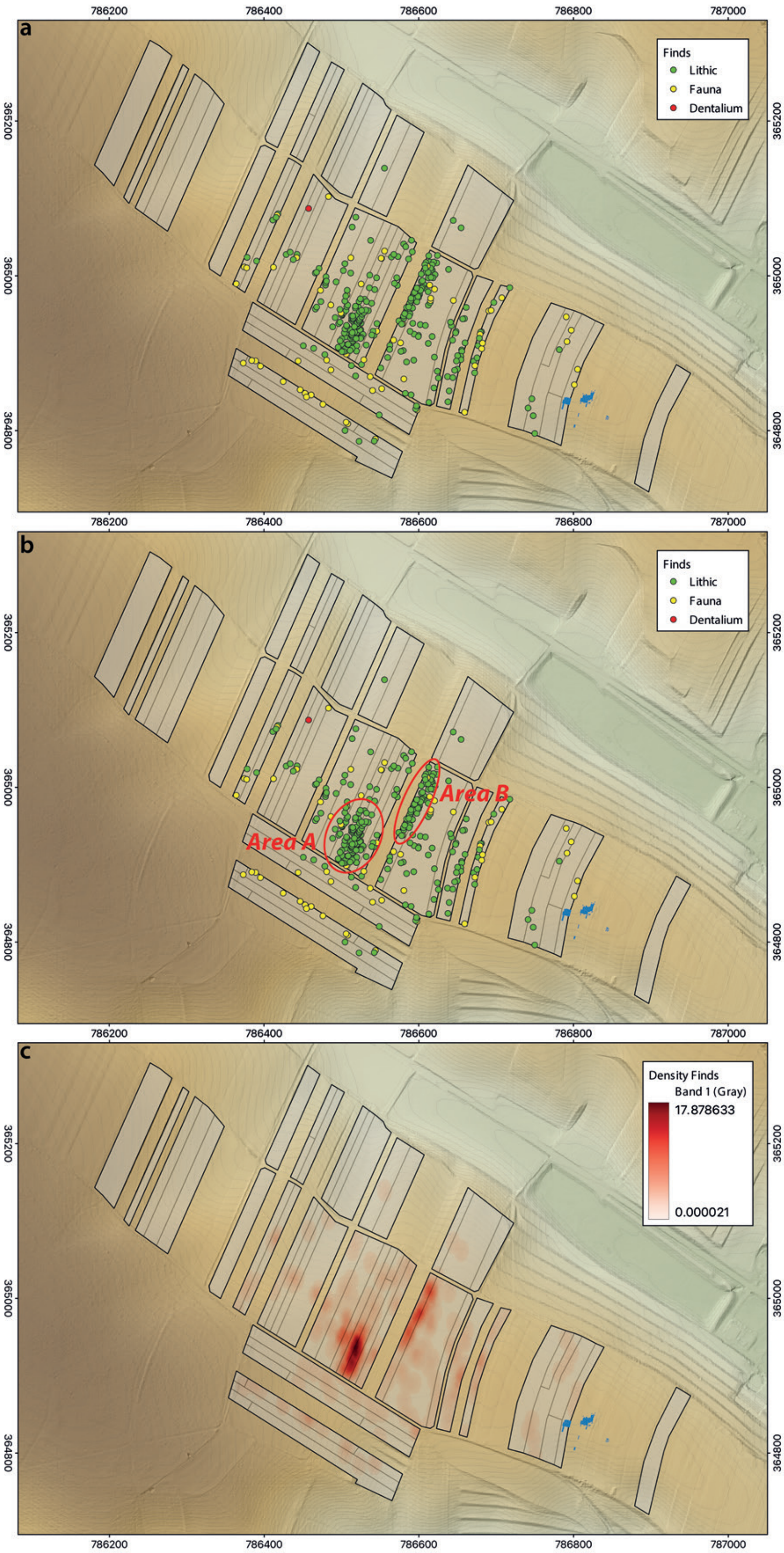

Fig. 8. Maps showing the spatial distribution of finds (colour coding: find category) (a), spatial distribution of finds and high-density Area A and B (b), and a KDE map of the finds (c). Excavation trenches (blue) of Grub-Kranawetberg I and II are shown for reference (Elevation and hillshade calculated from a digital terrain model with 1 m resolution: © Land Niederösterreich; coordinate reference system: MGI/Austria GK M34 [EPSG code 31259]. For KDE specifications, please refer to the Methods section; GIS and graphics: P. R. Nigst).

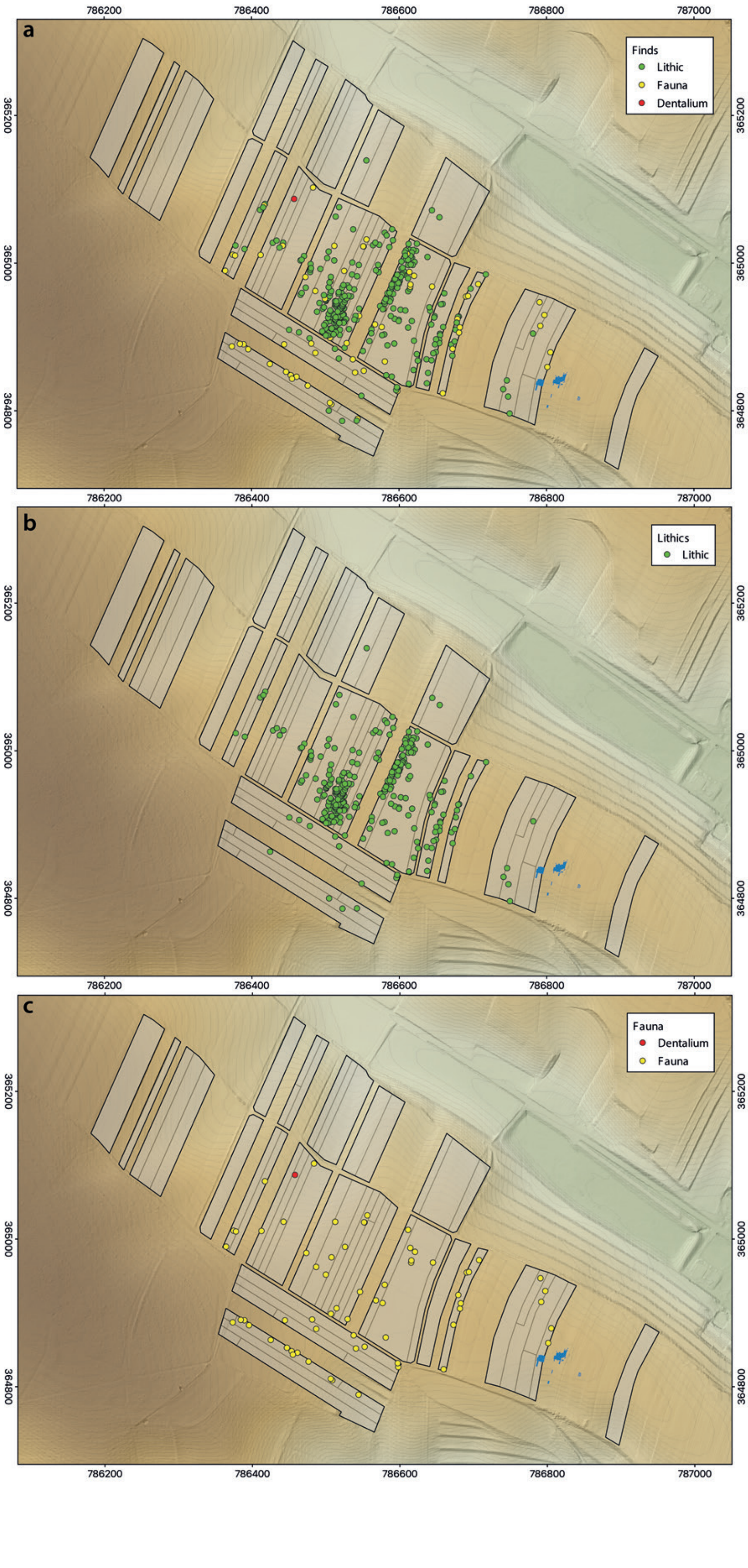

Fig. 9. Maps showing the spatial distribution of all find categories (a), lithic artefacts (b), and faunal remains (c). Excavation trenches (blue) of Grub-Kranawetberg I and II are shown for reference (Elevation and hillshade calculated from a digital terrain model with 1 m resolution: © Land Niederösterreich; coordinate reference system: MGI/Austria GK M34 [EPSG code 31259]; GIS and graphics: P. R. Nigst).

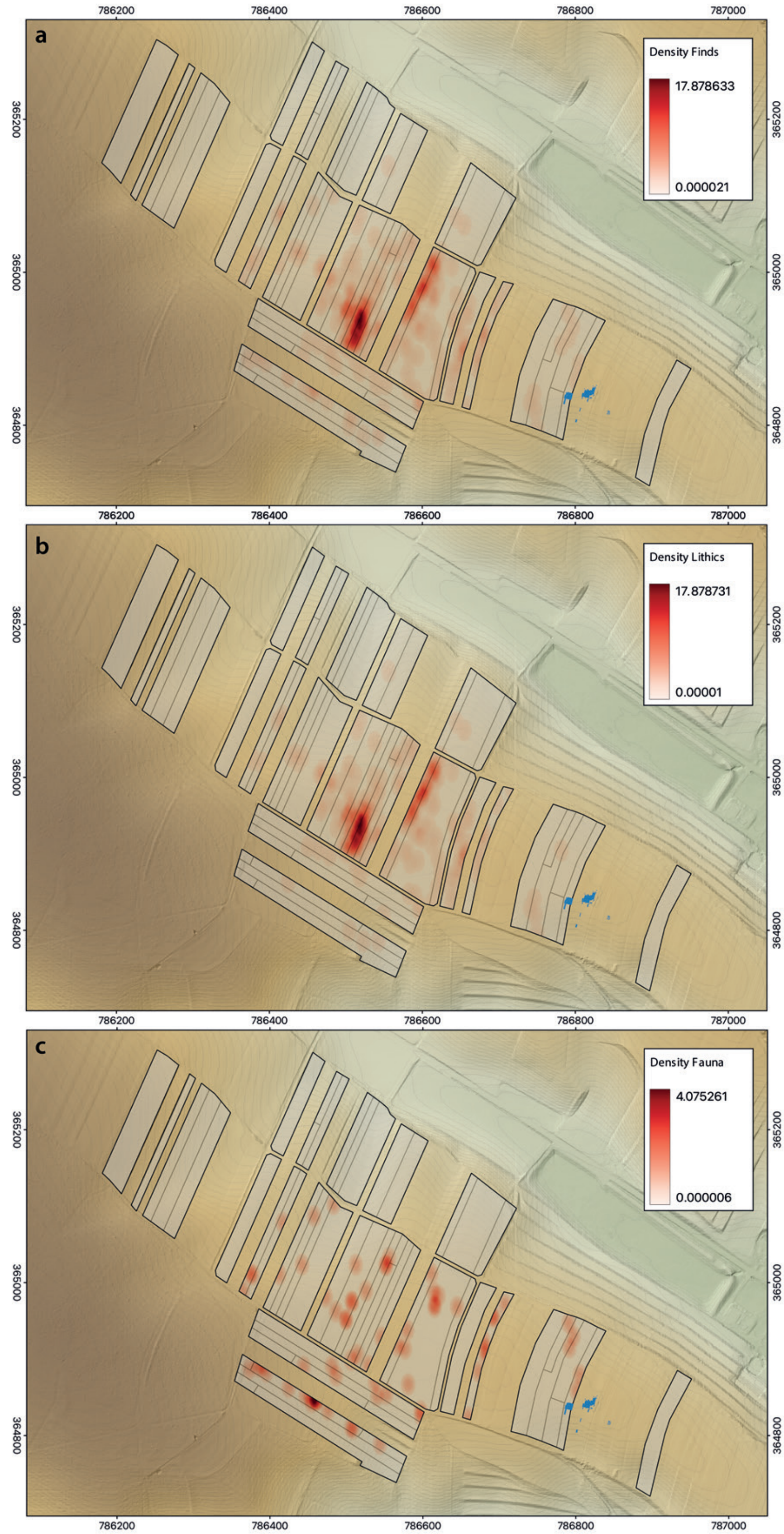

Fig. 10. KDE maps of all find categories (a), lithic artefacts (b), and faunal remains (c). Excavation trenches (blue) of Grub-Kranawetberg I and II are shown for reference (Elevation and hillshade calculated from a digital terrain model with 1 m resolution: © Land Niederösterreich; coordinate reference system: MGI/Austria GK M34 [EPSG code 31259]. For KDE specifications, please refer to the Methods section; GIS and graphics: P. R. Nigst).

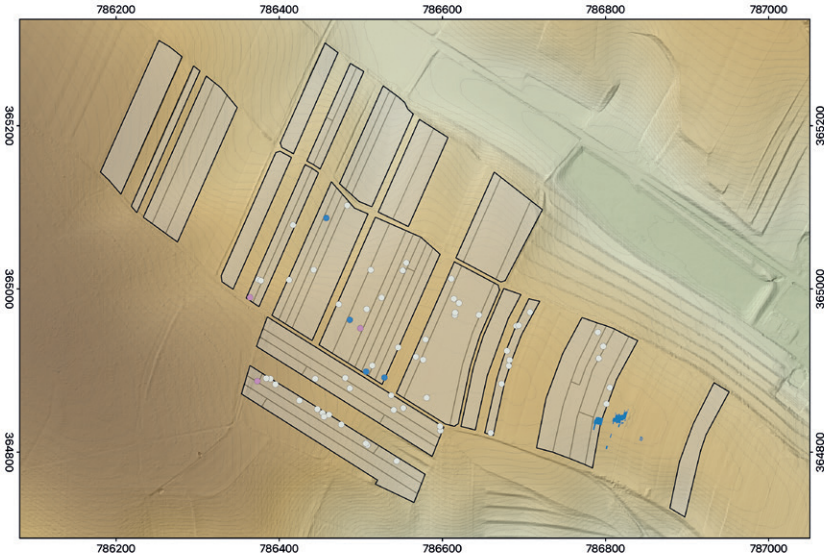

Fig. 11. Map showing the spatial distribution of faunal remains colour-coded by age (Blue: Pleistocene, purple: recent, light grey: n/a). Excavation trenches (blue) of Grub-Kranawetberg I and II are shown for reference (Elevation and hillshade calculated from a digital terrain model with 1 m resolution: © Land Niederösterreich; coordinate reference system: MGI/Austria GK M34 [EPSG code 31259]; GIS and graphics: P. R. Nigst).

Fig. 12. Map showing the spatial distribution of finds in relation to the slope (in degrees) (slope calculated from a digital terrain model with 1 m resolution: © Land Niederösterreich; coordinate reference system: MGI/Austria GK M34 [EPSG code 31259]; GIS and graphics: P. R. Nigst).

4.4. Fauna

A total of 69 faunal remains were recovered and studied from a zooarchaeological perspective. The faunal spectrum includes *Mammuthus primigenius, Bos* sp., *Capreolus capreolus, Sus scrofa, Lepus* sp. and *Fissidentalium badense*. Another 37 fragments could be assigned to body-size classes, leaving seven remains wholly unidentifiable (Tab. 6). Most of the faunal assemblage is probably fairly recent. For example, GK-2-62 and GK-2-64 comprise cow phalanges that are still greasy, partly mouldy and have remnants of tendons still attached. A few remains are clearly of Pleistocene (or older) origin, including three fragments of mammoth ivory (Fig. 13c) and an anthropogenically modified scaphopod/tusk shell (*Fissidentalium badense)* fragment (Fig. 13a). The specimen shows use wear in the form of smoothed edges on the apical and apertural side as well as two notches on the apical side (Fig. 13b). This is the only specimen that was visibly altered by humans, and the tubular shell was likely loosely strung either suspended as a bead or attached to hide as an appliqué.

From a taphonomic perspective, the bones are in a relatively good state with limited cortical surface weathering, mild root etching and recent plough marks being the most frequent. Burning is evident in 11.6 % of the specimens with both carbonization (n = 1) and calcination (n = 7) occurring.

While the vast majority of the faunal remains most probably date to the Holocene (including fairly recent

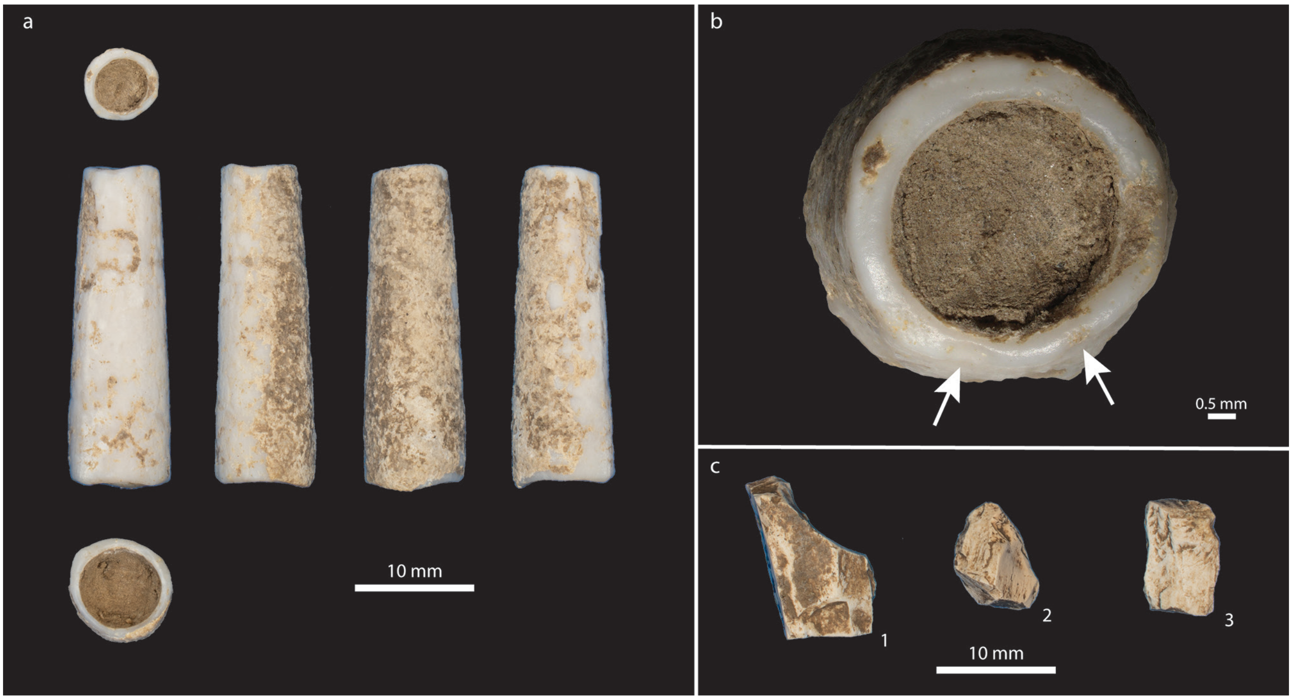

Fig. 13. Pleistocene faunal remains. – a. *Fissidentalium badense* (GK-2-71). – b. Enlarged apical view of the *Fissidentalium badense* (GK-2-71) with the two notches highlighted (arrows). – c. Fragments of mammoth ivory: 1. GK-4-61b; 2. GK-3-41; 3. GK-1-40 (Photos and graphics: M. D. Bosch, A. Kurzawska, P. R. Nigst).

Species	n
Mammuthus primigenius	3
Bos sp.	10
Capreolus capreolus	1
Sus scrofa	8
Lepus sp.	2
Dentalium sp.	1
UNG1	1
UNG1-2	4
UNG2	11
UNG2-3	6
UNG3	9
UNG3-4	2
UNG4	4
NID	7
Total	**69**

Tab. 6. Species list of faunal remains (n = 69).

specimens), there are a few specimens that can be attributed to the Palaeolithic, including the *Fissidentalium badense* shell fragment and the three pieces of ivory.

4.5. Lithic Artefacts

The 290 lithic artefacts are mainly made from heavily whitish-patinated raw material (n = 249, 85.86 %; Tab. 7), most probably a beige translucent and rather fine-grained chert, potentially flint. Those artefacts, together with other patinated lithic artefacts, account for 91.72 % (n = 266) of all lithic artefacts (Tab. 8), hinting at a Pleistocene rather than Holocene age for the majority of the lithic artefacts.

Recent edge damage is quite frequent (n = 75, 25.86 %) (Tab. 9). 159 lithics (54.83 %) show indeterminate edge damage, which is probably largely also modern/recent – but cannot be demonstrated to be so – suggesting the percentage of recent edge damage is probably much higher than 25.86 %. This is congruent with what one might expect from a surface collection originating from ploughed fields.

The lithic artefacts are dominated by flakes (n = 144, 49.66 %), shatter (n = 47, 16.21 %) and blades (n = 37, 12.76 %) (Tab. 10). There are also bladelets (n = 11, 3.79 %), cores (n = 3, 1.03 %) and core maintenance blanks (core tablet: n = 2, 0.69 %; crested blade: n = 1, 0.34 %; crested bladelet: n = 1, 0.34 %; crested flake: n = 1, 0.34 %). Chips and other small categories are clearly underrepresented, something we would expect for a fieldwalking collection. Overall, the lithics in the assemblage are of rather small size

Raw material	n	%
beige translucent, fine-grained chert/flint with white patina	249	85.86
green-grey-brown, coarse-grained chert	2	0.69
greenish-greyish, fine-grained chert	1	0.34
grey, coarse-grained chert	1	0.34
grey chert with red speckles	2	0.69
quartzite	1	0.34
radiolarite	16	5.52
n/a	18	6.21
Total	**290**	**100.00**

Tab. 7. Frequency and percentage of lithic artefacts (n = 290) per raw material group.

	n	%
patina	266	91.72
no patina	14	4.83
n/a	10	3.45
Total	**290**	**100.00**

Tab. 8. Frequency and percentage of patinated and unpatinated lithic artefacts (n = 290).

Damage	n	%
damage/use	13	4.48
damage/use and recent	32	11.03
recent	43	14.83
indeterminate	43	14.83
no damage	159	54.83
Total	**290**	**100**

Tab. 9. Frequency and percentage of edge damage types on lithic artefacts (n = 290).

Data class	n	%
< 10 mm	11	3.79
chip	8	2.76
flake	144	49.66
blade	37	12.76
bladelet	11	3.79
burin spall	1	0.34
core	3	1.03
core shatter	4	1.38
core tablet	2	0.69
crested blade	1	0.34
crested bladelet	1	0.34
crested flake	1	0.34
frost spalling	1	0.34
potlid	2	0.69
shatter	47	16.21
thermal shatter	12	4.14
n/a	4	1.38
Total	**290**	**100**

Tab. 10. Frequency and percentage of basic data classes of lithic artefacts (n = 290).

on average (mean = 19.53 mm, sd = 9.90 mm) and range between 4.97 mm and 67.91 mm. 75 % of all lithic artefacts are smaller than 23.90 mm. This suggests that while quite small pieces were collected, they are underrepresented when compared to size distributions from knapping experiments,[33] as expected.

Blade production is evident from several blades in the assemblage, mostly fragmented. Dorsal scar orientation evidences both uni- and bidirectional core reduction. If preserved, platforms are plain or linear with evidence of dorsal reduction and lips.

Bladelet production is documented by bladelet fragments, one blade fragment with a plunging distal end, one core, and two fragments of burin cores. While most bladelet fragments are from rather large and straight bladelets (blank width > 6 mm), the cores hint at a production of small bladelets (width < 6 mm); however, those seem to be missing in the collection, which might be due to the bias against the smallest fraction in surface collections. Details regarding the large bladelet production are hard to reconstruct due to the fragmented state of many bladelets and their small absolute number. Most of those bladelet fragments show unidirectional core exploitation immediately prior to their own removal. However, one bladelet fragment and one blade fragment with a distal plunging end (GK-5-10) hint at the production of large bladelets on volumetric platform cores with bidirectional production (Fig. 14). The core GK-1-17 (Fig. 15) and the core fragments GK-2-80 (Fig. 16/1) and GK-1-51 (Fig. 16/2) hint at production of small bladelets (width < 6 mm). The latter two are evidence of burin cores

33 E.g. Schick 1986.

for bladelet production on the edge of larger blanks (flakes?). All three are in an advanced stage of reduction and probably at the end of their use-life, either due to breakage, size or hinged removals.

Fig. 14. Distal blade fragment with a plunging end, GK-5-10 (Photos and graphics: M. D. Bosch, P. R. Nigst).

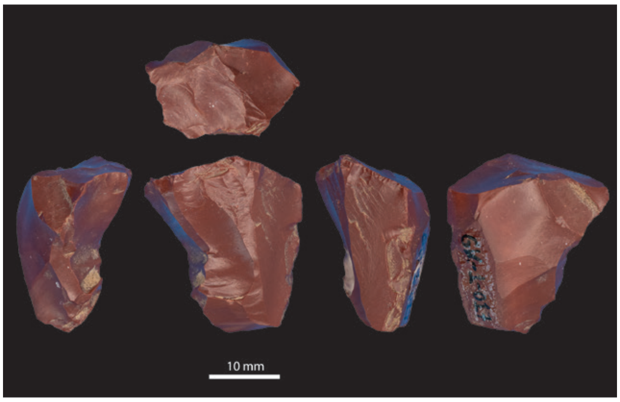

Fig. 15. Bladelet core, GK-1-17 (Photos and graphics: M. D. Bosch, P. R. Nigst).

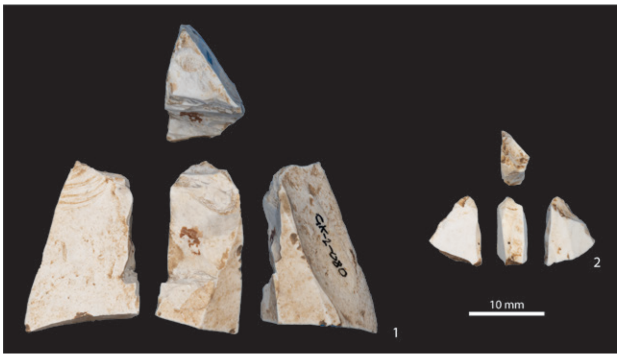

Fig. 16. Core fragments. – 1. GK-2-80. – 2. GK-1-51 (Photos and graphics: M. D. Bosch, P. R. Nigst).

Among the lithics are 51 retouched specimens (17.59 %), which are clearly dominated by retouched blades (n = 11, 21.57 %), retouched flakes (n = 11, 21.57 %) and splintered pieces (n = 10, 19.61 %) (Tab. 11). The ten splintered pieces (Fig. 17) – included in the list above as 'tools' following classic type lists and tool classification – probably showcase exploitation of small cores (made on flakes or other blanks) for the production of small blanks, either small flakes or bladelets, rather than tools.[34] They most probably represent the last stage of exhausted cores. The splintered piece GK-4-38 (Fig. 17/5) shows one removal scar that can be classified as a bladelet scar. The remaining splintered pieces all show small flake removal scars only, at least at this last stage of their use-life.

Obviously chronologically sensitive tool types are of interest for us to arrive at an assessment of the chronological position and potential chronological diversity of the surface collection. Chronologically sensitive tool types in the current assemblage are mainly the backed elements including backed bladelets (n = 1, 1.96 %; Fig. 18/1), a backed point (n = 1, 1.96 %), backed blades (n = 3, 5.88 %; Figs. 18/2–3) and other backed pieces (n = 2, 3.92 %). Additionally, there are fragments of pointed retouched blades (n = 2, 3.92 %; Fig. 18/6–7).

Two pieces, GK-1-9 (Fig. 18/5) and GK-2-46 (Fig. 18/4), were classified as a retouched blade and a backed piece, respectively. Both are fragmented and exhibit concave retouch (steep, backed retouch) on one edge and at first sight might resemble fragments of shouldered points. However, they more likely represent fragments that were backed at some point – either not finished or abandoned due to breakage – and, hence, related to the production of backed pieces.[35] A classification as shouldered points would be interesting regarding their chronological position, as it would point to a late Gravettian occupation.[36] Our fragments, however, cannot be assigned to the classic shouldered points of Kostenki type[37] or to the specimens described at some Central European sites, including (but not limited to) Willendorf II, Petřkovice, Kraków-Spadzista and the Moravany site complex,[38] which differ from the Kostenki examples. At present, we consider our two specimens as

34 See also discussion in, e.g., Le Brun-Ricalens 2006. – de la Peña 2013.

35 See the discussion in, e.g., Polanská, Hromadová, Sázelová 2021.

36 E.g. Otte, Noiret 2004. – Svoboda 2004.

37 E.g. Efimenko 1958. – Gvozdover 1961. – Lev 2009.

38 E.g. Otte 1981. – Otte, Noiret 2004. – Svoboda 2004. – Moreau 2009. – Polanská, Hromadová, Sázelová 2021.

Fig. 17. Splintered pieces. – 1. GK-1-62. – 2. GK-3-47. – 3. GK-3-35. – 4. GK-1-47. – 5. GK-4-38. – 6. GK-1-59. – 7. GK-1-21. – 8. GK-1-57. – 9. GK-1-56. – 10. GK-5-42 (Photos and graphics: M. D. Bosch, P. R. Nigst).

Tool type	n	%
backed blade	3	5.88
backed bladelet	1	1.96
backed piece	2	3.92
backed point	1	1.96
bilateral retouched blade	1	1.96
burin and truncation	1	1.96
point	1	1.96
pointed retouched blade	2	3.92
retouched blade	11	21.57
retouched bladelet	3	5.88
retouched flake	11	21.57
splintered piece	10	19.61
truncation	1	1.96
n/a	3	5.88
Total	**51**	**100**

Tab. 11. Frequency and percentage of retouched lithic artefacts (n = 51).

fragments of pieces involved in backing processes rather than shouldered point fragments. However, it should be noted here that among previous surface collection materials (collected by Herbert Preisl), there is one shouldered point of Kostenki type.[39] Further, there are two complete specimens of shouldered points (not Kostenki type) in AH 4 of Grub-Kranawetberg I (unpublished data, Antl-Weiser).

The backed bladelets are all fragmented, and hence, it is difficult to assign them to specific tool types. The fragmented backed bladelet GK-5-14 (Fig. 18/1) is backed on the left lateral edge while right-laterally medial it carries a marginal fine irregular retouch. Due to its fragmented state, it cannot be discerned whether this represents a fragment of a backed point (e.g. microgravette point) or a backed bladelet. GK-1-67 is a distal bladelet fragment with marginal fine retouch in the right-lateral medial position on the ventral face. GK-3-67c is a proximal bladelet fragment with bilateral marginal edge retouch. The bladelet fragment GK-4-63a displays steep retouch on its right-lateral edge.

These backed elements in the assemblage point towards a Mid-Upper Palaeolithic (Gravettian) chronological position. The remainder of the lithics fit very well into an Upper Palaeolithic context and are not at odds with a classification as Gravettian. There is no hint of spatial variation in chronologically different materials, especially due to the fact that all chronologically sensitive lithics point towards

39 Antl, Fladerer 2004.

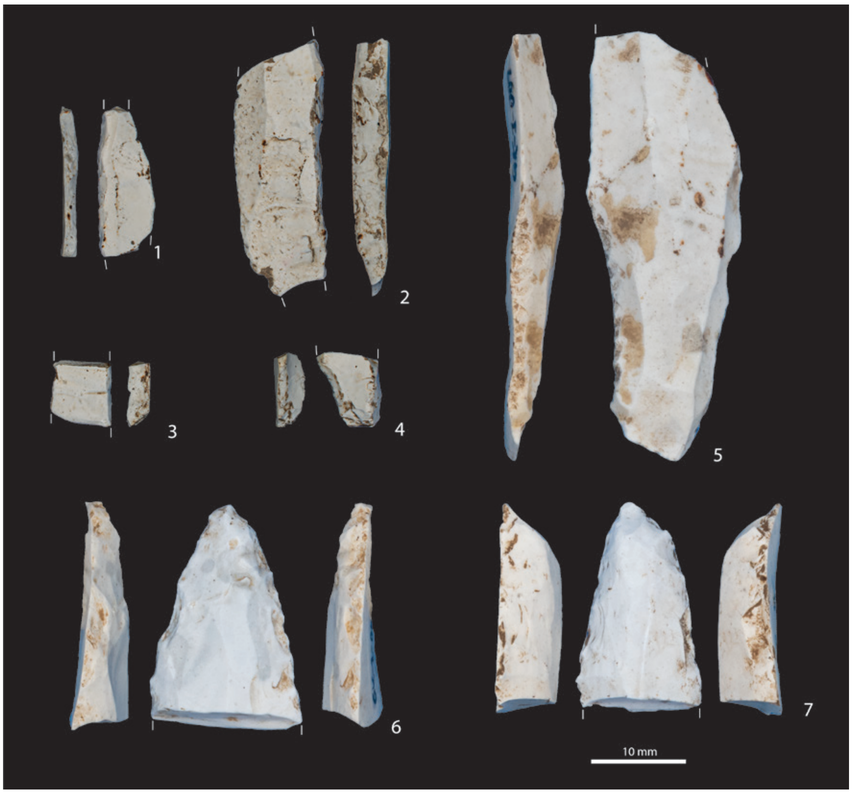

Fig. 18. Selected retouched tools. – 1. Backed bladelet fragment (GK-5-14). – 2. Backed blade (GK-2-81). – 3. Backed blade (GK-2-32). – 4. Backed piece (GK-2-46). – 5. Retouched blade (GK-1-9). – 6. Pointed retouched blade (GK-1-68). – 7. Point (GK-2-22) (Photos and graphics: M. D. Bosch, P. R. Nigst).

the Gravettian. We want to emphasize here that – since our collection stems from fieldwalking – the backed elements and their affinity with the Gravettian technocomplex do not necessarily say anything about the chronological or chronocultural classification of the rest of the material. To date, however, there are no clear indications of lithic artefacts that could be dated before or after the Gravettian.

The other surface collections – stored with local collectors or in the depot of the local museum (Stillfried – Zentrum der Urzeit) – have only partly been studied[40] but those studies and preliminary observations by Antl-Weiser confirm the Mid-Upper Palaeolithic (Gravettian) character of the surface collection materials.

5. Conclusion

In sum, our fieldwalking survey has provided 359 objects under not ideal fieldwalking conditions with regard to visibility. We were able to show that the state of the fields did not influence how many finds per parcel we recovered during our survey nor the find density per parcel. However, ploughing seems to influence whether or not finds were recovered, with ploughed fields not providing any finds.

The study of the faunal and lithic collections suggests that the Late Pleistocene materials fit with a Gravettian classification. No more precise chrono-cultural attribution (e.g. Late Gravettian) can be given based on the materials. The assessment of the spatial distribution showed clear concentrations (i.e. areas with a higher find density), and their location with regard to the topography suggests that concentrations are related to erosion of one or more archaeological horizons due to agricultural activity on hilltop locations. Due to this hilltop position, we assume that those archaeological horizons have been eroded. However, it might still be interesting to conduct verification fieldwork through coring and/or test pit excavations to explore the geomorphological situation in more detail and provide geoarchaeological data to test our current interpretation.

In terms of the extent and diversity of the find region on the Kranawetberg ridge, we do not see evidence of chronological periods other than the Gravettian represented, and at the current state of analysis, it remains

40 E.g. Weiser 1978. – Antl-Weiser 1996a.

unclear how the higher-density areas identified during our survey relate to the excavation at Grub-Kranawetberg I and Grub-Kranawetberg II. With regard to future fieldwork, it might be interesting to target the cadastral parcels that we were not able to survey by fieldwalking in September 2021, especially those in the eastern part of the Kranawetberg ridge.

Acknowledgements

M. D. Bosch was supported by a Seal of Excellence Fellowship from the Austrian Academy of Sciences ('TechnoBeads' project no. 101061287). P. R. Nigst benefited from funding by the University of Vienna and the Land Niederösterreich, Abteilung Wissenschaft und Forschung (project K3-F-530/005-2021) for the fieldwork. Fieldwork equipment used during the fieldwork was purchased with funds from the Faculty of Historical and Cultural Studies, University of Vienna. We would like to acknowledge the help and support by the Museumsverein Stillfried (Chair HR Mag. G. Antl). Many thanks to the Marktgemeinde Angern an der March for supporting our fieldwork in various ways. We would like to thank G. Sentall for administrative support and M. Schäfer for the transport of equipment and materials from Vienna to Stillfried-Grub and back. We also acknowledge the support from the Department of Prehistory (dir. Dr. K. Grömer), Natural History Museum Vienna. They kindly supplied us with find bags, boxes and other packing materials. Many thanks to the owners of the surveyed properties and their kind permission to conduct our fieldwalking survey on their properties: B. Binder, G. Binder, R. Döltl, S. Döltl, M. Klausbruckner, B. Klotz, C. and L. Küssler, R. and M. Leidwein, G. Lobner, Marktgemeinde Angern, O. Müllner, R. and I. Rathammer, B. Rainer, J. Staringer, M. Weik, E. Zens, and W. Zillinger. A special big thank you to our fieldwork team: D. Verdianu BA, Dr. L. Pribilovic-Leierer, K. D. Krupa, S. Messlender, F. Seiser, E. Spier, A. J. Szinovatz, and C. Thurner. We would like to acknowledge the help of Aldona Kurzawska (Polish Academy of Sciences) in taking the microscope photo of GK-2-71 (see Fig. 13b). Many thanks to Mathias Harzhauser (Department of Geology and Palaeontology, Natural History Museum Vienna) for identifying the *Fissidentalium badense*. The 2021 fieldwork was conducted under permit no. (Maßnahmennummer) 06008.21.01 issued by the Bundesdenkmalamt (Abteilung Archäologie).

Author Contributions

Philip R. Nigst: research design, data collection in the field in collaboration with the fieldwork team, data collection in the laboratory, data analysis, fieldwork funding, writing the first draft with input from co-authors

Walpurga Antl-Weiser: research design, data collection in the field in collaboration with the fieldwork team, obtaining permission from property owners

Marjolein D. Bosch: research design, data collection in the field in collaboration with the fieldwork team, data collection in the laboratory, data analysis

All authors contributed to and approved the final manuscript.

References

Antl, Fladerer 2004

W. Antl, F. A. Fladerer, Outlook to the East: the 25 ky BP Gravettian Grub/Kranawetberg campsite (Lower Austria). In: J. A. Svoboda, L. Sedláčková (Eds.), The Gravettian Along the Danube. Proceedings of the Mikulov Conference, 20.–21. November, 2002. The Dolní Věstonice Studies 11, Brno 2004, 116–130.

Antl-Weiser 1995

W. Antl-Weiser, Die Paläolithstation am Kranawetberg in Grub bei Stillfried, Niederösterreich (Vorbericht), Fundberichte aus Österreich 33/1994, 1995, 25–30.

Antl-Weiser 1996a

W. Antl-Weiser, Die paläolithischen Funde vom Kranawetberg in Grub bei Stillfried a. d. March, NÖ. In: J. Svoboda (Ed.), Paleolithic in the Middle Danube Region. Anniversary Volume to Bohuslav Klíma. Brno 1996, 81–91.

Antl-Weiser 1996b

W. Antl-Weiser, Grub/Kranawetberg, ein jungpaläolithischer Fundplatz, Préhistoire Européenne 8, 1996, 117–123.

Antl-Weiser 2008

W. Antl-Weiser, Grub/Kranawetberg and Ollersdorf/Heidenberg (Lower Austria) – two Gravettian camp sites in Eastern Austria, Wissenschaftliche Mitteilungen aus dem Niederösterreichischen Landesmuseum 19, 2008, 59–78.

Antl-Weiser 2016

W. Antl-Weiser, Lagerplatz mit Aussicht: Siedlungsstrukturen des älteren Gravettien in Niederösterreich am Beispiel der Fundstelle von Grub/Kranawetberg bei Stillfried, Mitteilungen der Anthropologischen Gesellschaft in Wien CLVI, 2016, 1–10.

Antl-Weiser et al. 1997

W. Antl-Weiser, F. A. Fladerer, R. Peticzka, F. C. Stadler, S. Verginis, Ein Lagerplatz eiszeitlicher Jäger in Grub bei Stillfried, Archäologie Österreichs 8/1, 1997, 4–20.

Antl-Weiser et al. 2010

W. Antl-Weiser, F. A. Fladerer, P. R. Nigst, A. Verpoorte, Grub/Kranawetberg (Lower Austria) – Insights into a Gravettian micro-region in Eastern Austria. In: C. Neugebauer-Maresch, L. R. Owen (Eds.), New Aspects of the Central and Eastern European Upper Palaeolithic – Methods, Chronology, Technology and Subsistence. Mitteilungen der prähistorischen Kommission 72, Vienna 2010, 231–243.

Antl-Weiser et al. in press

W. Antl-Weiser, M. D. Bosch, S. Pirson, P. R. Nigst, Bericht zur Ausgrabung Grub-Kranawetberg 2021, Fundberichte aus Österreich, in press.

Behrensmeyer 1978

A. K. Behrensmeyer, Taphonomic and ecologic information from bone weathering, Paleobiology 4/2, 1978, 150–162.

Bosch et al. 2012

M. D. Bosch, P. R. Nigst, F. A. Fladerer, W. Antl-Weiser, Humans, bones and fire: zooarchaeological, taphonomic, and spatial analyses of a Gravettian mammoth bone accumulation at Grub-Kranawetberg (Austria), Quaternary International 252, 2012, 109–121.

Bosch et al. in press a

M. D. Bosch, S. Pirson, B. T. Viola, D. Verdianu, P. R. Nigst, Bericht zur Ausgrabung Grub-Kranawetberg 2022, Fundberichte aus Österreich, in press.

Bosch et al. in press b

M. D. Bosch, B. T. Viola, D. Verdianu, P. R. Nigst, Bericht zur Bohrprospektion Grub-Kranawetberg 2022, Fundberichte aus Österreich, in press.

Chambers 1992

J. M. Chambers, Linear models. In: J. M. Chambers, T. J. Hastie (Eds.), Statistical Methods in S. Boca Raton – London – New York – Washington DC 1992, 95–144.

Davies, Nigst 2022

W. Davies, P. R. Nigst, An introduction to part 1 of the special issue, Paleoanthropology 2022/1, 2022, 32–34.

de la Peña 2013

P. de la Peña, The beginning of the Upper Paleolithic in the Baetic Mountain area (Spain), Quaternary International 318, 2013, 69–89.

Efimenko 1958

P. P. Efimenko, Kostenki I. Moscow 1958.

Einwögerer et al. 2014

T. Einwögerer, M. Händel, U. Simon, A. Masur, C. Neugebauer-Maresch, Upper Palaeolithic occupation in the Wachtberg area of Krems: the evidence of surveys, sections and core samples, Quaternary International 351, 2014, 50–66.

Felgenhauer 1959

F. Felgenhauer, Willendorf in der Wachau: Monographie der Paläolith-Fundstellen I–VII. Mitteilungen der Prähistorischen Kommission VIII–IX, Vienna 1959.

Foley 1981

R. A. Foley, Off-Site Archaeology and Human Adaptation in Eastern Africa: An Analysis of Regional Artefact Density in the Amboseli, Southern Kenya. British Archaeological Reports, International Series 97, Oxford 1981.

Gelman, Hill 2007

A. Gelman, J. Hill, Data Analysis Using Regression and Multilevel/Hierarchical Models. Cambridge 2007.

Gvozdover 1961

M. D. Gvozdover, Spetsifi cheskie osobennosti kremnevogo inventarya Avdeevsko paleoliticheskoi stoyanki, Kratikiye Soobchtenia Instituta Arkheologui 82, 1961, 112–119.

Haesaerts et al. 1996

P. Haesaerts, F. Damblon, M. Bachner, G. Trnka, Revised stratigraphy and chronology of the Willendorf II sequence, Lower Austria, Archaeologia Austriaca 80, 1996, 25–42.

Hallinan 2022

E. Hallinan, Landscape-scale perspectives on Later Stone Age settlement in the Tankwa Karoo, South Africa, Azania: Archaeological Research in Africa 57/4, 2022, 419–462.

Hallinan, Parkington 2017

E. Hallinan, J. Parkington, Stone Age landscape use in the Olifants River Valley, Clanwilliam, Western Cape, South Africa, Azania: Archaeological Research in Africa 52/3, 2017, 324–372.

Hromada, Kozlowski 1995

J. Hromada, J. K. Kozlowski, Complex of Upper Palaeolithic Sites near Moravany, Western Slovakia, Vol. 1, Moravany-Žakovska (Excavations 1991–1992). Krakow 1995.

Kozlowski 1998

J. K. Kozlowski (Ed.), Complex of Upper Palaeolithic Sites near Moravany, Western Slovakia, Vol. 2, Moravany–Lopata II (Excavations 1993–1996). Krakow 1998.

Le Brun-Ricalens 2006

F. Le Brun-Ricalens, Les pièces esquillées: état des connaissances après un siècle de reconnaissance, Paleo 18, 2006, 95–114.

Lev 2009

S. Lev, Stone artifacts at Zaraysk: typology. In: H. Amirkhanov, N. Akhmetgaleeva, N. Burova, A. Buzhilova, S. Lev, E. Maschenko (Eds.), Palaeolithic Studies in Zaraysk 1999–2005. Moscow 2009, 37–186.

Moreau 2009

L. Moreau, Geißenklösterle: Das Gravettien der Schwäbischen Alb im europäischen Kontext. Tübinger Monographien zur Urgeschichte, Tübingen 2009.

Mossler 1935

K. Mossler, Stillfried, GB Matzen, VB Gänserndorf: Ried „Kranebitter", Fundberichte aus Österreich 2/1, 1935, 29.

Neugebauer-Maresch 2001

C. Neugebauer-Maresch, Altsteinzeitforschung im Kremser Raum, Studien und Forschungen des Niederösterreichischen Instituts für Landeskunde 24, 2001, 39–55.

Nigst 2012

P. R. Nigst, The Early Upper Palaeolithic of the Middle Danube Region. Studies in Human Evolution, Leiden 2012.

Nigst, Antl-Weiser 2011

P. R. Nigst, W. Antl-Weiser, Intrasite spatial organization of Grub/Kranawetberg: methodology and interpretations – Insights into the spatial organization of Gravettian sites in Eastern Central Europe. In: S. Gaudzinski-Windheuser, O. Jöris, M. Sensburg, M. Street, E. Turner (Eds.), Site-internal Spatial Organization of Hunter-gatherer Societies: Case Studies from the European Palaeolithic and Mesolithic. RGZM-Tagungen 12, Mainz 2011, 11–29.

Nigst, Antl-Weiser 2012

P. R. Nigst, W. Antl-Weiser, Les structures d'occupation gravettiennes en Europe centrale: le cas de Grub/Kranawetberg, Autriche, L'Anthropologie 116/5, 2012, 639–664.

Nigst et al. 2008

P. R. Nigst, T. B. Viola, P. Haesaerts, G. Trnka, Willendorf II, Wissenschaftliche Mitteilungen aus dem Niederösterreichischen Landesmuseum 19, 2008, 31–58.

Nigst et al. 2014

P. R. Nigst, P. Haesaerts, F. Damblon, C. Frank-Fellner, C. Mallol, B. Viola, M. Götzinger, L. Niven, G. Trnka, J.-J. Hublin, Early modern human settlement of Europe north of the Alps occurred 43,500 years ago in a cold steppe-type environment, Proceedings of the National Academy of Sciences 111/40, 2014, 14394–14399.

Otte 1981

M. Otte, Le Gravettien en Europe Centrale. Dissertationes Archaeologicae Gandenses 20, Bruges 1981.

Otte, Noiret 2004

M. Otte, P. Noiret, Évolution du gravettien au moyen Danube. In: J. A. Svoboda, L. Sedláčková (Eds.), The Gravettian Along the Danube. The Dolní Věstonice Studies 11, Brno 2004, 8–32.

Patefield 1981

W. M. Patefield, Algorithm AS 159: An efficient method of generating random R × C tables with given row and column totals, Journal of the Royal Statistical Society, Series C (Applied Statistics) 30/1, 1981, 91–97.

Polanská, Hromadová, Sázelová 2021
M. Polanská, B. Hromadová, S. Sázelová, The Upper and Final Gravettian in Western Slovakia and Moravia: different approaches, new questions, Quaternary International 581–582, 2021, 205–224.
R Core Team 2021
R Core Team, R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, 2021, https://www.R-project.org/ (last access 20.12.2021).
Schick 1986
K. D. Schick, Stone Age Sites in the Making: Experiments in the Formation and Transformation of Archaeological Occurrences. British Archaeological Reports, International Series 319, Oxford 1986.
Škrdla 2005
P. Škrdla, The Upper Paleolithic on the Middle Course of the Morava River. The Dolní Věstonice Studies 13, Brno 2005.
Škrdla 2017
P. Škrdla, Moravia at the Onset of the Upper Paleolithic. Brno 2017.
Stiner et al. 1995
M. C. Stiner, S. L. Kuhn, S. Weiner, O. Bar-Yosef, Differential burning, recrystallization, and fragmentation of archaeological bone, Journal of Archaeological Science 22/2, 1995, 223–237.
Svoboda 1994
J. A. Svoboda, The Pavlov site, Czech Republic: lithic evidence from the Upper Paleolithic, Journal of Field Archaeology 21/1, 1994, 69–81.
Svoboda 2004
J. A. Svoboda, Afterwords: The Pavlovian as a part of the Gravettian mosaic. In: The Gravettian Along the Danube. The Dolní Věstonice Studies 11, Brno 2004, 283–297.
Svoboda, Ložek, Vlček 1996
J. A. Svoboda, V. Ložek, E. Vlček, Hunters Between East and West: The Paleolithic of Moravia. New York 1996.
Svoboda et al. 2016
J. A. Svoboda, M. Novák, S. Sázelová, J. Demek, Pavlov I: a large Gravettian site in space and time, Quaternary International 406, 2016, 95–105.
Weiser 1978
W. Weiser, Die paläolithischen Funde von Stillfried a. d. March 1879–1977, Forschungen in Stillfried 3, 1978, 5–14.
Wickham 2016
H. Wickham, ggplot2: Elegant Graphics for Data Analysis. New York 2016.
Wickham, Bryan 2023
H. Wickham, J. Bryan, readxl: Read Excel Files, https://github.com/tidyverse/readxl (last access 20.12.2023).
Wickham et al. 2022
H. Wickham, R. François, L. Herny, K. Müller, dplyr: A Grammar of Data Manipulation, R package version 1.0.9, https://CRAN.R-project.org/package=dplyr (last access 20.12.2022).

Philip R. Nigst
Department of Prehistoric and Historical Archaeology
University of Vienna
Franz-Klein-Gasse 1
1190 Vienna
Austria
&
Human Evolution and Archaeological Sciences (HEAS)
University of Vienna
Djerassiplatz 1
1030 Vienna
Austria
philip.nigst@univie.ac.at
orcid.org/0000-0001-7330-8768

Walpurga Antl-Weiser
Department of Prehistory
Natural History Museum Vienna
Burgring 7
1010 Vienna
Austria
walpurga.antl@nhm-wien.ac.at
orcid.org/0000-0003-4600-2979

Marjolein D. Bosch
Austrian Archaeological Institute
Austrian Academy of Sciences
Dominikanerbastei 16
1010 Vienna
Austria
&
Turkana Basin Institute
Turkana
Kenya
&
Human Evolution and Archaeological Sciences (HEAS)
University of Vienna
Djerassiplatz 1
1030 Vienna
Austria
marjolein.d.bosch@gmail.com
orcid.org/0000-0002-2829-3832