Eurasian Perspectives on Environmental Archaeology

Edited by
Mirosław Makohonienko, Daniel Makowiecki
& Jolanta Czerniawska

Annual Conference of the Association for Environmental Archaeology (AEA)
September 12–15, 2007, Poznań, Poland

AEA
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Eurasian Perspectives on Environmental Archaeology

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VOL. 3

Edited by
Mirosław Makohonienko, Daniel Makowiecki
& Jolanta Czerniawska

Bogucki Wydawnictwo Naukowe, Poznań 2007

The 2007 AEA Annual Conference
September 12–15, 2007 in Poznań, Poland

Eurasian Perspectives on Environmental Archaeology

organised by

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German Archaeological Institute – Eurasia Department in Berlin, Germany
Institute of Geological Sciences - Palaeontology Branch of Freier Universität in Berlin, Germany
Archaeological Museum in Poznań, Poland
& Biskupin Archaeological Museum, Poland

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The 2007 AEA Annual Conference,
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for Monument Conservation, Poznań, Poland

Marshal's Office
of the Wielkopolska Region in Poznań,
Poland

German Archaeological Institute
Eurasia Department in Berlin, Germany

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Cover page: Stonehenge, Biskupin, The Great Wall of China

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PREFACE

Proposal of the organization of Annual Conference of the Association for Environmental Archaeology (AEA) in Poland has been suggested by the President of the Association, David Robinson during a meeting in Cracow at the beginning of 2005. It coincided with the efforts to integrate the Polish scientific group of natural scientists and archaeologists studying the interaction between man and his environment. The result of this action was the 1st Symposium of Environmental Archaeology organized in Koszęcin in Upper Silesia on 19–22 of October 2005. During that Symposium, an initiative was proposed to establish an Association of Environmental Archaeology (SAS) in Poland and it was organized in April 2006. As the members of this Association, we have the great pleasure to co-organize and host the participants of this meeting.

The proposal of organizing the AEA conference in Poznań is a perfect occasion for the members to meet in a greater group of the environmental archaeologists from West Europe, East Europe and the eastern part of the Euroasiatic continent. We perceive the meeting as a forum for discussion on recent research in Environmental Archaeology in the broad context of the temperate zone of Euro-Asia. We will focus on the development of cultural landscape, cultural and environmental diversity, the dynamics of climatic and vegetation phenomena being the background for cultural processes, as well as on the recent progress in palaeo-environmental reconstruction methods.

Our plans have become real thanks to an enormous support and cooperation from the side of Prof. Yoshinori Yasuda from the International Research Centre for Japanese Studies in Kyoto; Dr Mayke Wagner from German Archaeological Institute – Eurasia Department and Dr Pavel Tarasov from the Institute of Geological Department of Freier Universität in Berlin. We wish to express our sincere thanks to all our co-organizers. We also direct our most cordial thanks for the help in the organization of our conference to the President of AEA – Dr David Robinson and Dr Nicki Whitehouse, to Gianna Ayala and Meriel McClatchie.

Our thanks go also to all participants in our conference, particularly to Prof. Victor Klochko from the Institute of Monument Preservation and Research Ministry of Culture and Tourism of Ukraine, Dr Petr Pokorny from the Institute of Archaeology, Academy of Sciences of the Czech Republic and Dr Mikola Kryvaltsevich from the Institute of History, National Academy of Sciences of Belarus who offered an active support.

The organization of the conference was possible thanks to the support of the President of the Seym of Wielkopolska Province, Mr. Marek Woźniak and the Wielkopolska Province Conservator of Monuments, Mr. Aleksander Starzyński. Our Conference is patronized by the Rector Magnificus of the Adam Mickiewicz University in Poznań. It is our privilege and honour that our conference takes place in the Archaeological Museum in Poznań, an institution which in this year celebrates the 150 anniversary of its origin. In this way, our conference will be recorded in the history of the wide and fruitful activity of the Museum including many very important events in the All-Polish and International activity in the field of archaeology as well as natural and archaeological studies. We hope that the respectable place selected for our meeting and its climate of 150 years activity will be an additional asset to our conference contributing to the fruitfulness of our discussions.

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Welcome Address

From Rector of Adam Mickiewicz University

The Adam Mickiewicz University in Poznań, from the very beginning of its existence belonged to the scientific institutions in our region and in Poland which included scientists dealing with the oldest history of the region referring both to natural science and to the history of culture. In the 1920-ies, the archaeologist from Poznań University, Józef Kostrzewski initiated the for those times pioneer cooperation between the humanists and natural scientists aiming to study the oldest relations between human activity and the transformations taking place in the environment. Effects of this cooperation became visible in the first interdisciplinary studies conducted by archaeologists and researchers of natural science. Their studies concentrated on Biskupin, a prehistorical defence settlement from the early Iron Age. The Second World War interrupted the initiated studies, but after the war, the University started again to attract outstanding specialists studying the history of nature and man and educating successive generations in the spirit of respect for the cultural heritage and nature protection seen in a wider perspective than just the present time.

In this connection, I wish to express my satisfaction that interdisciplinary studies referring to the environment and culture are continued in our University by the new generation of scientists. It is demonstrated by the active participation in the All-Polish Association for Environmental Archaeology which has its seat at the Faculty of Geographical and Geological Sciences.

On this occasion, let me express my thanks to the Association for Environmental Archaeology (AEA) for having entrusted the honour of organising the annual meeting of AEA in Poznań to the colleagues from our University. I also direct my thanks to all participants of this meeting for their numerous papers and posters contributed to this meeting and I wish to all of you very fruitful debates and a pleasant time spent during your visit in Poznań.

Rector of the Adam Mickiewicz University in Poznań

Prof. dr hab. Stanisław Lorenc

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Welcome Remark

From The Head of Wielkopolska Voivodship Office for Monument Conservation

Our meeting takes place in Poznań, the capital town of Wielkopolska (Great Poland). Wielkopolska belongs to the regions where archaeology has always played an important role in the studies on the past centuries and in the protection of the cultural and natural heritage of the country. Among others, it follows from the fact that Wielkopolska was the cradle of the Polish State created in the mid-10th century by the first historical dynasty of the Piast rulers. Also here, in the 1930-ies, a perfectly preserved fortified settlement from more than 2700 years ago was uncovered, and in the 1960-ies, a still older settlement was found in Bruszczewo. The latter settlement had a defensive character and it was established in the Early Bronze Age about the year 2000 B.C. However, the study of socio-cultural, economic and natural processes referring to the populations living on the area extending in the end of Pleistocene from the Carpathian and Sudeten Mountains to the Baltic Sea would not have been possible without the interdisciplinary archaeological and natural science researches.

Among important experiences in this field, one must mention the excavation studies in Biskupin carried out by a team of archaeologists and natural scientists under the leadership of Prof. J. Kostrzewski and by Prof. Z. Rajewski. Excavation works during those combined researches of archaeologists and natural scientists reached a perfect cooperation in the 1950-ies and 1960-ies when All-Polish studies were carried out in connection with Poland's Millenium. In that time, next to a number of other centers, in Poznań, being the center of Wielkopolska, there developed a series of research teams realizing the tasks of what we actually call "Environmental Archaeology". The studies were participated not only by archaeologists, ethnographers and historians, but also by anthropologists, archaeozoologists, paleobotanists, soil scientists, geologists, geomorphologists and other specialists.

The common effort supported by organizational and financial help from the side of the administrative authorities of the region helped in the creation and functioning of conservator's services. Also the actual Conservator's Office shows an enthusiastic approach to new initiatives in this field promoting a still better cooperation of historians and natural scientists in the investigation of human life in the past centuries and in the natural environment. All these efforts aim at the preservation of the possibly greatest number of relicts being a testimony of the past history.

I am convinced that our present Conference is a proof of our support for the initiative of an interdisciplinary cooperation of scientists. I welcome with satisfaction the invitation of the

Association of Environmental Archaeology to organize in Poznań such conferences every year. I believe that it would be a honorable distinction for Poland and Wielkopolska for the achievements in the Environmental Archaeology in Poland.

On behalf of the Conservator's Office supporting this Conference, I am pleased to welcome the participants of this important scientific event both for our region and for Poland. I hope that this Conference will be important and fruitful for all invited guests and it will contribute to the exchange of information and scientific ideas as well as to intensify the mutual contacts between the different fields of science. Our mutual efforts will certainly contribute to a better understanding of the people and nature on the area of Euro-Asia not only in the past centuries but also in the actual situation.

I wish you many fruitful debates and a pleasant time spent in Poland.

Aleksander Starzyński
The Head of Wielkopolska Voivodship Office
for Monument Conservation

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Annual Conference of
the Association for Environmental Archaeology (AEA)

September 12–15, 2007, Poznań, Poland

Programme

TUESDAY 11th SEPTEMBER 2007

Meeting at Poznań-Ławica Airport or Poznań Railway Station and transfer to hotels
Registration and accommodation in hotels
19:00 – 21:00 Dinner at the Restaurant "Sami Swoi", Poznań – Old Market 99/100

WEDNESDAY 12th SEPTEMBER 2007

7:00 – 8:00 *Breakfast – in hotels*

Venue:
Poznań Archaeological Museum – The Górka Palace, Wodna 27

8:00 – 9:00 Registration

9:00 – 9:20 Opening of the AEA Conference
Chaired by **Nicki WHITEHOUSE & Małgorzata LATAŁOWA**

Welcome and introduction by
Dr Marek CHŁODNICKI - the Host of Poznań Archaeological Museum
Prof. dr hab. Stanisław LORENC – Rector of Adam Mickiewicz University
Mr Marek WOŹNIAK – Marshal's Office of the Wielkopolska Region in Poznań
Mr Aleksander STARZYŃSKI – The Head of Wielkopolska Voivodship Office for Monument Conservation
Dr David ROBINSON – The Chairman of the Association for Environmental Archaeology
Dr Mirosław MAKOHONIENKO – on behalf of the Organizing Committee

9:20 – 9:40 Opening lecture
Environmental Archaeology and the AEA – Past, Present and Future
David Earle ROBINSON

9:40 – 10:00 Opening lecture
Environmental archaeology in Japan: a new approach using annually laminated lake sediments
Yoshinori YASUDA

Session 1: Man and environment interactions in the Atlantic regions of Western and Northern Europe (part 1)
Chaired by **Nicki WHITEHOUSE & Małgorzata LATAŁOWA**

10:00 – 10:15 **Islands in a Common Sea**
Jacqui MULVILLE

10:15 – 10:30 **Relationships between human culture and environment along the coast of western Norway through time**
Kari L. HJELLE & Lene S. HALVORSEN

10:30 – 10:45 *Discussion*

10:45 – 11:00 *Coffee/Tea Break*

Session 2: Man and environment interactions in the Atlantic regions of Western and Northern Europe (part 2)
Chaired by **Yoshinori YASUDA & David Earle ROBINSON**

11:00 – 11:15 **Seed impressions and charred remains: comparing evidence for crops in Bronze Age Ireland**
Meriel MCCLATCHIE

11:15 – 11:30 **Partial to pork at Llanmaes: a later prehistoric midden in the Vale of Glamorgan, Wales, UK**
Richard MADGWICK

11:30 – 11:45 **Grain pests from Roman military sites: implications for importation, supply to Roman army and agricultural production**
David SMITH

11:45 – 12:00 **Correlating Holocene land snail assemblages across Europe**
Paul DAVIES

12:00 – 12:15 *Discussion*

12:15 – 13:45 *Lunch*

Session 3: Man and environment interactions in Central and Eastern Europe (part 1)
Chaired by **Ralph FYFE** & **Kazimierz KLIMEK**

14:00 – 14:15 **Švarcenberk (southern Bohemia) - Mesolithic lakeshore settlement and its impact on the local environment**
Petr POKORNÝ, Petr ŠÍDA, Petr KUNEŠ, Ondřej CHVOJKA & Pavla ŽÁČKOVÁ

14:15 – 14:30 **Vegetation development and human impact during the Late Glacial and the Holocene in floodplain of Labe (Elbe) river in central part of the Czech Republic**
Libor PETR

14:30 – 14:45 **Settlement and prehistoric land-use in Central Bohemia: comparison of archaeological and pollen-analytical evidence**
Dagmar DRESLEROVÁ, Petr POKORNÝ, Petr KUNEŠ, Libor PETR, Radka KOZÁKOVÁ & Lucie ŠMAHELOVÁ

14:45 – 15:00 **Forest management and charcoal-burning activities in modern history of Bohemian Switzerland**
Vojtěch ABRAHAM, Přemysl BOBEK & Petr POKORNÝ

15:00 – 15:15 **Deforestation and reforestation in the Kraków region from the La Tene to the Medieval periods**
Halina DOBRZAŃSKA, Tomasz_KALICKI & Bartłomiej Sz. SZMONIEWSKI

15:15 – 15:30 *Discussion*

15:30 – 16:00 *Coffee/Tea Break and Poster Session 1*

Session 4: Progress in palaeoenvironmental reconstruction methods and environmental archaeology (part 1)
Chaired by **Pavel TARASOV & Dorota NALEPKA**

16:00 – 16:15 **Modeling 'landscapes' from pollen data: opportunities and limitations**
Ralph FYFE, Chris CASELDINE & Kari HJELLE

16:15 – 16:30 **Beetle-vegetation relationships and Holocene landscape structure: a modern analogue approach**
Nicki J WHITEHOUSE, David N. SMITH & M.J. BUNTING

16:30 – 16:45 **The well in the settlement - environmental studies through insect analysis of well samples**
Magnus HELLQVIST

16:45 – 17:00 **Bacterial ancient DNA as an indicator of human presence in the past – its correlation with palynological and archaeological data**
Jacek MADEJA, Agnieszka WACNIK, Agata ŻYGA, Elżbieta STANKIEWICZ & Witold GUMIŃSKI

17:00 – 17:15 **Laminated sediments and tephrochronology – an example from Lake Belau, Northern Germany**
Walter DÖRFLER

17:15 – 17:30 *Discussion*

17:30 – 18:00 *Afternoon Coffee/Tea and Poster Session 2*

Session 5: Progress in palaeoenvironmental reconstruction methods and environmental archaeology (part 2) – Lake Megata 2006 Project: high-resolution past environmental reconstruction in East Asia using annually laminated lake sediments in northeastern Japan
Chaired by **Yoshinori YASUDA & Tomasz GOSLAR**

18:00 – 18:15	**Lake Megata 2006 Project: an introduction** Kazuyoshi YAMADA, Katsuya GOTANDA, Yoshitsugu SHINOZUKA, Mitsuru OKUNO, Hitoshi YONENOBU, Junko KITAGAWA, Miroslaw MAKOHONIENKO, Markus SCHWAB, Timo SAARINEN, Tsuyoshi HARAGUCHI, Akira HAYASHIDA & Yoshinori YASUDA
18:15 – 18:30	**Stratigraphic analysis of the core samples from Lake Ichi-no-Megata, northeastern Japan** Kazuyoshi YAMADA, Katsuya GOTANDA, Hitoshi YONENOBU, Mitsuru OKUNO, Masayuki TORII, Tomasz GOSLAR & Yoshinori YASUDA
18:30 – 18:45	**Lake Ichi-no-Megata sediments – sedimentological and geochemical indicators of environmental changes in annually laminated (varved) sediments (Akita Prefecture, Japan)** Markus J. SCHWAB, Peter DULSKI, Gerald H. HAUG & Yoshinori YASUDA
18:45 – 19:00	**Geochemical analysis of the core samples from Lake Ichi-no-Megata, northeastern Japan** Yoshitsugu SHINOZUKA, Kazuyoshi YAMADA, Katsuya GOTANDA, Chungwan LIM, Akane UMEZU, Kazuhiro TOYODA & Yoshinori YASUDA
19:00 – 19:15	**Preliminary results of pollen analysis of the Lake Ichi-no-Megata core samples and the quantitative past climate reconstruction** Junko KITAGAWA, Yoshimune MORITA, Miroslaw MAKOHONIENKO, Katsuya GOTANDA & Yoshinori YASUDA
19:15 – 19:30	**Climate, famines as deduced from the comparative study on tree rings and annually laminated sediments** Hitoshi YONENOBU, Motonari OHYAMA, Yasuharu HOSHINO & Hirotaka ODA
19:30 – 20:00	*Discussion*
20:00 – 22:00	***Dinner and Social meeting*** **- Closed performance of “Łany” – The Song and Dance Ensemble of Agricultural University in Poznań**

THURSDAY 13th SEPTEMBER 2007

7:00 – 8:00 *Breakfast in hotels*

Venue:
Poznań Archaeological Museum – The Górka Palace, Wodna 27

Session 6: Man and environment interactions in the temperate zone of Central and Eastern Europe (part 2)
Chaired by **Małgorzata LATAŁOWA & Jacqui MULVILLE**

8:30 – 8:45 **Sedimentological and geomorphic record of Prehistoric and Early Medieval colonization of the Fore-Sudetic loess plateaus, Southern Poland**
Kazimierz KLIMEK & Edyta ZYGMUNT

8:45 – 9:00 **Neolithic and Bronze Age societies on Polish Lowland and their environment**
Janusz CZEBRESZUK & Marzena SZMYT

9:00 – 9:15 **The environment in South Kujawy (Central Poland) under early Neolithic pressure. Case study: Osłonki site**
Dorota NALEPKA, Stefan Witold ALEXANDROWICZ, Michał GĄSIOROWSKI, Ryszard GRYGIEL & Bolesław NOWACZYK

9:15 – 9:30 **The ancient landscape of the Roman Period settlement micro-region on the north shore of the former lake "Wons" in the Masurian Lakeland (NE Poland)**
Maciej KARCZEWSKI, Piotr BANASZUK, Aldona BIENIEK, Mirosława KUPRYJANOWICZ & Agnieszka WACNIK

9:30 – 9:45 **Animal subsistence economy in the Early Medieval stronghold cmplexes of western Slavs – comparative studies of Pomerania, Great Poland and Lower Silesia.**
Daniel MAKOWIECKI

9:45 – 10:00 *Discussion*

10:00 – 10:15 *Morning Coffee/Tea*

Session 7: Man and environment interactions in the temperate forest zone of Central and Eastern Europe (part 3)
Chaired by **Nadiezhda S. KOTOWA & Petr POKORNY**

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Alena KALECHYTS

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D.A. SUBETTO, P.M. DOLUKHANOV, T.V. SAPELKO, A.V. LUDIKOVA, D.D. KUZNETSOV, Kh.A. ARSLANOV, G.I. ZAITSEVA

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Mikola KRYVALTSEVICH, Galina SIMAKOVA & Angela RAZLUTSKAYA

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E.Yu. NOVENKO, M.P. GLASKO & O.V. BUROVA

11:30 – 11:45 *Discussion*

11:45 – 13:15 *Lunch*

Session 8: Man and environment interactions in the temperate steppe and forest-steppe zone of Eastern Europe
Chaired by **Walter DÖRFLER** & **Marzena SZMYT**

13:15 – 13:30 **Human adaptation to the climate change in the Ukrainian steppe in VII-V millennia BC**
Nadiezhda S. KOTOVA

13:30 – 13:45 **Environment and economic activities of Tripolyan population**
Galina PASHKEVICH

13:45 – 14:00 **The Margel Crest**
Victor KLOCHKO & Katarzyna ŚLUSARSKA

14:00 – 14:15 **Early nomads of the Pontic steppe in a context of climate changes**
S.V. MAKHORTYKH

14:15 – 14:30 **Kartamysh Bronze Age mining-metallurgical complex in the eastern Ukraine**
Yuriy M. BROVENDER

14:30 – 14:45 **The cave church with frescos on Zagaytanska rock in South-West Crimea in Ukraine**
Timur A. BOBROVSKY & Kateryna E. CZUJEVA

14:45 – 15:00 *Discussion*

15:00 – 15:30 *Afternoon Tea and Poster Session 3*

Session 9: Man and environment interactions in southern Siberia
Chaired by **Paul DAVIES & Elena NOVENKO**

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S. SVYATKO, E. MURPHY, R. SCHULTING & J. MALLORY

15:45 – 16:00 **Environmental transformations and human occupation of the Altai region during the last glacial-interglacial cycle**
Jiří CHLACHULA

16:00 – 16:15 **Holocene human and environmental dynamics in the Lake Baikal region derived from pollen and archaeological records**
Pavel TARASOV, Elena BEZRUKOVA, Eugene KARABANOV, Takeshi NAKAGAWA, Mayke WAGNER, Polina LETUNOVA, Anna ABZAEVA & Frank RIEDEL

16:15 – 16:30 *Discussion*

16:30 – 17:00 *Afternoon Tea/Coffee and Poster Session 4*

Session 10: Man and environment interactions in continental East Asia
Chaired by **Mayke WAGNER & Gui-Yun JIN**

17:00– 17:15 **Choice of resources: earliest settlement behavior in Northern China**
Mayke WAGNER

17:15 – 17:30 **Neolithic rice-paddy from the Zhaojiazhuang site, eastern China**
Gui-Yun JIN, Sheng-Dong YAN, Tetsuro UDATSU, Yu-Fu LAN, Chun-Yan WANG & Pei-Hua TONG

17:30 – 17:45 **Neolithic archaeobotanical records of rice and foxtail millet in East Asia and its problems for identification of wild or domesticated remains**
Hiroo NASU

17:45 – 18:00 **Development of cultural landscape in the Liao River basin, Manchurian Plain, North-Eastern China**
Mirosław MAKOHONIENKO, Fujiki TOSHIYUKI, Hiroo NASU, Pavel TARASOV, Mayke WAGNER & Yoshinori YASUDA

18:00 – 18:15 *Discussion*

18:15 – 18:45 *Closing speech*
Yoshinori YASUDA, Małgorzata LATAŁOWA, Mayke WAGNER, Pavel TARASOV, David ROBINSON

19:00 – 20:30 **Dinner**

20:30 – 21:30 **AEA Annual General Meeting**

FRIDAY 14th – SATURDAY 15th SEPTEMBER 2007

September 14–15, 2007 – Field sessions: Great Poland, Kuyavia, Chełmno Land.
Environment and Human Culture, Vol. 4

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Summaries of papers

Forest management and charcoal-burning activities in the modern history of Bohemian Switzerland

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Vegetation development was studied through pollen analysis of three cores from Bohemian Switzerland, in the northern part of the Czech Republic. The presence of an inaccessible sandstone landscape in this area allowed the preservation of natural forest, free from human impact, until modern times. The recording of a number of anthropogenic indicators in the pollen record since Atlanticum can be interpretated as representing long-distance transport. Archaeological evidence demonstrates that visits by prospectors were usually for residential purposes. While colonizations mainly affected the productive and peripherial parts of the region, the central acidic area of the continually-uninhabited Bohemian Switzerland, near our site 'Pryskyřičný důl', was altered by human impact only during the Baroque upswing, at the beginning of 17th century.

The core from the site 'Pryskyřičný důl' was dated using a depth-age model constructed with the use of 14C and 210Pb dating. Sample-ages follow intervals of around 12 years. Pollen analysis reveals three subsequent phases of forests: natural, influenced without artificial regeneration and influenced with artificial regeneration, which fits the historical data. The existence of fir-beech forests ended around 1720 due to forest management. Both a peak of micro-charcoals, as well as the discovery of kiln sites and a timber lodge that were dated by a forest map from 1795, confirm 100 years of charcoal-burning activity very close to the core. Anthracological analysis has provided evidence for high levels of *Pinus* and *Picea* at the kiln sites, while *Abies* and *Fagus* decreases in the pollen record. One of the reasons for this trend is the selection of certain species by charcoal-burners. This evidence indicates two different usages of the wood: spruce and pine for burning on site, while beech and fir are taken out of the forest. The vegetation cover, which was deforested to heaths along with open woodland, was easily cut up by wind-breaks in the winter of 1833/4. The large clearings were later reforested with spruce and North American tree species.

Table 1. Description and dating of charcoal accumulations according to historical documents

Number	Description	Historical dating
2	kiln site	–
3	kiln site	1921
4	resine furnace	–
5	kiln site	–
6	kiln site	–
7	kiln site	1795
9	kiln site	1796
10	kiln site	1796
11	resine furnace with lodge	1795

Correlation of log-transformed abundances from historical data within a radius of 600 metres with log-transformed pollen types was significant for *Abies*, *Betula* and NAP. Various pollen abundances related to pollen production (Pohl 1937) are discussed together with falling velocity (Dyakowska 1936) and vegetation cover from forestry data.

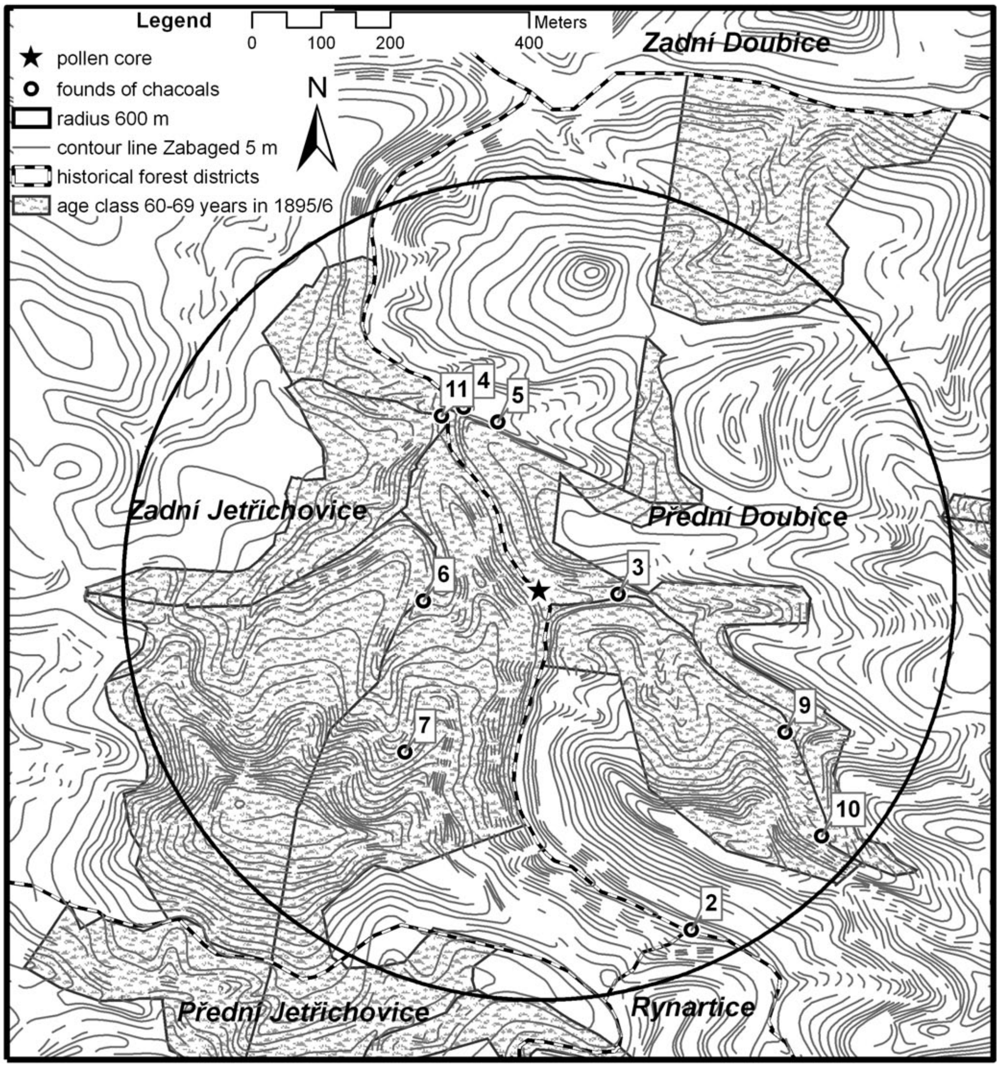

Fig 1. Map of the vicinity of pollen site Pryskyřičný důl with 600-m-radius, finds of charcoal (for description see Table 1), historical forest districts, and age class 60–69 years from the period 1895/8

The cave church with frescos on Zagaytanska rock in South-West Crimea in Ukraine

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This paper is devoted to questions arising from the study and interpretation of paintings of the cave church located on Zagaytanska rock (near a small town called Inkerman in South-west Crimea). The "church with frescos" was found by Timur Bobrovsky and Kateryna Czujeva in 2004 during a visit to the cave complexes of Zagaytanska rock. In 2005–2006 archaeological excavations and a visual inspection of the surviving areas of painting were made.

The "church with frescos" is a temple (5 m length, 3 m wide; the maximum height of the vault is about 3 m) with one apse, cut into the layer of mainland rock. The longitudinal axis of the building is aligned in relation to a line running north-south at 36º to east. The nave of the church is rectangular in plan and the apse is horseshoe-shaped. In former times a low trapezoidal stage led to the sanctuary. This stage was removed during subsequent replanning. The previously attached altar was on the floor, leaning against the north-eastern wall of the apse. Any traces of a stone-made chancel-barrier are no longer present; the grooves from a late wooden chancel-barrier were cut into the frescos.

Almost all surfaces of the walls and vault of apse, the overhead part of walls and the vault of the nave are covered with the frescos, which are very well preserved for the most part. A fresco covers both primary and posterior prothesis niches cut into the north-western wall of the nave and apses, as well as the niche in the south-east wall of the apse.

Fig. 1. The frescos of the sanctuary

Most of the extant pictorial compositions can be identified. There are three registers of pictorial compositions placed on the walls of the sanctuary. The half-length composition the "Deisuse" with the image of Christ-Emmanuel in the centre is situated in the conch. Under the "Deisuse" seven full-length figures of bishop saints are depicted. It is possible to identify the images of St. Nicholas, St. Gregory and St. Basilios. The scene of the "Ascension of Christ" is placed in the vault of the apse. The expressive images of one of the apostles and an angel were also found here.

The episode of the “Annunciation” is depicted at the altar arch. Beside the images of Our Lady and the Archangel Gabriel another two figures robed in emperor’s clothes are included in the composition (it is possible that we have the images of donors here).

There are two registers of extant compositions in the vault of the nave. Among them, the following compositions have been identified: the “Nativity” with the Adoration of the Magi, the “Baptism”, the “Presentation”, the “Transfiguration”, the “Crucifixion”, the “Anastasis”, and the image of Christ-Pantokrator (it is interesting that Jesus Christ is represented here as an Old Man).

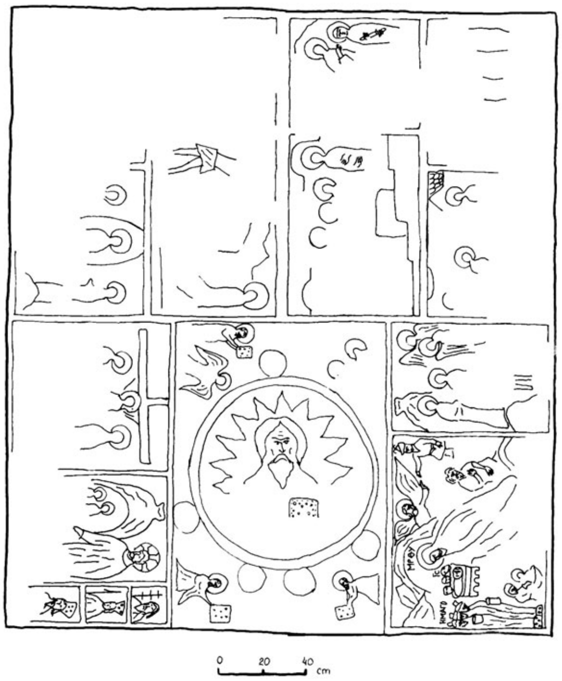

Fig. 2. The frescos of the naos

Finally, only few fragments of the composition of the “Assumption of Our Lady”, depicted above the doorway, could now be discerned.

Such compositions as the “Deisuse”, the “Annunciation”, the “Nativity”, the “Anastasis” are accompanied by Greek inscriptions.

Two funeral structures, a crypt with a rock tomb and a further tomb, are included in the complex of the “church with frescos”. Thus it is possible that the “church with frescos” was used as memorial chapel. The question of the dedication of the church still remains open.

The characteristic features of architecture and archaeological evidence from the complex allow us to affirm that the church was founded in the mid-13th century. The overall dating evidence, including some stylistic features of the painting, lead us to assume that the church was decorated with frescos in the second half of the 13th century.

Finally, it is necessary to note that the condition and pictorial quality of painting of the “church with frescos”, along with some peculiarities of the iconography, allows this cave monument to be recognised as unique not only for the Crimea but also for south-eastern Europe.

Kartamysh Bronze Age mining-metallurgical complex in the eastern Ukraine

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In recent years, because of active investigations of Bronze Age production activity in the East-European steppe and forest steppe, the Donetsk mining and metallurgical centre has risen to great importance as the powerful centre of ancient mining engineering, metallurgy and metal processing in the south of eastern Ukraine.

One of the most significant monuments of production activity, among the well-known ones, in the broad sense of the metal production monuments revealed within the area of the Donbass copper-ore manifestations, is the complex of the Kartamysh archaeological micro-district near the Novozvanovka village in the Popasnaya district of the Lugansk region.

Both the characteristic feature and the scientific significance of this historical-cultural and scientific site lie in the fact that over a rather restricted area (3,2 hectares) there are archaeological monuments which present all the cycles of ancient metallurgical production – from ore extraction to the manufacture of metal objects, that is to say the ore mining, ore-dressing, metallurgical and metal processing production; in effect, all of the components of any mining-metallurgical complex.

This micro-district includes three quarries, a complex of underground sites and a production site for ore dressing, as well as three settlements of ancient miners, two of which include traces of stone house building. The uniqueness of Kartamysh is explained by the fact that the majority of its material evidence has been preserved across the centuries in its original location.

Above all it is the large-scale volume of mining works, possible due to the surface exposure of copper sandstone ore deposits, that is of primary significance. The largest quarry bowl in the area, Chervone ozero-I, has an elliptic shape and its dimensions are 100 x 70 m (Fig. 1). The thickness of the rock used exceeds 6 m (the precise depth of the excavation has not been determined because of the significant thickness of silt). The quarry slopes are reinforced, with masonry preventing it from falling and washing away. Preliminary calculations show that about 60,000 tons of copper ore have been extracted here. Assuming that the copper content in the ore only comprises 5%, it is not difficult to calculate that nearly 3,000 tons of metal have been produced from this one site alone.

The most impressive site is the two-fold quarry of the Chervone ozero-II mine, stretching along the edge of the sandstone ridge on a west-east alignment. Its large eastern bowl has dimensions of 145 × 30 m and its depth reaches 8 m (without silts). The dimensions of the western bowl are 76 × 35 m and the depth is from 3 to 5 m. Within the excavations the 3 m block crosspiece has been preserved. The volume of the produced copper ore is more than 30,000 m^3 [Pryakhin, Otroschenko, Savrasov, Brovender, 2003).

The third open mine, Chervone ozero-III (of oval shape oriented in a north-western direction), is 40 m in length and 5 m in depth. The volume of the ore produced is about 4,000 m^3.

The underground tunnel excavations are located on the sandstone ridge and were originally fortified on the surface with funnel-like apices, with a diameter of up to 8 m at a depth of 2 m. The compactness of their location is the result of using the technology of vertical excavations in the form of mine shafts (Fig. 2) (Brovender, Gayko, Shubin, 2005). Some of them were connected by horizontal drifts (excavation 1 and 2). There is a further good reason to speak about the ancient origin of the underground excavations because a sacral burial of an ancient miner was found in one of them (Fig. 3) (Brovender 2005).

Not far from the underground excavations there is a production site for primary ore crushing and grading, as well as the dump of the used rock, together with the thoroughly crushed mining rock.

Fig. l. Opencast colliery of mine Chervone Ozero-I

Fig. 2. Working 1 of mine Chervone Ozero-IV

Fig. 3. Burial 1 of working 1 of mine Chervone Ozero-IV

Fig. 4. Building 1 of settlement Chervone Ozero-III

Within the area of the quarry Chervone ozero-I there is a wide man-made site where ore dressing was carried out. Within the studied area of the monument three stratigraphic horizons, corresponding to the three periods of its activity, have been discovered. The foundation pits of production buildings have also been found there. Practically all of the artefacts found within the area of the site are culturally uniform. The products of ceramic, bone and stone materials form the material evidence for this area.

Five radio-carbon dates have been determined from the animal bones found on the site of the quarry Chervone ozero-I. The analyses have been undertaken in the Kiev radio-carbon laboratory of the Institute of Environmental Geochemistry of NAS of Ukraine (analyst M.M. Kovalyukh). The average values of calibrated dates fall within the period 1700–1400 B.C. With the probability at one sigma, the date range is between 1681–1447 B.C., and at two sigma it is between 1741–1411 B.C. (Brovender 2005).

One of the most significant monuments of both the Donetsk mining-metallurgical centre and the Dnepr-Donskoy production site as a whole, in terms of Bronze Age production activity, is the settlement Chervone ozero-3.

The settlement is situated in the valley of a desiccated river 300 m to the south-east of the largest quarry Chervone ozero-I (Brovender 2005). The investigated area here extends to 212

m^2. During the excavations, a housing/productive complex consisting of two buildings was found. One of buildings (intended for habitation) had stone walls as its foundations (Fig. 4). The buildings were square in shape and were oriented south-east – north-west. The area of building 1 is about 30 m^2, building 2 (intended for production) – about 47 m^2.

Overall, we can note that the results of the investigations of the complex of the Kartamysh archaeological micro-district have presented exceptionally important information about metal production carried out in this locality during the Bronze Age.

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Environmental transformations and human occupation of the Altai region during the last glacial-interglacial cycle

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The broader Altai region, located at the junction of the northern boreal, the western Mongolian and the arid central Asian bio-geographic zones, has a major relevance for understanding the human history and biodiversity of north-central Eurasia in the context of past climate change and related (paleo)environmental transformations. The present interdisciplinary Quaternary studies represent a contextual part of the geomorphic and biotic mapping of the southern Altai area, East Kazakhstan, in direct geographic linkage with former investigations in the Gorno Altai, southern Siberia. The current research has been aimed at the elucidation of natural processes, their dynamics and chronology in the reconstruction of the climate evolution and natural (paleo)environments since the last interglacial. Systematic geomorphic mapping in the Buchtarma valley has focused on up to 200 m high glacio-fluvial terraces that indicate dramatic natural processes and pronounced climatic fluctuations in the mountain regions, particularly during the last glacial (Oxygen Isotope Stage 2).

Loess represents the major and most susceptible source of paleoclimate-indicative proxy data in the northern and south-western Altai foothills, incorporating archaeological (palaeolithic) records and paleontological remains. Intact stratigraphic sections of eolian (loess) deposits with horizons of variously developed buried chernozemic, brunisolic and regosolic paleosols provide evidence of natural transformations in the landscape corresponding with the shifts from parkland-steppe to boreal forest and tundra, respectively.

The documented stratigraphic sections distributed in the upper reaches of the Ob River drainage, south-western Siberia and the Buchtarma River valley, East Kazakhstan, display continuous alternating deposition of loess and soil formation events corresponding to Oxygen Isotope Stages (OIS) 1–5 (i.e. the time span of the last 130 000 years). The recorded magnetic susceptibility pattern displays the MS maxima (up to ~$6x10^{-3}$ SI) in cold OIS 2 and 4 (represented by loess) and minima (as low as ~$1x10^{-3}$ SI) in warm OIS 3 and 5 (represented by paleosols), typical of the southern Siberian loess zone and diagnostic of the past global climate change (Chlachula et al. 1998). The continuous stratigraphic records indicate, in association with other past climate proxy data, a very dynamic climate evolution and associated cyclic environmental transformations in the Altai area and the adjacent part of south-western Siberia (Chlachula 2001, Chlachula et al. 2004). The composite stratigraphic archives in the upper Ob / Biya river valley, readily interpreted in terms of the standard OIS chronology, with abrupt changes seen at the OIS 1/2, 2/3 and 3/4 stage boundaries, correlate to the Heinrich events (H1 to H6) seen in marine cores from the North Atlantic and thus indicating a general climate development across the Northern Hemisphere (Evans et al. 2003). Higher rates of loess accumulation during cold stages suggest high rates of eolian transport and sediment influx, as expected from the wind-vigour MS model also found in Alaska. The estimated rates of loess accumulation during stage 2 and stage 4 calculated at the Byisk section are 0.39 mm/a and 0.63 mm/a respectively. For stage 3, the estimated rate of accumulation of 0.28 mm/a reflects both deposition of eolian sediment from suspension settling and pedogenesis. Contextual stratigraphic data present a vital source of information completing the present paleoclimate evidence of north-central Eurasia. The dramatic character of geomorphic processes in the inter-mountain areas of central and southern Altai, triggered by climate change, is particularly evident in the prominent glacio-fluvial terraces of the central Katun, Argut and Buchtarma river valleys, dating to the last glacial and associated with the retreat of mountain glaciers and cataclysmic openings of glacial lakes due to global climate warming following the last glacial maximum.

Fig. 1. Glacio-fluvial terraces at Uryl at the Southern Altai range, East Kazakhstan, resulting from cataclysmic drainage of glacial lakes following the LGM

Past climate change and environmental transformations are well documented by the geomorphic and chronological distribution of particular archaeological sites and the stratigraphic location of cultural records across the investigated territory of the western and southern Altai. Hard-percussion flaked stone artefacts made of quartzite cobbles stratigraphically located *in situ* in the lower part of the 60 m high Biysk loess section on the northern Altai Plains, south-western Siberia, indicate an earlier occupation of the Altai plains presumably prior to the last interglacial. Numerous open-air sites with stone artefacts displaying typical typological and technological features of the Lower and Middle Palaeolithic found on ancient fluvial terraces in the presently arid steppe and semi-desert zones of Eastern Kazakhstan with rather climatic continentality suggest more favourable moderate natural conditions for peopling this vast open territory at various stages during the Pleistocene. Open Pleistocene-age sites positioned on granitic bedrock platforms along the margin of a glacio-fluvial basin at Dzhambul in the upper Bukhtarma River valley at elevation of 1250 m show earlier migrations to the inter-mountain valleys of East Kazakhstsan in some climatically moderate phases during the last glacial. The expedient stone industry made with granitic cobbles and green schist fragments suggests a successful adaptation to periglacial environments and the exploitation of local biotic resources.

The diversity of the relief and the Quaternary environments of the mountain areas of north-central Eurasia played a major role in the history of the inhabitation of this territory. The geographical and contextual distribution of the cultural records reflects a climatic instability in the Altai area. The results from the studied loess sections imply globally diagnostic past climate changes recorded in the local loess-paleosol sections incorporating evidence of the presence of early people in this part of Eurasia. Paleoenvironmental proxy data indicate that the natural conditions during the earlier stages were generally more favourable for early human occupation than during the later stages. The cyclic nature of the glacial and interglacial periods led to periodic landscape transformations and the generation of specific ecosystems adjusted to particular topographic settings and responding to climatic variations.

Fig. 2. An open occupation site near Dzhambul, the upper Bukhstarma River valley, with expedient lithic industry providing evidence of early migrations of people to intermountain areas of southern Altai, East Kazakhstan

The initial occupation of the broader Altai region associated with "pebble-tool" industries from alluvial formations probably occurred in some of the Middle Pleistocene interglacials during the process of the northern expansion of the temperate zone and biota. Mixed coniferous and broadleaf forests established in the tectonically active mountain zone with elevations of 1500–2000 m and parklands in the adjacent plains and continental basins provided a wide range of occupation habitats. There is limited evidence of the persistence of the Early Palaeolithic inhabitation during glacial stages due to inhospitable periglacial conditions.

The last interglacial warming evidenced by the re-colonization of southern Siberia by coniferous taiga forests is linked with the appearance of the Mousterian tradition. Changes in the relief configuration influenced the local climate regime and opened new habitats for the Middle Palaeolithic population concentrated in the transitional zones of 500–1000 m elevation in the karstic area of the NW Altai foothills. Occupation of the central and southern Altai during the early last glacial was impeded by harsh, ice-marginal environments and the expansion of glaciers in the valleys filled by large proglacial lakes. Progressive warming during the early mid-last glacial interstadial stage (59–35 ka BP) caused wasting of the ice fields accompanied by cataclysmic releases of ice-dammed lakes and large-scale erosional processes. Periodic outbursts of the glacial basins had a dramatic impact on the regional ecosystems, also obliterating the earlier cultural records.

The appearance of the transitional early Late Palaeolithic stone industries reflects the adaptation to mosaic interstadial habitats, including sub-alpine forest, dark coniferous forest, mixed parklands and open steppe. The identical geographical distribution of the Middle and Late Palaeolithic sites and the time-transgressive lithic technologies suggest a regional cultural (and biological?) continuity in the broader Altai area during the Late Pleistocene. The re-establishment of cold tundra-steppe and tundra-forest habitats correlates with the Late Palaeolithic horizon, with developed stone industries dominated by blade-flaking techniques that possibly survived in more protected locations characterized by a warm microclimate in the northern Altai throughout the last glacial maximum (20–18 ka BP), with a specific Late Pleistocene biodiversity. The emergence of microlithic assemblages associated with crude expedient stone industries made with local raw materials is linked to a new cultural adjustment in the final stage of the palaeolithic development in the Altai area, responding to transformations of the former periglacial ecosystems towards the end of the Pleistocene. Evidence of the ongoing global climate warming is apparent in a major annual retreat of mountain glaciers and gradual shifts in local biotic communities.

Acknowledgement

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Neolithic and Bronze Age societies of the Polish Lowland and their environment

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The Polish Lowland is a part of the Central European (or North European) Plain. For the purposes of our study we chose a western part of the Lowland: an area between the Vistula, the Odra, the Noteć river and the line of the southern Warta river (Fig. 1). Within this large macro-region one can find very diverse landscapes: lakelands, large valleys with peaty floors, poor sandy areas and plains with very fertile black soils (in the FAO-UNESCO glossary 1990: *mollic gleysols*, *gleyic phaeozems*). The latter form here a type of "fertile island" in various sizes: they are big (ca. 845 sq. km in the Kujawy region), small (100–300 sq. km in the Września or Kościan district) or really small (e.g. ca. 80 q. km in the Szamotuły district). The history of the Neolithic in the Lowland began on the "fertile islands" and thereaftern for many hundreds of years the areas of black soils were intensively used for human settlement.

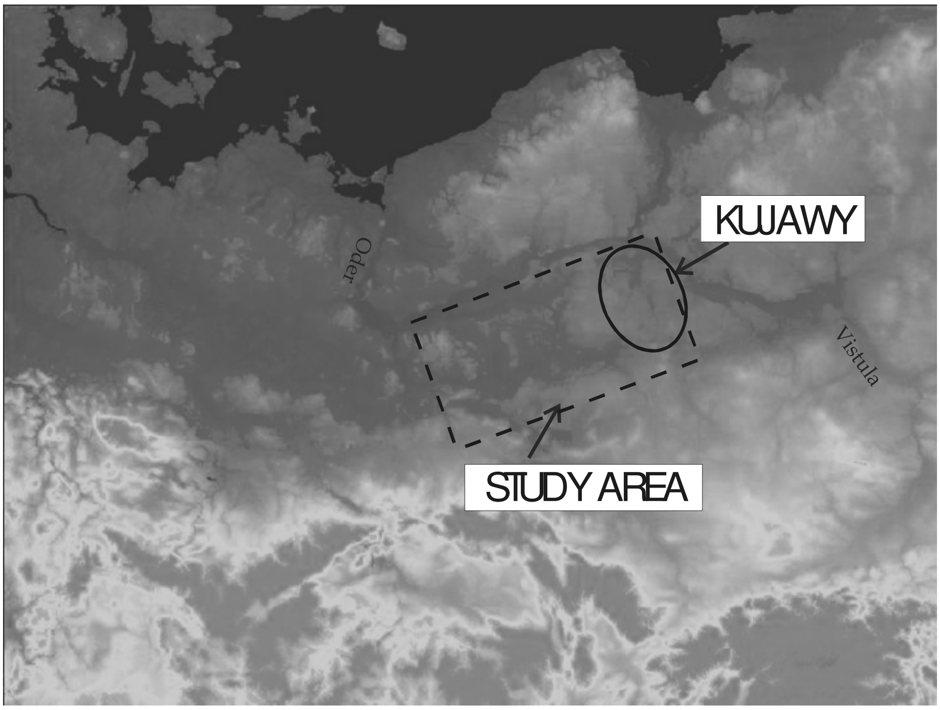

Fig. 1. Location of study area

A good example is the Kujawy region, the biggest "fertile island" of the Polish Lowland (Fig. 2). In the Kujawy one can find a few different elements: a Kujawy plain which is in the centre, two lakelands on the west and on the south, and two large valleys on the north and on the east. The flat Kujawy plain is covered with black soils. The lakelands and valleys have a varied relief and are mainly covered with sandy or clayey soils (*cambic arenosols*, *cambic podzols*, *luvisols* etc.).

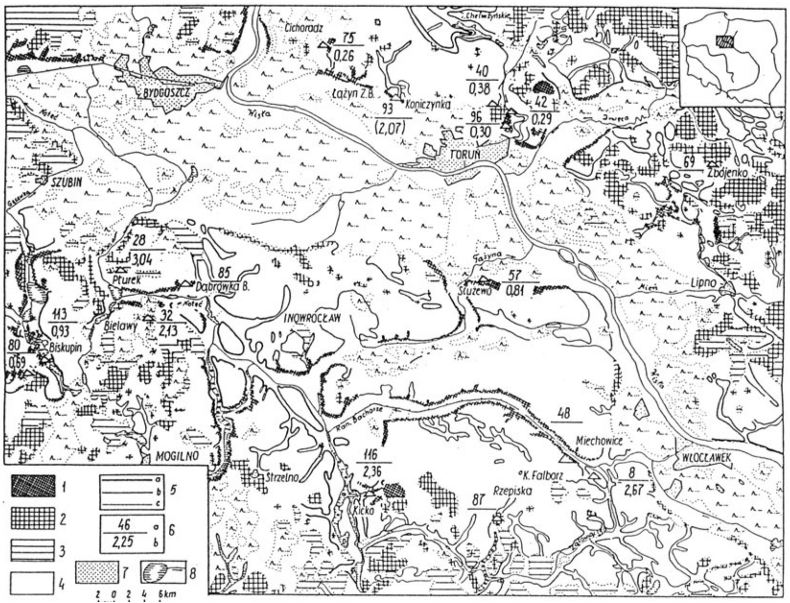

Fig. 2. A map of the Kujawy region

The first agriculturalists of the Lowland belonged to the Linear Pottery culture. They developed far to the south of the Carpathian mountains, on the middle Danube river, and then spread to the north, the west and the east. Their new territories included also the basins of the Odra and Vistula rivers. The newcomers settled in the Kujawy plain where they formed settlements (first villages) of 1–3 long houses (Fig. 3). Every house was used by a large family group. The Linear Pottery culture brought to the north their domesticated animals (cattle, pigs, sheep and goats) and domesticated plants (mainly wheat and barley). Their farming is called "garden-type". Their impact on the natural environment was rather limited and local. As in other regions they "did not significantly change the environment by its farming and animal breeding economies" (Grygiel 2005: 675).

In the fifth millennium BC this type of agriculture was continued and even intensified by groups of Late Danubian cultures, connected to the south as well as to the local area. They created bigger "village communities", but only on the areas of black soils. Their settlements consisted of several long houses and several large families. The settlement structure was rather concentrated and the impact on the natural environment was more profound but still localised.

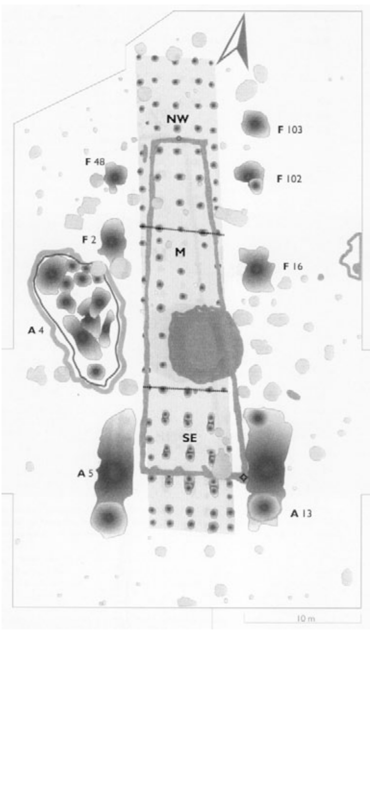

Fig. 3. Ground plan of long house (Bożejewice). After Czerniak 2000

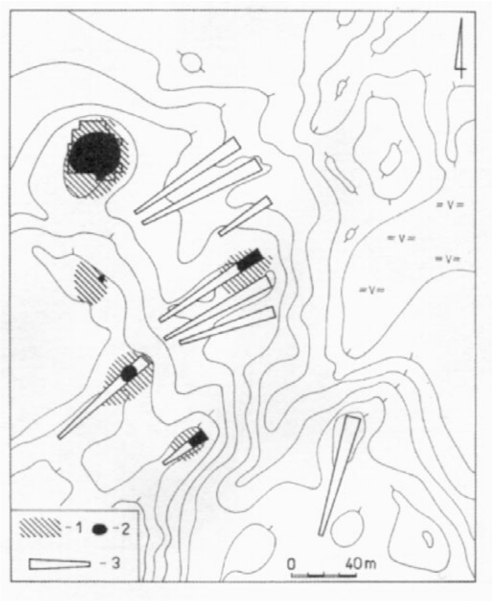

Fig. 4. Long barrows (Sarnowo). After L. Gabałówna and H. Wiklak

A profound change in early agriculture took place from the mid fifth millennium BC and is connected with the people of the Funnel Beaker culture. In their settlement and economic life they created new patterns based on a flexibility in the selection of settled areas (not only black soils but very often sandy soils as an alternative) and on the "tendency to use the environment to a maximum" (Rzepecki 2004: 224). The populations cultivated a slash-and-burn economy. Their dispersed settlement structures were formed by small family groups which built fairly small houses. Of prime importance for their social and ritual life were cemeteries consisting of long barrows (Fig. 4).

From the beginning of the third millennium BC one of the most distinctive characteristics of the Polish Lowland is the wide variety of cultural groups that formed a kind of "cultural patchwork". These societies often coexisted within a relatively small area and differed not only in their material culture but also in their social, economic and ritual activities. Societies still existed for whom crop cultivation was fundamental to the way of life (mainly late groups of the Funnel Beaker culture). However, other contemporary communities emerged who relied on a different strategy for procuring food. The majority of groups inhabiting the Lowland began to place greater emphasis at this time on the rearing of domestic animals as the basis of their livelihood (e.g. populations of the Globular Amphora culture which in special circumstances deposited their animals, mainly cattle, in special graves; Fig. 5). Moreover, the first populations appeared whose way of life was more mobile (mainly the Corded Ware culture).

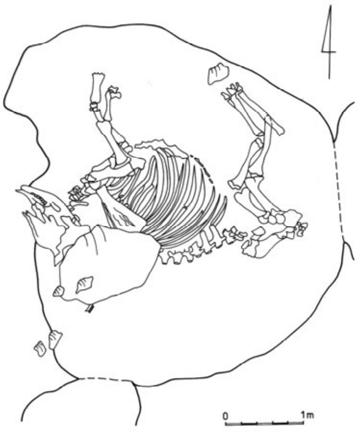

Fig. 5. A cattle deposit (Żegotki)

The Bronze Age, the beginnings of which are dated to ca. 2300 BC in this part of Europe, witnessed a more intensive development of the cultural landscape. In some areas new settlement structures were established, based on defensive (fortified) settlements. In such places settlement stabilized. A case in point is an Early Bronze Age settlement at Bruszczewo (Fig. 6) that continued in one location for about 400 years (2000–1600 BC), which was a rare occurrence in this part of Europe. Permanent occupation entailed a radical landscape transformation.

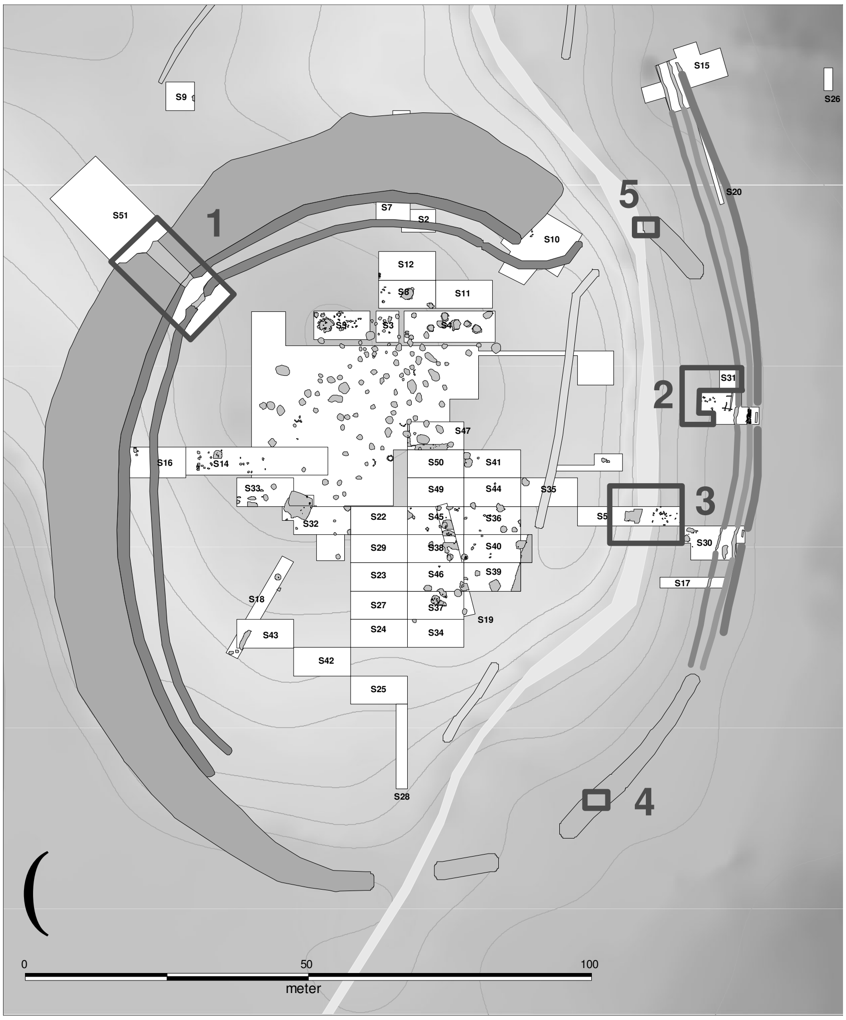

Fig. 6. An Early Bronze Age fortified settlement (Bruszczewo).

Correlating Holocene land snail assemblages across Europe

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In 1964 Ložek proposed a Holocene molluscan zonation scheme for the former Czechoslovakia, later refined to be applicable to central Europe as a whole. Since then similar schemes have been proposed for southern England, Poland, the Rheinland area of western Germany and Luxembourg, and France. Although some of these schemes are yet to be subjected to detailed radiocarbon dating the general details seem to be secure, and it is now possible to relatively date Holocene sequences across large areas of Europe using land snail assemblages. Obviously the molluscan species represented vary from region to region, but general correlations can be made across north-west and central Europe.

More specifically, it is also possible to correlate and/or compare land snail assemblages occurring in particular types of Holocene deposits across Europe. This can be used to infer similarities or differences in the environments in which those deposits accumulated. For example, there is some evidence that tufa deposits in both central southern England and Poland seem to have formed in wooded environments in smaller river and stream valleys but in more open environments in larger river valleys. The characteristics of molluscan assemblages recovered from overbank alluvium across Europe also seem to show some consistency. It is proposed that further comparison of Holocene land snail assemblages across Europe, particularly on a contextual basis, will provide valuable information on depositional settings and processes on a continental scale.

Deforestation and reforestation in the Cracow region (Southern Poland) from the La Tène to the Medieval periods

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The results of both detailed and long term paleogeographic studies on the evolution of the Vistula river valley, downstream of Cracow, combined with archaeological investigations and interdisciplinary research conducted in the area, enable a unique possibility for the analyses of landscape changes from the La Tène to the Medieval periods (Fig. 1).

Although settlement growth on the loess terrace of the Vistula river near Cracow lasts from the last quarter of the 3rd c. BC (Woźniak 1992) stable settlement flourishes during the Late Roman period (the second half of the 2nd c. AD to the third quarter of the 4th c. AD). Villages comprise 6–7 dwellings. Settlement prosperity is closely related to agricultural intensification and non-agricultural based production (pottery production, bronze founding, bronze and iron smithing and iron metallurgy) (Dobrzańska 1997) (Fig. 1A). In contrast to the Roman period, in the Early Medieval period the density of population decreased. Settlements of the Slavonic phase (5/6–7 c. AD) comprise 1–3 dwellings (Fig. 1B) and in the Tribal phase (7/8–10/11 c. AD) 3–4 houses (Fig. 1C).

In the Roman period a predominance of the use of oak wood is corroborated by the results of palaeobotanical analyses (Lityńska-Zając 1997; 1999). Because of the deforestation of the loess terrace oak forests on the flood plain constituted the raw material for specialized production and were used as fuel and building material (Dobrzańska, Kalicki 2003; 2004; Dobrzańska, Kalicki, Lityńska 2005).

The subfossil trunks (mainly oak) are often found in the Holocene alluvium of the Vistula river (Fig. 1). Despite the fact that in most cases the tree trunks do not directly date the deposits, because of redeposition (Kalicki, Krąpiec 1995), they provide information about the periods of bank erosion and the fall of trees during phases of intensification of river activity caused by climatic changes (Kalicki, Krąpiec 1996). Subfossil oaks from the La Tène to the Roman periods and from two early medieval periods (5/6 c. and 9/10 c. AD) are very frequent both in the alluvia of the Vistula river (Fig. 1 and 2) and in another Central european river valleys. Trunks cut by man were also found in the alluvia near Cracow and were radiocarbon and dendrochronologically dated to these periods (1950–1850 BP; 35 BC–240 AD; 231 AD; 976 AD) (Kalicki, Krąpiec 1992; 1996).

Detailed studies enabled us to reconstruct the palaeogeographical situation from the Roman period. Two avulsions of the Vistula downstream of Cracow in the Atlantic/Subboreal transition caused the deeper incision of the river. There were two steps of the Vistula flood plain in the La Tène and Roman periods and at the beginning of the Early Medieval period (Fig. 1A–C). These local natural conditions could have largely determined human activity and the degree of exploitation of the natural environment of the Vistula flood plain. People penetrated the drier valley bottom for a large part of the year. River activity was limited mainly to the narrow lower step of the flood plain. Floods were numerous but swift and the trees fallen due to bank erosion could even have provided easily available wood.

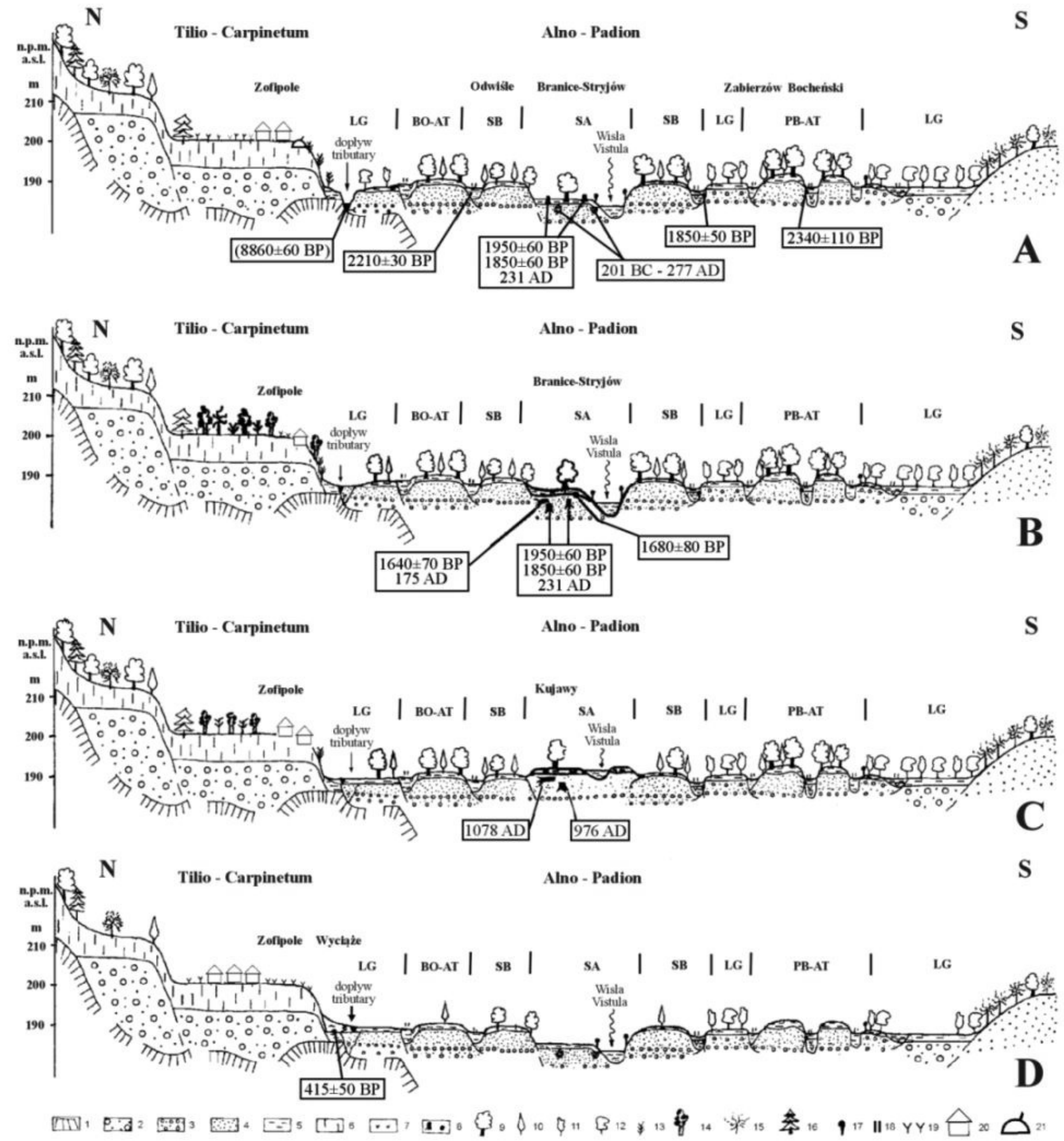

Fig. 1. Schematic paleogeographical section across the Vistula river valley in the Roman period – A (by T. Kalicki after H. Dobrzańska, T. Kalicki 2003), Early Slavonic phase – B, Tribal phase – C and Modern – D (by T. Kalicki).
1 – Miocene clay, 2 – Pleistocene gravels with sands, 3 – Holocene gravels with sands, 4 – sands, 5 – silts (overbank deposits), 6 – loess, 7 – peats, 8 – trees and trunks cut by man, 9 – Quercus sp., 10 – Carpinus betulus, 11 – Alnus sp., 12 – Salix sp., 13 – Corylus avellana, 14 – Betula sp., 15 – Pinus sylvestris, 16 – Picea excelsa, 17 – Carex sp., 18 – meadows, 19 – cereals, 20 – dwelling zone of the settlement, 21 – production zone of the settlement. Age designations: AT – Atlantic, BO – Boreal, LG – Lateglacial, PB – Preboreal, SB – Subboreal, SA – Subatlantic. Radiocarbon and dendrochronological datings in boxes

Radiocarbon and dendrochronological dating of the subfossil oak trunks accumulated in the Holocene alluvia of the Vistula river floodplain provided a phase of oak germination around 400 AD (Kalicki, Krąpiec 1995; 1996). It may be assumed that the decline of settlement and economic activity circa 375 AD were favorable for oak reforestation on the Vistula floodplain (Dobrzańska 2000; Dobrzańska, Kalicki 2003; 2004) (Fig. 2).

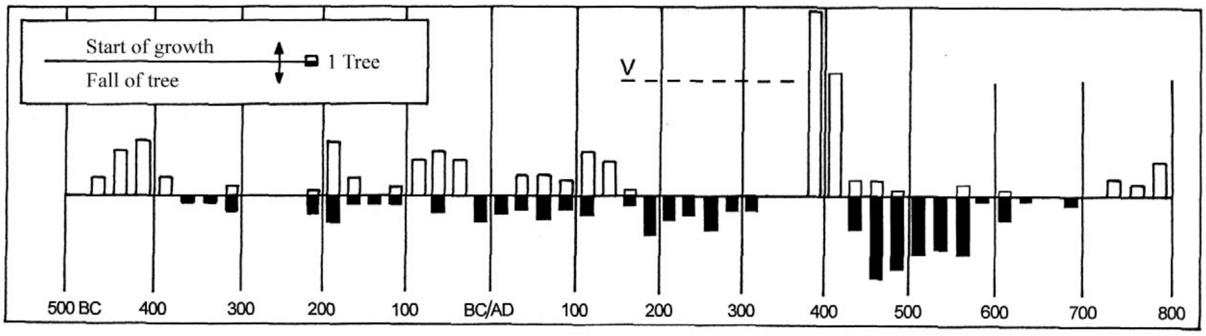

Fig. 2. Phases of the beginning of the growth and fall of oaks at the Vistula River Valley near Cracow from 500 BC to 800 AD (Kalicki, Krąpiec 1996, Madyda-Legutko et al. 2005). V – period of intensive human economical activity in the Vistula River Valley by H. Dobrzańska.

In the Roman and Early Medieval periods a gradual increase of the river bed level and an aggradation of overbank deposits on the flood plain occurred (Fig. 1A–C). Two phases of increased river activity took place in the 5th–6th centuries AD and in the 9th–10th centuries AD (Fig. 2). The embankments (floodbanks) in the Cracow suburbium (Okół) were constructed in the 10th century AD. A decrease of settlement density and economic activity caused reforestation (*Betula sp.*) of the loess terraces. The birch forests were used for wood tar production.

These landscapes changes were determined by natural processes and human activities linked with two different cultural models.

Laminated sediments and tephrochronology – an example from Lake Belau, Northern Germany

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Lake Belau is an 1.15 km² large lake in Schleswig-Holstein, Northern Germany (10° 16' E, 54° 6' N). Its maximum depth is 28 m and it has well preserved lamination in the cores of its deepest part. An overall core of 25.33 m of sediment spans the whole Holocene. Not all of the core is well laminated, as the uppermost part is disturbed by eutrophication. New warve-counts allow an estimate of the reliability of the counting. 79 % of the warves are very good and can be counted without any doubt. 10 % are good and 11 % are of minor quality. Thus the error can be estimated for different depths.

A number of investigations have been undertaken and published by Wiethold et al. (see literature). As the chronology is shifting and fixed to the elm decline in an adjacent peat bog new investigations were carried out to detect tephra-layers to fix the chronology. Three well defined layers were detected that allow a link to the tephrochronological frame for northern Germany (Van den Boogard, Schmincke 2002). By this method the dating can be corrected and settlement phases in the pollen-diagram can be linked to archaeological phases with high accuracy.

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Settlement and prehistoric land-use in Central Bohemia: comparison of archaeological and pollen-analytical evidence

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This paper presents a project in progress concerning long-term evolution of the cultural landscape of Central Bohemia. The project aims to understand the character of the landscape used and cultivated by man from the Late Glacial period up until modern times, to identify key stages of its development, and to study processes responsible for change. We explore both historical and methodological questions, which can be resolved through the integration of archaeological evidence and pollen analysis. The main questions are as follows: *What was the spatial structure of settlement areas? Is it possible to identify them by combining archaeological and pollen-analytical methods? Is it possible to identify the character of prehistoric farming systems? How strong was the regeneration capacity of natural ecosystems? Is the pollen-analytical method reliable enough for the detection of regional settlement history (i.e. can pollen analysis be used as a kind of archaeological prospection method)?*

From an archaeological perspective, the valley of the middle Labe River is one of the better-studied regions within the Czech Republic, and possibly Central Europe as a whole. Fortunately, numerous lake sediments exist in this region, and these may be used for pollen-analytical reconstructions of vegetation development from Late Glacial to modern times. A detailed comparison between archaeological and pollen-analytical data sources aims to reveal the danger of: a) over-simplistic interpretation of the archaeological and pollen data, and b) the extension of such simple generalized pictures to a wider area.

Archaeological analyses are being undertaken within a 3km diameter circle around the coring sites, representing, in theory, an area in which the pollen in likely to have originated. Every 3km diameter circle is divided into 24 segments and the archaeological finds assessed according to: a) their presence in individual segments, b) the number of segments containing finds within 1 km, 1–2 km, 2–3 km, c) an area of 25 ha, which is taken to represent the hypothetical settlement area cores of prehistoric and Early Medieval cultures, d) the index created from the number of segments containing finds divided by the duration of the archaeological period.

When the reconstructed picture of archaeological settlement is compared with the results of pollen analysis, a surprising incompatibility between the data sources is revealed. The strongest indicator of human impact in the pollen diagram was left by cultures that made the smallest archaeological impression: the Middle Eneolithic, Final Bronze Age and the Migration period, together with the older phase of the Early Medieval period. Although the Late Bronze Age was archaeologically well-represented, this period was unimpressive in the total pollen record; the Early Medieval period III–IV appears to be similar. Correlation of the settlement picture with the pollen-analytical evidence apparently needs to take account of the archaeological data from an area of only 1km in diameter, which is considered to be preliminary evidence for very local origins of the pollen spectrum, even in a flat, open valley-bottom landscape. A period of major vegetation change can be observed between the Late/Final Bronze Age to the Hallstatt period. The original forest structure and composition was changing at this time, and secondary formations were taking over. All the parameters followed also show increasing deforestation. This evidence contradicts local archaeological data, which do not show higher settlement intensity. The contradiction can most probably be explained by the general dynamics of vegetation development. If vegetation changes are occurring on an "under-critical level" – i.e. on a small scale in the background of dominant vegetation – they are usually reversible. However, if some vegetation formation spreads for any reason on a wider scale (by accumulation over time or by sudden impact), it becomes significantly more stable. Small grazing areas surrounded by woodland, for example, become easily covered by self-seeding vegetation. Large grazing areas in an open landscape remain unchanged for a long time, even if the intensity of grazing has decreased. That rule applies for field cultures as well as, for example, secondary woodland growth in their relationship to forests in their original form. The natural vegetation formations were thus isolated, becoming islands only within the secondary vegetation (secondary woodland or open field). According to the results of the analysis, this shift was caused by the cumulative effect of human impact during the Late/Final Bronze Age period.

Our current experience in the field shows that evolution of the landscape through human impact cannot be seen purely as a unidirectional process of environmental modifications by humans, but that the process is characterized by a dynamic interplay between natural and cultural factors. Quantification and subsequent direct comparison between archaeological and palynological sources of evidence revealed some serious discrepancies. An attempt to solve this incompatibility resulted in three main conclusions: *a) The archaeological picture may be strongly influenced by processes of archeological transformation or by an inability to identify traces of certain prehistoric occupation periods archaeologically. b) The pollen record is very local; therefore its correlation with archaeological data is optimal if the analysis area has a diameter of less then 1km. c) Whereas the quantity of archaeological remains does not substantially increase over time, we can observe progressive cultural landscape development in the pollen diagrams. This can be best explained by the cumulative effect of human impact on the vegetation.*

The results obtained in this project are, of course, limited to the area under research. As we are presenting the results of this still-ongoing project in this paper, we hope for fruitful discussion during the AEA Conference.

Acknowledgements

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Modelling 'landscapes' from pollen data: opportunities and limitations

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The ability of recently developed models of pollen dispersal and deposition to reconstruct past vegetation communities provides a novel approach of immense potential for archaeology (Fyfe, 2006). Landscape in many forms often provides a central theme in archaeological research, and the potential to identify 'likely' or 'plausible' scenarios (*sensu* Caseldine and Fyfe, 2006) gives new dimensions to debates concerning the impacts of vegetation/landscape on human communities and vice versa. There are several ways in which the model-based landscape reconstructions can be used by archaeologists, all of which present different questions, both technical and philosophical. This paper examines some of the opportunities that this novel approach offers, and the issues surrounding application of the model-based approach to landscape reconstruction.

We argue that the term 'landscape' should be used criticially when discussing pollen-based reconstructions (Caseldine *et al*., in press). Landscapes may be considered to be social constructs loaded with multiple meanings, whereas pollen reflects vegetation and vegetation patterning, a physical property of the environment. We make a distinction between virtualisation of past vegetation patterning and visualisation of landscapes, and discuss the varied scales at which the approach has been, and may be, used. A distinction between virtual and visual past landscapes has importance for the wider dissemination of understanding about past environments. The modelling approach, in providing 'plausible' landscape reconstructions offers a much more rigorous basis for visual reconstruction, and in doing so can also inform debates concerning the way communities interacted with their landscapes in ways other than seeing them as simply a resource base.

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Environment and Stone to Bronze Age man in the Lithuanian territory

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Preliminary data from osteological material, pollen analysis and related archaeological evidence demonstrate natural change and intensity of human influence on the environment during the Late Glacial, Early and Middle Holocene in the Lithuanian territory.

According to results from these investigations, natural environmental changes are predominant during the Late Glacial period in the Lithuanian territory. The open and forest–tundra landscape of Bölling and Older Dryas were altered by the growth of light pine-birch forest during Alleröd.

According to radiocarbon dates, mammoth skeletons from the Lithuanian territory date to the Middle Wechselian period. Mammoths were not recorded during the Late Glacial period.

Vegetation and fauna were also affected by Late Glacial climatic change. These environmental changes in the East Baltic, as in Lithuania, formed two separate regions – the Coastal and Continental regions. The foraging economy developed in different ways in each region. As a result, different economic activities emerged in each region.

In the Late Paleolithic, the economy was based on the hunting of herd animals – reindeer (*Rangifer tarandus L.*). During the Late Glacial period after the retreat of the glaciers, hunting was focused on reindeer in the territory of Lithuania. Skeleton bones and horns of reindeer, as well as spearheads made from these materials, were collected in 16 localities of the territory of Lithuania. Reindeer lived from the Bölling period to the beginning of the Pre-Boreal period in the territory of Lithuania.

Hunting practices changed during the Paleolithic-Mesolithic transition, when the hunting of individual forest fauna developed. A microlithic technology emerged in hunting tools. There was a change in the species composition of hunted animals and fish. The type of foraging undertaken by coastal inhabitants and by mainland inhabitants also differed. The former were engaged in seal and fowl hunting, while the latter were involved in the hunting of forest animals and birds, and the catching of freshwater fish. In the entire Lithuanian territory, however, elk, beaver, boar, red deer, and, among the birds, duck and geese were hunted.

All fishing methods and implements appeared and developed during the Mesolithic, including nets, fishhooks, creels, beating through the ice and weirs. Fishing techniques and tools were improved and became more varied with time. During the entire Mesolithic, the fish most often caught by inhabitants were pike, pikeperch, catfish, common bream and perch.

The Mesolithic human impact on the environment emerged during the second half of the Pre-Boreal period and became more visible during the Boreal, but was still very local, related to the appearance of apophytes and higher charcoal content in sediments close to the settlements.

The flourishing of broad-leaf forests occurred during the Atlantic period. During the second part of the Atlantic period in the Early Neolithic, but more noticeably in the Middle Neolithic, plants characteristic of meadows appeared. Together with the presence of apophytes and the changing level of *Ulmus* pollen recorded, the start of cattle breeding can be detected, as well as an increase in environmental changes caused by human activity, in the vicinities of the settlements.

In the Early Neolithic, boar, elk, red deer, roe deer, beaver, bear, marten, seal in the coastal zone, and birds, such as ducks, were most often hunted.

With changing climatic conditions, the species composition of hunted fauna changed during the Middle Neolithic. Seals, elk and red deer became the most hunted. The first two faunal species were most widespread in the coastal area, while red deer was most widespread in the continental zone. Ducks were the most hunted of the recorded fowl.

From the Early Neolithic, more fish species were being caught along the coast, such as flounder and cod. Osteological data show that during the Middle and Late Neolithic, the amount of fish caught from the sea increased.

In the southern east Baltic at the end of the Early Neolithic, alongside the traditional branches of economy – hunting, fishing and gathering – the beginnings of a farming economy appeared: stock-breeding and agriculture. Changes in economy were largely influenced by links between the southern East Baltic people and the tribes of the Funnel Beaker culture. The economic base of the latter was agriculture and stock-breeding. Isolated domesticated animal bones are found in East Baltic settlements of this period, as are isolated occurrences of *Avena* and Cerealia pollen grains.

The main elements of the economy during the Middle Neolithic were still hunting, fishing and gathering. It was during the Middle Neolithic that coastal and continental economies began to diverge in the Lithuanian territory, with an emphasis on the development of stock-breeding in the former, and stock-breeding as well as agriculture in the latter.

Sub-Boreal climate deterioration began alteration of the broad-leaf forest by birch, pine and spruce. Besides cattle breeding, human impact on the environment became more intensive after agriculture started at the second half of the Early Sub-Boreal, Late Neolithic.

In the Late Neolithic, the predominant hunted animals were elk, even pushing red deer from the continental region to second place. In the coastal area, seals were particularly hunted, as well as boar and elk.

A foraging economy remained dominant during the Late Neolithic. A farming economy in the coastal region of the Lithuanian territory reached its substitution phase, while in the northern East Baltic region, only its availability phase was apparent. Stock-breeding developed more in the Lithuanian continental region at this time, while both stock-breeding and agriculture developed in the coastal region. This dual development in the production economy was influenced by the trade of amber in the south. In some cases at this time, cereal pollen reaches 1% in pollen diagrams. The local Narva culture inhabitants' ties with the Globular Amphora and Corded Ware culture people influenced these processes. The Globular Amphora culture people lived alongside the local inhabitants, and the Corded Ware culture people of the entire East Baltic practiced stock-breeding. Since the economic base of the Corded Ware culture people was not very profitable, they were usually forced to adopt local forms of economy, and, being war-like, they took over quarry and resource areas, thereby having a profound impact on their neighbours.

The beginning of the Bronze Age coincides with increasing representation of herbs in pollen diagrams. These changes could be related to the development of open, forest-free areas.

In the Early Bronze Age, among the most hunted fauna were elk, beaver, boar, red deer, and marten. Seals were still regularly hunted along the coast.

The osteological material discovered at Early Bronze Age sites suggests an increasing importance of cattle breeding for local inhabitants. The occurrence of continuous Cerealia curves in pollen diagrams suggests improving agriculture.

Two time periods stand out in the development of a farming economy in the East Baltic: the Middle Neolithic and the end of the Early Bronze Age, when farming spread quickly. The hypothesis put forward here is that the spread of a farming economy is strongly related to the influence of the Funnel Beaker culture in the Middle Neolithic, as well as being related to climatic changes and a decrease in food resources, whereas the intensification of the farming economy at the end of the Early Bronze Age is associated with the working of metal and its use on the farm.

Palaeoenvironmental studies provide detailed new data relating to environmental history and human activity in the Lithuanian territory during the Late Glacial, Early and Middle Holocene.

The well in the settlement-environmental studies through insect analysis on well samples

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In this paper, I present the results from analysis of subfossil insect remains in investigated wells from four settlements dating to prehistoric and medieval time in the county Uppland, southeast Sweden (Hellqvist, 2005, 2006a & 2006b). The prehistoric settlements are dating from Neolithic time until Iron Age, but the majority of the investigated wells are from the first part of Iron Age and primarily the Pre Roman Iron Age and Roman Iron Age (following the time chronology by Hedeager & Kristiansen, 1985).

The well construction has played an important role in the daily life of people in the settlement, both during prehistoric and historic time as well as today. The method to analyse insect remains, primarily beetle (Coleoptera) remains, is very suitable for samples from wells, since the well function as a big trap for insects (Hellqvist, 1998). One important factor for this is that the insects are not prevented from falling into the well even if it is covered on top. This is also proved in a taphonomic investigation on insect remnants in samples from a modern farm well (Hellqvist, 2004). The question, weather the well have been covered or not, is also an issue for discussion since there is no evidence or traces found yet in Sweden that can support this. My opinion, though, is that wells probably in most cases have been covered – at least during Iron Age and onwards.

Several of the investigated wells revealed very little or no insect remains during the analyses of samples and this was also true for a great part of the macrofossil plant remains and other kind of organic material. This is not easily understood since the sediment in the sampled wells provided very good preservation conditions. One interpretation is that this is an effect of how long time the wells have been used. When the wells have been used for a very short time, the number of insect remains that can be deposited is limited. It is though sometimes difficult to understand the reasons for the short usage times for the wells, but this is probably connected to bad construction of the well, low or decreasing water table in the well and/or bad water quality.

In opposite to the situation today, several of the investigated settlements were situated by or close to the sea (Baltic Sea) at the time of activity. Therefore, there is a possibility that some of the wells may have been affected by sea water (salt) making the quality of the well water worse, a possible situation that increases as we go back in time. Today this has changed rapidly in the region of county of Uppland, since Sweden experience heavy land elevation from the end of the last glaciation (Weichsel, stadial III). At most, the isostatic land uplift is in present time up to 9 mm/year in northern part of Sweden, and in the investigated region this increases from south to north from about 4 to almost 5 mm/year.

Several authors have tried to categorise wells from *e.g.* the viewpoint of different layers of filling material in the well (Eriksson, 1995:26ff) or the presence of plant- and animal remains in the well (Hall *et.al.,* 1980). But in the study presented here, a simple categorisation is used based on the results from the ***insect analysis*** and the ***construction*** of the well. The first category is the wells that have been primarily used as water resource for people/animals at the settlement. They have all a more ore less characteristic funnel shaped form and have usually been filled with different kind of layers of infilling materials and/or may also be the result of collapsed walls of the well construction. As a result from this, most of the remnants of insect remains connected to the usage time of the well are normally found in the bottom layer of these wells.

The other type of wells are those that in a first stage have been used as water resource for people/animals, but that in a later stage have been partly filled in and then reused as water resource for grazing animals. In the investigation presented here this is evident by the presence of aquatic beetle species together with beetles strongly indicating grazing animals and those connected to dung. They are found in filling layers in the well higher up in the stratigraphy, post-dating the bottom layer. Also, there is usually a shift where the well infilling between these two stratigraphical units is sedimentologically different and have very little or non organic (*e.g.* insect and plant remains) remains. In the investigated wells presented here, it is characteristic that the wells first have been primarily constructed as two separated pits and/or wells that in a later stage have been combined to a larger construction. In at least one investigated case, it seems like that the primarily purpose from the beginning was to construct a water pit for the cattle etc.

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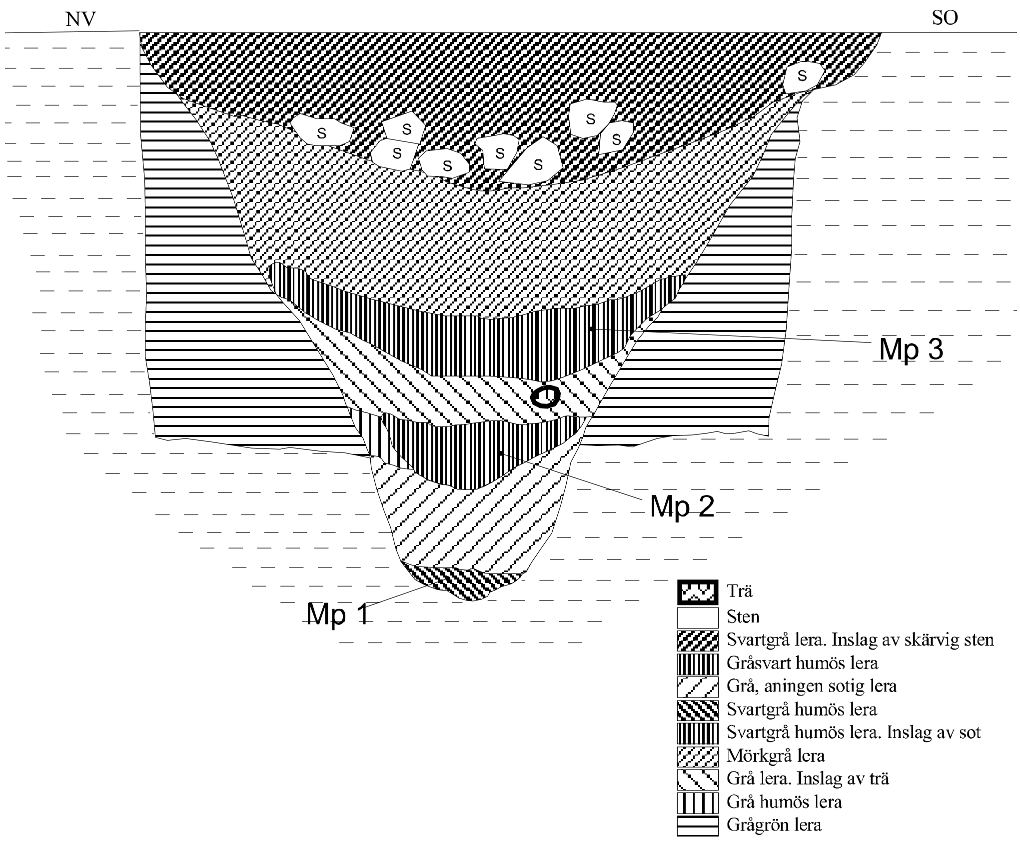

Fig 1. Example of a well from the Pre-Roman/Roman Iron Age Vaxmyra, in the county Uppland, south-east Sweden. The layers are built up by clay with different colours and amount of charcoal, wood etc., the white indications are stones. Samples for insect analysis are marked as Mp1, Mp2 and Mp3. The well is example of a well used for two purposes: the bottom layer (Mp1) is the time when the well was used as water resource with a diverse picture of the surroundings, in the next sample (Mp2) the number of finds decrease rapidly but the moist situation dominates, the third sampled layer (Mp3) is dominated by aquatic and dung species. The well is interpreted to have changed from primarily water resource for people/animals to open water resource for grazing animals in the settlement (maybe even enclosed around it).

Another construction studied in this investigation, parallel with the studied wells from prehistoric settlements, was a feature from a excavated small medieval settlement (crofter's holding). Among the features found, my study was focused on a different type of construction, which initially was interpreted as a possible well or some kind of cool storing for food. The study of insect remains in samples from this construction was combined with an investigation of the geology of the area and from this it was clear that it was not a well. The sample provided a very limited number of finds of beetle remains, but even though it was possible to interpret that the construction most probably was a cool store for food.

When studying wells in the settlement in the prehistoric and medieval landscape, it is easy to reflect over the palaeohydrological situation and the relation between people and water. It is not always a straightforward understanding on the usage of the well and in my investigation it may be a quite diffuse relation between the well and other natural water resources in the landscape around the settlement. All the settlements in the investigation presented here are situated close to natural water resources like smaller rivers, so the well must have functioned as an important complementary water resource.

It is not unusual to see the clear relationship between the settlement and a river situated close to it when studying the insect remains found in samples from wells, since insects living in the river often get trapped in the well deposit. In Hellqvist (1999) this situation is showed through insect analysis in wells from two farm settlements from Iron Age in south central Sweden. The relation between the natural water resources in the landscape and the well in the settlement is from this point of view not simple to understand, but the role of water for survival of people and animals is not questionable. The palaeohydrology is therefore always one of the most important landscape situations to understand in archaeology.

Note. This investigation is one of several different investigations together with archaeological excavations from the building of the new motorway (E4) in the county of Uppland, south-east Sweden. The archaeological excavations, together with many specialist investigations, was carried out between 2000 and 2004 and the final publications are planned to be presented during late 2007 and beginning of 2008. Except the archaeological reports, a series of four book volumes will be published, with articles in Swedish but with summaries in English.

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Relationships between human culture and environment along the coast of western Norway through time

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The coastal area of western Norway is characterized by heathlands of *Calluna vulgaris*, developed and maintained through burning and grazing by domestic animals. The development from forest to heathlands has taken place in different time periods and through different phases of human impact, depending on culture and the characteristics of the environment, especially the relationship to soil favourable for arable cultivation. Pollen diagrams made in relation to archaeological sites from five different areas illustrate the strong relationship between human culture, opening of the forest, and heathland development.

Diagrams from outfield areas today show main heathland development during the Late Iron Age/early medieval time, after ca. 800 cal AD. In contrast to this, the development close to areas well suited for agriculture, documented through finds of charred macro remains of barley (*Hordeum vulgare*) in post-holes from buildings, shows heathlands managed through burning and grazing already in the Early Bronze Age (ca. 1500–1250 cal BC). At this site, the infields continued to be heavily maintained as cultivated fields and meadows until modern time. On an island heavily influenced of land-rise until ca. 500 BC, the landscape and possibilities for agriculture changed within a small area through time. Differences in local development are identified, revealing a history of changes in management practices and vegetation types in time and space. Comparing this pattern with the other sites presented shows the same pattern on a larger scale. Already in the Mesolithic openings of the forest resulted in *Calluna* expansion, but it is not until the Bronze Age that continuous management of heathlands is documented. Agricultural expansion phases in the Bronze Age, Iron Age and medieval time resulted in heathland development in some areas. In other, local phases of regression or changes in land-use practices resulted in heathland development in what were earlier infields, or in other cases reforestation.

Neolithic rice-paddy from the Zhaojiazhuang site, eastern China

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To identify and study the Neolithic rice-paddy in Shandong, eastern China, is not only an important question for the development of Chinese rice agriculture, but also a key part of the study on rice spread in eastern Asia. In the agricultural history field, the study of rice spread in eastern Asia is a long lasting and important scientific question. There are three different views about this topic. The "Southern China Hypothesis" maintains that rice agriculture spread from south-eastern China (Fujian Province) through the Liuqiu (琉球群岛) islands to southern Japan. There is no archaeological evidence for this at present. The "Middle China Hypothesis" holds that rice agriculture spread from the mouth of the Yangtze River to Japan. Some archaeologists maintaining this hypothesis believe that it is impossible that rice agriculture spread from areas of northern China like Shandong and Korea to Japan because that these areas are not the ancient rice agriculture centres. But archaeological discoveries do not provide good evidence for this hypothesis. The latest Neolithic rice-paddy to be unearthed in the area of Lake Tai is older than 6000 years BP but the earliest Neolithic rice-paddy discovered in Japan is 3500 years BP., so it is hard to find any connections of rice agriculture between these two areas. The "North China hypothesis" advocates that rice agriculture spread from China to Japan from Shandong to the Liaodong Peninsula and then to the Korean Peninsula or from Shandong directly to the Korean Peninsula and then to Japan. The present archaeological discoveries of carbonized remains and phytolith fossils of rice assist this hypothesis. To prove this hypothesis conclusively, it is crucial to find Neolithic rice-field remains in Shandong.

With the development of archaeological research, a new tendency has emerged to systematically collect and analyse every kind of material from archaeological sites and to study the ancient society comprehensively. The multi-disciplinary study of man's economic activities in the past has become the main focus of the current archaeology. The Neolithic cultures in Shandong are the main parts of that archaeology in China and the archaeological emphasis is to research the regional ancient cultures, and particularly the role of agriculture in the development of the ancient civilization. The archaeological material indicated that, during the Longshan period, rice was one of the main grains for the local people, because carbonized remains and pytolith fossils of rice have been found on several archaeological sites. But with these discoveries alone, it is impossible to testify that rice was cultivated in the locality and furthermore, to research the rice agriculture, we need to obtain information about the structure of rice-paddy and the methods of its cultivation. Thus, to prove conclusively the existence and development of rice agriculture in Shandong during the Longshan period, it is a key step to find and affirm the archaeological remains of rice-fields. With the development of archaeobotanical research in China, a mature method of agricultural archaeology to testify the evidence of rice-paddy in archaeological sites is by the use of phytolith analysis.

The Zhaojiazhuang site is located in the south of Hanjiazhuang village (36º03'01.47"N, 119º47'16.31"E, 88m above sea level), Jiaozhou City, Shandong Province. Preliminary archaeological prospecting reveals that the site is 100,000 square metres and the cultural remains of Longshan period covered more than 20,000 square metres. The 3,000 square metres of excavation unearthed settlement remains of the Dawenkou Culture, Longshan Culture and the Eastern Zhou Period. The remains of the Longshan Culture include houses, a well with a wooden frame, storage pits, ash-pits and tombs, in which a large amount of artefacts such as stone tools and pottery were found, and these remains were placed in the third period of the Longshan Culture, according to the typology analysis of the pottery. The systematic archaeobotanic analysis of the cultural material and soil samples from the above mentioned features revealed that plentiful crop remains have been preserved in this settlement and rice and millet should be the main crops in this settlement during the Longshan Period.

In the east of the living and funereal areas, some possible farming remains of 700 square metres have been unearthed. These remains are directly covered by the modern farming field and have been damaged by modern activities, which is the main reason for the difficulty in the identification of the precise extent of these remains. They can be divided into two parts, in the west and the east respectively, and are isolated by a patch of immature soil with width of 3–6 metres.

The west patch was poorly preserved condition and only some water retention pits, ditches, farming ridges and fields can be identified. The eastern part was well preserved with a rectangular shape, more than 220 square metres in area. Some ridges partition this area into several fields and the largest one is 0.165 acres in extent.

In the earlier period of rice-paddy studies in Japan, scholars established the standard of 5000 rice fan-shaped phytoliths in a 1g sample of rice-paddy. With the development of rice-paddy studies, Japanese archaeologist's abilities in the identification of rice-paddy was much improved and they found rice-paddy remains in the Jinwei (筋违) site by excavation, but the phytolith analysis showed that the rice fan-shaped phytolith density is just 2000/g. These results indicated that the soil can still come from ancient rice-paddy although the rice fan-shaped phytolith density is only 2000 or even lower.

The soil samples from the Zhaojiazhuang site were quantitatively analysed in the University of Miyazaki in Japan and in the Univerisity of Shandong, China respectively. All samples were identified with the microscope Nikon E800, apart from the samples C of all sampling areas, and photography was undertaken for the main phytolith types.

In addition to the phytolith of rice plants, the phytolith of rice field weeds like barnyard grass (*Echinochloa* Beauv.) and of hygrophilous plants like sedge (Cyperaceae) have also been identified. The amount of glass beads and fan-shaped rice phytolith has been counted for the calculation of the phytolith density, but for the phytolith of other plants, only the existence or absence was recorded. The reference for the identification of fan-shaped rice phytolith was the results published by Yongji Wang, Houyuan Lu and Fujiwara, and for sedge, barnyard grass, reed and Bamboo it was the results published by Yongji Wang; for the awngrass it was the results published by Cailin Wang.

Phytolith analysis results show that phytolith from rice and other plants have been preserved in the soil samples. The phytolith of rice includes fan-shaped, dumbbell and double-peak shapes. The density of the fan-shaped rice phytolith can be divided into five levels, such as level 1 (more than 10000), level 2 (5000–10000), level 3 (1000–5000), level 4 (500–1000) and level 5 (0). In a total of 63 A-samples, rice fan-shaped phytolith was found in 42 samples with a percentage of 66%, and among these samples, eight contain more than 10000 rice fan-shaped phytoliths, nine contain more than 5000–10000 rice fan-shaped phytoliths, and 22 samples contain more than 1000–5000 rice fan-shaped phytoliths. According to the above mentioned rice-paddy affirmative standard used in Japan, it is suggested that most of the soil samples are from rice-paddy areas.

This phytolith analysis results coincide with the judgment made during the excavation. During the excavation, 46 sampling areas were judged as possible rice paddy, which include 6 samples from ridge areas. The phytolith analysis results showed that, among the 40 samples from fields judged to be rice paddy, fan-shaped rice phytolith was identified in 31 samples, including 5 samples with density level 1, 7 samples with density level 2 and 17 samples with density level 3. This result proves that the "grey-brown and dark-brown clay" unearthed during the excavation, which was also judged as possible rice-paddy during the excavation, can be conclusively proved to be ancient rice-paddy by phytolith analysis.

The identification of the phytolith of barnyard grass, reed, bamboo, awngrass and sedge also forms strong evidence for the existence of rice-paddy, because that barnyard grass is a kind of common paddy weed and the hygrophilous plants such as reed and bamboo always grow in a similar ecological environment as paddy rice. Based on the above results, the possible farming areas judged during the excavation can be conclusively proved to be the remains of rice-paddy. Fig. 4 shows the range of the proven rice-paddy. It is necessary to note that, due to the poor preserved condition, more materials and further research are needed to obtain the detailed structure of the rice-paddy.

The discovery and proof of the rice-paddy in the Zhaojiazhuang site illustrates with irrefutable facts that rice was cultivated in the locality and rice agriculture might have developed as the main economic activities in the settlements of the Longshan Culture in Shandong. Although the cultivated remains in the Zhaojiazhuang site are preserved incompletely, they still indicate that there were once paddy fields near the settlement and paddy rice was once cultivated. Considering the remains of the water retention pit, the ditch, farming ridge and fields preserved in the western patch of the rice-paddy, there must be a complete network of irrigation canals and ditches in this area. It is noted that the ditches should have both irrigation and drainage functions placed together. In the eastern patch, the structure of ridges and fields is very clear and the absence of ditches might be due to the limitation of the scale of excavation. A similar situation was also found in the Bronze Age site in Jinzhou (晋州) City, South Korea, where an upland field was discovered and the ditches located only in the end and centre of the field for drainage and indications of field limits. The common existence of the phytolith of rice-paddy weed like barnyard grass and damp plants like reed or bamboo is also an important proof for the rice-paddy. The discovery and affirmation of rice-paddy in Zhaojiazhuang site has undoubtedly great importance for the spread route of rice agriculture in eastern Asia.

The earliest rice-paddy in the Korean peninsula was excavated at the site of Yuxian, which is dated to 1000 BC. The rice-paddy discovery in the Zhaojiazhuang site, which is dated to 2600–2300 BC, cut down the time gap between the rice-paddy in China and the Korean peninsula and pushed forward the research into the rice agriculture spread in eastern Asia. If we merely check the dating information of the rice-paddy in these two areas, it seems that there is a big time gap. But if we comprehensively survey the archaeological material, there is obviously hope to improve and make clear the history of rice agriculture spread in eastern Asia.

Firstly, the archaeobotanic researches have revealed that rice remains have been discovered in all those sites, which have been studied with systematic methods in recent years, and almost all sites contain the cultural remains of the Late Longshan Culture, such as Liangchengzhen, Yaowangcheng, Jiaochangpu, Tonglin and Zhuanglixi. It is obvious that it is possible to find rice field remains later than those in Zhaojiazhuang. The discoveries of carbonized rice grains in the features of the Yueshi Culture in Tenghualuo and of the middle Shang Dynasty in Daxinzhuang showed the probability of finding rice field remains later than the Longshan Culture, which will further shorten the time gap mentioned above. Secondly, the earliest rice remains unearthed in the archaeological sites in the middle of the Korean peninsula are dated to 2500 BC and this might hint of the development of rice agriculture in the locality, but no field remains are preserved and it is yet to be discovered.

Conclusions: In this paper, rice-paddy in the Zhaojiazhuang site was conclusively proved by phytolith analysis. These rice-paddy remains are the first examples to be testified by systematic archaeobotanic research in northern China. The results indicate that (1) during the Longshan period, rice agriculture developed in the Shandong area, (2) the affirmation of rice agriculture in the Shandong Longshan period meanwhile raised a new view on the communications within the ancient Yi group (3) lastly and most importantly, rice agriculture might spread from the Shandong peninsula directly to the Korean peninsula, which supports the "North China Hypothesis" effectively.

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Stratigraphic conditions at Palaeolithic sites in Belarus in the light of new data

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As early as the 1930s, two Upper Palaeolithic open settlements – Berdyzh and Juravichy – were detected in the southeast of Belarus, in the Sozh and the Prypiats basins. Both monuments had been repeatedly excavated, which, nevertheless, did not let the scientists arrive at unanimous conclusions concerning the artefacts' cultural-chronological and stratigraphic attribution. More doubts concerning the Juravichy settlement have recently emerged. As the most recent researcher of the above mentioned monuments, I feel it necessary to provide several comments on the interpretation of the acquired stratigraphic data. These points are particularly important for archaeological and geological correlation of dates, as well as clarifying the genesis of cryogenic formations common in periglacial areas. The previous scientists had an opportunity to base their research not on isolated trial pits, but on observations over vast areas. The stripping system of linear and transversal ravine and terrace sections enabled detection of a complex but clear stratigraphic layout in the cultural strata zones, enabling identification of their single-layer nature as well as full destruction of occupation layers associated with on-going soliflual processes.

The argument is constructed using analyses of numerous axial sections, cross drifts and photographic materials. The conclusions below are based on studies of these resources, as well as archive materials, preserved collection fragments containing flint and palaeontological data, tests and appropriate analogies.

1. According to 14C dating, Juravichy is the most ancient Upper Palaeolithic monument in Belarus (data from 2007). Its artefacts were dated using mammoth teeth and date back to ЛУ-125 26,470±420. Since the excavations of 2006, we can state that it is a single-layer monument with scarce flint artefacts and abundant osteological residues.

2. According to palaeontologist A. Motuzko, the composition and quantitative correlation of finds, their stratigraphic distribution and the absolute predominance of mammoth bones on organic surfaces dotted with boulders enable the identification of the area as an animal slaughter site. The open settlement itself can presumably be detected nearby.

3. Abundant traces of the layer's cryoturbation in the form of tiny plications provide further evidence of the monument's age. The monument existed in periglacial conditions. Lithological and X-ray diagnostic data allow association of the genesis of rhythmic-fissile sediments that overlap occupational residues with wind-borne processes.

4. The furthest northern open settlement on the territory of Belarus – Berdyzh of Upper Palaeolithic – was founded, according to the same laboratory 14C data ЛУ-104 23,430±180 years ago. This is a monument of the Kostenkovo-Avdeevo Culture. It can undoubtedly be viewed as one of the reference monuments for studies of complex processes of morpho- and lithogenesis in the periglacial zone of the last glaciation.

5. Due to the deposition of well-marked soliflual grey-green sand clay, the occupation layer is clearly traceable in the transverse section. The area of soliflual series is about 500 sq. m., corresponding approximately with the area of the ancient settlement, which has been totally destroyed by cryoturbation processes.

6. The author assumes that the stratigraphic evidence allows us to state that Berdyzh open settlement is a single-layer monument of the Upper Palaeolithic. Later communities populated this site during the Holocene. V. Budko's interpretation of bone accumulations as dwellings and separate parts of stows (Padluzha-11, Padluzha-111) as self-standing cultural horizons of Palaeolithic age is incorrect. It has not been proved by any of the excavated remains from different investigations or in any work by other researchers.

The ancient landscape of the Roman Period settlement microregion on the north shore of the former lake "Wons" in the Masurian Lakeland (NE Poland)

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Remains of the Bogaczewo culture settlement micro-region on the north shore of palaeolake "Wons" were discovered during archaeological research, which has been carried out in the central part of the Great Masurian Lakes District since 1983. The settlement network of the micro-region was composed of three settlements and a cemetery, located along the north shore of the palaeolake. The extent of the archaeological recognition of the individual elements of the micro-region varies. So far, the cemetery at site 1 in Paprotki Kolonia has been the most fully investigated. Here the excavation research, which began in 1991 and has still not been completed, led to the discovery of 506 cremation graves, 11 horse burials and remains of funeral pyres. Of the three settlements, site 41 in Paprotki Kolonia was excavated in the years 1994–1998. This was the settlement in the nearest vicinity of the cemetery. 82 objects were discovered here, most of which were the remains of storage pits from the Roman Period. The remains of the other two settlements were reconnoitred solely on the basis of surface research. In the case of the settlement at site 12 in Marcinowa Wola Kolonia a detailed surface inventory was also conducted alongside the research carried out within the framework of the Archaeological Polish Record.

Excavation of the settlement and the cemetery not only provided a rich collection of artefacts and information on their archaeological context, but also led to the discovery of an equally rich collection of macroscopic plant and animal remains. The macroscopic plant remains (including charcoals), animal bones and fish remains that were found in the fills of storage pits, supplied the means for the attempt to reconstruct the picture of the geographical environment surrounding the settlement, as well as part of the economic activities of its inhabitants. This was undertaken between 1997 and 1999. Interdisciplinary research focused on reconstructing the picture of selected elements of the geographical environment: geomorphology, hydrography and flora in the immediate vicinity of the settlement, as well as the animal world of the area that was exploited by its inhabitants. Because of the lack or disintegration of pollen in the deposits from Bagna Nietlickie (the Nietlickie Marshes), located at the site of the palaeolake, it was impossible to reconstruct the picture of the flora in a wider area covering the whole settlement micro-region.

At the cemetery research within the field of environmental archaeology began in 2000, which went beyond the standard archaeozoological analysis of animal remains and species analysis of charcoals. At that time the analysis of samples collected from grave pits for macroscopic organic remains content was introduced as a constant element of excavation research. Notable results were obtained in 2006. Charred remains of cereals used in the funeral rite were found in the fills of most grave pits investigated that season.

At the same time in 2006 and 2007 geological/geomorphological research was undertaken on the area of the cemetery and attempts were made to locate, within the area of the settlement micro-region or in its immediate vicinity, a deposit containing pollen from the Roman Period. Such a core was collected from lake Jędzelek, located on the western outskirts of the micro-region. The results of its analysis have been correlated with the palynological profile from Lake Miłkowskie (Wobel) and Wojnowo, located 6 and 9 km respectively to the north-west of the settlement at site 12 in Marcinowa Wola Kolonia.

A broad source base has now been created which makes it possible to attempt a reconstruction of the ancient landscape within the area of the settlement micro-region from the Roman Period on the north shore of the former lake Wons. The ancient landscape is seen here as a set of interconnected natural and cultural elements occurring in the first centuries of our era, in the area inhabited by a community closely connected with the cemetery at site 1 in Paprotki Kolonia.

Determining the boundaries of the settlement micro-region involved using data concerning the lie of the land and its soil cover, palaeohydrography and the distribution of settlement points from the Roman Period. Vestiges of intensive settlement can be found in the several-hundred-metre belt of light soils, bounded in the south by the thaw basin of the palaeolake and in the north by the edge of the moraine plateau. Postglacial troughs, presently occupied by lakes Buwełno and Wojnowa in the east and lakes Jagodne and Szymoneckie in the west, marked out the eastern and western boundaries of the micro-region. This area was shaped by fluvioglacial processes.

Most of the undulating moraine plateau which bounds the micro-region to the north presently lies at an altitude of 130–140 metres above sea level, and locally reaches 145–155 metres above sea level. Its surface is diversified by hillocks and moraine hills with a relative altitude of over 10 m.

Over the last two thousand years the hydrography has undergone a very great transformation. In the XVII century in the place of palaeolake “Wons” there were two lakes – Klein and Gross Wons. In the second half of the XIX century and the first half of the XX century work was carried out which resulted in the drainage and then improvement of the remains of the palaeolake. The subsequent agricultural usage of this land resulted in the destruction of the shore zone and the displacement of peat deposits. This makes it impossible to present a detailed reconstruction of this element of the landscape. However, there are some hypothetical variants including two extreme ones. The first – locating the shore line of the palaeolake in the immediate vicinity of the cemetery and the settlements, and the second in which the shore line is located a couple of hundred metres from the cemetery and the settlements. The difference between the two reconstructed water levels of the lakes does not exceed 1 metre.

Pollen diagrams from lakes Jędzelek, Miłkowskie and Wojnowo indicate the existence of thick forests surrounding both lakes. The area of the moraine plateau was covered with coniferous forests consisting of pine, oak, birch and spruce. In wetland areas, near lakes, there were communities of the birch and bog alder forest types with alder, willow, birch, poplar and ash. Less common were forests of the linden-oak-hornbeam type with hornbeam, linden, elm, maple and hazel overgrowing habitats preferred by prehistoric settlements. Small deforested areas were used agriculturally as pastures and arable fields. Rye, wheat, barley and hemp were cultivated. Fields were located a short distance from the shores of the lakes. Pastures covered sandy and dry territories overgrown with heather as well as wetlands overgrown with grass-sedge communities with filipendula, lychnis and meadow buttercup (*Ranunculus acris*). The existence of human settlements has been confirmed, not only by archaeological sources, but also by pollen and macroscopic plant remains of ruderal plants, mainly artemisias, from storage pits. Lake shores were overgrown with rush communities. The large amount of birch pollen points to the periodic abandonment of areas used agriculturally and their self-regeneration.

The most problematic issue in research on the ancient landscape, which is impossible to interpret explicitly, is the reconstruction of the actual distribution and relationship between all its elements, as well as determining the dynamics of their change with time. This limitation concerns both natural and cultural elements.

Preliminary results of pollen analysis of the Lake Ichi-no-Megata core samples and the quantitative past climate reconstruction

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Plant resources are closely connected to livelihood and vegetation changes affect on not only plant food but also faunal distribution; namely animal food. Northeastern Japan was one of the highly developed regions in the old time and development of Jomon culture was caused by the vegetation change of the early Holocene. To understand the rise and fall of civilization and culture in Japan, it is essential to understand the details of vegetation change.

Oga peninsula is a boundary area of warm temperate region and cool temperate region and it is classified to a *Fagus crenata* region at present. The vegetation is unique since it includes *Machilus thunbergii* and *Camellia japonica* which are considered as warm temperate elements of vegetation. *Machilus thunbergii* might be brought by birds, but *Camellia japonica* is considered to be brought by human because it is not likely to be dispersed by animals and has been a useful plants. Over 150 archaeological sites from Jomon to Yayoi period have been found in Oga peninsula. People in Oga peninsula must have somehow interacted with the surrounding vegetation. Ichi-no-Megata core is annually laminated sediments and palynological data enable us to reconstruct not only vegetation change but also climate change. We will present our preliminary result of a part of annually laminated sediment recovered from Lake Ichi-no-Megata last year and document the vegetation change and reconstruct the climate.

Pollen diagram shows that the forest had been cool-temperate deciduous broad-leaf forest from ca. 8500 to ca. 6000 cal. yr BP. Even in the same vegetation category, the type of elements changed and climatic oscillation was detected by the best modern analogue technique. Ichi-no-Megata core has a potential to reconstruct climate at higher resolution and the relationship between climate and human activity than previous works.

Sedimentological and geomorphic record of Prehistoric and Early Medieval colonization of the Fore-Sudetic loess plateaus, Southern Poland

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The major relief features of the loess Głubczyce and Rybnik Plateaus situated in the Sudetes Mountains foreland were shaped in severe, periglacial climatic conditions of the Pleistocene. The loess "mantle" deposited was at that time smoothly over the uneven older bedrock. During the Holocene warming, fertile soils were developed in these areas, which were covered by forest communities. Already in the Neolithic Age these plateaus, which were more abundant in surface waters, and produced more biomass, were settled by Linear Band Pottery Culture communities migrating from the Carpathian / Pannonia Basin to the north via the Moravian Gateway. The development of agriculture and herding as well as the establishment of permanent settlements led to the deforestation of increasingly large areas, initiating soil erosion. The sedimentological and geomorphic record of this erosion in the form of redeposited sediments constitutes a chronicle enabling the determination of the time when these processes occurred and their rate.

Despite the apparently monotonous landscape, the loess plateaus under analysis exhibit significant local variation in relief features. In the interior, they are more compact and usually dissected by the valley heads of tributaries of smaller rivers (Fig 1A). Towards the edge, the plateau is dissected by valleys of tributaries of "autochthonous" rivers with headwater areas located within the plateau and "transit" rivers – the Osobłoga (Fig.1B) or the Odra (Fig.1C) whose headwater areas lie in the Sudetes (Fig. 1). Given such diverse slope / valley systems, the record of the soil erosion process has been varied.

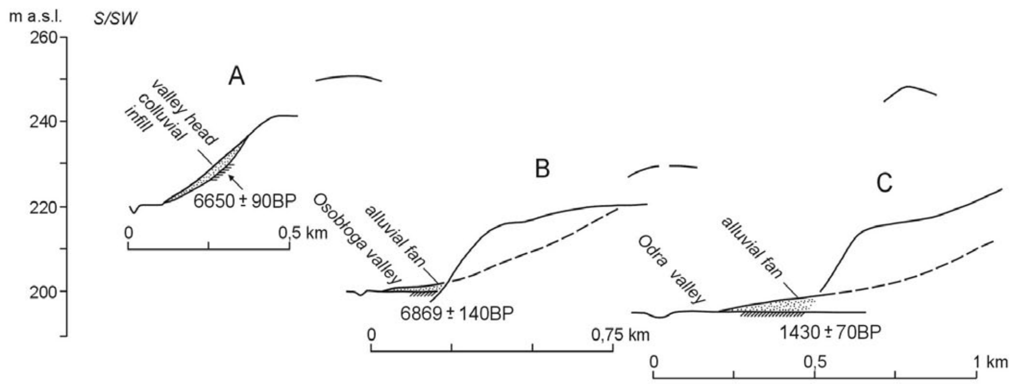
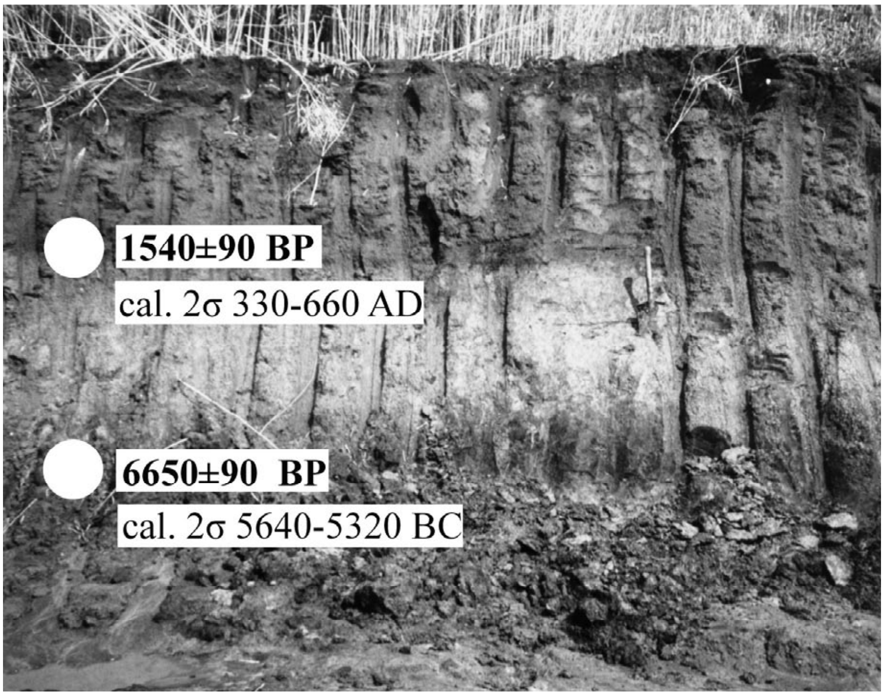


Fig.1. Locations of sediment deposition derived from man penetrating/farming lands

The northern slope of the interior part of the Głubczyce Plateau is dissected by the headstreams of the Biała river, which is in turn a tributary of the Osobłoga river. These valley heads, with gradients ranging from 30 to 50 m/km, are incised into the summit area, which reaches an altitude of 250 to 270 m a. s. l. (Fig. 1A). In one of the upper reaches of such small dry valleys with south-east exposure, 3 to 3.5 metres of colluvial infill was found, interbedded by two layers of chernozem type fossil soil. The lower / older soil, which contained up to 2.27% of organic matter, was formed in the former valley head floor, which was sodded, while the adjacent summit area was probably entirely covered with forest. The radiocarbon date for the sample collected at the depth of 15 to 20 cm from the top layer, which was not clearly delineated, was 6650±90 years BP (cal. 2σ 5640–5320 BC); (Phot. 1) It was later covered by a 0.9 m thick layer of colluvium derived from the surrounding slopes, with granulometric features very similar to those of the loesses from the adjacent plateau area. This process of colluvium transfer and redeposition may be attributed, with high probability, to settlement, which started in the Neolithic Age and continued through the Lusitian Culture of the Bronze Age (Kulczycka-Leciejewiczowa 1993). The OSL date indicates (Bluszcz et al. *in press*) that the accumulation of colluvium may have continued until after the Roman Period, i.e. for about 5,000 years, at the rate of 1.8 cm per century. The significant gradient of the valley head floor was not conducive to the accumulation of colluvia in larger quantities. In light of these results it appears that Neolithic and Bronze Age settlement in the vicinity of Biała reached much farther than suggested by archaeological research to date (Kulczycka-Leciejewiczowa 1993). In the uppermost layer of the colluvia a higher/younger layer of fossil chernozem soil developed, which was 0.4 m thick. Its middle part was radiocarbon dated to 1540±90 years BP (cal. 2σ 330–660 AD); (Phot. 1). Its formation may be linked to the depopulation of the area during the Migration Period and perhaps with the beginnings of Slav colonization in this part of the plateau (Parczewski 1982, Foltyn 1998). The high organic material content in the middle section of this soil layer suggests that it was also sodded or forested ground formed during the period when the valley head was covered by forest. The upper horizon of the younger fossil soil is covered by yellow colluvium, infilling the valley head floor. They may have been linked with a new phase of intensive soil erosion, which started in the early Middle Ages.



Phot.1. Two fossil chernozem fossil horizons at valley head infill, Biała site

Medieval agricultural colonization in the Opole Duchy developed very quickly at the turn of the 14th century, which is confirmed by historical and geomorphologic sources (Ładogórski 1955, Panic 1992, Klimek 2001). This caused a rapid increase in the area of agricultural land at the expense of former fallow land or forested areas inherited from the Migration Period when there had been no settlement. This, in turn, accelerated soil erosion as well as the transfer and deposition of colluvium. Taking into account the thickness and the short period of deposition it may be claimed that the colluvium deposition rate in the valley head of this valley was by an order of magnitude higher than in the previous (Neolithic) period of slope activity.

As concerns the transit Osobłoga river valley (Fig. 1B) whose sources are situated on the northern slope of the Sudetes, its steep south-western slopes, which are 30 to 40 metres high, are nowadays dissected by dry valleys. At their mouths, alluvial fans are present, linked to soil erosion within their small catchment areas. In the vicinity of Klisino, at the mouth of a small valley, which is only 0.86 km long and exhibits a high catchment gradient, the alluvial fan prograded onto the mossy and sedgy peats covering the original valley floor. In its proximal section (20 metres from the valley mouth), 2.1 metre thick alluvial fan deposits interrupted the accumulation of peats whose uppermost part dated back to 6895±80 years BP (cal. 2σ 5919–5543 BC); (Zygmunt 2007). This means that after this period, humans – probably Linear Pottery Culture communities – deforested the south-western slope of the valley to such a degree that heavy rainfall initiated soil erosion, and consequent sedimentation at the valley mouth. Due to the small size of the valley basin and probably periodic reforestation at later times, the later rate at which the fan prograded varied. The youngest sediments forming its most recent / distal part covered the top layers of peats, which were dated to 1920±140 years BP (cal. 2σ 120 BC–416 AD). This corresponds to the Roman Period during the Iron Age.

The conclusions of the sedimentological and geomorphologic research conducted at the foot of the Osobłoga valley slopes have confirmed the results of archaeological research. The latter has indicated (AZP-Matuszczak 1991) that Neolithic artefacts dominate in this part of the area adjacent to the valley, followed by medieval and Iron Age ones.

The headwater areas of the Odra valley are located in the Beskides and Sudetes; this has contributed to the significant horizontal and vertical movement of the river channel. In most cases this was also the cause for the river removing the accumulated sediments / colluvium at the foot of the Głubczyce and Rybnik Plateaus, which had been deposited on adjacent summit areas in older / Neolithic soil erosion phases, and depositing them on the valley floor.

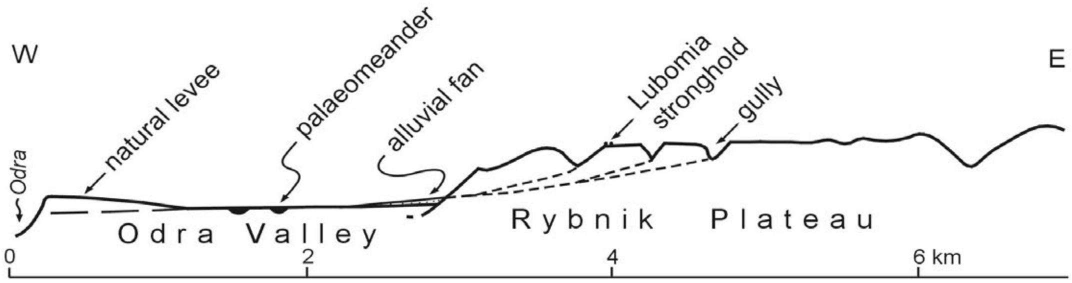


Fig. 2. Cross-profile of the Odra valley floor and the Rybnik Plateau Slope

The natural levee deposited nearby the Odra river channel at the foot of the north-western slope of the Rybnik Plateau partly covered the palaeomeanders present there, which were dated as older than 4000 years BP. This indicated intensive soil erosion having been initiated after this period and the supply of sediments from the higher situated Ostrava Basin, where the Beskides and Sudetes tributaries of the Upper Odra meet. On top of this levee, settlements formed at least from the mid-13th century onwards (Buków 1303, Kamień 1308, Nieboczowy 1290, Odra 1264) (Panic 1992). This indicates that in the early Middle Ages, floods in this Odra reach were of limited amplitude.

On the south-western slope of the Rybnik Plateau, in Lubomia, a 7th-century stronghold of the Gołęszyce tribe can be found, which was destroyed in the 9th century as a result of a Great Moravian incursion (Fig. 2). There is, however, no other archaeological evidence for the early medieval colonization of this margin of the plateau.

The south-western slope of the Plateau is dissected by streams with headwater areas in the large valley heads which dissect the south-western slope of the summit area: Lubomka, Syrynia, the “Osiny” stream and others. The prograding alluvial fans of these streams entered onto the organic sediments present in the Odra river valley floor, which made it possible to determine the date on which erosion was activated again within their valley heads. The age of organic interbeddings covered by the most recent sequences of sediments forming these alluvial fans is as follows: at the mouth of the Syrynka valley 1430±70 years BP (cal. 1σ 540–670 AD; Fig. 1C), and at the mouth of the “Osiny” stream 1390±80 years BP (cal. 1σ 540–700 AD). Despite the significant (6 km) distance between the headwater areas of these streams as well as their mouths in the Odra river valley, the times at which the fans’ progradation accelerated and organic substances fossilised were very similar. The increased rate at which headwater areas were dissected on the south-western slope of the Rybnik

Plateau as well as the increased rate of sediment transfer and alluvial fan progradation can be, with high probability, linked to the settlement of the basins on the south-western slope of the Rybnik Plateau. This coincided with the beginning of the period when this region was colonized by Slav tribes (Foltyn 1998). An organic layer found within the alluvial fan sediments in Łubowice (Głubczyce Plateau) indicating a phase of Medieval erosion too (1210±100 BP/cal. 2σ 654–998 AD, 1175±70 BP/cal. 2σ 67–989 AD, 1140±70 BP/cal. 2σ 767–1021 AD; (Zygmunt 2007). Radiocarbon dating of the earlier phases of erosion/development of the fans was impossible because the alluvial fan prograded on the alluvium of the Odra valley but archaeological dates (AZP maps) show very early, Neolithic colonisation of this area. An unquestionable indicator of enormous deforestation and soil erosion during the Bronze Age is the presence of woody stronghold of Lusitian Culture (8/9 century BC), situated near the alluvial fan.

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The Margel Crest

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The complex archaeological monument of the Margel Crest, located near the village of Stepanivka (Perevalsk district, Luhansk region, Ukraine), was discovered in 2004 by a local amateur archaeologist. According to visual observations, the monument consists of the remains of stone constructions over a total area of 1.3 sq. km. From the north the monument is surrounded with the ruins of a stone wall. The stone platform, which had probably been part of a huge construction of a sacral purpose, was built of finished slabs of a local variety of limestone, which the local dwellers call "margel". Gaps between the stone slabs were plastered with a clay mixture with the addition of finely broken and ground limestone. That mixture was well preserved under the mound of the barrow, and its features display a certain resemblance to modern concrete.

Preliminary research demonstrated that the ancient constructions had been of enormous size and had been built with the use of rather sophisticated construction techniques. The wall surrounding the monument from the north was built of giant (1.5–2 metres long) stone slabs, placed horizontally on one another. From the outside the wall was additionally strengthened with large stone slabs placed on edge. During the excavation of the wall in the ditch, remains of an offering of a horse skull and an iron Scythian harness were found, dating back to the IV century BC. The age of the construction itself, however, has so far not been identified.

On the platform there are four large and three small earth and stone mounds. Excavation of Barrow 4 revealed Srubnaya and Catacomb culture graves. The Srubnaya graves were cut into the upper part of the mound of the existing barrow. They date back to 1800–1600 BC. The remains of a sacrifice dating to this period, the Late Bronze Age, and consisting of a few sheep – goat bones and a small amount of charcoal were found in the mound of the barrow.

The Catacomb graves were the first ones to appear in the barrow, and the barrow itself was built over Grave 7. All of them belong to the early stage of the Donets Catacomb Culture and date back to 3300–2900 BC. These dates are far more ancient than any other dates of the Donets Catacomb Culture that have been discovered to date. Hence, this phenomenon requires further research and explanation.

The time of construction of the stone platform, on which Barrow 4 was subsequently built, has yet to be determined. The location of that platform on the highest point of the landscape and its location to the east (the sunrise) allow an assumption that it is the remains of a solar temple. Therefore, the constructions of the complex served as temples and burial sites for various tribes of the area within a few thousand years. Based on preliminary research, the monument dates back to 4000–2000 BC, i.e., it belongs to the Late Eneolithic – Bronze Age.

Among the monuments of Eastern Europe of that period there are no other equally large and complex stone-made sacral constructions as the Margel Crest complex. Further research into the monument will extend our knowledge of the most ancient periods of the history and culture of Indo-European peoples, not only for the Donets region, but also for the whole of Eastern Europe. The development of a museum of the monument will make it possible to bring it to the attention of a wider audience as one of the most remarkable pieces of global cultural heritage.

Human adaptation to climate change in the Ukrainian steppe in VII-V millennia BC

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The Ukrainian steppe is a vast region stretching from the Dniester river in the west to the Don river in the east, from the Black Sea and the Azov Sea in the south to the forest-steppe zone in the north. It includes the Dniester and Dnieper rivers and the basins of a few smaller rivers.

The Neolithic and Eneolithic sites occupy the first river terraces. During the last 20 years six new multi-layer settlements in the Azov Sea area (Semenovka 1 and 2, Chapaevka, Razdolnoe, Bugaevo and Karatuk) have been excavated. The Semenovka 1 and Razdolnoe sites contain archaeological layers from the Early Neolithic to the Middle Ages. All of the strata of the Neolithic and Eneolithic that have been examined to date belong to small camps. They existed only during the warm seasons.

The Ukrainian steppe is characterized by a constant deficiency of humidity. The dryness in the southern areas of the steppe is six times greater than that for the northern areas. The vegetative cover of the steppe, determined by the climatic conditions, is also varied. The stocks of phytomass increase from 28 tons per hectare at the northern limits of the steppe to 48 tons per hectare in its middle zone, and are reduced to 9 tons per hectare on its southern limits. The centre of the steppe zone is an optimal area from a combination of heat and a sufficient amount of precipitation.

The summer drought connected with the falling away of the amount of precipitation seen in the spring and the autumn is a feature of the steppes from the Dniester to the Don. Here, in comparison with the more easterly areas, there are a lot of plant mesophytes and not so many xerophyts with a big underground phytomass. This makes the north Black Sea steppe more vulnerable and reactive to climatic change. The small amount of xerophyts with the advanced root system cannot prevent the rooting of wood vegetation. With increasing humidity this promotes the easy access of trees to the steppe territories and the expansion of the forest-steppe zone in the southern direction.

The Steppes from the Don to the Ural are characterized by a greater dryness in comparison with the Ukrainian steppe. During climatic aridity the landscapes of their southern areas become similar to deserts. There are numerous xerophytes in this eastern steppe. During the climate humidity they stop the expansion of the forest-steppe zone in the southern direction. The dryer character of eastern steppe region as compared to the Black Sea area is very important for understanding cultural processes in the prehistory of Eurasia.

The ancient climate and landscapes in the Ukrainian steppe can be reconstructed on the basis of the palynological analyses of samples from the multi-layer settlements and bogs. The palynological spectra of three settlements (Chapaevka, Kamennaja Mogila and Razdolnoe) were studied. Ukrainian evidence added a detailed scheme for the climate and landscape changes of the Holocene in Eastern Europe, developed by the Russian palynologist Elena Spiridonova.

According to her scheme the Atlantic period included several sub-periods of climatic fluctuations. During the wet sub-periods the forests spread in the river valleys in the southern area of steppe and the amount of motley grass in the structure of grassy vegetation increased. During the dry sub-periods the forests in the south of the steppe zone disappeared, the role of motley grass decreased and the quantity of wormwood grew in the structure of grassy vegetation.

However all the wet sub-periods during the Atlantic period were dryer than the current climate and the northern border of the steppe was on the territory of the modern forest-steppe zone. This situation lasted until the beginning of the sub-Boreal period, when that border became similar to the modern one.

The climate fluctuations influenced the cultural situation in the steppe. A decrease in the amount of rain and snow determined a deterioration of living conditions for an ancient population and – on the contrary – a rise of precipitation improved existence in the steppe. Taking into account the data about the landscape, environment and ancient economy, it is possible to reconstruct the adaptation of steppe populations to the climate changes.

There are some regularities of human adaptation to climate changes in the Ukrainian steppe during the Neolithic and Eneolithic. At the time of climatic aridity the steppe inhabitants experienced a crisis in their traditional way of life and a part of the population migrated to the north in the southern area of the modern forest-steppe where, during aridity, the steppe landscapes spread. At the same time a latitudinal migration from the east to the west occurred. That migration was connected with the wetter climate of the Ukrainian steppe in comparison with the dryer climate of the Volga-Ural steppe. The people of the eastern steppe looked for new pastures in a similar steppe landscape, because during aridity the climatic conditions of the Ukrainian steppe became the same as the Russian steppe during a wet period. As a result of those migrations (migration to the north and migration to the west) we have the formation of new cultures.

But some differences between cultural changes during the strong aridity and the weak aridity can be identified. For the Atlantic period of the Holocene two strong and eight weak aridities of climate have been established. During the strong aridity numerous migrants moved along the steppe and two new cultures formed in the steppe zone. One culture is located in the north of the steppe at the border with the modern forest – steppe zone. This culture included the traditions of migrants from the southern steppe and the local culture of the forest–steppe zone. The second culture was formed in the south of the steppe on the basis of extant inhabitants and the migrants from the Russian steppe.

During weak aridity another situation prevailed in the steppe zone. Usually only one new culture was formed, or sometimes the transition from one period to the following period in the development of the steppe culture is seen. It is connected with insignificant changes of landscapes, when the steppe moved not so far to the modern forest–steppe zone and the conditions for living in the south of the steppe were not so bad. In that case a little part of the population migrated to the north and contacts of migrants with the local culture of the forest-steppe zone were not intensive. Migrants from the east were not so numerous too and the population of the Ukraine steppe could retain the main characteristics of its culture, changing only some elements.

Another situation occurred during climatic humidity. Comfortable conditions of life in the steppe allowed the steppe population to increase and groups from the northern part of steppe, where the forest-steppe landscape spread, migrated to the south. The sites of wet periods are most numerous in the steppe zone and during these periods the cultural traditions of the steppe population were constant. But the migrations and the formation of new cultures are only one aspect of human adaptation to the climate changes and landscapes. Another side of this process lies in the adaptation of an ancient economy.

We now have some data about the economy of the Neolithic and Eneolithic populations in the Ukrainian steppe. There are palaeozoological materials and prints of plants on the ceramics. From the Early Neolithic the steppe population was engaged in agriculture. Barley, wheat and millet were cultivated in the region, but the basic branches of the economy were hunting and cattle-breeding. The population of the southern steppe had to change those branches of the economy during the climatic variations. The intensification of one or another of them depended on the climatic period and landscape type.

During the favorable wet period of climate cattle breeding and hunting gave an equal percentage of meat to the Neolithic and Eneolithic population. This is understandable because at that time people had the greatest number of animals to hunt. Wild boar, red deer, roe, bison and Bos primigenius (tur) lived in the woods of the river valleys. In the open steppe spaces people hunted the saiga and wild donkey. But in the periods of aridity, when the woods in the river valleys disappeared and the steppe animals alone became the basic objects for hunting, the role of animal husbandry grew in the economy.

Numerous bones of domestic animals on the Neolithic and Eneolithic sites include remains of cattle, sheep, goat, horse and pig. We have established some differences between herds in the dry and wet periods. During aridity sheep and goat were the most numerous in the herds of the steppe populations. In wet periods the quantity of cattle and horse increased.

However the basic changes in the economy were typical only for those people who dwelt in the southern area of the steppe. During aridity some communities migrated from the south of the steppe to the northern region, where they found a customary landscape and climate. Those migrants retained the character of their economy.

Thus the Neolithic and Eneolithic cultural material of the Ukraine steppe has shown two elements of human adaptation to climatic variations. The first part is connected with migrations. During the climatic aridity, when natural resources reduced, a part of the population had to migrate to the northern area of the steppe. In that wetter zone migrants could continue their traditional life, because the climate and landscape in the northern region of the steppe during aridity are similar to the climate and landscape in southern steppe region during humidity. But only the economy of the migrants was unchanged because, following contacts with the population of the forest-steppe, the culture of the migrants changed and as a result a new culture or a new period of a steppe culture was formed.

The second part of the adaptation was typical of the population that continued to live in the southern area of the steppe during climatic aridity. These people had to change their economy. These are the main features of human adaptation to climatic changes, which we can study on the basis of the archaeological evidence of the Neolithic and Eneolithic.

The emergence of early agriculture and stock-rearing in the territory of Belarus: several issues and aspects of research

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This paper provides palynological and archaeozoological data*, revealing evidence for early land cultivation, stock raising and their core periods. This paper also correlates palynological and archaeozoological data with the results of the archaeological research.

Palynological data. Pollen research is based on the study of 36 sections of Holocene sediments. The chronological borders were indicated according to the stratigraphic scheme for Late Glacial and Holocene sediments in Belarus (Vielichkevich, Zernitskaya 2002).

The earliest traces of anthropogenic influence on plant cover were detected in the Middle Atlantic period in Southern and South-Eastern Belarus. In particular, wheat pollen (*Triticum* type) can be detected in the layers of lakes Peschanoye, Seliakhi and the bog Zdzitava (Zernitskaya, 1998, p. 38). The sediments date to 5000–4000 bc**, and in Zdzitava, according to 14C-dating, they date to 7020±70 bp*** (Tln-588). In the sediments of Lake Bobrovitskaye (Western Palesse) a distinct level of *Triticum* type pollen was detected beneath the layers, with a radiocarbon date of 6230±80 bp (IGSB-810) (Simakova, Zernitskaya *et al.*, 2007). In section Aziarnoye 3 at Northern Palesse (Kryvaltsevich, Simakova, 2004), the first emergence of *Triticum* type pollen is observed at 6630±125 bp (IGSB-826). The earliest sporadic evidence for pollen of *Tricium* type and barley (*Hordeum* type) in the territory of Belarus is estimated to occur in the final phase of Atlantic period. A distinct level of *Triticum* type pollen has been traced in the sections of Northern Belarus (section Asavets 4) during the primary phase of the Sub-Boreal period (after 3000 BC).

According to palynological data, the earliest indications of stock-rearing in the territory of Belarusian Polesse can be traced during the Middle Atlantic period (4600–4000 bc). Pollen spectra from the sections of Aziarnoye and Abakumy are characterised by an increase of reliable indicators of pasture: *Plantago lanceolata* L. and *Rumex acetosa/acetosella* L. (Simakova, Kryvaltsevich 2002). In Central Belarus, the initial stage of stock-rearing is attributed to the borderline of AT/SB (Kalicki et al, 2002; Simakova, 2004). In the North of Belarus, in the River West Dvina basin (section Asavets 3) the rise of indices providing evidence for pasture occurs at the initial phase of the Sub-Boreal (after 3000 bc).

A significant rise of indicators of anthropogenic influence on the environment in the territory of Belarus occurs at the initial phase of the Sub-Boreal (3000–2200 bc). At the borderline of AT/SB, essential changes in the structure of forest associations take place, which is brought about by climatic and adaphic conditions, as well as anthropogenic influence. Pollen spectra of the initial phase of SB show a low proportion of broad-leaf tree pollen (*Ulmus, Tilia, Quercus, Fraxinus* and *Corylus),* increases in the amount of *Picea* pollen up to 1–5 % in the South and 20–25 % in the North, an increase in *Pinus* pollen up to 90%, *Salix* up to 1%, *Betula* up to 13–30% in the South and up to 20–35 % in the North, *Alnus* up to 10–20 % in the South and up to 18–25 % in the North. Pollen spectra contained charcoal fragments and spores of *Pteridium*, which signifies that fire was used for forest clearance. The increase of pollen evidence for dwarf-shrubs Ericaceae, upland herbs (NAP, 10–20%) on the diagrams of archaeological monuments Aziarnoye and Zatsenne 2 sections signify the development of forest scarcity. Poaceae (up to 10%) dominates among herbs. There is evidence for the pollen of plants that accompany crops, fallow lands and pastures (*Artemisia* 0.7–1%, Chenopodiaceae 0.8%, *Rumex acetosa/acetosella* L., Silenaceae*, Taraxacum, Polygonum* *persicaria* L., *Centaurea cyanus* L., *Fagopyrum, Plantago lanceolata* L. and others). Pollen of the Cannabaceae family occurs repeatedly. In the central regions of Belarus, the level of *Triticum* pollen reaches 0.2–1.3%, while *Hordeum*, oats (*Avena*) and flax (*Linum*) occur only occasionally. In the sediments of northern sections, *Triticum* seldom occurs (0.1–0.2%). Yet representatives of Asteraceae, Cicloriaceae and *Ranunculus* occur consistently. An increase in the quantity of Fossombronia and Chenopodiaceae representatives (up to 0.8%) – as well as the presence of fractured soil – signifies intensification of erosion processes in the river valleys.

When compared with previous periods, indicators of anthropogenic influence are more extensive. Active expansion of agriculture and stock-rearing are also detected in the deposits of 2200–1400 bc. It should be stressed that clearance of the forest for the purpose of obtaining cultivation lands in Southern, South-Western and Central Belarus had probably begun earlier – at the borderline of AT and SB (around 3000 bc). In the sections of Southern and South-Eastern Belarus, one can detect *Triticum* (3–4%)*,* rye (*Secale*)*,* Cerealia*,* Cannabaceae*,* and in Central Belarus (Zatsenne) there is pollen of *Triticum,* Cannabaceae*, Secale* and peas (*Vicia*) (0.2–0.3%; dated to 4040±120 bp – IGSB-263). Among cultivated plants, Cerealia*, Triticum, Cannabis*, and more rarely *Secale*, pollen occur in deposits of the early SB. The latter is presumed to be a weed in crop cultivation. Unlike Southern and Central Belarus, on the Belarusian territory of the Dvina region, agriculture played a less important role. Here, among grain cereals, pollen of *Triticum* and *Cannabis* were detected in the Sub-Boreal sediments of sections Asavets 2, 3, 4 and Kryvina 1, 3.

As a result of the cultivation of lakeside landscapes, changes in lake sedimentation start to occur around the second phase of SB, providing evidence for erosion processes that are attributed to anthropogenic influences on these landscapes.

Features of ploughing and crop-cultivation are first detected in Southern Belarus during the late SB (around 1200 bc). Traces of field-crop cultivation in the central region are found in layers dating back to the late SB-early SA (Zernitskaya, Simakova, Pavlova 2001, p. 14). In the Northern region, field-crop cultivation emerges during the SA (Kalicki, Savchik et al, 2006).

Thus, palynological research makes it clear that agriculture and stock-rearing emerged and spread in Belarus in 5000–4000 to 3000 bc. It should be noted that the spread of a production economy could have taken place from the middle AT to the early SB in the direction from South-Western and Southern to North-Eastern and Northern Belarus. In the Sub-Boreal period, particularly at its middle stage (2200–1400 bc), agriculture and stock-rearing spread extensively, providing final confirmation for a production economy in the territory between the Pripyat and the West Dvina.

Archaeozoological data. Bones of ox *Bos primigenius f.taurus* were detected in the lower horizon of settlement Kamen 2 (Western Polesse) (early stage of the Nioman culture). Bone remains of pig *Sus scrofa d.* and horse were detected in the upper late Neolithic horizon of Kamen 2 (Ščeglova 1972, 1975; Isayenko 1976). The early stage of Kamen 2 is dated within the 5th millennium bc (Isayenko 1967; 1976, p. 113), the late stage, 2500–2300 to 1800–1700 bc (Isayenko 1967; 1976, p. 113–115).

At the site of the Neolithic peat-bog settlement Kuzmichy 1 situated in Northern Palesse, the occupational layers dated primarily back to middle-second half of the 4th to late 3rd millennium BC**** (the Dnieper-Donets culture, elements of Corded Ware culture circle). Bones of domestic animals were detected (pig, sheep/goat, ox and horse), but up to 85% of the collection consists of the bones of wild species. Horse and domestic ox (A. Razlutskaya's definition) were predominant in the herd. 2030 bone specimens were excavated at settlement Voikovichy 1 (the Upper Nioman regions) of the Pripyats-Nioman Neolithic culture. The lower horizon contained bones of sheep *Ovis aries* and horse *Equus caballus*. In the upper horizon, where corded ware occurs, there are ox and pig bones (2005, c.259). The quantity of domestic species constituted 8.9–25.3% of the assemblage. The settlement's inhabitants hunted wild bore, elk and roe.

The largest and most important collections of bone material were obtained at the peat-bog settlements of the Dvina region (Asavets 2 – 9431 bone specimens; 4, 5, 7 – 1100 bone specimens; Kryvina 1; 2 at Kryvina peat-bog) (the materials have been studies by V. Shchaglova, V. Bibikava and A. Razlutskaya). At Asavets 2 (a settlement of the Usviaty and the North Belarusian cultures – from the middle of the 3rd to third-quarter of the 2nd

millennium bc) 726 bone specimens of 87 domestic individuals were recorded (pig – 227 specimens, domestic ox – 190 specimens, sheep – 156 specimens, goat *Capra hircus* – 44 specimens, horse – 86 specimens, dog *Canis lupus familliaris* – 23 specimens). In layer classification, the percentage of domestic animals extends from 6.9–16.4%. Later layers contain pig and more rarely ox, sheep and horse. At the settlement of the North Belarusian culture Asavets 7 (late 3rd to third-quarter of the 2nd millennium bc) among 1250 bone specimens, domestic animals constituted 11–15%. The inhabitants of the settlement hunted 21 animal species (Charnyauski 1997; Razlutskaya 1999–2001).

During research into the burial complexes of the Globular Amphora culture near Krasnaselski (the Nioman region) a ritual object was found. It contained remains of 13 animals (Šceglova, Czernyavskiy 1976). The remains were mostly cattle bones (9 individuals, among them 2 young individuals aged below 1.5 years), pig (1 individual of a very young age), sheep or goat (2 young individuals) and horse bones (of a small size). This burial complex dates back to 2640±190 BC (*ca.* 2580 BC) (Szmyt, 2001).

Bones of domestic animals were detected in the burials of the Middle Dnieper culture located on the territory of the Upper Dnieper region. They were found, in particular, in barrow burials: Khodasavichy-Dzednaye, barrow 1, burial 1 (pig bones); at Khodasavichy-Palik there were 2 horse and cattle bones near the burial, and horse, cattle and pig bones in the offering pit (Artemenko 1964, p. 62, 57). In burial 82 of burial field Stralitsa, cow teeth were found (Artemenko 1976, p. 88). Khodasavichy barrow burials date back to around 2500–2200 BC and Stralitsa dates back to the late 3rd to early 2nd millennium BC.

Bone remains were detected at other settlements in the territory of Belarus. There, apart from Neolithic and Early Bronze Age complexes, the scientists found artefacts of the Iron Age and Middle Ages. In particular, 1364 bones were analysed in the course of research carried out by N. Alexandrovich, O. Zhurauliova and A. Razlutskaya. Domestic animal bones constituted 21–45% of the total assemblage. The majority belonged to oxen, horses, and a smaller quantity to pigs, sheep and goats. From 1057 bone remains at Vialikiya Bortniki (the Dnieper region), the scientists detected bones of pig, goat, sheep, ox and horse. The percentage of domestic animals was 15–23%. 15 animal species have been estimated, the majority being elk, wild bore, bison, deer, roe and beaver (Kalechiz, Razlutskaya 2006, p.25–37; Razlutskaya 2004, p.541).

Thus, the osteological material is found in Neolithic complexes and marks the emergence of stock-rearing in Belarus. The earliest complexes probably belong to the 5th to 4th millennium bc and are found in the South of Belarus (Kamen 2, Voikovichy). At that time, a domestic animal herd appears to have consisted of ox, horse and presumably sheep. One can definitely state that in the 3rd millennium bc, the local population raised pigs, cattle, sheep, goats and horses throughout the whole territory. The uneven representation and absence of complex collections do not allow to precise definition of the relative composition of the herd, the proportion of different species in the herd and the structure of the economy. Looking at the osteological material of the open settlements of Kryvina peat-bog in the Dvina region, we can see that domestic animals emerged later here. For a long time, these animals were of minor value in the economy; a foraging economy was still of primary importance (probably up to the third-quarter of the 2nd millennium bc – i.e. until the end of the North Belarusian culture's existence). Meat nourishment was provided by hunting elk, wild boar, bear, beaver and 45 bird species, mostly ducks (according to E. Antsipina).

Correlation of the archaeological data with palynological and archaeozoological evidence. The processes of Neolithization and the spread of early agricultural and stock-rearing skills in Belarusian Palesse probably occurred as a result of the influence of the Neolithic cultures of neighbouring southern regions – Volhynia and the Middle Dnieper region. The emergence of pottery, early agriculture and stock-rearing among the Mesolithic population of Ukrainian Palesse, forest-steppe Dnieper region and North Donets, where the Dnieper-Donets culture was being formed, took place in the third stage of Neolithization in the Ukraine during the 5th millennium bc under the direct influence of the Boh-Dniester, the Sursk, the Lower Don and the Azov-Dnieper cultures (Kotova, 2002). From 4700 BC, the population of the Linear Band Pottery (*Linearbandkeramik)* culture began to influence the development of the respective trends of the Volhynia Neolithic culture productive economy (the Dnieper-Donets cultural community). This population had a well-developed agriculture, as well as stock-rearing of Balkan-Carpathian type. Later, in the 4th millennium bc, the

Tripolye culture greatly influenced further development of the productive economy of the Dnieper-Donets cultural community in the territory of the Ukraine (Kotova 2002).

The spread of early elements of agriculture and probably stock-rearing took place in South-Western Belarus during the 5th to 4th millennium bc, judging by palynological and archaeozoological data. At that time, at stage IA of early Neolithic (4500–4200 to 4000–3800 bc) in Eastern Palesse, ancient Comb pottery emerges (the Dnieper Donets culture), and in the Upper Pripyats region the Nioman culture emerges (Isayenko 1976). The cultural impulse occurs under the influence of the Boh-Dniester culture and the Linear Band Pottery culture. The Neolithization process probably comprised not only the imitation of pottery-making by the local Mesolithic population, but also adoption of several elements of a productive economy. The process initially expanded in Volhynia and then spread over the territory of Western Palesse in the 5th to 4th millennium bc. In Eastern Palesse, starting from the 4th millennium bc, the Trypolie culture was of great importance during the course of expansion of the productive economy. Its elements were detected in the lower Pripyats basin. The spread of agriculture and stock-rearing took place at the above mentioned stage in Southern and probably partly in adjacent regions of Central Belarus, i.e. within the borders of the Nioman and the Dnieper-Donets cultures.

According to palynological and archaeozoological research, an extensive expansion of agriculture and stock-rearing in the territory of Belarus took place during the 3rd to the first-half of the 2nd millennium bc (3700–1700 BC). Examination of the archaeological evidence indicates a dramatic expansion of settlements and population in Palesse during the Late Neolithic (Isayenko 1976). The active absorption of productive economy skills by the local population took place at that time through the penetration of the Funnel Beaker culture to Western Palesse and the Upper Nioman region. At the same time, at the borderline of AT and SB, an active forest clearance process can be observed in the territory of Southern, South-Western and Central Belarus. In the 3rd millennium BC, the Globular Amphora culture and the Corded Ware culture penetrate to the territory of Belarus. In Eastern Palesse, one can observe an influx of elements of the steppe cultures (the Yamnaya and Catacomb cultures). Adoption of a productive economy in the territory of Belarus must be connected with exogenous factors. This stage can be characterised by the expansion and practical adoption of slash-and-burn agriculture, and the rearing of pigs, cattle, sheep, goats and horses. It is most probable that stock-rearing outweighed agriculture in the territory of Palesse, the Upper Nioman and the Upper Dnieper regions. For the time being, it is still impossible to estimate the proportional importance of certain economic trends, including foraging, due to the lack of qualitatively and quantitatively sufficient complexes. The population of the Belarusian Dvina region is also drawn into the sphere of productive economy expansion. In this region the Narva culture gradually disappears, and the North Belarusian culture develops. Yet it is important to note that foraging forms of economy (hunting, fishing and plant gathering) had dominated here for a long time.

Notes:

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bc** – uncalibrated age Before Christ;

bp*** – uncalibrated age Before Present;

BC**** – calibrated age Before Christ.

Bacterial ancient DNA as an indicator of human presence in the past – its correlation with palynological and archaeological data

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Palynological investigation is one of the most important tools for the reconstruction of past vegetation. Some plants have proved to be relatively sensitive indicators of human activity, but most of them are not specific. In this paper, we propose a method which can be used for the verification of phases of anthropogenic impact on vegetation, as distinguished in pollen diagrams. In this work, we have adopted the existing molecular methods for tracking bacterial ancient DNA (*Bifidobacterium* and *Bacteroides-Prevotella* – known as a human- and cow-specific genetic marker) in palynologically and archaeologically elaborated sediments. These methods can be helpful in determining the local human presence especially in those time periods when pollen analyses have not always been successful (Paleolithic and Mesolithic) and at sites without archaeological data.

Partial to pork at Llanmaes: a later prehistoric midden in the Vale of Glamorgan, Wales, UK

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This paper presents preliminary results from ongoing research on the faunal assemblage recovered from Llanmaes, a Bronze Age/Iron Age midden in the Vale of Glamorgan, Wales. Four seasons of excavations, carried out from 2003 to 2006 by the National Museum of Wales have unearthed a large faunal assemblage of unusual character.

Middens of the British Late Bronze and Early Iron Age are vast accumulations of cultural debris incorporating faunal remains, pottery, human bone and metalwork and are often explained as refuse dumps. The Llanmaes midden has typically large assemblages of a diverse range of material culture types. The faunal assemblage is particularly notable in the way in which species representation differs from comparable sites of the period. The most striking contrast with other sites based on the 2003/04 (Mulville and Powell 2005) and 2005/06 (Madgwick 2007) assessments is the overwhelming dominance of pig remains at Llanmaes. Although British middens such as Potterne (Locker 2000), Runnymede (Serjeantson 1996, in press) and Whitecross Farm, Wallingford (Powell & Clark 1996), all show a relatively high proportion of pig remains, none have pig as the dominant species at the site, as is overwhelmingly the case at Llanmaes (see Fig. 1). The other middens of East Chisenbury (Serjeantson, in press), All Cannings Cross (Jackson 1923) and Eldon's Seat (Cunliffe and Phillipson 1968) contrast with the aforementioned sites in that they have a very low proportion of pig remains and are similar to the non-midden Bronze Age sites of Burderop Down and Dean Bottom (Maltby 1992), as shown in Fig. 1.

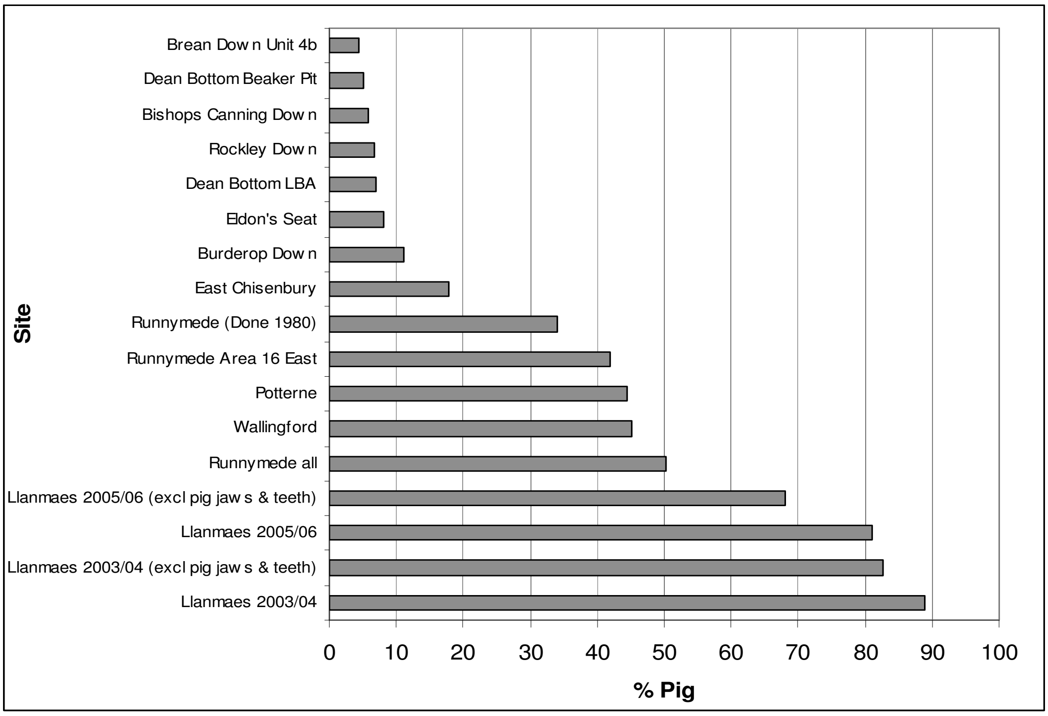

Fig. 1. Percentage of Pig fragments of the total Pig and Sheep assemblage

It is rare for pig remains to occur in such abundance in the Bronze Age/Early Iron Age (Serjeantson, in press) and consequently sites such as Potterne, Runnymede and Wallingford are exceptional. However, as shown in Figure 1, none of these sites rival the proportion of pig at Llanmaes. One notable comparison comes from a certain area (zone 3) of a cave system at the Iron Age site of High Pasture Cave on the Isle of Skye. This exhibits c. 89% 'likely' pig in a sample of 1171 (Drew 2004, 2005), in spite of being in an environment wholly unsuited to the rearing of pigs.

Pigs are popularly thought to be economically costly animals to husband, particularly in reduced woodland environments (as was the case with the deforestation of the Bronze Age landscapes), as they offer no secondary products (other than manure) and cannot be used for traction. This has led to the suggestion that high proportions of pigs are indicative of high status. In addition pigs are commonly thought to be particularly well suited for feasting, as it is not essential to maintain a core group in support of a secondary product economy (Albarella & Serjeantson 2002; Serjeantson, in press). Therefore this suggests that the economic cost of raising pigs (possibly for feasting) for eventual deposition at Llanmaes was outweighed by the social importance of activities which brought about the midden's formation. Consequently the large quantity of pig at Llanmaes may be indicative of high status feasting and is noteworthy in the context of the British Bronze Age/Early Iron Age.

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Early nomads of the Pontic steppe in the context of climate changes

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This paper is focused on the role of the environment in the development of the history of the Cimmerians, who were the first historically known nomadic people in Eastern Europe. The beginning of the 1st millennium B.C. was characterized by the formative development of nomad pastoralism throughout the Eurasian steppes. During this time specialised nomadic economies developed and most of the steppe regions were occupied by groups of nomads with their characteristically mobile way of life.

Eurasian steppe nomadic cultures created their own economic system – cattle breeding with horizontal and vertical migrations, in which the structure of herds was basically formed of horses and fine cattle. At the same time, the transition to nomadism in the different regions of Eurasia had distinctive historical features, which promoted the emergence of diverse cultural formations. Their development followed local, regional characteristics. In connection with this, for the period of transition from the late Bronze Age to the early Iron Age a primary task is a detailed study of the separate regions of Eurasia, from which the following results have been obtained.

The Black Sea is the most isolated ocean in the world with a high catchment area that makes its ecosystems particularly sensitive to climatic changes and anthropogenic developments. This region can be considered as a unique natural laboratory for climate change studies and ecosystem evolution under natural and anthropogenic pressures.

According to paleoclimatic data, between the 15th–12th centuries BC the territory of Eastern Europe was under the influence of a relatively wet and cool climate. In these favourable climatic conditions, the population of the Pontic steppe experienced economic growth. Archaeological evidence for this period is represented by numerous, large, long-term settlements with stone, clay and wooden architecture. Its economy was based on settled agriculture, reflected in the continuous use of the same land.

About the 11th century BC in Eastern Europe a period of long climate aridity began. The evidence for this change is seen in the sea level alterations and the regressions of the Black Sea and the Caspian Sea. As a result of this change in the ecosystem, the population of the Black Sea steppe region was affected by a common ecological crisis. The worsening of climatic conditions had a negative effect on archaeological cultures located here, with their mixed pastoral-agricultural economy. The crisis might also have been strengthened by anthropogenous influence on the local environment, too.

Climate changes in the considered region at the turn of second to the first millennium BC led to a reduction of areas under crops as well as a diminution in the quantity of heat necessary for the ripening of cereals, that eventually contributed to a transition to a nomadic economy. This transition took place in the form of a sudden change which, however, was not a single, one-time act, but represented a series of uniform jumps. Each of them was short-term and included the transition of a separate family-production group to a nomadic way of life, but the series of such jumps expanded across the entire region. The strongest family-production collectives of the Belozerka and Post-Srubnaya cultures kept on the traditional mode of economy “to the end”. The impoverished collectives, whose areas suffered most from changes of climatic conditions, were forced to pass to nomadic cattle breeding. The drastic delimitation of traditional and new forms of housekeeping, as well as their coexistence whilst the population used the various ecological niches, determined the specificity of cultural – historical development of the Northern Black Sea area for almost two centuries.

A state of crisis with significant social and economic consequences is especially typical of the edges of historical-archaeological periods, including the transition from the late Bronze

Age to the early Iron Age. These are rather short periods, but rapid periods are characterized by the most tenacious and purposeful searches for new ways of social and economic adaptation, with the decline of one culture and the fast blossoming of other cultures, the activisation of migratory processes, a birth of new ethnoses, etc. During these central periods, saturated with dynamism, the social and economic development of ancient societies increased repeatedly.

The collapse of such large late Bronze Age communities as the Belozerka and Post-Srubnaya cultures was a result of this ecological crisis. The population of these cultures had a complex economy dependent on agriculture and cattle breeding. The increasing aridity of the climate forced the steppe inhabitants to move to a nomadic economy. It is probable that already in the late Bronze Age the cattle breeding direction in the economy, which gradually took a more mobile form, began to strengthen. The crisis in agriculture was also growing simultaneously. In these conditions the role of the horse increased in significance. This created the necessary preconditions for the transition to nomadic and semi-nomadic pastoralism, which was soon spreading amongst the inhabitants of east European steppe.

During the period of increasing climate aridity and decreasing steppe productivity, the early nomadic economy probably experienced a crisis in the 11^{th} –10^{th} centuries BC. A part of the population was forced to leave the Pontic region and to move into areas with a more suitable environment. Among these areas were the Dnieper forest-steppe zone, the Crimea and the Northern Caucasus. These new centres were located in areas of wetter climate and their positions allowed them to play an important role in the prehistory of Eastern Europe.

The spreading of the nomadic economy and a new lifestyle led to the disappearance of many former elements of culture, given up in place of new ones corresponding better to the changed way of life. The formation of a new Cimmerian culture on the basis of several older local steppe communities is accompanied by the emergence and wide distribution of innovations in burial ritual practices (podbois-, catacomb-type grave pit constructions, interment in a supine position, etc), and the particular material culture of Cimmerians (metal bridles, spouted vessels, etc).

The increase in population movement associated with environmental and economic changes, as well as the appearance of horse riding in the early 1^{st} millennium BC dramatically increased contact between various Eurasian nomadic groups as well as contact with sedentary peoples living on the periphery of the steppe region. The Cimmerian cultural complex represented a new dynamic phase of social organization and mounted nomadic warfare, spurred on by a closer interaction with the settled world.

Development of cultural landscape in the Liao River basin, Manchurian Plain, North-Eastern China

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The presented new data from Manchurian Plain, Muchang and Dahuofang sites, revealed the key role of man in forest destruction and spread of grasslands in northeastern areas of China. Extensive deforestation accompanied by agricultural practices (buckwheat cultivation) has been dated to 900–1100 cal. yr AD. Accordingly to the radiocarbon dates, the discussed period of deforestations corresponds to the times of development of the early mediaeval dynastic states. In the areas of Manchuria, in 907 AD, appeared a powerful political entity under the rules of Liao dynasty representing Khitan ethnicity. The core area of the Khitan group and the state center was located in the basin of the Liao river which gave name to the dynasty. Subsequently, since 1125 AD, the power was taken over by the Jin dynasty belonging to Jurchen ethnic group originating from eastern Manchuria. These dynastic states possessed already their own script, and in militarily categories represented more or less equal status with the weaker, at that time, China proper of the Song period (960–1279 AD).

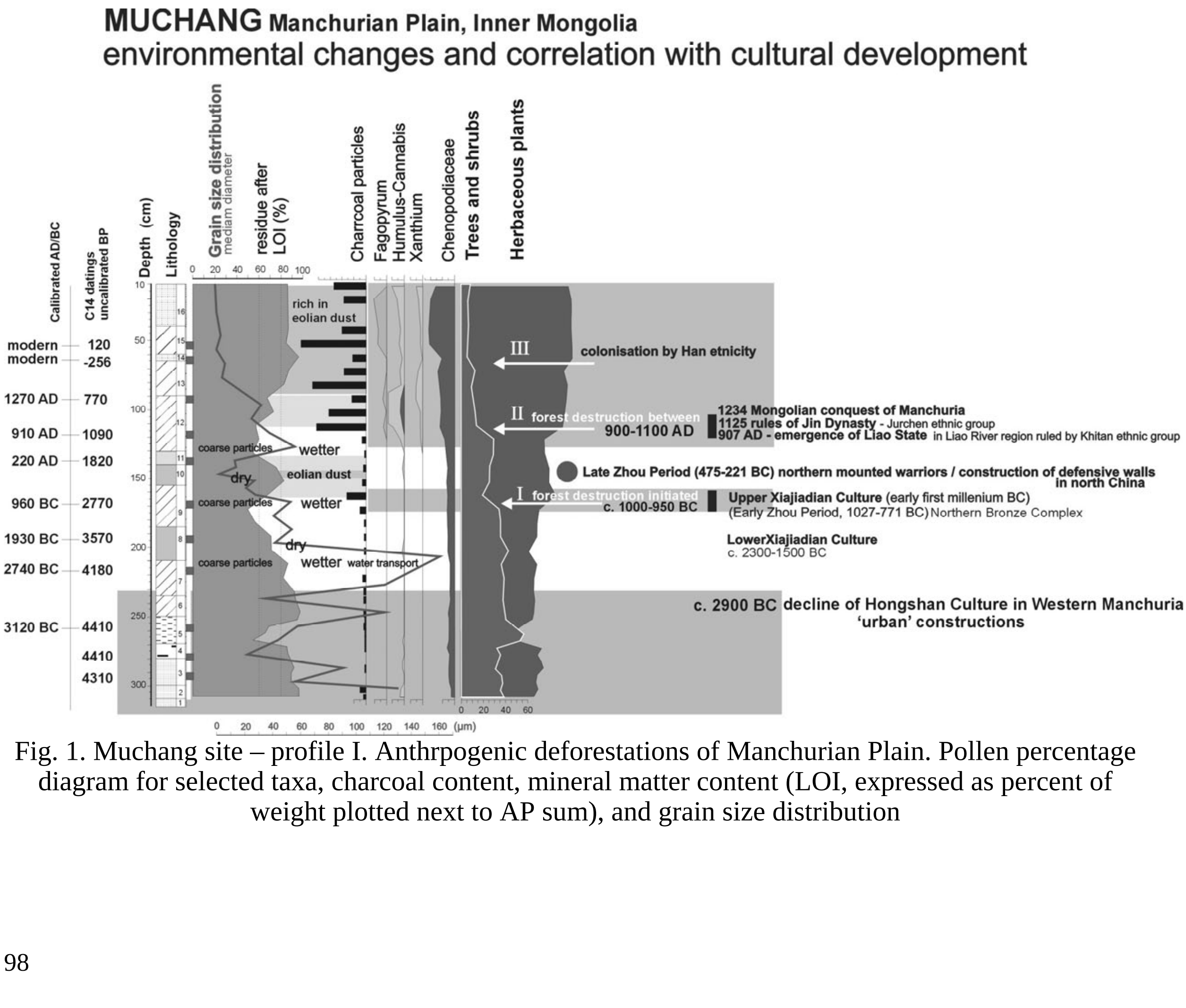

Fig. 1. Muchang site – profile I. Anthrpogenic deforestations of Manchurian Plain. Pollen percentage diagram for selected taxa, charcoal content, mineral matter content (LOI, expressed as percent of weight plotted next to AP sum), and grain size distribution

The reconstructed scale of deforestation and cultivation practices clearly point at a sort of sedentary way of life and allow to determine the period of Liao and Jin states as a turning point in the intensification of settlement processes in the Manchurian Plain. The scale of anthropogenic activities, evaluated through the impact on natural vegetation, was, in a broad sense, already comparable with those known from recent centuries. The reconstructed man-made changes of the environment of the Manchurian Plain led thus to the spread of grasslands before the Mongol conquest of Manchuria, completed in 1234 with the defeat of Jin empire.

The significant man-made disturbances of vegetation cover within present steppes zone reach back in time at least to the first millennium BC. An evidence of earlier human interference in forest destruction has been dated to around 900 cal. yr BC. Phases of anthropogenic deforestations showed increase in circulation of eolian dust resulted from landscape opening and soil erosion.

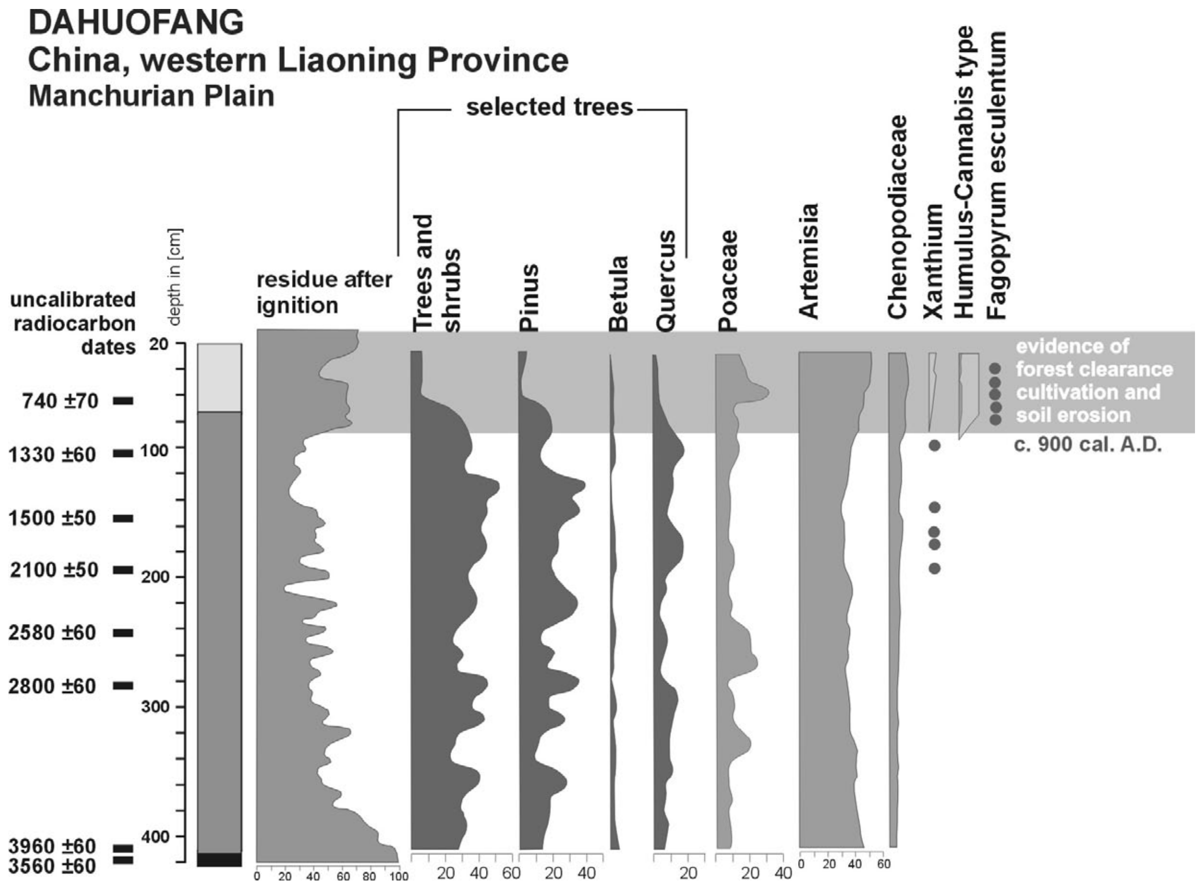

Fig. 2. Dahuofang profile – simplified pollen percentage diagram for selected taxa, illustrating spread of anthropogenic (steppe) vegetation during mediaeval times.

According to the pollen data, the forest phytocoenosis occupying western Manchurian Plain, prior to the their catastrophic destruction in medieval times (900–1100 AD), composed mainly of *Quercus* and *Pinus*. The other deciduous constituents as *Ulmus*, *Tilia*, *Carpinus*, *Acer* and *Fraxinus* formed minor admixture. Macrofossils analyses, proved the local existence of oak stands in the vicinity of Muchang site. The finds of leaf fragments were attributed to the deciduous oak *Quercus* x *hopeiensis*, which present northern limit of geographical distribution reaches mountain areas of Hebei Province, that is at least 500km further to the south-west of the studied area. Presented evidence of forest destruction indicated that the northern lowland stands in Manchurian Plain of the discovered oaks were strongly affected first of all by human activity. A climatic background might have played a secondary role. Significant amount of herbaceous plants in the pollen spectra prior to 900–1100 AD, allows to reconstruct the vegetation cover of western Manchuria as sparse woodland or mosaic of forests and patches of steppe communities.

Animal subsistence economy in the Early Medieval stronghold complexes of western Slavs – comparative studies of Pomerania, Great Poland and Lower Silesia

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On the basis of archaeozoological investigations of Early Medieval strongholds and settlement complexes, the following problems were considered: 1) the importance of stock breeding, hunting and fishing, 2) the significance of particular species amongst the domestic mammals, 3) the significance of particular animals amongst the wild mammals, 4) the significance of domestic and wild birds, 5) the significance of fishery, 6) the methods of slaughtering cattle, pigs, sheep and goats, 7) the size of cattle, pigs, wild boar and horse, 8) the importance of bone and horn as a raw material (Makowiecki 2006).

Domestic mammal breeding was of key importance in the system of production and food supply in early medieval stronghold complexes (Fig. 1), although natural environmental resources such as wild mammals, birds and fish were also utilised everywhere. For some settlement complexes at least, the breeding of domestic mammals was an important element of everyday routine. The inhabitants of the Kałdus settlement micro-region practised a different strategy. One may assume that in that region, the meat of wild mammals was a significant source of food. The importance of hunting as the form of exploiting the natural environment was much higher there than in other early medieval settlement complexes.

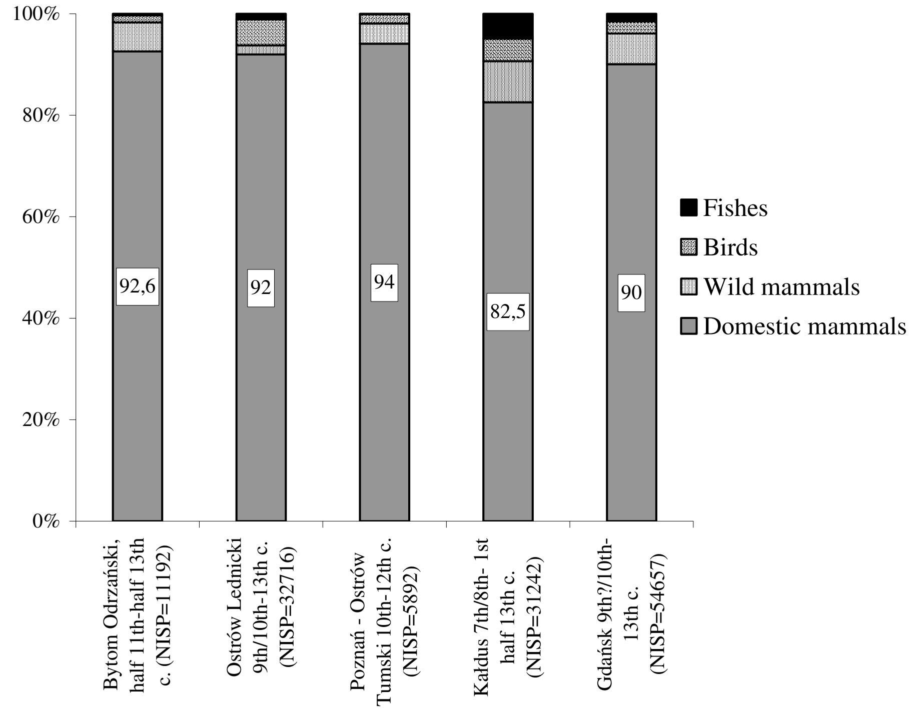

Fig. 1. Percentage of animal groups in bone assemblages from the early medieval settlement complexes (Makowiecki 2006)

Among the domestic consumable mammals, pork and beef were the most important meats, although their proportions vary across particular centres. In Bytom Odrzański, there was a visible preponderance of cattle bones over pig (Fig. 2). In the Lednica settlement complex as well as in the Poznań–Ostrów Tumski complex, the percentage of pig remains was considerably higher than those of cattle. The percentage of domestic species remains was almost the same in Gdańsk and Kałdus.

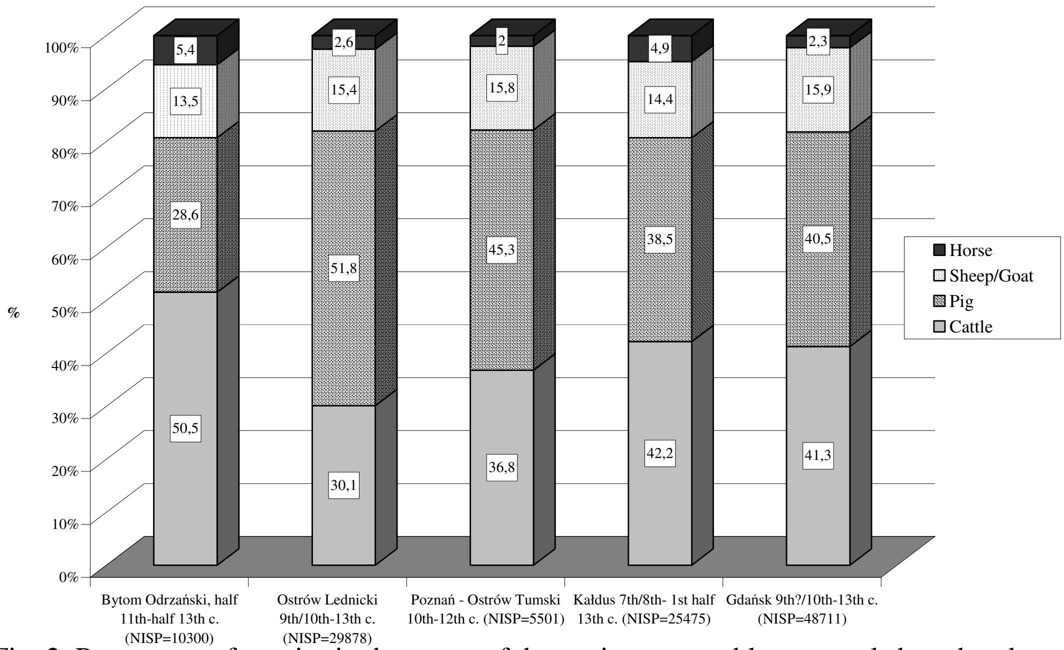

Fig. 2. Percentage of species in the group of domestic consumable mammals based on bone assemblages from medieval settlement complexes (Makowiecki 2006)

The remains of wild mammals were found in every early medieval site considered here (Fig. 3). Three types of hunting were noted. The first type was observed in Wielkopolska, where the *animalia superiora* were the smallest proportion of the hunted groups of mammals and where the *animalia minuta* as well as the *animalia mediocra* were more often hunted than in other centres. The second type of hunting was practised in Bytom Odrzański and Kałdus. With this type, very few *animalia minuta* were caught and *animalia superiora* were most commonly hunted. The third type of hunting was practised in Gdańsk where *animalia superiora* were the most popular, whereas *animalia mediocra* constituted the smallest percentage.

Amongst the birds, domestic chicken were consumed by the majority of inhabitants of the early medieval settlements. They also ate a lot of graylag goose, mallard, capercaillie and black grouse (Makowiecki, Gotfredsen 2002). White eagle was hunted for religious reasons and for practical purposes as well; its feathers were used as arrows. Goshawk *(Acipiter gentilis)* was used for hawking to catch ducks, partridges and hazel grouse.

The types of fishing differed across the various settlements (Makowiecki 2003). In Szczecin and Wolin, sturgeon was most commonly caught, whereas Kołobrzeg-Budzistowo was a centre for herring fishing. Fishermen from Gdańsk caught sturgeon and pike/perch, whilst carp, pike, perch and catfish were important species. The most popular sea fish were *Clupeidae* including herrings, whereas cod and flatfish played a less significant role. In Great Poland, at Kuyavia and Chełmno, the list of fish caught was as long as in the centres located at the sea side, and thus it can be suggested that fishing was the one of the important components of the food strategy. In Mazovia, fishing was practised in rivers and sturgeon catches are the most common. The same type of fishing was undertaken by fishermen in the settlements of Lower Silesia. Herring are the only species testified both by archaeological remains and by the historical record, as they were traded from sea centres to the interior.

The same rules of breeding were used in all of the analysed regions. In the case of cattle, the rotation of the herd lasted ca. 7–10 years (Fig. 4). In that time, animals were slaughtered at three age thresholds: firstly, individuals at the age of 4 to 14 months, secondly 19–28 months old and thirdly individuals at the age of 3,5–5 years. Herds of pigs also were slaughtered at three thresholds across the life cycle (Fig. 5). The two younger groups were far less numerous than the third, older one. Sheep and goats were also slaughtered at three thresholds in the cycle (Fig. 6). The differences among particular settlements are merely those of percentages. The lowest quantities of lamb or young goats (4–8 months of age) were slaughtered in Bytom Odrzański, whereas the most numerous were in Kałdus. The next group was selected at 10–17 months of life. The greatest number were slaughtered in Bytom Odrzański, the fewest in Kałdus. The last group of selected animals included individuals in the age range of 3–4 years.

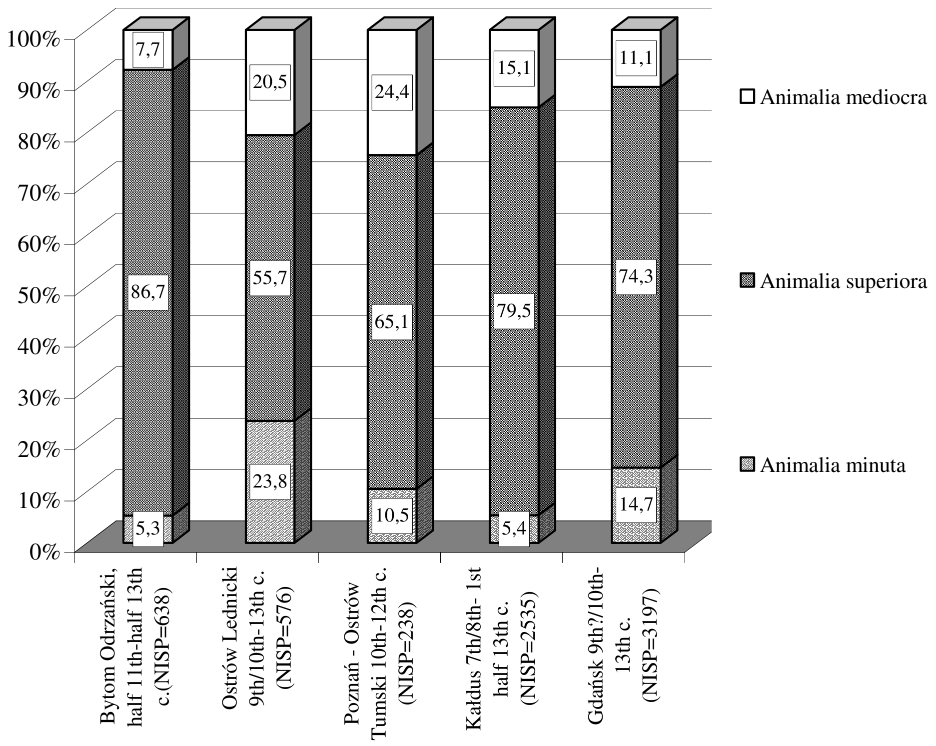

Fig. 3. Percentage of wild group mammals in the medieval settlement complexes

The sizes of animals bred in early medieval settlement complexes were similar. Cattle were from 92 to 118 cm high (Fig. 7). The smallest animals were discovered in Great Poland, whereas the largest were in Gdańsk (Pomerania) and Kałdus (Chełmno). The smallest pigs were only 60 to 67 cm high, whilst the largest reached 74–81 cm (Fig. 8). The zone of pig-wild boar transgression covered animals with withers heights of ca. 81–88 cm. Nevertheless, they only constituted a small percentage of the whole population of *Sus scrofa,* which leads to the conclusion that cross-breeding between domestic pig and wild boar was not very common. The largest horses were bred in Lower Silesia whereas the smallest ones were in the Gdańsk and Chełmno areas. The withers heights of early medieval horses extended from 107 to 149 cm (Fig. 9).

The importance of animal bone and horn as the raw material for manufacturing everyday objects and tools is illustrated by data obtained from the investigations in the Giecz stronghold (Makowiecka 2001). The manufactured objects were made not from pig and cattle bone but from antlers and the skeletal elements of red deer, and below this the next group, forming a reasonably high percentage of objects, were made from pig, horse, cattle and small ruminant bones (Fig. 10).

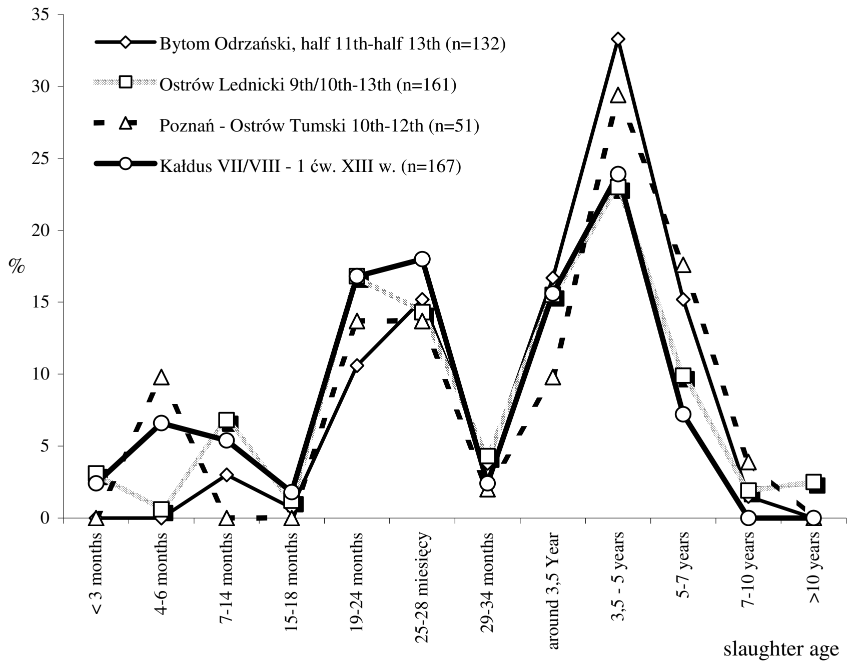

Fig. 4. Slaughter age of cattle in the medieval settlement complexes

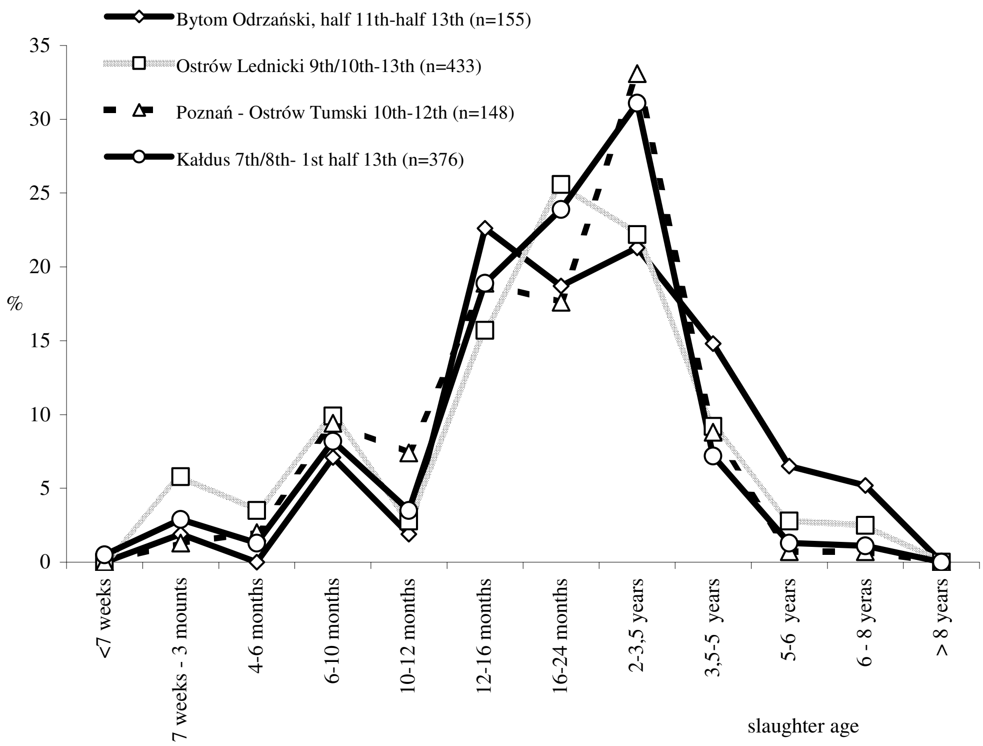

Fig. 5. Slaughter age of pig in the medieval settlement complexes

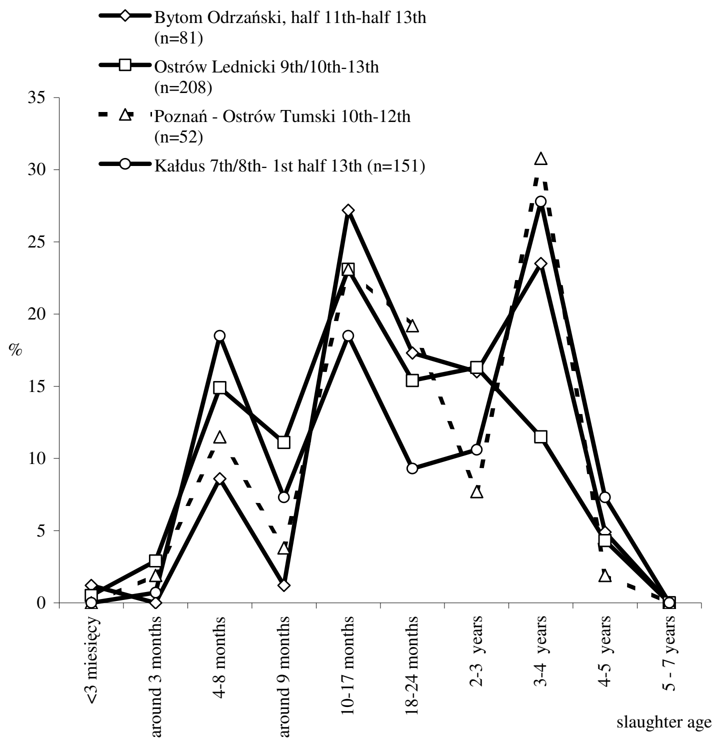

Fig. 6. Slaughter age of sheep and goat in the medieval settlement complexes

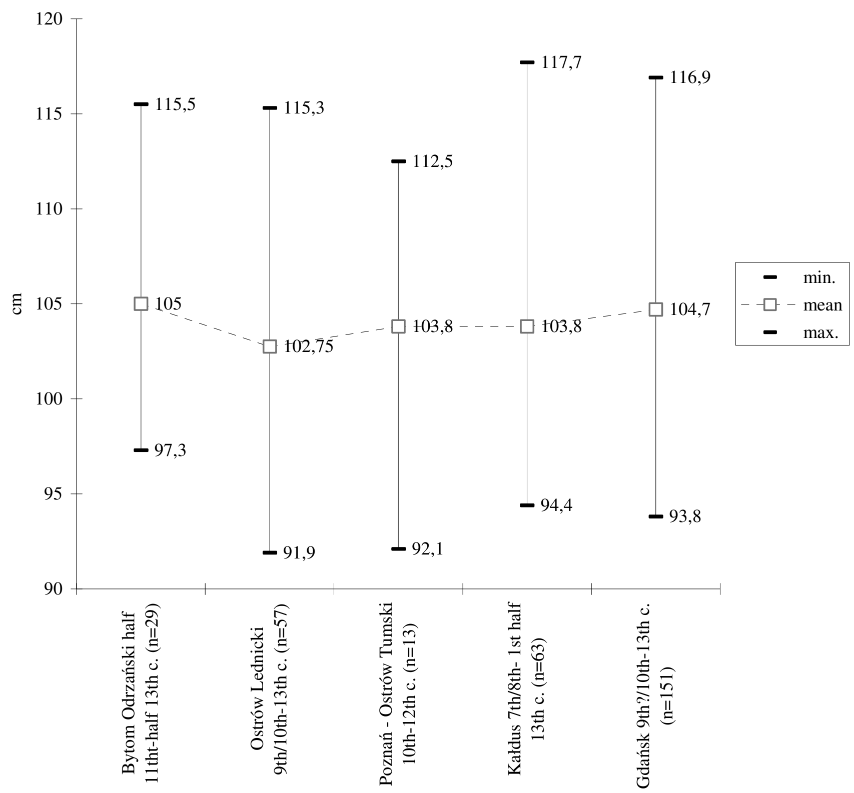

Fig. 7. Withers height of cattle in the medieval settlement complexes

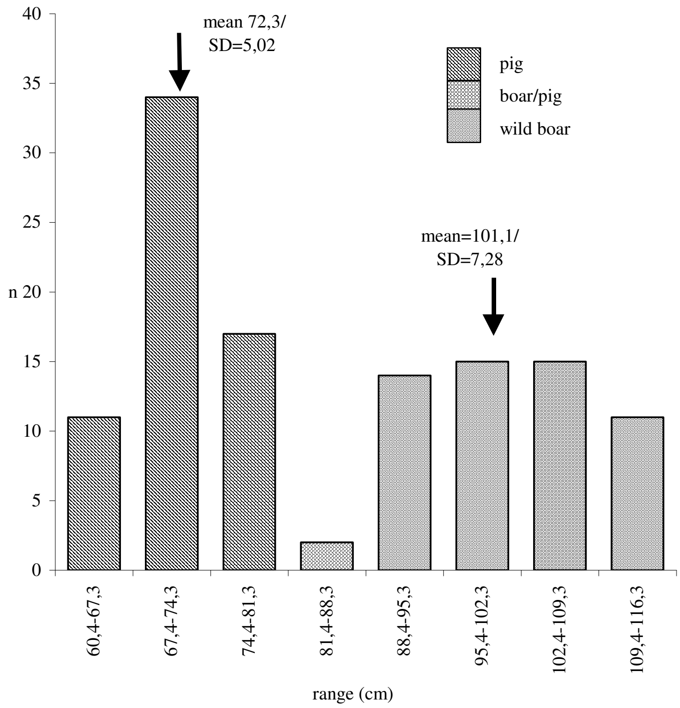

Fig. 8. Withers height of pig and wild boar in Kałdus settlement complex

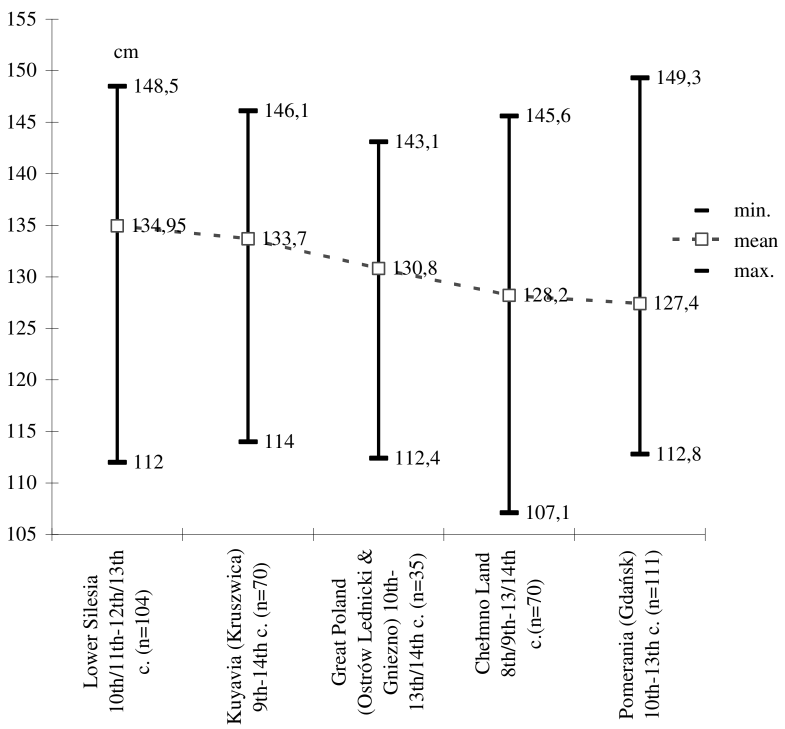

Fig. 9. Withers height of horse in the medieval settlement complexes

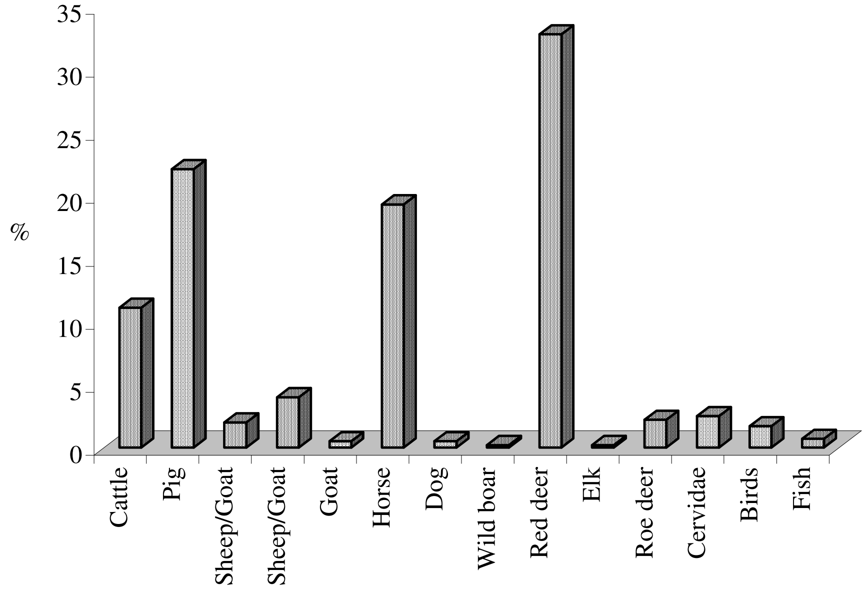

Fig. 10. Percentage of particular species in bones and antlers used for manufacturing of tools

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Seed impressions and charred remains: comparing evidence for crops in Bronze Age Ireland

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Studies relating to social and economic issues in Bronze Age in Ireland have often focused upon non-agricultural evidence. Where resource management has been considered, this has largely been investigated in terms of activities such as metal production. Archaeological evidence for the production and consumption of cereals in Bronze Age Ireland has regularly been recorded, but little attention has been paid to exploring this evidence in any detail.

This paper will investigate arable crops and farming systems of Bronze Age Ireland, considering evidence primarily from the macro-remains of cultivated plants. Early studies relied heavily on evidence from plant impressions on ceramic vessels. It seems that some ceramic vessels were produced in locations where arable crops were also present, and seeds were incorporated into the vessels during manufacture. The seeds were often destroyed during the firing of a pot, but they left an identifiable impression in the fabric of vessels. Early work, based on evidence from seed impressions, suggested that barley (*Hordeum vulgare* L.) was the predominant crop of this period in Ireland, with wheat (*Triticum* spp.) playing a very minor role in farming economies. This model was first put forward in the 1940s, and has since gone largely unchallenged. The more recent collation of unpublished data as part of my PhD research represents the first study of crops based mainly on plant macro-remains from Bronze Age deposits in Ireland.

Based upon the newly-collated plant macro-remains evidence, it seems that previous hypotheses relating to the relative significance of various crops during this period are incorrect. Wheat is far more significant in faming systems of Bronze Age Ireland than previously assumed, and the study has also provided evidence for the regular presence of oat (*Avena* sp.) at this time and an early occurrence of rye (*Secale cereale* L.). The clear contrast between evidence from plant impressions on ceramic vessels and evidence from plant macro-remains demonstrates the danger in relying solely on plant impressions when attempting the reconstruction of cereal economies.

In the case of Bronze Age Ireland, the association of certain cereal types with ceramic vessels may be better viewed as representing a relationship between ceramic vessel production and activities associated with the processing of these cereals. By linking crop production and use with activities such as ceramic manufacture, this study demonstrates the potential of using archaeobotanical evidence in the consideration of social organisation, particularly with regard to the deployment and scheduling of labour.

Islands in a Common Sea

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This paper summarises recent work undertaken on British Atlantic islands. After many years of research into the Scottish islands, in particular the Western Islands, it has become apparent that islands have their own special environments and economies. In order to more fully understand the special nature of island community new research into islands lying off the further south off the coast of Britain, the Isles of Scilly has been initiated. Drawing on this research this paper considers some of the themes that are currently being explored.

Coastal sites offer a plentiful supply of terrestrial, aerial and marine resources, and their environmental archaeology generally reveals a continuing reliance on a wide range of resources even when more inland sites have turned their back on the sea. It remains an archaeological conundrum that in these assemblages, where the use of marine resources is attested from the faunal record, stable isotopes have generally failed to identify significant human consumption of marine resources (Neighbour *et al* 2002, Barrett *et al* 2001).

In addition to marine animal foods (mammals, birds, fish, molluscs, crustacea etc) plant foods were exploited either for direct consumption or possibly as animal feed (Smith and Mulville 2004). Initial work on the diet of Hebridean animals has revealed difference in the management of cattle/sheep and pigs and has revealed a distinct difference between the wild (red deer) and domestic ruminants (Mulville et al 2007).

The limited resources on islands sometimes lead to specialised economies (e.g. dairying, Mulville et al 2005, Craig et al 2005) with new evidence for specialised economies occurring on smaller islands, for example the assemblages from the recently analysed assemblages from the Shiant Islands (Madgwick and Mulville 2007) are comparable to the historically attested sea bird economies of St Kilda.

The introduction of food, and non-food, animals to islands has continued up until modern times but it is the introduction of wild species that is of most interest. Recent work by Fairnell and Barrett (2007) has pointed to the introduction of fur species to the Northern Islands whilst the introduction of red deer to the Western and Northern Isles has previously been discussed. A brief review of other islands lying off the coast reveals an on-going obsession with the introduction and management of cervids on islands; they are reported everywhere from the tiny isle of Lundy in the Bristol Channel to the Isles of Scilly. Research on the Hebrides, and elsewhere, continues to provide a fascinating insight into the movement, management and maintenance of this ‘wild’ species providing glimpses of a close, on-going relationship with one of humankinds earliest food species.

The small size of many islands restrict population sizes, which in some case has lead to a reduction in species sizes whilst other evidence can be found in the increased incidence of small changes of bone and tooth structure (e.g. bovine pillar in sheep) and pathologies (Powell 2007). This paper considers some of the evidence for island effects on domestic animal populations.

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The environment in South Kujawy (Central Poland) under early Neolithic pressure. Case study: Osłonki site

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The history of the South Kujawy region is a subject of great interest as this region has been intensively used for agriculture due to its fertile soils since early Neolithic times (Jażdżewski 1938, Grygiel 1986, 2004, Grygiel & Bogucki 1997).

Excavations at Osłonki have discovered one of the largest settlements belonging to early farmers in the Polish lowlands (Grygiel & Bogucki 1997, Grygiel 2004). Of exceptional interest is the fortified settlement belonging the earliest farmers and stock herders of the Lengyel culture located at Osłonki village, with traces of long, trapezoidal houses and richly equipped graves located nearby. The occupants of Osłonki were not only farmers, but also hunters and fishers, who impacted heavily on the local environment.

Intensive palaeoenvironmental investigations have been conducted in the proximity of Osłonki village, complementary to the archaeological research. These multi-proxy studies have addressed the abiotic environment (geomorphology by Nowaczyk 2005), and biotic elements: palaeobotanical analyses (pollen and spores by Nalepka 2005 and macrofossils by Bieniek 2002 and unpubl.), (diatoms in prep.), animal microfossils (cladocera by Gąsiorowski & Nalepka 2004, Gąsiorowski 2005) and macrofossils (molluscs by Alexandrowicz 2005). Many other investigations are still being conducted in Osłonki area, for example geology, mineralogy, anthropology and archaeozoology, but the results of these will not be included in this paper.

Palaeoenvironmental studies of South Kujawy revealed its Late Glacial and the Holocene history.

The development of the surrounding relief and the history of vegetation and environment in the vicinity of archaeological site at Osłonki were considered in two periods. The first period saw natural environmental changes in the late Plenivistulian and early Holocene, dependant on climatic conditions. The second period saw environmental changes during the middle Holocene. Since early Neolithic tribes (LPC and LC) settled in the Osłonki region, biotic and abiotic conditions were influenced by their activities, not only by natural climatic changes (Nowaczyk & Nalepka, 2005).

The palynological reconstruction of the vegetation history of the Osłonki region considers the Late Glacial, and the earlier and middle parts of the Holocene up to the Subboreal chronozone (Nalepka 2005).

Sequences of pollen and spores, molluscs, cladocera and diatoms, characterizing changes in the environment during the Late Vistulian – Late Holocene, have been found in sediments accumulated in small ancient lakes at the archaeological site of Osłonki.

Sequences of molluscan assemblages reflect phases of enrichment and impoverishment of the fauna dictated both by changes in climate and the human impact. The latter were connected with the multicultural settlement situated close to the water body, which gradually filled up with sediment and transformed into wet meadows and a peat bog (Alexandrowicz 2005).

Cladocera analysis allowed reconstruction of primary conditions at the site; human activity caused dramatic changes in the composition of the cladoceran assemblages. Reductions in Neolithic settlement were clearly reflected in the partly restoration of the cladoceran community (Gąsiorowski 2005).

During the middle Holocene, the vegetation history of the Osłonki region could not be characterised on the basis of pollen data as a continuum of processes but only as episodes interrupted at times when sediments were destroyed. This destruction was caused primarily by early Neolithic settlers and subsequently by late Neolithic groups. Prior to the early Neolithic occupation, primeval mixed deciduous forest with *Quercus*, *Tilia*, *Ulmus*, *Fraxinus* and *Corylus* covered the landscape in the vicinity of Osłonki. Only small, open areas with heliophilous herbs were present. The first farmers appeared in a forested environment. Cereals, along with segetal weeds and ruderals, reflect the spread of agriculture. *Triticum* and *Hordeum* were cultivated (also documented by macrofossils by Bieniek 2003). The inhabitants of Osłonki exploited wild plant resources available in the neighbourhood. They used wood, first of all oak and pine, but also of other trees and shrubs such as birch, poplar, and hazel, although the latter probably in smaller quantities.

The landscape around the Lengyel settlement must have been exploited quite heavily; in the immediate vicinity of the houses and beyond, the timber required for longhouse construction would have resulted in substantial felling of trees, to which can be added the constant requirement for fuel, tool use, and house repairs. In all, a picture emerges of very intensive local landscape use. After the Lengyel settlements at Osłonki, there was settlement of the late Neolithic (Globular Amphorae and Funnel Beaker culture) at Brześć Kujawski. The late Neolithic pattern in this region is not seen in as much detail as in early Neolithic items, due to the lack of appropriate sediments for palaeoecological analyses (Nalepka 2004).

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Neolithic archaeobotanical records of rice and foxtail millet in East Asia and problems for identification of wild or domesticated remains

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The beginning of rice and millet agriculture is one of the most significant elements in the Neolithization of East Asia. Archaeological studies in China show that the earliest evidence for rice (*Oryza sativa*) grains has been recorded in the middle of Yangtze River basin, dating to ca. 9,000 years BP, whereas the earliest grains of foxtail millet (*Setaria italica*) and broomcorn millet (*Punicum milleaceae*) have been recorded at the lower Yellow River basin, at almost the same time as the occurrence of domesticated rice.

Some problems still exist, however, in understanding the domestication of these two crops in East Asia. The most significant problem relates to reliability in the identification of wild or domesticated rice remains. Wild rice (*Oryza rufipogon*) may be distributed in the middle of Yangtze River basin during the early Holocene. Domesticated rice is, however, difficult to distinguish from wild rice using just the carbonized grain. Many archaeobotanists have recently suggested that the spikelet (rice husk) base is the most reliable identification feature in distinguishing wild or domesticated rice. The domesticated rice husk has a scar on the stem where it was connected to ears before threshing. Wild rice, on the other hand, is identifiable by its smooth abscission scars. The records of ancient rice from China should be re-examined to confirm the presence or absence of these features. Some sites show mixed occurrences of wild and domesticated rice. If we check these features carefully and collate the evidence, we should be able to confirm the timing of rice domestication, as has been done with wheat and barley domestication in West Asia.

In the case of millets, identification features also present problems. For example, the grain size and shape of foxtail millet overlap with green foxtail, which is the wild ancestor of foxtail millet. The identification of microstructures on the grain surface (upper lemma) – which are formed of horizontal lines and papillae size – should instead allow us to increase the number of reliable records of foxtail millet.

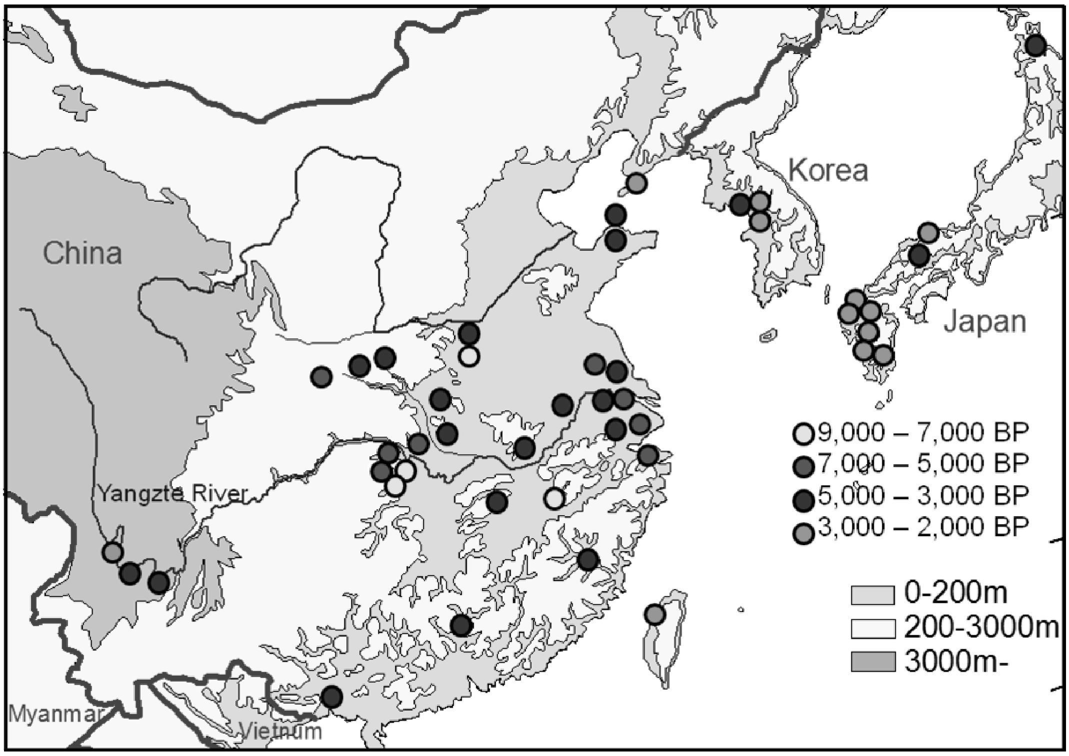

Fig. 1 Neolithic records of rice (*Oryza sativa*) in East Asia

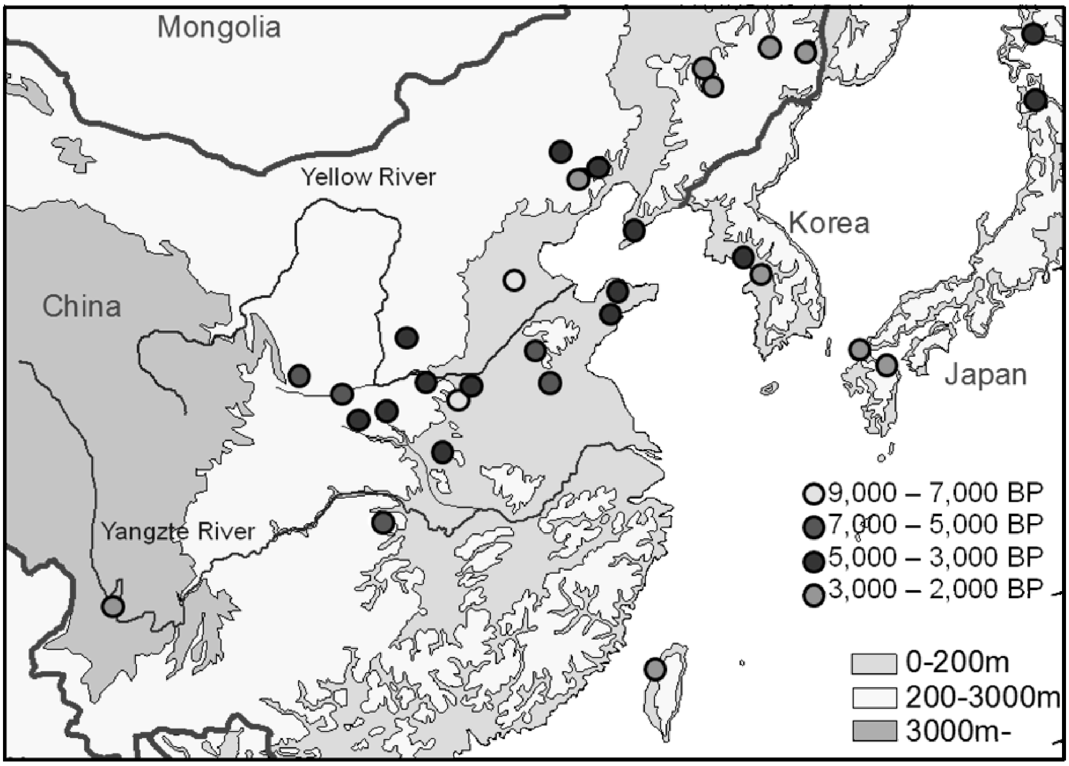

Fig. 2 Neolithic records of foxtail millet (*Setaria italica*) in East Asia

Landscape-and-climate dynamics and land use in the Late Holocene: Kulikovo Battle Field case study, Russia.

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The Holocene dynamics of forest-steppe landscapes in the centre of the East European plain and the history of its agricultural land-use remain fascinating topics of scholarly studies. This ecotone, being an intermediary between the steppe and forest zones, is highly sensitive to even minor climate changes. Its principle cause resides in the 'null area', an important bio-climatic entity, featuring the precipitation/evaporation balance, being located within its limits.

The landscape diversity of the northern part of the forest-steppe and its richness in natural resources made these areas attractive for early humans, causing regional differences, which became apparent in the Late Holocene. According to the available records (Folomeyev et al., 1990; Khotinsky et al., 1979; Glasko et al., 2000), the Upper River Don area includes Mesolithic, Neolithic and Bronze Age sites, early Slavic settlements of the 9th and mid-10th centuries AD, and more then 200 Old Russian settlements, hill-forts and 'flat' cemeteries dating from the late 12th to the late 14th centuries AD. Starting with the 10th–12th centuries, the forest-steppe develops into one of Russia's main farming areas with an advanced agriculture and stock-breeding (Gonyanyi, 2003).

For the last 30 years, archaeological and palaeogeographical studies have been undertaken in the area, which includes the Upper Don, the Nepryavda, its tributary, and their interfluves. The multidisciplinary studies of the area were initially focused on the reconstruction of the natural landscapes that would correspond to those that would have existed for the Kulikovo Battle of 1380 (the historically important military engagement in which the Russians defeated the Tatar-Mongol forces). The present paper discusses the newly available lithological-stratigraphical and pollen evidence resulting from the study of two key sequences on the 'Kulikovo Battle Field', as well as the reconstruction of landscapes and climate for the time-span ranging from the Mid-Atlantic period to the present.

The Holocene sequences of the Don floodplain were chosen as the study objects: the Don-1 near Monasatyrshchina-Tatinki village (E 38.79°, N 53.65°E), and the Ust'ye 1 on River Tabola, near Ust'ye village (about 8 km east from section Don-1).

The reconstruction of the main parameters of the past climate (mean July and January temperature and annual precipitation) was carried out with the use of Klimanov's (1984) information-statistical technique, based on the calculation of climatic tolerance of the main components of the pollen spectra. The calculations were made for the Don-1 sequence and controlled by those for the Ust'ye-1. Historical records were used for the reconstruction of the aspects of climate of that period.

According to the obtained data for the Atlantic period (PAZ Don 1, Fig. 1) the forest-steppe landscapes were widespread in the studied area. Arboreal vegetation consisted of birch communities with the participation of oaks, elms and limes, and alder forests on the floodplains. Meadow-steppe dominated the watersheds, with meadows in more humid areas. The climate was warmer than now, mainly due to the higher winter temperature (t_I =–5° – 8°C), which is higher than today's by 3°–5° C. The annual precipitation is estimated as 400–500 mm, an amount sufficient for the development of arboreal communities.

As indicated by archaeological records (Folomeyev et al., 1990), the floodplains of the Don and its tributaries in the Kulikovo Battle Field area were settled by human groups, beginning in the Early Neolithic. Archaeological finds stemming from the Don-1 sequence correspond to the existence of an ox-bow lake, which created a comfortable environment for the settlement. The age of these archaeological materials, based on the radiocarbon date obtained for a piece of wood from the ox-bow deposits (lithological unit 4, Fig. 1) containing the Neolithic pottery, may be estimated as 5780±60 BP.

During the first part of the Sub-Boreal (PAZ Don 2, fig.1) the abundance of arboreal communities markedly decreased and open steppe landscape became widespread. Alder and birch woodlands were restricted to the floodplains and valley slopes. Meadow steppe communities dominated watersheds. According to the estimates, the climate became more continental and drier; mean annual precipitation being reduced to 300–400 mm. The estimated summer temperature increased (t_{VII}=22°–24°C), while the winter temperature decreased (t_I =–8° –10°).

As follows from our data, during the formation of the alluvial-meadow-type palaeosoil (lithological unit 2, Fig. 1), corresponding to the second half of the Sub-Boreal – first half of the Sub-Atlantic period, the meadow steppe was in existence over the entire area of study. In contrast with the previous phase of vegetation, the herb communities included larger proportions of mesophylous plants (Rosaceae, Ranunculaceae, Cyperaceae, Apiaceae,), with the reduced participation of wormwood. Typical steppe plants (*Echinops*, *Ephedra*) totally disappeared from the spectra. According to our evidence, the vegetation cover was of a mosaic character and consisted of meadow steppe, meadows and woodlands with broad-leaved species in the wettest areas, mostly within the depressions. The climate featured warm summers (t_{VII} =20°–22°) and relatively mild winters (t_I=–5° –8°). According to the estimate based on the Don 1 and the Ustye 1 sequences, mean annual precipitation was about 500 mm.

Existing archaeological evidence suggests the occurrence of predominantly nomadic Bronze Age stock-breeding groups in the Kulikovo Battle-Field area (Folomeyev et al. 1990). Their sites were located on vast floodplain meadows. At this stage, the pollen spectra suggest human-induced modifications of the landscape. The spectra include large amounts of Cichoriaceae, which normally grow on disturbed soils, as well as other plants viewed as indicative of humanly-induced degraded communities (*Rumex, Convolvulus, Centaurea cyanus, Chenopodium album*, and Hepaticae spores).

The historic period is recognized by finds of 13th–14th century pottery in the Ust'ye 1 sequence. The corresponding pollen data suggest the occurrence of a forest-steppe-type landscape. Arboreal communities included birch, lime, oak and alder. Meadow-steppe occupied the open space. Summer temperature was higher than now (t_{VII} =22°–24°C), while winter temperature was similar to the present one (t_I =–8°–10°C). Mean annual precipitation is estimated as 500–600 mm.

The pollen spectra from the upper section of the talus deposits (lithological unit 1, fig.1) that had been formed over the past 200–300 years, show an open landscape that emerged under the strong anthropogenic impact. Plant communities consist of pioneer species typical of disturbed habitats and agricultural cenoses. Lithological evidence shows the enhancement of erosion in the neighbouring areas, the completion of soil-building and the accumulation of talus deposits. The pollen data suggest an intensive soil erosion, which is shown by appearance of liverworts and a sharp increase in the amount of redeposited Mesozoic spores in pollen assemblages. The climate of that time may be estimated, based on historical records. According to Afremov (1850), mean annual temperature in the Tula *guberniya* in the mid-19th century was +6^{o}C; mean summer temperature +15° ÷ +17^{o}C, and mean winter temperature –5 ÷ –6^{o}C. Apparently, the estimation of winter temperature is exaggerated, as the writer's assessment was based not on the temperature of the coldest month, but on the winter season as a whole.

Historical sources show the occurrence of a sedentary Slavic population in the Upper Don basin in the Middle Ages. More than 130 Old Russian sites are identified in the Kulikovo Battle Field area. Significant anthropogenic changes in the vegetation occurred from that time onwards. The 17th century, when the population density markedly increased and watersheds were ploughed, marked a turning point in Man-Environment relationships. Natural vegetation communities were gradually destroyed, changed by an agricultural landscape.

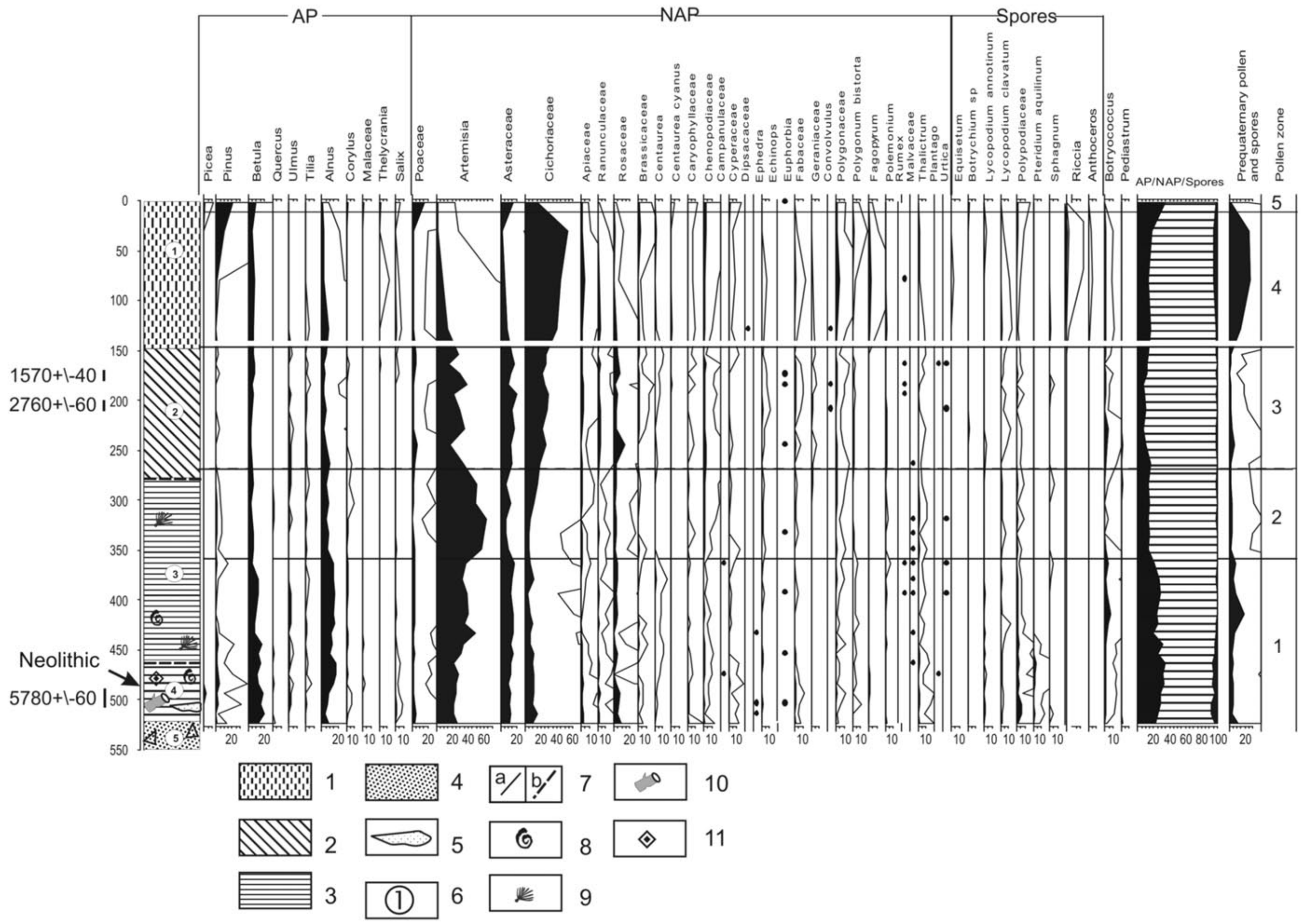

Fig.1. Pollen diagram of the section Don-1. Pollen sum = AP+NAP+Spores. Additional curves represent x10 exaggeration of base curves. Lithological composition: Alluvium-talus deposits; 2 – meadow-type paleosoil on floodplain deposits, 3 – ox-bow and back-water facies of alluvium; 4 – channel facies of alluvium; 5 – sand lenses; 6 – number of lithological unit; 7 – boundary between layers: a – sharp, b – gradual; 8 – molluscs, 9 – plant remains; 10 – wood remains; 11 – pottery.

Conclusions

Forest-steppe and steppe landscapes were widespread over the investigated area during the formation of the floodplain deposits. Forest communities occurred on the Don's floodplain, its tributaries, and the valleys of minor water channels. Climate reconstructions do not show any significant changes for the second half of the Holocene. Nonetheless, even small-scale reductions in annual precipitation, from 400–500 mm in the Atlantic, to 300–400 mm in the Sub-Boreal period, accompanied by the rise of summer temperature, from 20°–22° C to 22°–24°C respectively, were sufficient to cause landscape restructuring, a shift from the forest-steppe to typical steppe communities. Being a regional-order ecotone, the steppe is highly sensitive to even minor changes in temperature and precipitation. Small rises in winter temperature and annual precipitation in the Sub-Atlantic resulted in increased vegetation diversity.

Signals of anthropogenic changes in the vegetation are clearly visible in the pollen spectra. Neolithic hunter-gatherers were fully adapted to natural environments, and their impact on the vegetation was negligible. During the Bronze Age, several indices of agricultural activities appear in the pollen spectra, yet the human-induced changes in the vegetation remained small. Large-scale landscape changes and the degradation of natural vegetation became conspicuous only over the past two or three centuries. The present-day state of plant communities in the forest-steppe in the Upper Don basin is totally controlled by anthropogenic factors.

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Environment and economic activities of the Tripolyan population

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Tribes of the Tripolye culture were distributed over the greater part of the modern forest-steppe zone, from the Prut as far the Dnieper. With calibration, the dating of the Tripolye culture covers the 5th to the 3rd millennia BC. It corresponds to the second half of the Atlantic – beginning of the Sub-Boreal period of the Holocene. Ancient farmers advanced from the Near Eastern centre of agriculture, via the Balkan Peninsula, reaching Southeast Europe, including the south and southwest Russian plain. They brought with them knowledge of cultivated plants together with the skills for their cultivation.

Palynological data show that forest – steppe vegetation was dominant in the landscape (Pashkevich 1989: 133–137; Kremenetski 1991: 80 and 111–112; Yanushevich, Kremenetskii, Pashkevich 1993: 143–152; Pashkevich 2005: 231–237). Meadow forest – steppe formations included forests with oak, lime, elm, hornbeam and mesophytic grass-herb meadow formations.

The Tripolye culture consists of three sequential stages of development. The earliest traces are known from Romania (Precucuteni 1). The Precucuteni tribes occupied the dry steppe and foothills of the Carpathians and then, during the Precucuteni II – Tripolye A, spread quickly to the east, reaching the Dniester and the Southern Bug. Tripolye tribes, Stage B, reached the Middle Dnieper during the next period under the much wetter conditions of the Atlantic climate. Their settlements became larger and more numerous. The tribes of the Tripolye culture disappeared during the drier climate phase of the Sub-Boreal (Tripolye, Stage C). The grass-herb steppe was replaced by the grassy variety, while the area of forests was considerably reduced. However, in its final stage, the Tripolye tribes occupied a vast area, not only the forest – steppe zone, but also penetrating further into the forest area to the North and the steppe zone to the South. These changes were reflected in the character of the economy. The economic activities were mixed, combining agriculture with animal husbandry. At this time nomadic tribes appear in some areas of a wooded zone of Eastern Europe and in Siberia. The number of agricultural tribes distributed in a forest-steppe zone of Ukraine and Moldova is reduced. There are favourable conditions for development of cattle breeding, first of all nomadic and semi-nomadic.

The modern vegetative cover of Ukraine developed around the 8th–6th century BC, corresponding to the early Iron Age. From this point the influence of economic activities on the vegetative cover increases considerably.

During the existence of the Tripolye culture there was an extensive colonization by ancient farmers of the Ukraine. Three hulled wheats *Triticum dicoccon, Triticum monococcum, Triticum spelta* with naked barley *Hordeum vulgare var.coeleste* and hulled barley *Hordeum vulgare* formed the staples of the Tripolyan farmers. The list of cultivated plants also includes *Pisum sativum* and *Vicia ervilia*. *Panicum miliaceum* too was part of the assortment and values for it increased only in settlements on the border of the steppe zone with tribes of the Usatovo culture during the Tripotye C stage (Yanushevich 1976: 27, 31; Yanushevich 1980: 228; Kuzminova 1990: 126; Pashkevich 1980: 234–242; Pashkevich 1990: 131–134; Pashkevich 2003: 194–200; Pashkevich 2005: 231–245).

The natural habit of these plants was well adapted to primitive methods of management. The fields were cultivated by antler and stone hoes. Hulled wheats are always sown by the spikelets. The harvesting technique was adapted for cutting ears. The ancient harvesting tool comprised a flail of two 30–50-cm long sticks joined by rope. Low yields, long periods of natural soil regeneration, primitive tools and the use of undemanding plants – these were the basic features of Tripolian agriculture. The use of a land management system without periods of fallow and low crop capacity demanded movement of settlements so that 'virgin land' was continuously brought into cultivation. The crisis was further intensified by the Sub-Boreal drought and ultimately resulted in the total transformation of the economy. The economic activities were of mixed character, combining agriculture with animal husbandry. Subsistence strategies were used by both nomadic and semi-nomadic tribes.

Vegetation development and human impact during the Late Glacial and the Holocene in the floodplain of Labe (Elbe) River in the central part of the Czech Republic

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The Labe (Elbe) is the biggest river in the Bohemian lowland. The environment of the present-day floodplain consists of Aeolian dunes, river terraces and, mainly, of chernosem soils. The annual mean temperature is around 8.8 °C degrees. Total annual precipitation is from 520 to 560 mm. Until recently the state of palaeobotanic research in the lowlands of Central Bohemia was very poor. Fortunately, sediments suitable for palaeobotanical research are commonly present: numerous palaeochannels, former shallow lakes and large calcareous mires and swamps. Currently we have at our disposal a rich archaeological evidence of the past occupation of the region (Dreslerová et all 2004).
The sites:

Hrabanovská černava

A former shallow calcareous lake, 185 m a. s. l. The palaeoecological importance of the site was already appreciated from the 1930's (Losert 1940b). Most of the recent palaeoecological research was performed by L. Petr (2005). The lake was created in the Late Glacial period, when the Aeolian dune dammed the basin. The oldest lake sediments are dated 13630 ± 60 uncal. BP and the peat buried under the Aeolian dune is dated 11850±100 uncal. BP.

Mělnický úval – Přívory

A large former shallow lake situated southeast from Mělník town. Altitude is around 175 m a. s. l. The first palaeobotanical research by H. Losert (1940a) is also from the 1930's. Again, the lake was created during the Late Glacial period. The origin is probably similar to that of Hrabanovská černava. The oldest lake sediments are dated 14850 ± 110 uncal. BP. Layers of fluvial sand are present in lake sediments, being the evidence of fluvial activity. The Holocene peat is being destroyed by present-day agricultural activities.

Chrást

This former oxbow lake of the Labe river is situated 2 km east from Chrást village. Its locality is beyond the present-day floodplain. The sediment stratigraphy is very complicated. It consists of fine sand, peat and lake sediments. The palaeochannel is dated to the Late Glacial.

Kozly 1 and Kozly 2

The complex of old channels is situated within the present-day floodplain. Profile Kozly 1 is from a younger, outer, channel and profile Kozly 2 is from an inner, older, channel.

The oldest period preserved in the studied sedimentary records is the Late Glacial Interstadial (Alleröd/Bólling), at Hrabanovská černava, Mělnický úval – Přívory and Chrást. The vegetation consisted of scarce trees (pine, birch and spruce) and rich steppe (mainly *Artemisia* and *Helianthemum*). At Chrást, birch and willow formations developed first and pine expanded later. This was probably caused by the local conditions – location within the river environment. The start of the Younger Dryas is defined by the decline of trees and expansion of open steppe. Trees were present mainly at wet habitats in the floodplain of Labe River. During the Early Holocene, pine and birch forests expanded. *Corylus* was not in the region, unlike the other regions in the Czech Republic. Mixed oak woodlands were characteristic for the Middle Holocene at Hrabanovská černava, but with pine also playing an important role. During this period, former lakes at Hrabanovská černava and Mělnický úval completely infilled and changed to open swamps and wet meadows. Mixed oak woodland is recorded at Kozly 2. Its rapid decline is connected with the appearance of the first pollen indicators of human activities. Human influence rapidly led to forest decline and a new expansion of pine. In the Middle Holocene silver fir and hornbeam expanded. Vegetation development recorded in the Middle Holocene former oxbow lake Tišice has similar features to Kozly 1 and Kozly 2 (Dreslerová and Pokorný 2004). A similar pollen record was obtained from a palaeochannel near Chrást village (Břízová 1999, Dreslerová et all 2004).

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Švarcenberk (southern Bohemia) – Mesolithic lakeshore settlement and its impact on the local environment

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The discovery of the extinct Lake Švarcenberk dates to the beginning of 1970s, when V. Jankovská discovered lake sediments under a layer of peat in the flood zone of the present-day fishpond (Jankovská 1976, 1980). In the mid 1990s we followed up this discovery with extensive stratigraphic investigations. These showed that we were dealing with a natural lake of significant size and that in the middle of the basin a massive sequence of lake sediments of an unexpectedly high age had been preserved. Two littoral profiles and a central profile were gradually processed using the methods of pollen analysis, the analysis of algal remains and macro-remains analysis with the aim of describing the progress of the silting up of the lake basin and the long-term vegetation succession connected with it (Pokorný, Jankovská 2000). The chronology of the sediment record is based on radiocarbon dates, on indirectly dated traces of rubidium (for this newly developed method see Veselý et al. 2006, in print) and on relative palynostratigraphic dating. The central profile, whose lower 5 metres formed during the Late Glacial period, was used for the reconstruction of the vegetational development and geochemical changes in the basin of the lake in connection with the severe climatic changes at the turn of the Pleistocene and Holocene (Pokorný 2001, 2002). Sedimentological research verified the presence of Aeolian material in the lake layers. It was possible to clearly correlate traces of Aeolian activities in the lake sediments with the formation of blown sand dunes in adjoining parts of the Lužnice River terraces and explain them as a reaction to the climatic deterioration, which took place at the beginning of the Younger Dryas (Pokorný, Růžičková 2000). The palaeoecological potential of this exceptional lake site has not by far been exhausted by the above-mentioned research. The remains of aquatic organisms are preserved in the sediments and they can be used to reconstruct changes in the local environment and for the study of climatic changes of a regional to global character. The remains of diatoms (Bešta 2004) and aquatic crustaceans, for example, have been gradually processed (Cladocera – K. Nováková, unpublished).

The circumstances of the discovery of the Mesolithic settlement on the banks of the former Lake Švarcenberk are rather interesting from a methodological point of view. Up until now we had only known individual finds of a chipped stone industry of clearly pre-Neolithic date from the immediate surroundings (in summary form see Vencl et al. 2006, Pavlů 1992). If we leave aside these individual finds, extensive Mesolithic settlement was only indirectly substantiated on the basis of the presence of pollen grains of anthropogenic indicators and microscopic charcoal particles in lake sediments dated to the Early Holocene (Pokorný 1999). Strong indirect evidence caused us to suspect the presence of an exceptionally dense settlement in the immediate vicinity of the former lake at least from the very beginning of the Holocene up to Atlantic period. The following archaeological investigation, carried out in 2000 by S. Vencl (Vencl et al. 2006), and on a larger scale in 2005 and 2006 by the authors of this contribution, produced plentiful finds of chipped stone industries dated to the late Palaeolithic and mainly to the Mesolithic. With the aid of surface collections we have gradually discovered nine sites in the south-eastern segment of the foreshore zone of the lake. We have thus in the meantime obtained a small but generally well-dated collection (Mesolithic, so far without microliths, which are difficult to pick up by surface collection). Thanks to the presence of a distinct sunken feature we discovered the plough-undisturbed site

7 (Fig. 1) on an oval rise, close by the bank of the former lake. The first exploratory sondage undertaken in autumn 2005 covered an area of 1x9 m. The discovered features were full of a dark brown sandy fill and only contained a stone industry. We associate their origin with the Mesolithic settlement. An industry of 195 pieces in total was produced by the sondages (a density of 21.7 artefacts per square metre). Its dominant components are amorphous fragments (109 pieces; 55.9 %). This is followed by chips (51 artefacts; 26.2 %), blades (23 artefacts; 11.8 %) and cores (2 artefacts; 1 %). So far we have 10 tools in the collection (4 triangles, 3 scrapers, 2 burins and 1 blade with lateral retouching; 5.1 %). Too little data has so far been obtained for the evaluation of the planography – we will be able to formulate appropriate conclusions after the investigation of a larger area of the site.

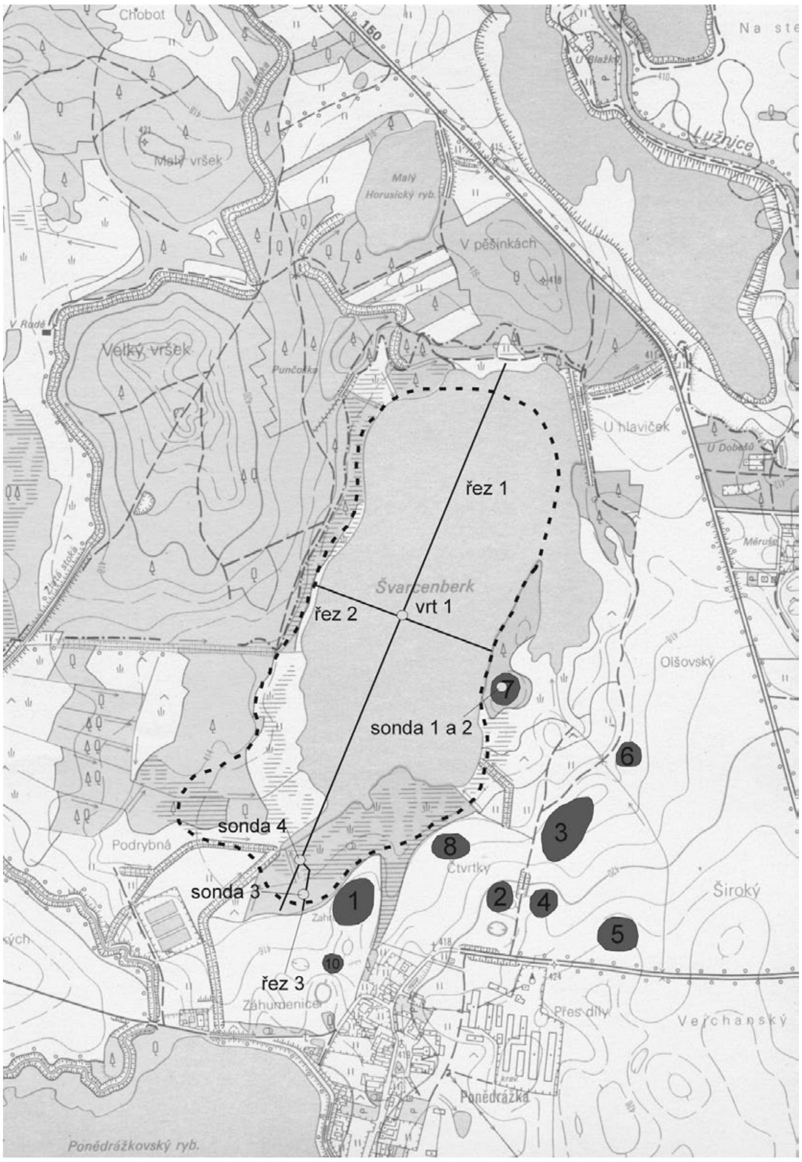

Fig. 1. Extent of the former lake, location of the individual archaeological sites (in red), cores (“vrt”), sondages (“sonda”) and sections (“řez”)

The as yet final phase of the exploratory excavation took place in spring 2006. This time we concentrated on the least disturbed southern stretch of the bank of the former lake. The main aim was the verification of the archaeological potential of the moist shoreline areas and the taking of profiles for palaeoecological analyses. An exploratory sondage of 2x4 m picked up, in its lower part, the coastal facies from the period after the transgression of the water surface. This organic layer with clay and sand showed itself to be rich in pollen grains and plant macro-remains, including fresh wood and large pieces of charcoal. Fourteen of the discovered fragments of wood bear clear traces of working. In some cases we know their probable function (an arrow shaft and probably its semi-finished product), in other cases the function is still unclear. It has been possible to radiocarbon date the fragment of the arrow shaft. The resulting date is 9500±50 BP. Further wood finds bear traces of working; they are, however, often burnt either over the whole surface or at one end. In the appropriate parts of the layer pollen analysis shows the presence of a series of types of herbs that have been evaluated as secondary anthropological indicators. Likewise some finds of plant macro-remains from these layers – shells of hazelnuts and raspberry seeds – are surprising in lake sediments, because they represent taxa that grow in drier areas. The interpretation is obvious: We are clearly dealing with the remains of gathered foodstuffs. Half of the hazelnuts found in a layer between 92–100 cm have been radiocarbon dated to 9280±50 BP. We regard the find as exceptional in respect to its ascertained age. At the very beginning of the Holocene hazel only occurs sporadically in the Czech Republic. The hazelnuts found within the context of lake sediments with artefacts can thus be provisionally regarded as indirect evidence of the diffusion of this tree by man. It is possible that man contributed to the diffusion of hazel by transporting the harvested fruits over longer distances (during the seasonal movements of hunter-gatherer groups), by reducing the canopy connecting the forest and, it is not to be ruled out, by deliberate management as well, which for the meantime only remains at the level of a hypothesis.

The layer of reed bogs above the bed of the above-described deposit came into being after the silting up of the lakeside zone roughly between 9000 and 5000 cal. BC. (on the basis of radiocarbon dating). The black-coloured upper part of this layer is the result of the presence of a large amount of microscopic charcoal. Its continual occurrence either indicates direct settlement (in the case that the charcoal came from a fireplace), or the burning down of woodland or lakeside vegetation in the surrounding area. Microscopic charcoal from wood can often be distinguished from charcoal of herbal origin (for example from reeds). Both categories of find are probably present in the studied material from lake sediments. The increased occurrence of pollen grains of some anthropogenic indicators correlates with the presence of microscopic charcoal particles. These are a combination of plants which prefer an open grassy environment (*Thalictrum*, *Rumex acetosella*, *Melampyrum*, *Plantago lanceolata*, Gramineae) and types which expand onto fire affected areas (*Pteridium aquilinum, Calluna vulgaris*). The occurrence of some aquatic and lakeside plants (*Ceratophyllum*, *Typha latifolia*), or as the case may be, plants from damp, nitrogen rich environments (*Solanum dulcamara*, *Urtica*) at the same time could be connected with eutrophication, i.e. with an increased supply of nutrients into the lake and its shoreline zone. Finds of some taxa (*Artemisia*, Chenopodiaceae, *Plantago major*-type) can be evaluated as evidence of the presence of ruderal stands at the settlements.

The occurrence of water chestnut (*Trapa natans)* at the studied site is also interesting in connection with the Mesolithic settlement. It has been preserved in the lake sediments in the form of plentiful macro-remains (of fruit) and pollen grains. Water chestnut is a floating aquatic plant, whose starch-rich nuts formed a significant part of the bill of fare of Mesolithic man (Vuorela, Aalto 1982, Zvelebil 1994). The oldest finds of water chestnut in the sediments of Lake Švarcenberk date to the very beginning of the Holocene. The surprisingly early appearance of this warmth-loving plant is not only proof of the favourable climate at the relevant time, but moreover again arouses suspicion of its deliberate introduction.

The relatively late date of the end of the continuous settlement, which has for the moment only been indirectly indicated in the lake sediment, is at least surprising. On the basis of the radiocarbon dating of palaeoenvironmental records we obtain a date of closely around 5000 cal. BC, which from a chronological point of view already lies within the Neolithic period that had developed in areas that were more favourable to agriculture. The Třeboň Basin with acidic and waterlogged soils was completely unsuitable for agricultural subsistence and thus it cannot be ruled out that a hunter-gathering population persisted here for some time after the expansion of the agricultural way of life in the fertile lowlands. This corresponds very well to the concept of the long-term survival of the Mesolithic in peripheral areas of Bohemia, as has been formulated by S. Vencl (Vencl et al. 2006). There is a distinct temporary hiatus in settlement in the pollen record from roughly 5000 cal. BC until the period around 3800 cal. BC when indicators of agricultural activity start to appear in the form of cereal pollen grains. The presence of a later Neolithic population in the immediate vicinity of the area under investigation is archaeologically suggested by Lengyel Culture pottery and several stone artefacts from the nearby gravel-pit (Beneš 1976).

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Environmental archaeology and the AEA – past, present and future

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The life and earth sciences have been an integral part of archaeology since its emergence as an academic discipline more than 200 years ago. The term "Environmental Archaeology" was first coined to describe these aspects of archaeology in the mid-20th century. The Association for Environmental Archaeology (AEA) was formed in 1979, largely in response to the increasing involvement of life and earth scientists in UK rescue archaeology. Where are we heading?

This paper will take a brief look at the history and present status of Environmental Archaeology and the AEA and offer a personal view of prospects for the future.

Ichi-no-Megata Lake sediments – sedimentological and geochemical indicators of environmental changes in annual laminated (varved) sediments (Akita Prefecture, Japan)

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In recent years, geological investigations of lake sediments have become increasingly common in reconstructions of Holocene climatic and environmental history. This is mainly due to the fact that lakes act as sedimentary basins on the continent, leading to the formation of more complete depositional sequences than in other terrestrial sediments. In addition, frequently occurring high sedimentation rates and organic carbon contents often enable high-resolution reconstructions, with good stratigraphic control via radiocarbon dating. Finally, the terrigenous, biogenic and chemical compositions of lake sediments reflect the environmental conditions in both the water column and the catchment area of the lake during the time of sediment formation.

The objective of the Megata project is to make a contribution to our understanding of climatic variability and the mechanisms of climate-related processes during the past 10000 years, a period, characterized by the interplay of natural climatic oscillations and anthropogenic activities, the effects of which are difficult to disentangle.

In this presentation we would like to illustrate the usefulness of laminated lake sediments in paleoenvironmental reconstructions, especially if investigated using multi-disciplinary approaches. For this purpose, we present results from two different areas, the Dead Sea in Israel and Ichi-no-Megata crater lake in Japan. These lake sediments represent a variety of lacustrine facies successions, and their individual potentials for reconstructing climatic, glacial or sea-level variation.

Our interests are focussed on the sedimentological and geochemical composition and variations in these in recent times and during the late Holocene at the *Ichi-no-Megata* locality. Investigations of the textural and mineralogical properties, as well as counting of the laminae of the core, are presently in progress and first results show the potential of the laminated sediment sequence. As paleo-environmental proxy data, core segments were measured by micro-XRF for geochemical characterization by µXRF-element scanning (Mg, Al, Si, P, S, Cl, Ca, Ti, Mn, Fe, Sr) in annual to sub-annual resolution (500 µm)(fig.1). Additionally we analysed the sedimentology in the texture of the lacustrine laminae and “event horizons” like turbidites at the selected sections of cores (IMG A01 0–0.85 m and IMG B09 6.05–6.85 m). The advantage of the method is its combination of annual to sub-annual resolution element chemistry with the sedimentological implications of thickness, texture, and succession of the varve sublayers, bearing imprints of the lake's environmental history and regional human impact.

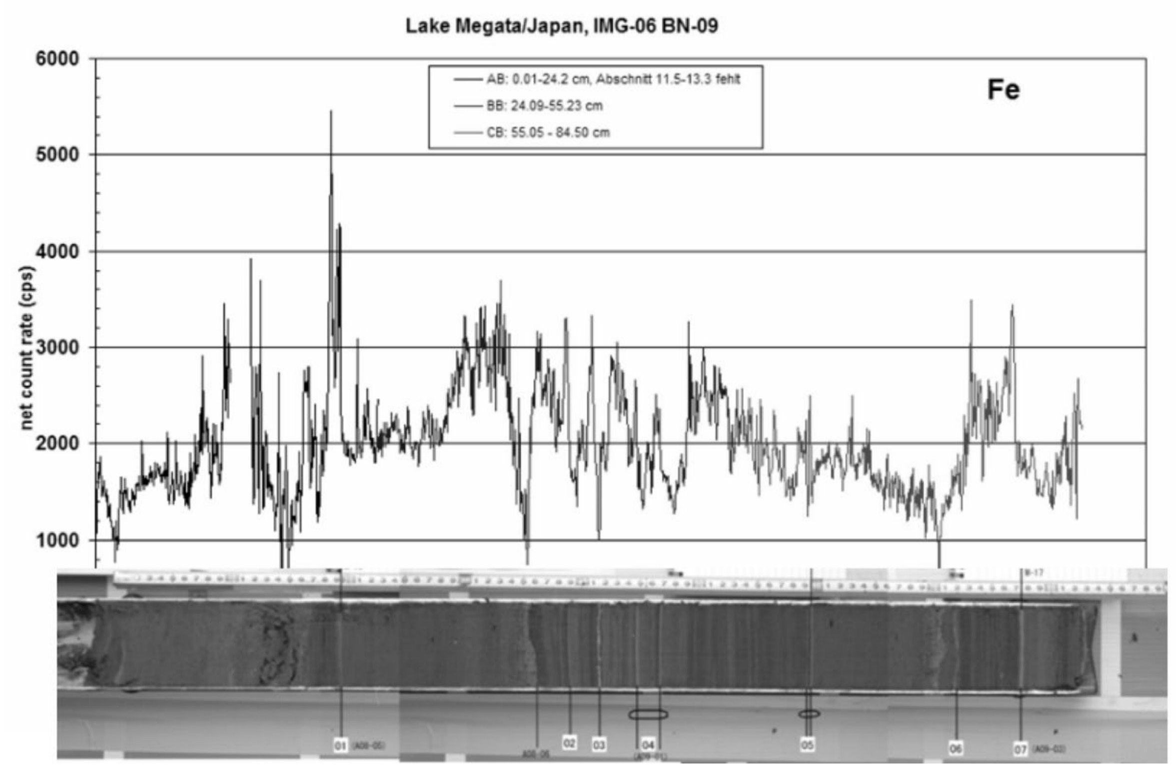

Fig 1: Varved lacustrine sediments of Lake Ichi-no-Megata core BN09 (depth 605–685 cm). Graph shows high resolution X-ray-fluorescence variations in chemical composition (here for iron) characterising the varves, turbidites, and tephra-layer sediments in comparison to the core (photo).

In comparison we present results of investigations in the Near East region. High quality information of climatic conditions together with detailed documentary evidence enable chronologically accurate assignment of the proxy data response to climatic variation and to changes in character and intensity of human activities in the Dead Sea region.

Geochemical analysis of the core samples from Lake Ichi-no-Megata, northeastern Japan

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We are performing instrumental neutron activation analysis (INAA)(Ta, Sc, Th, Yb, Eu) and ICP-AES (Ti, Al, Fe, Mn, Mg, Ca, P, S, Ba, Sr) on ca.280 samples collected at contiguous 1 cm intervals within the laminated layers at 0–10 m depth (0–10,400 14C yr BP) of an IMG06 core drilled at Ichinomegata Lake in the winter of 2006.

The alkaline tephra from continental volcanoes has significantly different characteristics to the general tephra erupted by island arc volcanism. The Ta/Sc elemental ratio of glass shard in alkaline tephra is about 15, whereas the average Ta/Sc value in sediments of Lake Ichinomegata is below 0.05. INAA is the supersensitive and effective detection of alkaline cryptotephras. Cryptotephra are tephra horizons that are invisible to the naked eye. The occurrence of Ulleung Oki (U-Oki) tephra (alkaline tephra) originated in an explosive eruption ca. 9,300 14C years BP. The U-Oki tephra is regarded as an important time-marker during the Last Deglaciation. And, it is suggested that some unknown alkaline ash fall events, which are probably from the Ulleung island, had happened besides U-Oki tephra between AT and K-Ah. In this study, U-Oki tephra is invisible to the naked eye. We detected seven spike changes (9360, 7080, 6620, 4,930, 1070, 770, 510 14C yr BP) from core profile of the Ta/Sc ratio in the IMG06 core. The volcanic ashes will be included, only 0.3% which we calculated from the value of Ta/Sc ratio. We are going to confirm using microscopy and EPMA analysis whether volcanic glass shards are included now. These spike changes may correspond to U-Oki tephra or other alkaline tephra.

The general tephra has significantly different characteristics within the sediment of Lake Ichinomegata. The Na/Al elemental ratio of glass shard is about 0.3, whereas the average Na/Al value in sediments of Lake Ichinomegata is below 0.07. We detected a spike change (composite depth 2.01 m: about 1cm lower part of the Baegdusan-Tomakomai (B-Tm) tephra) from a core profile of the Na/Al ratio. We could confirm volcanic glass shards by microscopy. We are going to examine what kind of volcanic ashes it is likely to be.

Ti, Al, Th, Sc, Yb, and Eu are considered to be the most immobile elements during the weathering, the elemental ratios of these elements are useful to detect the change of source materials in sediment samples.

The value of Ti/Al, Th/Sc and Yb/Eu ratios showed an approximately constant value(Ti/Al: 3.96±0.22, Th/Sc: 0.36±0.03, Yb/Eu:1.64±0.16). We assumed that climate changes don't have an influence on these elemental ratios during the Holocene. Besides these environmental changes, we detected a spike change (6,320 14C yr BP) from core profile of the Mn/Fe ratio. And the average Fe/S value increased from 1.9±0.6 to 3.0±1.5 from composite depth 1.83m, and the average Fe/P value increased from 6.3±2.3 to 20.2±5.5 from composite depth 1.83m, too. We thought that an environment in the lake or productivity changed. We are examining this now, and will compare it with the examined items of the other fields.

Grain pests from Roman military sites: implications for importation, supply to Roman army and agricultural production

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Introduction

In 1978 Paul Buckland examined the distribution of grain pests in Roman deposits in Britain. This paper presented a number of rather striking conclusions:

1. Grain pests such as *Sitophilus granarius, Oryzaephilus surinamensis* and *Laemophloeus ferrugineus* were relatively common in a range of Roman 2nd and 3rd century AD deposits in Britain.
2. There were no apparent records for grain pests in Britain before the arrivals of the Romans.
3. Buckland suggested this pattern resulted from three factors:
   I. a lack of trade with the continent before the Roman invasion,
   II. predominant use of below ground pit storage during the Iron Age which would have stopped infestation due to CO^2 'flooding' as opposed to the large scale open plan granaries seen in the Roman period.
   III. The relatively small scale of grain production and trade in the Iron Age as opposed to that in the Roman period.
4. The presence of so many grain pests suggests that there must have been a considerable loss of harvested grain during the Roman period. Modern loss is around 20% and it presumed that this would have been higher in the past. This makes modelling the Roman economy difficult.

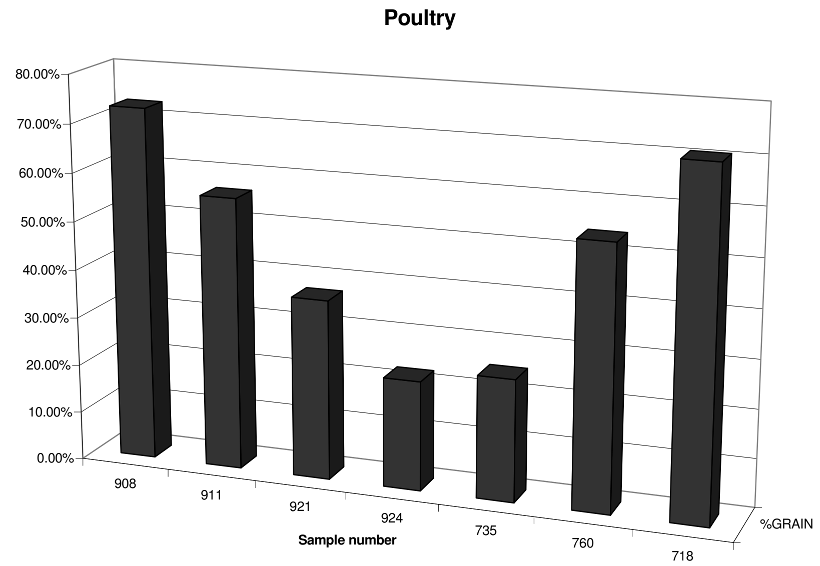
Buckland outlined the latter difficulty thus:

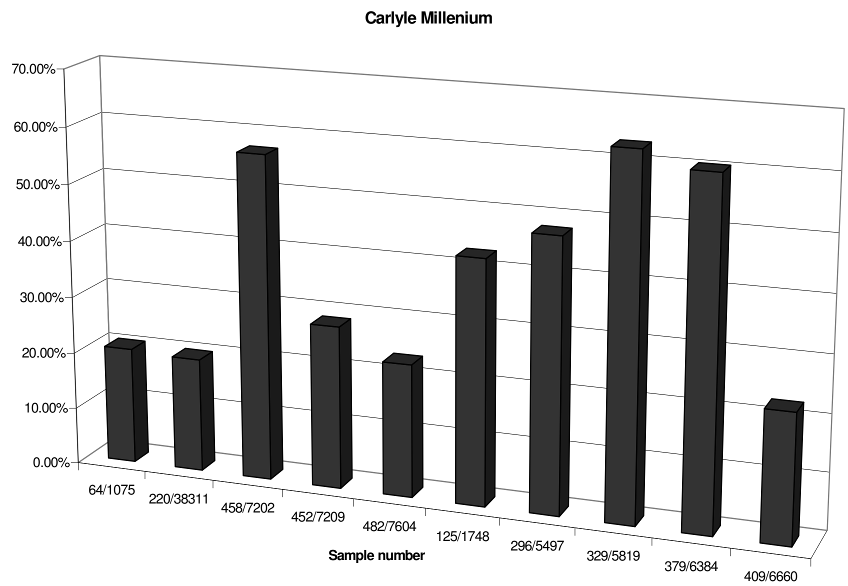
> *the great increase in land under cultivation [in Britain] sometimes claimed for the Roman period may not be the result of increased population under the* Pax Romana *or the heavy burden of the* annona militaris *but the outcome of the increasing attention of an unwanted guest,* Sitophilus granarius *[the granary weevil]* (Buckland 1978, 45).

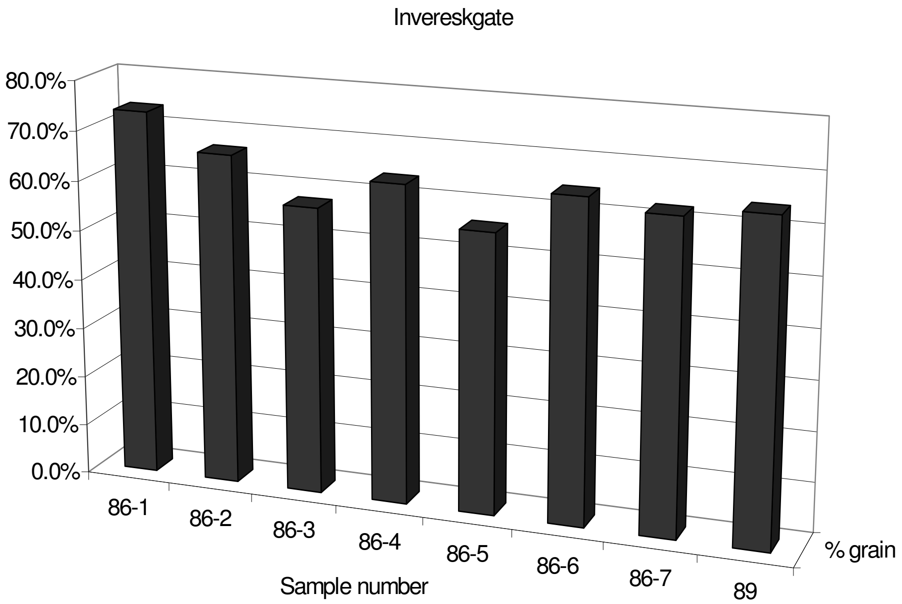
This paper presents the results of a further 28 years research into this question. New data from a number of excavations will be considered which suggests that the occurrence of grain pests in Roman deposits in Britain may be of an even larger scale that indicated by Buckland and to have occurred earlier. It offers a reconsideration of the apparent lack for grain pests in the Iron Age of Britain. It also explores how grain pests can become deposited into the archaeological record in the first place. Finally, further research into this question on the European continent is urged.

New Research

Figure 1 presents the percentage occurrence of grain pests at a number of early, unpublished, Roman sites in Britain. At both Poultry and Gresham Street London the deposits sampled all date from the earliest period of the city's occupation, 47–60 AD. Similarly the deposits examined form the fortresses at Carlisle, Cumbria also are from the earliest period of Roman occupation (70–85 AD). The insect faunas present are dominated by finds of grain pests. This clearly suggests that grain pests arrived very early with the Roman invasion and were a dominant feature of grain storage almost from the start. Other 2nd century deposits in London along with sites such as the wells at Invereskgate, East Lothian and York (Hall *et al.* 1980), The Coney Street Granary, York (Kenward and Williams 1979), the Rougier Street site, York (Hall and Kenward 1990) and the dump of burnt grain in the fortress ditch at Malton, Yorkshire (Buckland 1982) all indicate that this problem persisted throughout the Romano-British period.







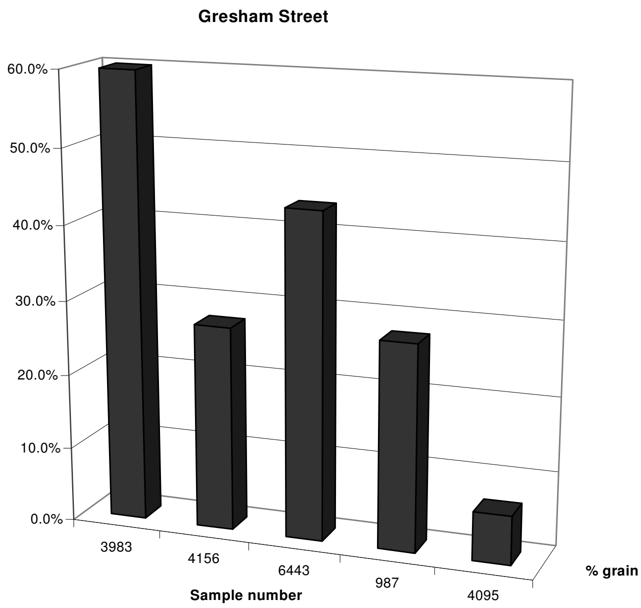


Fig. 1. Percentage of grain pests found in the insect faunas from a range of Roman Age sites in Britain

A recent synthesis of the archaeological insect faunas from London clearly demonstrates this dominance of deposits by grain pests is essentially a Roman problem. Figure 2 summarises the overall percentage occurrence of grain pests for a number of archaeological assemblages from London. There is a clear decline in both the Anglo-Norman periods and the early Medieval.

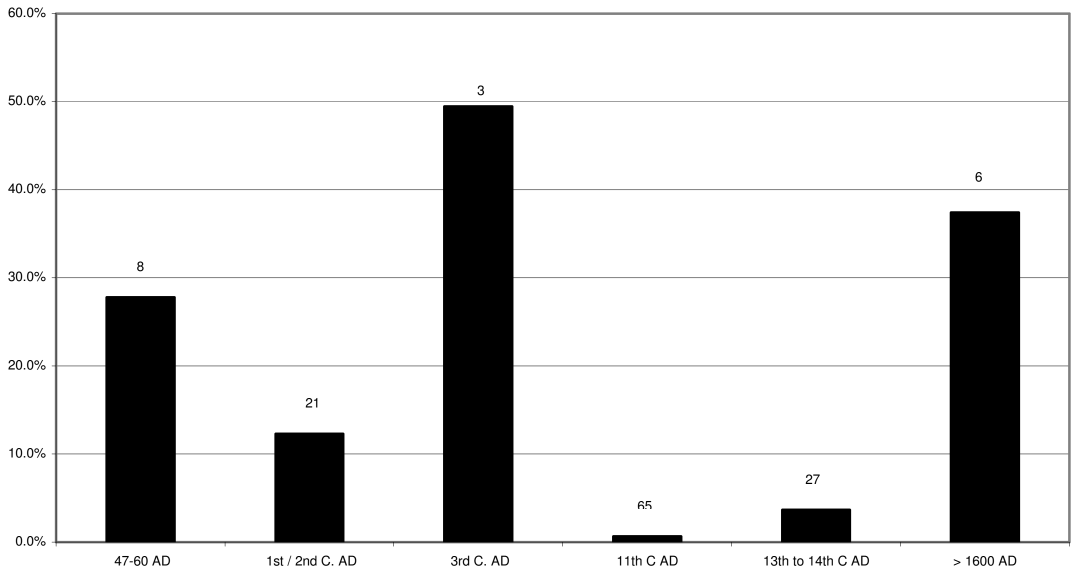


Fig. 2. The percentage occurrence of grain pests in all samples from differing periods in London (The figure over the bar represents the number of samples in the specific period)

How do insect grain pests get into Roman Archaeological deposits in such numbers?

This seems to how infested grain is disposed of. Four methods of disposal seen in the archaeological record are:

Burning. This can be seen at Malton, North Yorkshire (Buckland 1982), Droitwich, West Midlands (Osborne 1997) and the granary at Coney Street, York (Kenward and Williams 1979).

Dumping. There are clear examples of large amounts of infested grain occurring in the base of wells which clearly represents disposal (for example those at Ivereskgate, East Lothian and at Skeldergate, York (Hall *et al.* 1980). Similar deposits are also found in the repair foundations of roads in 3rd century London.

Feeding spoilt grain to stock animals. There are indications that the insect pests in the gullies below the barracks at the fort in Carlisle may have passed through horses as feed, since there is some evidence to suggest that these barracks may have been for cavalry.

Use in malt. A recent villa site at Northfleet, Kent has produced evidence that suggests that spoilt grain was used for malting. Records from the 1960s suggest that a minor infestation of grain pests may not have a significant effect on the flavour of the resulting beer but it is also rather nice to think that the inhabitants of the Villa were producing ‘shoddy’ beer for either the ‘tourists’ at the nearby temple at Springhead or to supply the Roman Army.

Why this dominance by grain pests only in the Roman period?

Of Buckland’s original arguments to explain this distribution some are now clearly out of favour. His suggestion that there was little trade in grain in the late Iron Age has been questioned. Equally, recent work by Van der Veen and Jones (2006) has clearly indicated that grain production and trade were large scale in southern Britain during this period. Work by both Cambell (2000) and Hill (1995) has indicated that there is more to Iron Age pits than grain storage alone. This also still leaves the status of ‘four poster’ structures in this period unexplained. It is suggested here that the problem probably lies with the use of ‘Mediterranean’ grain stores in a damp northern environment, the widespread trade of grain across Europe at this time and the shear scale of production and storage concerned.

It has also been suggested that in terms of the Iron Age of Britain we may have been looking for grain pests in the wrong places. Most Iron Age sites in Britain are not from settlements themselves and are often open field ditches. It is suggested that these are not deposits where we would expect to find grain pests in the first place. However, extensive sampling and research at settlements such as Iron age Goldcliff, Gwent (Smith *et al.* 2000) and Meare, Somerset (Girling 1979) has also failed to produce any grain pests.

To some extent this pattern is still a mystery. There is clear evidence for the presence of grain pests in the Mediterranean and Northern Europe before this period (Smitt *pers. com.*, Panagiotakopulu 2001) and why Britain (and the grain pests) have to wait for the Roman invasion is not clear. There is clearly a need for similar research on this issue to be undertaken on a range of deposits of Roman date throughout the entirety of the Roman Empire.

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History of the Ladoga-Baltic water connection and early human migrations in the Holocene

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The connection between Lake Ladoga and the Baltic in the northern lowland of the Karelian Isthmus, NW Russia, emerged after the retreat of the ice-sheet ca. 14,000–12,000 cal. BP. At that time, prior to the catastrophic dropping of the Baltic Ice Lake (BIL) water-level that occurred ca. 11,500 cal. BP, Lake Ladoga was a deep easternmost bay of the BIL. During the ca. 8000 years following 11,500 cal. BP, a river-like strait existed in the northern part of the Karelian Isthmus. The earliest evidence of human settlement in the north-eastern Baltic Area is attested at Antrea-Korpilahti (11,200–10,250 cal. BP), where artefacts were found in the deposits of a channel between the Ancylus Lake and the Ladoga Lake. The influx of fresh water and the tectonic uplift caused a rise of the water level of the Ladoga Lake known as ‘Ladoga transgression’. This culminated around 4000–3000 cal. BP when a new outflow – the River Neva – was formed and the waterways of the entire area were completely reshaped. New results of the palaeolimnological and archeological studies, which were carried out in the area of the Ladoga-Baltic connection in the frame of INTAS project “Waterways and Early Human Movements in NW Russia” and RFBR project (N07-05-01115), will be presented during the Conference.

Our multidisciplinary investigations focused on the lakes in Karelian Isthmus, located along the former Ladoga-Baltic water-system connection. They studied the lakes Lamskoye, Makarovskoye, Uzlovoye, Volojarvi, Laurinlampi on the Puutsaari Island (Northern Ladoga). As our main methods of investigation, we have chosen threw coring and sampling of lake deposits, with subsequent high-resolution radiocarbon dating, pollen and diatom analyses. We correlated results of paleolimnological investigation with archaeological remains of the Stone Age and Early Metal Period (Lavento *et al.* 2002; Gerasimov, 2003).

Table 1. Coring site characteristics

Site	Altitude, m a.s.l.	Longitude	Latitude	Water depth, m	Core, m
Lake Makarovskoe	11,6	60°43',5 N	29°08',8 E	0,90	2,32
Lake Lamskoe	14,2	60°44',0 N	29°08',6 E	2,70	2,00
Lake Uzlovoe	13	61°05',6 N	29°44',8 E	3,00	6,00
Lake Volojarvi	16	60°18',2 N	30°48',4 E	2,20	3,25
Lake Laurinlampi (St. Sergij)	15	61°30' N	30°34',8 E	5,4	2,5

The objectives of our investigations are as follows:

- Development of a high-resolution radiocarbon-based chronology of sites;
- Correlation of the chronology of archaeological sites with environmental changes;
- Reconstruction of the dynamics of the main waterways in the Karelian Isthmus and their impact on the initial settlement and early development of human groups in that area;
- Assessment of the impact of waterways on the formation and interaction of main ethnic entities in north-eastern Europe;
- Identification of the main stages in the development of the Ladoga and its relation to the Saimaa lake system and the Baltic Sea;
- Assessment of the impact of changes in the hydrology and configuration of lakes and rivers on the early human settlements and trade links on the Karelian Isthmus;
- Assessment of the early human impact on the environment in that area.

A considerable amount of new evidence has been obtained in the Veshchevo area (formerly known as Heinijoki), located in the northern part of the Karelian Isthmus Lowland. These sites were located at Lake Lamskoye (14.5 m a.s.l) and Lake Makarovskoye (11.6 m a.s.l.)

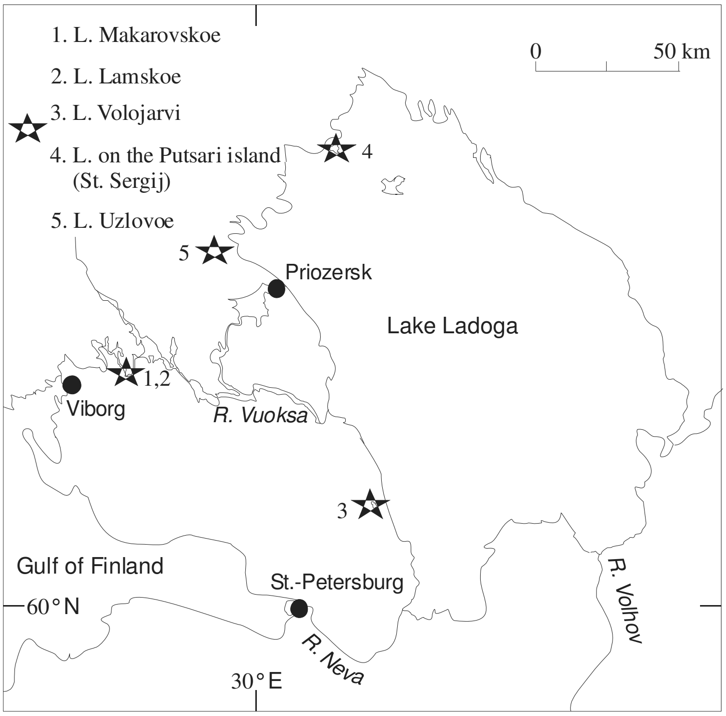

Plate: Location of sites

The pollen data and radiocarbon measurements obtained for both Lake Makarovskoye and Lake Lamskoye strongly suggest that the accumulation of gyttya occurred in an environment of boreal pine and spruce forests with the varying occurrence of alder and broad-leaf species (oak, lime, elm and ash), culminating in the level postdating 3500–3000 BP. Remarkably, that level signals the presence of Cerealia and indicators of agriculture. New pollen data indicated the early agricultural activities.

Investigations carried out in the low-laying Makarovskoye, Lamskoye and Uzlovoe lakes shed light on the final episodes of the Ladoga-Baltic waterway (Dolukhanov *et al.*, in press). Two stages in the development of these lakes may be recognized, based on the diatom evidence. The former stage features dominate the present-day planktonic diatom flora of Ladoga Lake (Davydova *et al.* 1997), alongside the sedimentary diatom assemblages of small lakes, experiencing an incursion of Ladoga waters (Saarnisto & Grönlund 1996). In the Makarovskoye and Lamskoye lakes, the fossil diatom assemblages were apparently formed under relatively shallow water, in a circumneutral or slightly alkaline and rather nutrient-rich environment. Following 3500–3000 BP, the disappearance of the "Ladoga assemblage" from the fossil diatom records indicates that the regressing Ladoga water could no longer reach the lake basins. The diatom compositions of both Makarovskoye and Lamskoye lakes are fairly similar, suggesting that the development of both lakes was essentially similar. The diatoms denote a high trophic state, implying lower water transparency as a result of the higher concentrations of dissolved organic matter. Noticeable changes are visible in the uppermost samples, especially those of Lake Makarovskoye. These changes should be attributed to an increasing human impact.

Preliminary results include:

- Sediment sequences from both lakes demonstrate at least two stages in their development: the stage of a straight/river and the stage of isolated mesotrophic lakes;
- The age of isolation is *c.* 3500 BP;
- At the same time, pollen of cultural plants appeared in sediments.

Lake Uzlovoe (14 m a.s.l) is located further to the north-east, 10 km south-west of Kuznechnoe railway station (Subetto *et al.* 2006).

- In the earlier stage, Lake Uzlovoe (Riukjärvi) was flooded by Lake Ladoga waters, which is evident from the presence of typical Ladoga species in the lowermost part of the sequence;
- A sharp upper litostratigraphical boundary and the quite abrupt disappearance of Ladoga species from the diatom record prove that the isolation from Lake Ladoga was quite rapid;
- Rich organic sediments from the upper unit and small lake diatom species correspond with the isolated lake – Lake Uzlovoe;
- In the uppermost part of the sequence, the lake became more eutrophic, which might be accounted for by human activity in the catchment that could result in increased nutrient loading and erosion.

The lakes Volojarvi and Laurinlampi on the Puutsaari Island situated at 15–16 m above sea level were believed to be inundated by Ladoga waters during its mid-Holocene transgression. The basal sediment archive of Lake Volojarvi, in turn, only provides information on the latest stage of the Ladoga transgression. Sediment from Lake Puutsaari dated back to the early Holocene represents a long record of the Ladoga history (Ludikova *et al.* 2006)

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Environment, lifestyle and diet of the prehistoric populations from the Minusinsk Basin, Southern Siberia, Russia

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Introduction

The nature of the prehistoric environment and its effect on human adaptation has attracted wide attention for several decades. This paper reports the first attempt to study the complex inter-relationships between the environment, lifestyle and diet of the prehistoric populations of the Minusinsk Basin, Southern Siberia. The main objective of the study is to gain an understanding of the reasons behind the dietary and economic changes that occurred from the Neolithic to the Iron Age periods in the region. As such, the research focuses on human remains derived from the six main archaeological periods and prehistoric populations of the area – people of the *Neolithic period*, and peoples of the *Afanasyev, Okunev, Andronov, Karasuk* and *Tagar Cultures* – which are considered to date from the 25th to the 1st century BC.

A multidisciplinary approach has been followed which is based on carbon and nitrogen stable isotope analysis, dental palaeopathology analysis and statistical analysis of selected burials.

Geography and Climate

Among a number of Eurasian regions studied, the Minusinsk Basin stands out particularly for its unique climatic and geographical specifics. It is a naturally isolated region, surrounded by mountains on three sides, located in the modern Republic of Khakassia in Southern Siberia. Thus the prehistoric people who lived in the basin were relatively isolated from their neighbours (Gryaznov 1969). Recent research on the palaeoclimate of the area has revealed the close connection between climatic changes and the dynamics of occupation of the basin by prehistoric cultures (Dirksen et. al 2005, Zaitseva et. al 2004).

The scarcity of Mesolithic and Neolithic remains in the region is possibly due to aridization of the territory in the Middle Holocene, and the main occupation of the Minusinsk valley, which began during the Bronze Age, may have been facilitated by increasing humidity of the steppe areas (Gryaznov 1969, Zaitseva et. al 2004). The most intensive occupation of the basin appears to have taken place in the 1st millennium BC and saw the emergence and development of the *Tagar Culture* of the Scythian period. This may have been caused by a wet and warm climate which appeared in the area in about 8th century BC, increasing the bioproductivity of the region (Gryaznov 1969).

Archaeological Background

All peoples studied had different origins, lifestyles, cultural and economic patterns.

Data on the *Neolithic* population of the Minusinsk area are scanty, because very few sites of this period have been discovered and just one possible burial has been identified. Nevertheless, Neolithic people are believed to have practised hunting, fishing, gathering and possibly stock-rearing (Gryaznov 1953, Vadetskaya 1986).

The population of the Early and Middle Bronze Age – peoples of the *Afanasyev, Okunev* and *Andronov Cultures* successively – are believed to have practised hunting, stock-rearing and fishing as the main aspects of their economy (Gryaznov 1969, Vadetskaya 1986). Some archaeologists have proposed that agriculture was introduced to the region by the people of the *Afanasyev Culture* (Gryaznov, Vadetskaya 1968), but as yet no direct evidence has been found to support this theory.

It is believed that in the Late Bronze Age and Early Iron Age, during the time of expansion of the *Karasuk Culture* and succeeding *Tagar Culture* in Southern Siberia, the intensive development of the steppes began. It led to a change in lifestyle from sedentary to semi-nomadic, and the development of elite strata of society (Gryaznov 1969). People are thought to have practised stock-rearing, hunting, fishing and agriculture. It is worthy of note that direct evidence of agriculture (barley and millet grains and scales) has been found in Tagar sites (Gryaznov 1969, Vadetskaya 1986).

Diet and the Basis of the Economy

There is no common opinion concerning the nature of the economies of the six archaeological cultures, and in particular the timing of the introduction of agriculture into the Minusinsk Basin.

To date, conclusions about the subsistence economy have largely relied on material remains recovered during excavations. The current research introduces new methods and addresses the following issues:

- the nature of the foods available and used by the different prehistoric populations from the Minusinsk Basin;
- the relative proportions of the various foods present in their diet;
- changes in the economy through time.
- variation between sexes and between "poor" and "rich" people within each population.

Methods

Two main methods have been employed in the research:

Roberts, Manchester 2005

- *carbon and nitrogen (C and N) stable isotope analysis* – This allows an estimation of the proportions of protein-containing plants versus meat and fish, and the proportions of C_3 (most plants) versus C_4 plants (such as millets) in the diet of ancient people (Chisholm 1989);
- *dental palaeopathology analysis* – This will further help us to understand the nature of the different diets as dental disease is generally linked to certain types of diet (Roberts, Manchester 2005). During the study, the following pathologies have been observed: caries, calculus, periodontal disease, dental enamel hypoplasia and abscesses. Dental attrition has also been recorded.

Additionally, when possible, statistical analysis of the associated graves has been undertaken for the purpose of analyzing the social structure of each population, and its possible relationship with diet. It is intended to link the results of these studies to general archaeological and palaeoenvironmental information, as well as to undertake a new program of radiocarbon dating on the remains.

Preliminary Results

To date, the stable isotopes of more than 300 adult individuals have been analyzed, and a number of the individuals have also been radiocarbon dated. So far, the stable isotope results have revealed the existence of dietary differences between individuals of different cultures and between groups of individuals within one culture.

The single available *Neolithic* individual came from the site of Bateni. Late Neolithic and Early and Middle Bronze Age samples derive from the following archaeological sites: the *Afanasyev Culture* – from Afanasyeva Gora and Karasuk III, the *Okunev Culture* – from Uibat III, Uibat V and Verhniy Askiz I, and the *Andronov Culture* – from the site of Yarki.

Almost all these individuals analyzed have low $\delta^{13}C$ values indicating consumption of mostly C_3 plants, and high $\delta^{15}N$ values indicating a highly meat- and/or fish-based diet (Fig. 1).

The isotopic results of people of the *Afanasyev Culture* showed that the two groups of individuals coming from different sites had different dietary patterns. People from the

Afanasyeva Gora have higher $\delta^{15}N$ values than those from the Karasuk III, which may indicate a greater reliance on fish.

Fig. 1. C and N values for individuals of the Neolithic-Andronov Culture

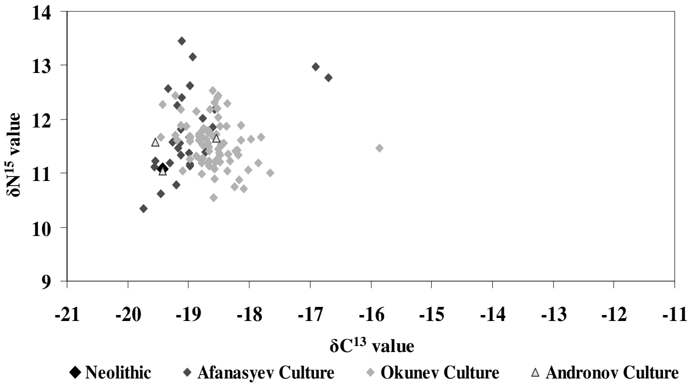
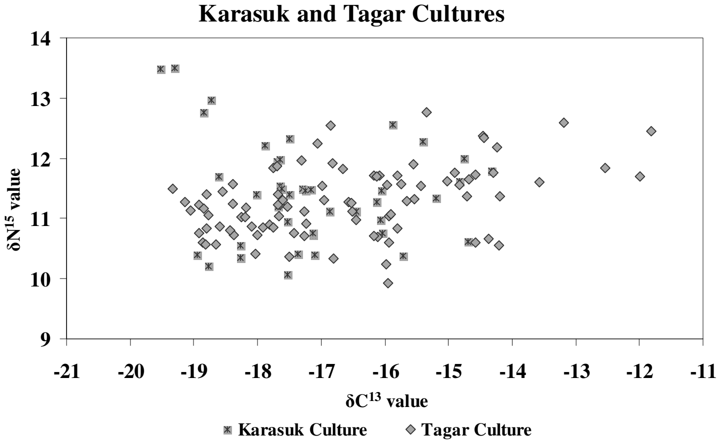


Fig. 2. C and N values for individuals of the Karasuk and Tagar Cultures



One individual from Afanasyeva Gora, one from Karasuk III and one from Uibat V have notably higher $\delta^{13}C$ values. This means they had a different diet from other members of their groups, one that may have included more C_4 plants.

Overall isotopic results of people of the Neolithic and Early and Middle Bronze Age have revealed a diet apparently based on C_3 food chains, and probably including large amounts of animal protein.

Individuals of the second half of the Bronze Age and Early Iron Age analyzed came from the following sites: the *Karasuk Culture* – from the Bateni Sovhoz, Melnichniy Log, Okunev Ulus, Solnechniy Log, Upper Karasuk River and Yarki; the *Tagar Culture* are from the sites of Bateni-Saragash, Chernoye Ozero I, Grishkin Log, Lepeshki, Nurilkov Ulus, Okunev Ulus, Podgornoye Ozero, Saragash, Saragashinskoye Ozero, Saragashinskiy Spusk and Yarki.

All $\delta^{15}N$ values of individuals from the *Karasuk* and *Tagar Cultures* analyzed remain high, and are comparable to those of the earlier periods, which possibly indicates their continued reliance on meat and fish, but higher $\delta^{13}C$ values – in some cases considerably higher – than those of preceding cultures, indicating their greater reliance on C_4 plants (Fig. 2).

The results have also revealed great disparity in isotopic values within individuals from the same archaeological site, which may indicate different dietary patterns among individuals within single groups. The most scattered results in terms of both carbon and nitrogen isotopes of *Karasuk* individuals are those coming from Okunev Ulus and Bateni Sovhoz. The *Tagar* individuals are dispersed mostly in $\delta^{13}C$ values: especially varied are samples derived from Nurilkov Ulus, Podgornoye Ozero and Saragash. Such a wide spread indicates differential reliance on C_4 plants among members of the society or possibly a change in the dietary patterns of people through time, if the individuals with different $\delta^{13}C$ values belonged to different phases of activity from each cemetery. Forthcoming radiocarbon dating of these individuals will help to address this issue, and will provide important information on the timing of the appearance and significant use of millet in Southern Siberia

Isotopic results of individuals of the *Karasuk* and *Tagar Cultures* have revealed a change in the dietary behavior of the Minusinsk people during the second half of the Bronze Age and Early Iron Age. The greater reliance on C_4 plants appears to indicate the increased role of agriculture in their economy. The greater differences in diet within single societies may be a reflection of significant social stratification within the *Karasuk* and *Tagar* communities.

In addition, a small number of animal bone samples from the *Okunev*, *Karasuk* and *Tagar Cultures* have been analyzed. Unfortunately, more animal (and particularly fish) bones are currently required to enable us to establish possible links between human and animal isotopic values.

Statistical analysis of the associated graves has shown evidence of social differentiation among individuals derived from separate sites, particularly those of the *Karasuk* and *Tagar Cultures*.

Conclusions

The present ongoing research has revealed many features of the diet of the six main prehistoric populations of the Minusinsk Basin. The study suggests that agriculture was extensively introduced in the region during the second half of the Bronze Age and Early Iron Age, and contributed to a more pronounced stratification of society. There is still much to do to explain significant variations of the results among the individuals of the *Afanasyev, Okunev, Karasuk* and *Tagar Cultures* that derive from the same sites. Also supplementary analysis of animal bone is needed to provide valuable information for the reconstruction of further details concerning prehistoric food chains and palaeoenvironment.

Acknowledgements

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Holocene human and environmental dynamics in the Lake Baikal region derived from pollen and archaeological records

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Numerous examples from the ancient and recent past demonstrate that humans often played an active role in interactions with the environment. Forest clearance for obtaining fuel and construction materials and the creation of pastures and fields are among the most frequently reported human activities responsible for changing natural vegetation and modifying landscapes. In this recent study the results of the quantitative reconstruction of the four bioclimatic variables – mean temperature of the coldest month (T_c), mean temperature of the warmest month (T_w), mean annual precipitation (P_{ann}) and moisture index (α), calculated as the ratio of actual to equilibrium evapotranspiration – derived from the Buguldeika pollen record, are compared with published archaeological and palaeoenvironmental data in order to (a) evaluate the possible role of climate in the mid-Holocene hunter-gatherer habitation discontinuity and culture change in the Lake Baikal region; (b) discuss anthropogenic and climatic controls of Holocene vegetation dynamics.

The Holocene core (52°31'N, 106°09'E) presented in this study was recovered from a depth of 355 m in the 25-km wide underwater Buguldeika saddle separating the southern sub-basin of Lake Baikal from its central sub-basin. The biome reconstruction shows that tundra and steppe biomes have highest scores between ca. 15,000–13,300 cal. years B.P. and that taiga became a dominant vegetation type after ca. 13,300 cal. years B.P. Our quantitative reconstruction indicates an onset of relatively warm and wet conditions soon after ca. 10,000 cal. years B.P. The warmest and wettest climate with $T_w \sim 16$ °C, $P_{ann} \sim 480$ mm and $\alpha \sim 0.9$–1 has been reconstructed for ca. 9000–7000 cal. years B.P. In the Lake Baikal region this interval is characterized by the appearance and spread of hunter communities (Kitoi culture). Consistently a hiatus in the regional archaeological record (4900–4200 years B.C. or 6850–6150 cal. years B.P.) coincides with the interval of a major climate deterioration which followed the 'climatic optimum'.

An attempt to find a relationship between the archaeological record and the spread of steppe and meadow communities in the Lake Baikal region around 7500, 5500, 3000, and 1000–500 cal. years B.P. demonstrates that, despite extended habitation of the area, human impact on the vegetation was local rather than regional and likely did not affect the pollen record from Lake Baikal. The reconstructed peaks in the steppe biome scores during the last 9000 years are consistent with short (one to five hundred year) episodes of weak Pacific (summer) monsoon supporting our interpretation that the Holocene vegetation changes around Lake Baikal are associated with large-scale circulation processes controlling regional water balance rather than with human activities.

Choice of resources: earliest settlement behaviour in Northern China

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The transition from mobile to sedentary life, from foraging to food producing modes of subsistence is regarded as one of the most far-reaching developmental steps in the history of mankind. Recent archaeological discoveries and studies concerning the earliest pottery, farming and house building in Eastern Asia have challenged our general understanding of "Neolithisation".

The term "Neolithisation" commonly implies the appearance at the same time of domestication of plants and animals, fired pottery and polished stone tools. The earliest forms of permanent settlement and the beginnings of domestication are known from the Near East and have been dated to approximately 11,000 cal. years BP. Two millennia later the agrarian economy started spreading from the Eastern Mediterranean towards Europe, North Africa and Central Asia. On the Japanese archipelago the use of ceramic vessels seems to have started as early as about 16,000 cal. years BP but permanent settlements do not appear before ca 10,000 cal. years BP at the southern tip of Kyushu Island and agriculture even later. About 8000 cal. years BP the vast region of northern East Asia, comprising the Russian Far East (*Primor'e*), northeast China, Korea and Japan, shares some characteristic cultural features: funnel-shaped ceramic vessels with a small flat bottom and wide mouth and distinctly textured surface, small stone or nephrite rings with a radial cut (earrings) and symmetric arrangements of rectangular houses in villages. These common characteristics make the region appear culturally closely related. In one of the settlement sites in northeast China millet has been found. Millet cultivation nevertheless dates back to ca 9500 cal. years BP in the lower reaches of the Yellow River within a cultural context which is distinctively different from the one prevailing in northern East Asia.

In this presentation selected sites from Northern China will be introduced which mark the onset of sedentary life between 9000 and 8000 cal. years BP. The focus of this comparative study will be put on locally specific choices of building materials for houses and tombs, raw materials for tools as well as animals and plants for nutrition. The southernmost of the sites under review is the Jiahu house and tomb cluster (33°36'N; 113°40'E) with a radiocarbon dated period of existence from about 9000 to 7800 cal. years BP. The Jiahu site is located at the northern periphery of early rice cultivating communities nevertheless it exhibits close cultural links to inhabitants of the northern plains. It has become famous for the oldest playable musical instruments being parts of complex sets of grave goods.

The northernmost site is Baiyinchanghan (43°35'N; 118°03'E). Here the main settlement phase dates back to ca 8200 cal. years BP following an initial phase for which only scarce data are available at present. Rectangular houses, with an area of between 20 and 100 m^2, are arranged in rows within a trench, interring of the dead in burial grounds outside the settlement in single graves with stone slabs, manufacture of elaborate nephrite ornaments and medium-sized stone sculptures are evidence of a community with a multifaceted and well organised economic and ritual life. There was a reliance on big game hunting of forest animals and plant gathering. Field cultivation has not been confirmed in Baiyinchanghan.

Any considerations of the driving forces behind the beginning of sedentary life in Northern China including the questions: who were these settlers – were they native hunters and gatherers who gradually became farmers, or farmers who migrated from elsewhere, must include chronologically well controlled data from the entire north-east Asian region.

Beetle-vegetation relationships and Holocene landscape structure: a modern analogue approach

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Insect faunas, usually the remains of Coleoptera (beetles), have been seen as valuable indicators to potentially support or refute, the 'Vera hypothesis' (*c.f.* Vera 2000), its associated implications for palaeoenvironmental studies and the reconstruction of the structure of the 'wildwood' (*c*. 9500–2000 cal BC) in Northern Europe (Svenning 2002; Bradshaw *et al.* 2003; Bradshaw and Hannon 2004; Whitehouse and Smith 2004; Buckland 2005; Mitchell 2005). The implications of this debate for modern conservation strategies and our understanding of present and past woodland ecology have also been widely explored (Vera 2000; Kirby 2003, 2004; Mitchell 2005; Hodder *et al.* 2005) since an accurate reconstruction of the nature of "primeval woodland" is seen as a starting point of present forest policy (Sutherland 2002; Kirby 2004). From palaeoecological perspectives, this debate questions our ability to reconstruct landscape structure and forest density and suggests that we should consider a more diverse range of possible Holocene landscape models.

The debate concerns two opposing viewpoints of past, present and future forest plant ecology. The 'traditional' view of the primeval forest draws on Clementsian succession, which forms the theoretical basis for the forest "climax". Current ideas of forest succession, centred on 'gap-phase' regeneration, suggest that openings in the forest canopy are mainly created by the death of individual trees and account for only a small proportion of the forested landscape. Essentially, both models suggest that the early forests of Northern Europe consisted of predominantly closed canopy, or 'high forest'. The 'Vera hypothesis' is that ancient forests were more akin to 'wood-pasture', with a relatively open mosaic landscape supporting tree stands of varying densities, where vegetation structure and dynamics were driven by large herbivores Vera (2000). The detail of Vera's arguments have been summarised elsewhere (e.g. Mitchell 2005) and we do not repeat these here, except to draw attention to the fact that Vera (2000) questions the ability of palaeoenvironmental data to accurately identify past woodland density and reconstruct past vegetation types. This follows discussions about the complex relationship between pollen production, transport and deposition in sediments and the vegetation which initially produced it. One particular criticism concerns the ability of pollen analysis to "see" open community taxa such as grasses (see Sugita *et al.* 1999; Bunting *et al.* 2004). Vera makes the point that most pollen records for the early post-glacial period in northern Europe contain relatively large proportions of oak (*Quercus*) and hazel (*Corylus*), tree species that are shade-intolerant and favour the forest edge. He suggests that this implies an increased role for shade-intolerant trees in the present interglacial and a reduced role for shade-tolerant taxa such as beech (*Fagus*), Lime (*Tilia*) and Elm (*Ulmus*).

Vera's ideas have generated intense discussion amongst conservationists, biologists and palaeoecologists. Several palaeoecologists and palaeo-botanists continue to favour the 'high forest' hypothesis. Mitchell (2005) used pollen from a number of forest hollows and lakes in Ireland to test the 'Vera hypothesis'. Key to the hypothesis testing is 'grazing exclusion'. Mitchell points out that Ireland in the early and mid Holocene lacked the large herbivores that are central to Vera's arguments but there are no perceivable differences in the pollen spectra between Ireland and the rest of Europe. Mitchell's work has been seen as the 'smoking gun' that killed the 'Vera hypothesis' (see Birks 2005; Moore 2005). Others (e.g. Alexander 2005, Bell and Walker 2005), including Mitchell himself (2005), point out that:

- The unexplained ‘oak – hazel problem’ remains; how do these taxa regenerate under “closed canopy” conditions? Have their requirements for light changed over time (Mitchell 2005), or are we under-estimating the complexity of woodland structure in the Holocene? Are we under-estimating the role of human activities in this debate, including coppicing?
- Is the current understanding of pollen taphonomy understood well enough to be able to answer questions concerning woodland structure and landscape openness?
- Other proxies should be considered in the investigation of this complex problem, including fossil insect and molluscan data.

Fossil insects provide a a proxy for vegetation and landscape structure and therefore can contribute to this debate. Here, we present a review and re-analysis of 28 early and mid-Holocene (9500–2000 cal BC) sub-fossil beetle faunas from Britain (Whitehouse and Smith, submitted). We have examined terrestrial percentage values for open ground and pasture versus tree taxa, and tree host data. Open and pasture indicator species (including dung beetles) are persistently present over the entire review period, although they fluctuate in importance.

During the early Holocene (9500–6000 cal BC), open and pasture indicators are initially high, at levels which are not dissimilar to modern data from pasture woodland. However, during the latter stages of this and the next period, 6000–4000 cal BC, open ground and pasture indicators decline and are generally low compared with previously. Alongside this pattern, we see woodland indicators generally increase in importance, although there are significant local fluctuations. Host data associated with the fossil beetles indicate that shade-intolerant trees such as oak, pine, hazel and birch are important components of the tree canopy during the earlier Holocene (c. 9500–6000 cal BC), in accordance with much of the current pollen literature. Shade-tolerant trees do not become dominant until the middle Holocene (6000–4000 cal BC) suggesting that at this stage the woodland canopy was relatively dense, although open ground and pasture areas appear to have persisted in some locations. The onset of agriculture (4000–2000 cal BC) in the early Neolithic coincides with significant fluctuations in forest composition. There are also increases in the amounts of open ground and pasture represented by the faunas. This is presumably as a result of human impact, although here there are significant regional variations. One of the most striking aspects is the variable nature of the landscape suggested by the palaeoecological data, particularly but not exclusively with the onset of agriculture: some earlier sites indicate high variability between levels of tree-associated species on the one hand and the open ground and pasture beetle fauna (including dung beetles) on the other hand, indicating that in some locations, open areas were of local significance and can be regarded as important features of the Holocene landscape. Whether these are created as a result of natural (e.g. succession, forest fires, climate change, browsing animals) or anthropogenic activities associated with human intervention and manipulation of the landscape is a moot point; there are several possible interpretations to such findings.

One of the difficulties of this type of palaeoecological data relates to the problem of translating proportions of taxa into vegetation mosaics and landscapes. As a result of this, we have initiated a research project which is generating modern and fossil beetle-vegetation relationships from a range of ancient woodlands of known value for their saproxylic fauna (=the wood decay system), under differing management regimes, to establish a fossil insect “signature” of such landscapes. This research is funded via the Natural Environment Research Council (NERC). We are also examining the nature of the pollen signature of these same landscapes. The sites we are examining include a deer park (Dunham Massey), closed forest (Epping Forest), pasture woodland with many lone ancient trees (Windsor Great Park) and coppice woodland with scrub and pasture (Hatfield Forest). We have sampled surface sediment from c. 25 ponds in these sites, collecting a total of over 100 individual samples, identified the modern “fossil” insect faunas and counted the pollen assemblages. Here, we present results from one site, Dunham Massey, northern England. The results so far are encouraging and suggest that there is a positive relationship between fossil beetles and landscape structure, although the role of grazing animals appears to be an important moderator of results. We discuss the implications of this work for re-interrogating existing palaeoecological data and gaining a fuller understanding of past vegetation structure.

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Lake Megata 2006 Project: an introduction

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In the context of environmental archeology, it is increasingly important to better understand natural and anthropogenic environmental variability throughout the Quaternary using high resolution proxy records. Annually laminated lake sediments are unique terrestrial archives that provide seasonal to multidecadal environmental data. In East Asia, there have been recent efforts to improve the coverage of such records from several lakes. Since November, 2006, we started a new lake drilling project at Lake Ichi-no-Megata, in which we obtained c. 38m long boreholes covering the last 30 ka. L. Ichi-no-Megata is located at Oga peninsula along the Japan Sea coastal region of the northeastern Honshu Island, Japan (39°57'17"N, 139°44'21"E, 100m a.s.l.). Before drilling, the lake bed configuration was studied using acoustic exploration. The drilled core are now being investigated based on several scientific disciplines, e,g, stratigraphy, lithology, radiocarbon dating, pollen , diatom and geochemical analyses and so on. In this paper, we will present a brief introduction and future perspectives of our project with the recent analytical results.

Stratigraphic analysis of the core samples from Lake Ichi-no-Megata, northeastern Japan

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We collected 37-m-long non-glacial varved sequences from Ichi-no-Megata maar in Oga Peninsula, north-eastern Japan. The Ichi-no-Megata maar occupies 0.25 km^2 with a maximum water depth of ca. 45.1 m. The shape of the lake is a kettle-type basin and its deepest bottom is very flat. The water column of the lake is unlikely to be overturning due to the appearance of thermo-cline around 2–4 m of water depth all over the year. We took core samples (hereinafter IMG06 core) at the center of the lake (N39°57' 16.04", E139°44'19.16") from November to December in 2006. In order to take sediment samples completely continuously, we drilled three boreholes that are ca. 5 m apart from each other.

As a result of the drilling, we obtained 37-m-long continuous sediment except for a thick volcanic deposit between 26.5 and 31.7 m in depth. The sedimentological feature of the IMG06 cores is dominated by thin lamination clay/silt from the upper-most part to 37 m with turbidites characterized upward fining structure. The SEM images of the core sections showed that the sponge-like laminae consist of diatom assemblage, and on the other hand the dark colored laminae consist of mixture of detritus minerals, clay minerals and diatom. It is suggested that the former was deposited during spring, and that the latter is deposited during other three seasons. Thus the thin lamination of the IMG06 cores was identified as varves.

In the IMG06 core, six volcanic ash layers were observed: Baitoushan-Tomakomai (B-Tm: 1.1 ka) at 1.99m, Kikai-Akahoya (K-Ah: 7.3 ka) at 6.64 m, Asama-Kusatsu (AsK: 16 ka) in 12.18m, Daisen-Higashidaisen (DHg: 19 ka) in 16.35 m, a scoria-type ash at 19.87 m and Aira-Tanzawa (AT: 29 ka) at 36.5 m. In addition, radiocarbon dating was performed using macro remains (broad leaves, seeds and branched) collected from 38 horizons of the core. An age-depth model was developed using dendro-calibrated dates. The mean sedimentation rate was c. 0.7 mm/year. The dating result showed that the IMG06 cores have a potential to reconstruct the past environmental changes in East Asia over the last 25000 ^{14}C yr BP.

Environmental archaeology in Japan: a new approach to reconstructing past environment using annually laminated lake sediments

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In Japan, environmental archaeology was established in 1980 by Yasuda. One of the marked progress in this scientific domain in Japan is in the recent discoveries of the annually laminated sediments, which has made us capable not only of reconstructing the environmental changes in the past at a high resolution (annual to subannual) but also of discussing the relationships between man and environment. In this small session, we would like to present the recent progress and the future perspectives of the studies using annually laminated sediments collected from Japanese lakes. The annually laminated sediments were also found at the Dead Sea Basin by Migowski and his colleagues. In this report, the author will make an attempt to compare the lake level fluctuations of the Dead Sea Basin with the sea level changes reconstructed from the study of the annually laminated sediments from Lake Tougou-ike in Japan. The results will show a new insight on the relationship between man and environment.

Climate, famines as deduced from the comparative study on tree rings and annually laminated sediments

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The East Asian monsoon is an important component of the global climate system, and impacts the livelihood in the highly populated regions of East Asia. Long-term, high-resolution climate records are essential to better understand the nature of the East Asian monsoon. For the last decade or so, efforts have been made in Japan to obtain annually resolved archives of past environment, i.e. tree rings and varved lake sediments.

In this study, we report on the recent results of dendroclimatic reconstructions in Japan. Tree-ring chronologies been developed mainly using Hinoki cypress (*Chamaecyparis obtusa*) and Japanese cedar (*Cryptomeria japonica*) on the central and northeastern Honshu Island, Japan. The reconstructions were validated against the regional climatic records in East Asia. The Hinoki chronology, strongest at capturing interdecadal climatic variability, identifies five cooling events for the late Little Ice Age in Japan.

Our reconstruction shows a reasonable agreement with previously obtained documentary evidence and other reconstructions in East Asia. Documented records of prolonged famines and unusual climatic phenomena support our reconstruction for cold periods during the 1780s, 1810s and 1830s; the latter two are also indicated in the northern hemispheric reconstructions. In consequence, these comparisons have revealed that our tree-ring chronologies have enough potential to reconstruct the climatic variability back into the past. Finally, we will present our future plan of a comparative study of tree rings and annually laminated sediments of Lake Megata.

Summaries of posters

The Late Pleistocene-Early Holocene diatom record from a former lake, Velanská Cesta (Czech Republic)

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A former lake, Velanská Cesta, belongs to one of the few localities covering the Late Pleistocene-Early Holocene period in the area of the Czech Republic. Its sediments, recently overlain by a peat-bog, are situated approximately 3 kilometres west of the town of České Velenice (Gmünd). The lake originated in the Bölling period. The presence of biotic indicators of the aquatic environment terminated in the Preboreal period. As part of a multiproxy study from the site, a diatom analysis of the radiocarbon dated main-core sediment was undertaken.

118 diatom taxa were distinguished in 50 samples using 2 cm sediment sections. At least 650 valves were counted per sample. Diatom based indices of the trophic state and salinity (Van Dam et al., 1994) together with TP, pH and TOC, calculated using transfer functions from EDDi (http://craticula.ncl.ac.uk/Eddi/jsp/), were compared to Late Pleistocene-Early Holocene temperature shifts as recorded on the $\delta^{18}O$ GISP2 curve (Stuvier et al., 1995). Although the trophic state and salinity showed a decreasing trend during the lake development, they tended to reach higher values, in relative terms, throughout the colder events. This tendency is also supported by the finding of colder climate macrofossil indicators in the corresponding samples. We suggest the increased transport of nutrients into the water environment, caused by the lower production of surrounding vegetation within colder periods, as an explanation. Another cause could lie in the longer ice cover duration and consequent accumulation of nutrients in the water induced by the limited vegetation season of water plants and algae.

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The vascular plants of earthworks in the Wielkopolska region (western Poland)

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Introduction

The Wielkopolska region is situated in mid-western Poland. At the transition between the 1st and 2nd millennium AD, Wielkopolska became the cradle of Polish statehood. In the 10th century, the centralist influence of dukes from the Piast dynasty led to the unification of neighbouring districts and the birth of the Polish state. In the newborn country, a special role was played by fortified towns, which were the seat of governing dukes, courts, administration, fiscal authorities and armed detachments. These sites were usually fortified with a wall of earth and wood, and surrounded by a moat. The remnants of such ancient towns, abandoned and ruined, are described as earthworks.

The rapidly-developing country – with its dense network of fortified towns and settlements, well-developed agriculture and good economic and trade relations – impacted significantly on the natural environment. The presence of a large number of various archaeological structures in the Wielkopolska and poor knowledge of their geo-botanical characteristics led to the initiation of systematic floristic studies in the region. The aim of this work was to describe the vascular plant flora of the historical earthworks and to separate out the group of old crop-plants (relicts of cultivation), as well as to compare the flora of the earthworks with that of the surrounding landscape.

Material and methods

This work presents results of studies carried out in 233 localities, including concave (141) and conical (84) earthworks, and castles (8). Concave earthworks (ring-shaped) are distinguished by a small depression surrounded by a wall of earth with a moat and, at times, an additional outer wall and moat. In contrast, conical earthworks are mound-shaped. They are often surrounded by a moat and sometimes by a wall of earth, as well as another moat. In the course of this study, 1050 floristic and ecological relevés were taken. The total number of floristic records amounts to nearly 25,000.

Characteristics of the flora of earthworks:

1. The vascular flora of the 230 archaeological structures studied comprises 797 species representing 401 genera, 106 families and 6 classes.
2. In the flora of the earthworks, rare species (from class 1 and 2) and less rare ones (from class 3 and 4) are predominant. They constitute 90% of the flora, i.e. 727 species. Frequent species (class 5) and common ones (class 6) represent only 10% of the flora, i.e. 70 species.
3. Within the flora of the earthworks, there is a clear predominance of native species over antropophytes, with 626 indigenous species (77.4%) and 183 species of alien origin (22.6%). In a group of spontaneophytes, 272 species occur outside their natural and semi-natural communities (apophytes). Among anropophytes, archeophytes dominate (83 species; 10.3% of the flora), followed by kenophytes (59 species; 7.3%) and diaphytes (40 species; 5.0%). The latter are comprised exclusively of species that had escaped from cultivation and run wild, i.e. ergasiophytes. The majority of alien species belong to the families Asteraceae, Poaceae and Brassicaceae (64 in total). Only antropophytes are represented by Malvaceae (5 taxons), Cucurbitaceae (3) and Amaranthaceae (2).
4. Among the most numerous life forms are hemicryptophytes and therophytes. Perennials constitute 45.3%, while annuals constitute 22.7%. In the cryptophytes group, geophytes

dominate over hydrophytes, and for phanerophytes, shrubby forms dominate over arborescent ones. In all groups, except for therophytes, native species are prevalent. They are particularly well represented in the chameophytes, hemicryptophytes and cryptophytes groups. Therophytes produce the largest share of synanthropic species, both native and alien. In the group of phanerophytes and hydrophytes, no archeophytes were recorded, while phanerophytes contain the largest number of species that had escaped from cultivation and run wild.

5. The diversity of species associated with the historical earthworks was manifested, among others, in the sociological and ecological composition of flora. The largest proportion contains plants of meadow and sward communities – 231 species. A large group also consists of plants of mesophyll forest and nitrophilous scrubs, as well as ruderal communities. Althogether, these 4 groups constitute 54.6% of the total flora. The smallest group is species from epilithic communities. Native species appear in all sociological and ecological groups, although they were most numerous among meadow communities (116 taxa). Anthropophytes were not found in 5 groups, but they dominate in groups 13, 14 and 16. Archeophytes are particularly numerous in segetal and ruderal communities.

6. The largest number of species is associated with mesohemorobic and euhemorobic habitats (709 and 505 respectively). A total of 145 species were recorded within the oligohemorobic grade, with only 21 in the polyhemorobic grade. In oligohemorobic habitats, the analysis of geographical and historical groups revealed a prevalence of native species (97.9%). Among them, 63.4% are made up of non-synantrophic spontaneophytes. Along with the increased influence of anthropogenic factors on habitats, the share of spontaneophytes (particularly non-synanthropic examples) diminishes, with an increased number of anthropophytes. Almost 30% of the latter are associated with euhemorobic habitats. In all types of habitats, the dominant role is played by hemicryptophytes. Accompanying the increase of hemoroby, the proportion of terophytes also rises, with a corresponding decrease of other groups, especially chameophytes and cryptophytes. The latter groups are absent from the polyhemorobic ecosystems. Four species were observed within all grades of hemoroby: *Acer platanoides, A. pseudoplatanus, Betula pendula* and *Taraxacum officinale*.

7. Earthworks are refuges of species diversity in the agricultural landscape of the Wielkopolska. Thanks to the specific plant formations that developed on their grounds, biodiversity has been significantly enhanced. Floristic dissimilarity between earthworks and the rural surroundings is a result mostly of the small size of those structures and the high diversification of habitats – within one structure we often find, e.g. a boggy moat, xerothermic embankments, afforestations and crop fields, as well as a large number of endangered, vulnerable, rare and legally-protected species and relicts of cultivation. There are also many trees of monumental size in those historic sites.

8. Amongst the species that grow on the grounds of the earthworks, a group of cultivation relicts was recognized. These plants are the remnants of ancient cultures and include such species as *Malva alcea*, *Lavatera thuringiaca*, *Allium scorodoprasum*, *Origanum vulgare* and *Lithospermum officinale*.

Malva alcea L. and other relics of cultivation in the flora of central Europe

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Plants are inextricably linked with human beings from the beginnings of our history. They are a source of food, medicines, fabrics and building materials. In the beginning, people used only plants growing in their immediate surroundings but later on, they brought them also from the remote regions of our planet. The flora of each country contains some species which are the remnants of old cultures. In due course their usage has ceased and at present, they are often not even associated with the group of crop plants. Such species are called the relics of cultivation. In its narrow meaning or sense, this group includes only alien species, brought from distant regions (relics *sensu stricto* – ergasiolipophytes). In its broader meaning, it contains also native taxons introduced into cultivation from natural localities (relics *sensu lato*). Native species, in the past or at present, which were used intentionally and later went wild again are called oekiophytes or oekiolipophytes.

Relics of cultivation (in German: 'Kulturreliktpflanzen') can be classified according to the historical periods in which they were cultivated, e.g. prehistoric, early medieval or medieval. Furthermore, names of some groups of relics derive from the names of tribes which introduced and cultivated them, as with plants of the Slavic period (in German: 'aus slavischer Zeit') or characteristic structures they were associated with, e.g. "earthwork" plants (in German: 'Burgwallpflanzen').

In the middle Europe, the first studies on plants of historical earthworks and relicts of cultivation associated with them were undertaken by German researchers in the 19th century. On a wider scale, studies on this issue were conducted in Meklemburgia by Bauch in the 1930's (1937, 1951/1952). In his work he concentrated on 150 Slavic earthworks. Of this group the most interesting were structures situated in isolated places, as for example on the Burgwall Island in Lake Teterow. Investigation of the flora of earthworks in Meklemburgia were continued by Hollnagel (1953) in the 1950's. He focused his attention on the Slavic settlements of lake islands in the Neustrelitz region. At the end of the 20th century, research on relicts of cultivation was undertaken by, amongst others, Russow (2002), Russow and Schulz (2001) and Privarci and Behm (2001). In Poland, studies on the flora of earthworks were initiated in the Gdańsk Pomerania region (Buliński 1993), where several dozens of historical earthworks and settlements were examined. The detailed investigations undertaken in the Wielkopolska region (western part of Poland) in the beginning of the 1990's comprised about 230 archaeological sites (Celka 1999, 2004, 2005). At present, research on the flora of medieval settlements and relicts of cultivation are carried out on selected sites in Poland, the Czech Republic and Ukraine.

Relicts of cultivation are a very diverse group of plants, representing many taxonomic units. The duration of their cultivation practices also varies significantly – from a few dozens to several thousands of years. They had been introduced into cultivation at the different stages of mankind's history, e.g. in prehistoric times or in the Middle Ages. The cultivation of some species, like e.g. *Viola odorata*, was abandoned and resumed repetitively during a few historical periods. Species which today are recognized as relicts were cultivated in the fields, within settlements and fortified towns, in monastery and church gardens and in the grounds of castles. Nowadays, their distribution is connected with the remains of such sites (earthworks, ruins of castles, old walls, parks and gardens). Some of the species, taking advantage of favorable conditions (e.g. the development of the road network or the increase in the number of ruderal habitats), spread widely, while others remained exclusively at the sites of their original cultivation. A group of relicts includes, among others, former medicinal herbs (e.g.

Malva alcea, Leonurus cardiaca, Parietaria officinalis), traditional dyer's plants (*Isatis tinctoria, Reseda luteola*), spice herbs (*Allium scorodoprasum, Artemisia dracunculus*) and ornamental plants (*Viola odorata*).

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Biśnik Cave: a reconstruction of the site's occupation in the context of environmental changes

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The results of sedimentological, geomorphological, palaeozoological and archaeological investigations provided the basis for reconstruction of the habitation history in Biśnik Cave in the southern part of the Częstochowska Uplands. It should be emphasized that almost throughout its 400,000 years of occupation, the cave was surrounded by a very diverse natural environment, with stretches of steppe, tundra, forest, marshy grounds and aquatic areas. The importance of Biśnik Cave is due to the presence of one of the oldest habitation structures ever discovered in Poland, the unique discovery of traces of Middle Palaeolithic deer antler-working, the discovery in the stratigraphic sequence of around twenty cultural levels, and the opportunity to correlate sedimentological, palaeozoological and archaeological findings. All of this evidence is extremely significant for the palaeography of the Middle and Upper Pleistocene in central Europe.

Settlement and environmental history around Lake Wonieść, Northwest-Poland

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Palynological studies were undertaken during the course of archaeological investigations of a Bronze Age settlement near the village of Bruszewo. The location is an important site of the Aunjetitz-culture in Great-Poland, with a fortified settlement and a number of waterlogged structures dating from the Early to Late Bronze Age. Archaeobotanical investigations were carried out by S. Karg and H. Kroll, while on-site palynological investigations were undertaken by W.L. Walmüller and J.-N. Haas. In order to achieve a regional view, a deep lake, around 15 km east of the settlement site, was cored. A water depth of 14m and an overall core length of 23m were recorded. The pollen diagram represents work-in-progress and ^{14}C-dates have not yet been obtained.

On a local scale, it appears that Bronze Age settlements were strongly influential (Hass 2004), but on a regional scale, woodland was predominant in the landscape throughout most of the prehistoric period, including the Bronze Age.

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Reconstructing land cover from historical maps and pollen assemblages from small lake in Tuchola Forest

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The results of a pollen analysis of the semi-liquid part of the sediment of lake Świdno, situated in the eastern part of Tuchola Forest, are presented here. The profile of sediment, taken with the Kajak sampler, was cut into 1 cm slices in the field. Each sample was dated using the ^{210} Pb method, so that the pollen diagram of the upper parts of the sediment of this basin corresponded to an age scale. The depth of core taken is 42 cm. The deepest sample was dated to 186 ± 30 years.

Changes of the landscape in the vicinity of the abovementioned basin were also examined on the basis of the analysis of cartographical materials. A set of five historical and modern maps was used. The oldest one is the Schrötter- Engelhardt map (c. 1800). The next one is the Masstischblätter map (1823–1830). Maps of the Wojskowy Instytut Geograficzny (1931–1934), topographical maps under the co-ordination of GUGIK (1975–1985) and under the co-ordination of 1992 were also used. These maps show signatures for forest, meadows, fields, waters and buildings. The maps were geo-referenced using the program Arc Gis v.9.0. All of the maps within a distance of 2000 m from lake Świdno were digitized. The main stage of this work consisted of contouring the forest patches with the program Arc View 3.2.

In the next stage the statistical coefficients, which one can define as the quantitative specification of the structure and pattern of landscape, were calculated. The landscape indices were used to compare the structure of landscape and land cover read from each map.

The area of forest on the Schrötter- Engelhardt map occupies 55 % of the total area. In the next period (Masstischblätter map) the acreage of afforestation decreases below 50 % and this is the highest degree of deforestation on all of the maps. An increase in the fragmentation of the landscape and a complication of the shapes of meadows and forest patches was also noted. From the beginning of the 20th century the acreage of forest has been increasing in the vicinity of lake Świdno.

The comparison of the results of both methods shows that the analysis of cartographical sources gives detailed information about the changes of the landscape structure and develops interpretational possibilities for the pollen analysis.

Animal bone remains from the Early Iron Age settlement in Jeziorko

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Site No. 1 in Jeziorko is situated in the western part of the Mazurian Lake District on a single post-glacial hill in a post-glacial valley. This location was undoubtedly of considerable defensive value. The complex consisted of the main settlement and two further settlements outside of the walls (No. 1 and No. 2, respectively). The first methodical excavations were undertaken there in 1950–54 (Antoniewicz 1964, Antoniewicz and Okulicz 1958). In 2003 another series of excavations began and they are still ongoing (Jaremek 2006). During this research it was established that the settlement in Jeziorko started in the late phase of the Hallstatt D Period, or at the end of the Hallstatt D Period and the beginning of the La Tene Period by establishing a defensive settlement which was then destroyed in the La Tene Period. It was inhabited by people of the West Baltic Barrow Culture. The later settlement in this location dates from the Early Middle Ages (10^{th}–13^{th} century).

This paper presents the results of the archaeozoological analysis of the osteological material excavated in 2003 and 2005–2006 from settlement No. 1, which dates back to the Early Iron Age. The animal bone remains obtained in the 1950s from settlement No. 2 were analysed by K. Krysiak (1958).

The examined material consists of 4,159 animal bone fragments. 3,629 of these, representing 87.3 % of the sample, could be identified to species and skeletal element. The vast majority of the material can be identified as mammal remains, with very few fragments belonging to birds or fish (Table 1). The mammal remains are mainly from domesticated animals and only 2.7 % of them belong to wild animals. Amongst the wild animal bone, red and roe deer are the most commonly represented, elk and boar come next, and single fragments belong to beaver and hare, with two fragments of aurochs or European bison.

Table 1. Zoological composition of animal bones from settlement No. 1 in Jeziorko

Zoological identification	N	%
Cattle	1,325	37,7
Sheep/Goat	904	25,7
Pig	315	8,9
Horse	959	27,3
Dog	13	0,4
Domestic mammals	3,516	100,0
Red deer	40	
Roe deer	29	
Boar	11	
Elk	13	
Hare	1	
Beaver	1	
Aurochs/European bison	2	
Wild mammals	97	
Birds	6	
Fishes	10	
Total	3,629	

The domestic animal bone is dominated by cattle (37.7 %). It is followed by horse, and sheep and goat. The percentages of their remains were similar at 27.3% and 25.7 % respectively. The least numerous are pig bone fragments (8.9 %), and only a few fragments belong to dog (0.4 %). The zoological analysis indicates that people from the settlement in Jeziorko were mostly preoccupied with breeding cattle, as well as small ruminants and horse. Hunting wild animals and fishing supplemented the breeding, but they did not play a very important role.

The anatomical distribution was analysed for the breeding animals. It showed that all of the parts of the skeleton were represented, together with the digital bones (Table 2). Therefore, it can be inferred that slaughtering and meat jointing, as well as consumption, took place within the settled area. There were no disproportions amongst the numbers of particular parts of the carcass, which means that none of those parts was taken away from the site or brought to it. The only exception concerned the presence of a significant percentage (over 40 %) of valuable parts of the horse carcass.

Table 2. Anatomical composition of breeding mammal remains from settlement No. 1 in Jeziorko

Anatomical element	Cattle		Sheep/Goat		Pig		Horse	
	n	%	n	%	n	%	n	%
Head	278	21,0	195	21,6	122	38,7	227	23,7
Trunk	353	26,7	180	19,9	50	15,9	425	44,3
Proximal part of fore limb	195	14,7	129	14,3	55	17,5	70	7,3
Distal part of fore limb	74	5,6	52	5,7	9	2,8	38	4,0
Proximal part of rear limb	264	19,9	230	25,4	50	15,9	78	8,1
Distal part of rear limb	109	8,2	103	11,4	17	5,4	57	5,9
Finger elements	52	3,9	15	1,6	12	3,8	64	6,7
Total	1325	100	904	100	315	100	959	100

The age of the animals was estimated on the basis of their tooth development (Lutnicki 1972) and the fusion of long bone epiphyses with their shafts (Kolda 1936). For each species the percentage of animals killed before reaching morphological maturity was estimated. For cattle and sheep/goat these percentages reached 4.5 and 5.9 %, respectively, which suggests economical breeding with the right balance between slaughtered animals and those kept alive for their useful features (eg. milk, wool). The percentage of remains belonging to young horses was also low at 3.0 %. The rest of the osteological material of horses belonged to those less than 8 years old, from 6 to 11 years old and from 15 to 17 years old. Useful features of living horses were definitely valued, as the animals were rarely slaughtered when young.

Some of the long bones were preserved intact which assisted in the calculation of the cattle withers height according to Fock's coefficient (1966) and the horse withers height according to Kiesewalter's coefficient (1888, quoted after Driesch and Boessneck 1974). The sheep withers height (Teichert, quoted after Driesch and Boessneck 1974) and the goat withers height (Schramm 1967) were also calculated. The cattle withers height did not exceed 110 centimetres which indicates that herds were dominated by small cattle of the *Bos taurus brachyceros* type. Horses were also small, with withers height between 120.4 and 125.8 centimetres. Only one measurement of 135.8 centimetres revealed the presence of a medium-size individual.

The measurements for sheep ranged from 57.7 to 64.1 centimetres. The withers height was calculated for two individuals and was 66.1 and 67.8 centimetres, respectively. It means that the small ruminants were represented by relatively low forms at that time and sheep were of the mouflon-type.

The bone remains from the site in Jeziorko bear numerous traces of both the pre-consumption treatment and the consumption treatment itself. Most of them have marks identified as the results of chopping, extending even to the less valuable parts of the horse carcass, such as the metapodial bones or astragals. Some of the remains have black or white coloured burning marks.

It can be concluded that the animal economy in settlement No. 1 in Jeziorko was dominated by cattle, sheep and goat and horse breeding, whilst wild animal hunting and fishing were less important. The breeding was economical and slaughtering as well as consumption took place within the settlement. Horse played an important role and marks on horse bones indicate consumption. All animal species were identified as relatively small forms which was common on other sites in the Early Iron Age in the north-east of the Polish territories (Piątkowska-Małecka 2003).

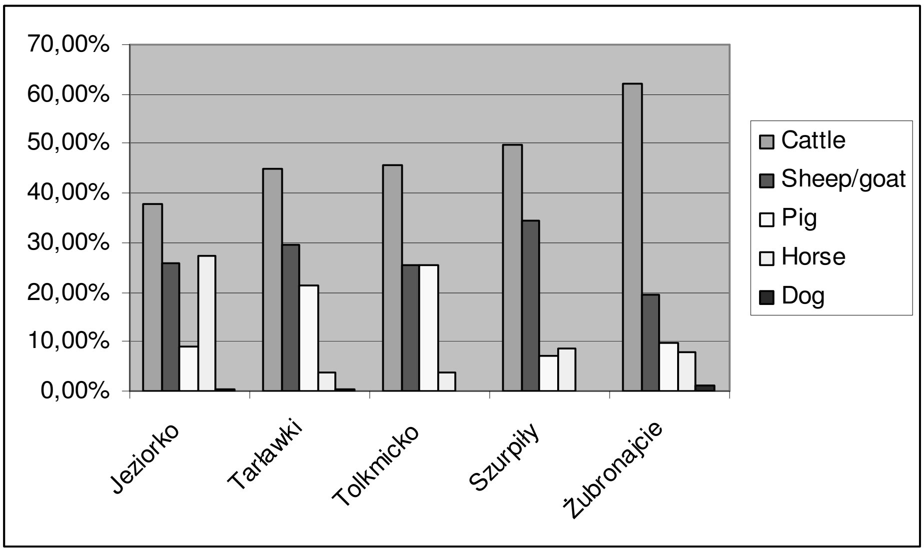

Fig. 1. Relative Proportions of domestic mammal remains on West Baltic Barrow Culture sites in the Early Iron Age

The special role of small ruminants and horse was already indicated by Krysiak (1958). His analysis indicated that these species were dominant and constituted almost 70 % of all of the domestic animal bone remains. This feature is characteristic of this particular site, whilst other similar sites had a different animal economy (Fig. 1). In Szurpiły, Tarławki, Żubronajcie and Tolkmicko cattle were dominant and constituted between 45.0 % and 62.0 % of the breeding population. Sheep and goat came second followed by pig, whereas the percentage of horse remains was low and did not exceed 9.0 % (Piątkowska-Małecka 2003). The prevalence of cattle indicates a settled people preoccupied with land cultivation. The animal economy in Jeziorko, where the breeding and consumption of small ruminants and horse was preferred, suggests a mobile people favouring a pasturage economy. At the moment there is not enough data either to prove or to reject this hypothesis. It requires further archaeozoological investigation of the osteological material from other similar sites dating back to the Early Iron Age.

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Anthropogenic relief transformations of the middle part of the Great Poland Lowland (Nizina Wielkopolska) as a result of prehistoric settlement and economic processes

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Research has been conducted into the mid-Great Poland Lowland, i.e. the Kościan Plain (Równina Kościańska) and adjacent geographical regions (Fig. 1). Such a perspective enables evaluation of morphometrical conditions at the settlement and economic processes. Geomorphologically, the study area is situated within the zone of the Leszno stage of the Baltic glaciation. The significant surfaces of this area are made up of morainic plateaus that are cut by glacial channels (marginal), which have taken on the character of the plateau islands. The lowest altitudes are in the order of 70–80 m above sea level and can be found in the Obra Outwash Valley zone, in the northern part of the area. The region rises southwards in the zone of the frontal morainic hummocks within the vicinities of Leszno, reaching around 150 m above sea level in that area.

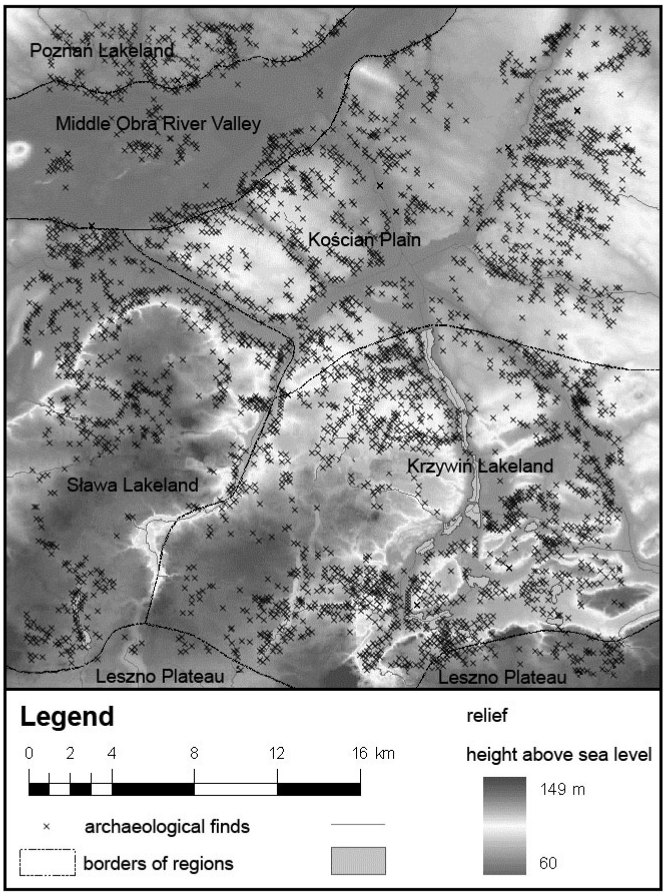

Fig. 1 Map showing the results of the Archaeological Picture of Poland against the background of the Digital Terrain Elevation Data (DTED 2), the hydrographical network and the physico-geographical regions.

Favourable topography, as well as the extensive hydrographical network (the outwash valley and the glacial channels, together with the lakes located within) – and, for some cultures, the soil cover (the presence of the black-earth on the Kościan Plain) – have favoured prehistoric settlement. According to data from the Archaeological Picture of Poland, Mesolithic settlement is present within the examined area, and settlement is particularly intense from the Neolithic period until the early Middle Ages.

Spatial analysis of the settlement (with the use of GIS methods) enables the distinction of high-density settlement regions concentrated in the middle part of the Kościan Plain during the Neolithic and Bronze Age periods. In the Iron Age, however, the disappearance of one settlement centre can be observed, with several smaller centres emerging. This process continues in the early Middle Ages.

In the distinguished settlement regions – where the intensification of settlement processes is the greatest – their influence on the relief is marked. These processes can be observed in the hypothetical settlement micro-regions:

Micro-region Kiełczewo is situated in the mid-Kościan Plain, known as the Kiełczewo Mountains (Kiełczewskie Góry). The area consists of Eolithic layers and was settled in two main stages (Stempin 1994): in the Neolithic period (the Funnel Beaker Culture, or FBC, settlement), and in the Roman impact period (the Przeworsk culture settlement). Use of the area surrounding the settlement during the Neolithic period contributed to the initiation of aeolian processes and the covering of the FBC settlement on the Kiełczewo 45 site with a 1m thick sand layer. The fossil soil occurring in the lower part of the profile can be associated with this settlement level. The settlement of the Przeworsk culture can be associated with the upper level of the fossil soil (one distinctly-shaped deposit or several less distinct ones) present in an area of a few hectares. These levels demonstrate repeated initiation of aeolian processes caused by the range and the intensity of the Przeworsk culture settlement.

Micro-region Bruszczewo is situated on the western escarpment of the Kościan Plain. This area was settled in the Early Bronze Age by the Unietic culture population. The relief transformations observed in that micro-region are of a diverse character (Czebreszuk, Müller 2004; Czebreszuk and Hildebrandt-Radke 2007). Their most spectacular form is represented by the digging of a 20m wide and over 4m deep moat, cutting off the settlement situated on the fluvioglacial peninsula from the plateau basement. The moat protected the settlement site, which was surrounded on the remaining sides by the marshy glacial channel of the Samica River. The presence of denudative layers, originating as a result of the erosio-denudational processes connected with the use of the settlement, signifies another form of relief transformations in the Bruszczewo site. These layers occur in the escarpment zone of the archaeological site. They correspond with several stages of the settlement use: the Unietic (the Early Bronze Age), the Lusatian (the Bronze Age) and the medieval stages.

Micro-region Bonikowo is situated within the Obra River outwash valley. The concave old rampart was built on the broad, boggy area of the outwash valley during the early Middle Ages. The old rampart encloses a large area of 2.5ha (including the moat), consisting of ground-reduction measuring 25m in diameter surrounded by three systems of ramparts and a small rampart (Fig. 2).

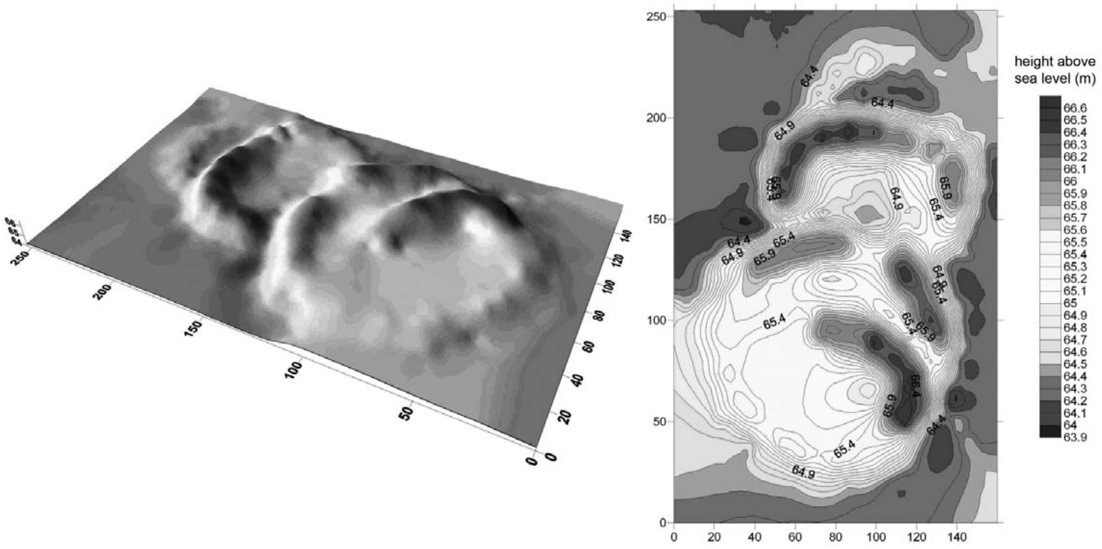

Fig. 2 Hipsometrical plan of the old rampart at Bonikowo.

The entire site is surrounded by a moat measuring approximately 8m in width, which can presently be seen as a small depression in the ground. The whole form is of an anthropogenic character and is the result of the transformation of its original area. The local building substrate (originating from deepening of the surface within the rampart and the digging of the moat) has been replenished with stony material collected from the fields. Within the ramparts, traces of the grillage construction (wooden framework) are also encountered (the wood has turned to ashes). The height of the ramparts reaches 2.20 m. The cubic capacity of the material used to construct the ramparts measures 24,000m^3. Analysis of the ceramics from the reductions indicates that various elements are not contemporary with one another. Rampart II originated during the beginning of the B stage of the early Middle Ages, while Ramparts I and III are later (they originated during the end of the B stage).

In conclusion, spatial analyses of settlement processes indicate that settlement intensity appears to be concentrated in regional areas. Within the larger settlement regions, local relief transformations can be observed at a micro-regional scale (the archaeological sites).

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Multi-proxy records of colluvial deposits at Księża Góra fan on Kożuchów Hills (south-western Poland)

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[4] Czech Geological Survey, Praha, Czech Republik

Introduction

The long climatic and environmental history of the earth is examined, as contained in various proxy records. As indicators, the proxies duly represent or record aspects of local climate. In measuring past climate changes to extend our records of past climates we use proxy climate data. Proxy climate data are records of natural conditions or events that are strongly controlled by climate. According to N.R. Catto, historical (written), archaeological, geomorphic, sedimentological, biological and paleosol data belong to the main types of palaeoclimatic proxies. Proxy climate data provide general climatic trends.

Studies of past high-frequency climatic variability require sedimentary sequences. Peat bogs and colluvial deposits provide good records of local vegetation changes during wet interglacial periods, while loess sequences with high accumulation rates are well suited for the study of dry, cold glacial periods.

Geomorphic response to land use in south-western Poland can clearly be seen in the widespread occurrence of truncated loess profiles on the hills and slopes, and soil erosion-derived colluvial and alluvial sediments. Due to land use, the unprotected soils became susceptible to erosion by water. Thus, sediments derived from soil erosion have long been the subject of pedological and geomorphological studies in Central Europe (Lang 1994, Lotter et al., 2003, Zoeller et al., 2001). More recently, interest in these studies has increased as archaeologists have recognized the value of such artefact-bearing sediments for studying the longer-term interactions between human activity and the landscape. Additionally, research on such sediments indicates the long-term costs and consequences of soil erosion (Niller 1998).

Study site

The study site at Księża Góra (51°47'31"N, 15°27'30"E) is located on the Kożuchów Hills at an elevation of 190 m a.s.l. The Kożuchów Hills are the north-western part of the Dalków Hills, a huge glacitectonic form created during the Warta Glaciation. Księża Góra is localized in south-western Poland between the Wilkopolska lowland and the Lower Silesia lowland.

Materials & methods

Preserved at the slope of the Kożuchów Hills, three sets of paleosol horizons within 5 m deep excavations of the sedimentary record on a small colluvial fan have shown the main climatic trends in Holocene typical for Central Europe as a whole (Lamb 1995, Lotter et. al 2003, Daansgard et. al 1993). The main proxies which are studied at Księża Góra are sedimentological, geomorphological, paleobotanical and paleopedological, along with isotopic dating, environmental magnetism, archaeological and historical data (Fig. 1).

The application of multi-proxy records helps us to recognise climatic changes in this region of Poland, mainly from the middle and Late Holocene, whilst on the other hand human impact could also be recorded, mainly during the Neolithic revolution and the early Medieval period. Based on C14 dating and OSL dating we can show cascade re-sedimentation of these colluvial deposits (Wintle et. al 1993).

Environmental magnetism based on magnetic susceptibility for Księża Góra telecorrelated with the results of paleoclimatic data from Central Europe – Lake Holtzmaar (Stockhausen, Zoltischka, 1999) allowed the recognition of two climatic periods. The first period could be correlated with the LIA and the second correlated with the MWP (Fig. 2). Sediments resulting from early soil erosion in the Neolithic to Iron age periods were mainly deposited on the upper slopes. Significant deposition on the lower slope occurred for the first time during the Iron age and the Roman period. Since then deposition rates have increased because of more intensive land use (Lang et al, 2003a, b). Palynological investigations also confirm this suggestion.

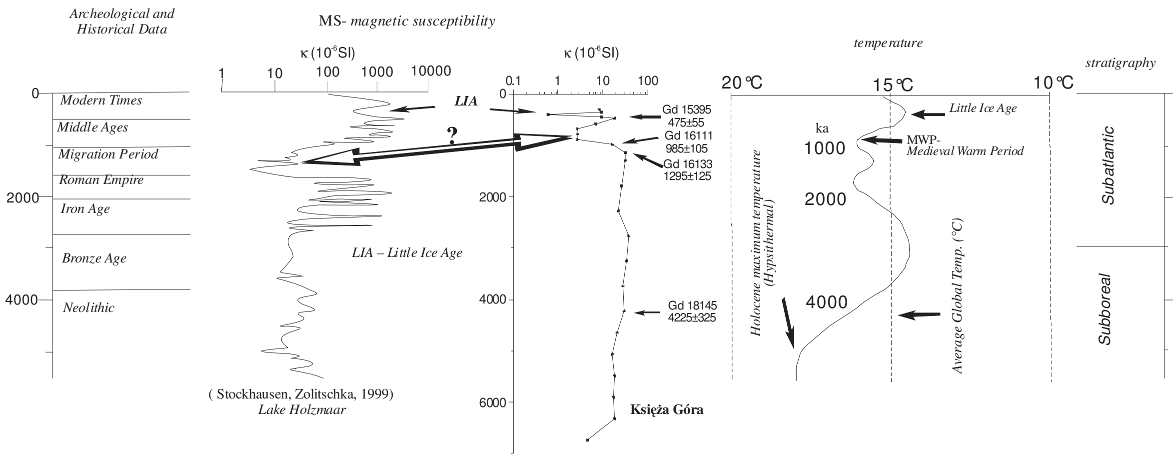

Fig. 1. Multi-proxy data records from Księża Góra

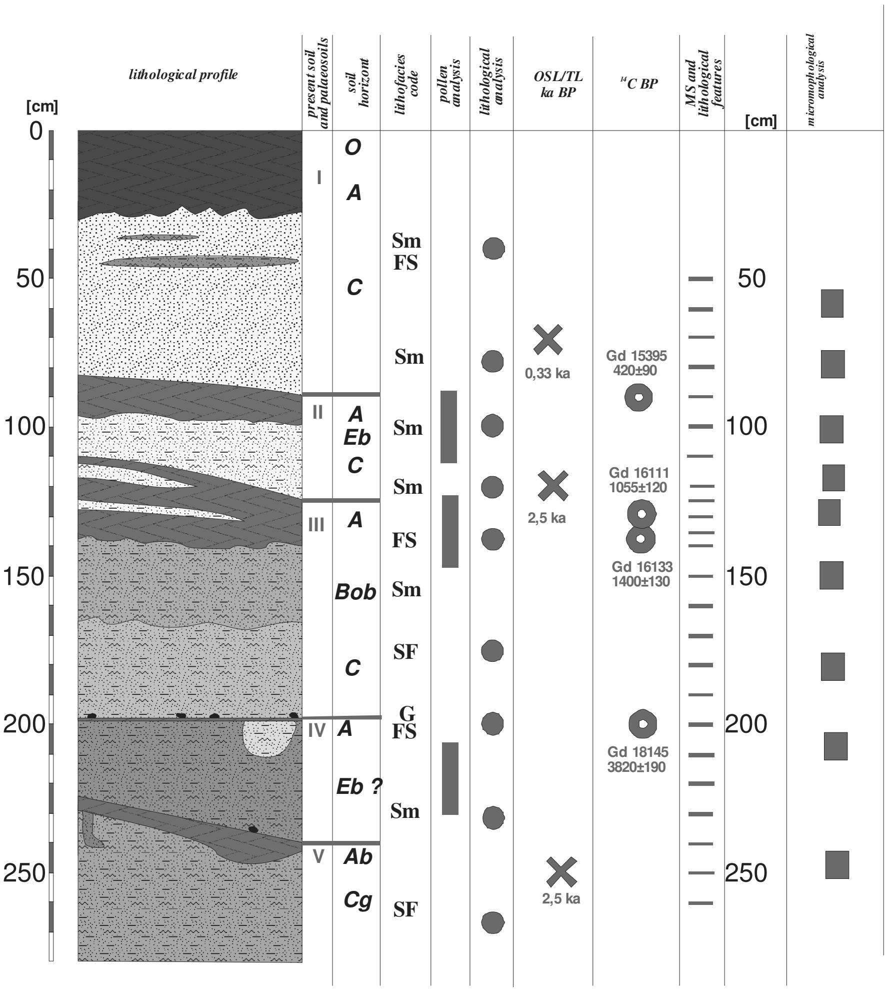

Fig. 2.

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Point-pattern analysis as a way of examining settlement processes. An example of early medieval settlement from the central-southern part of the Great Poland Lowland

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Until recently, archaeology did not have at its disposal any statistical methods for spatial analysis which would, in a quantitative way, consider mutual relationships in the arrangement of settlement points. The point-pattern analysis method, which has been developing since the 1980s (cf. Diggle 1983, Cressie 1992), provides tools for analysing patterns of point objects in quantitative terms. Although it was Hodder and Orton (1976) who raised about the possibility of using these methods in archaeology, it was De Meo et al. (2000, 2003) who first applied them in settlement research. The aim of this work is to introduce an attempt to apply point pattern analysis in scrutinizing the Archaeological Picture of Poland (APC).

Area of investigation, data and research methods

The study area comprises the Kościan Plain and fragments of the bordering geographical regions. The original dataset includes over 7700 settlement sites. These data originate from archival sources of ACP and include the whole of prehistory and medieval times. The method of transforming this archive material into the digital format of the geographical information system GRASS[(1)] and PostgreSQL[(2)] database will be presented in detail in a separate paper.

To illustrate this subject, a series of issues relating to the early medieval settlement has been selected from the whole. This early medieval settlement consists of two subsets: permanently settled sites – mostly settlements in APC terms (Fig. 1A) and temporarily settled sites – points and traces in APC terms (Fig. 1B).

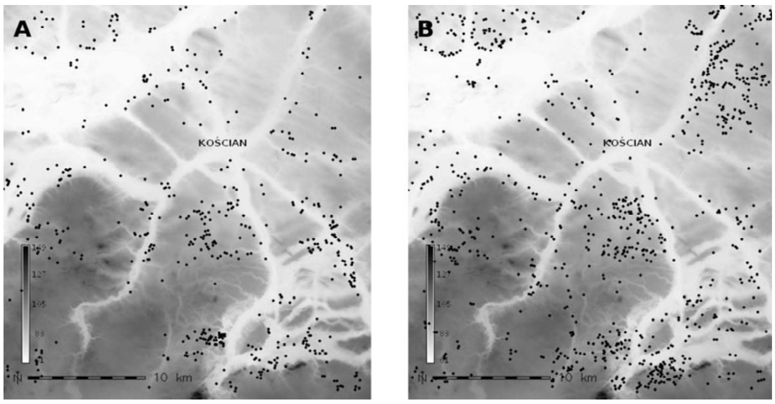

Fig. 1. Plots of settlement points against elevation: A) early medieval permanently settled sites, B) early medieval temporarily settled sites

Point-pattern analysis was performed using the package spatstat (Baddeley, Turner 2005), an extension of R[(3)]: the language and environment for statistical computing and graphics. All programs mentioned (1, 2, 3) are freely available over the Internet with no limitations and fees. The theoretical background for the point-pattern analysis method is mentioned primarily by Cressie (1992), but additional information may also be found in the works of Baddeley, Turner (2005) Baddeley et al. (2005) and in the documentation for the spatstat package.

Analysis of a point pattern arises when the important variable to be analyzed is the location of "events". The first and most important question to be answered is whether the point pattern exhibits: 1) complete spatial randomness, 2) clustering, 3) regularity. If a point pattern tends to show complete spatial randomness this means that it has been formed by a random process and the arrangement of the points was not affected by any additional factors.

An ascertainment that the pattern is clustered, i.e. the number of events in a given "event-to-event" distance is greater than the pattern of complete spatial randomness would indicate, allows the following: 1) execution of quantitative analysis of the degree of concentration and relations between relative points; 2) execution of density estimation and determination of the clusters of settlement centres on the basis of statistical criteria; 3) examination of the interrelation between subsets in a set; 4) fiting the point pattern to a given model, mainly using the trend and covariance analyses, then testing the goodness of fit and the reliability of the model.

Exploratory analysis of point pattern: summary statistics

Exploratory analysis of the point pattern is based on a comparison of the empirical pattern curve with the K,L,F,G function, (cf. Cressie 1992, or Baddeley, Turner 2005) with the theoretical layout of the homogenous Poisson distribution, inside envelopes of complete spatial randomness (csr), simulated using a Monte-Carlo random generator. Simply, if the empirical pattern curve lies within the csr envelope, it indicates a random layout of the events. If curve lies outside the envelope, this means that the layout forms a cluster or is a regular (inhabited) pattern.

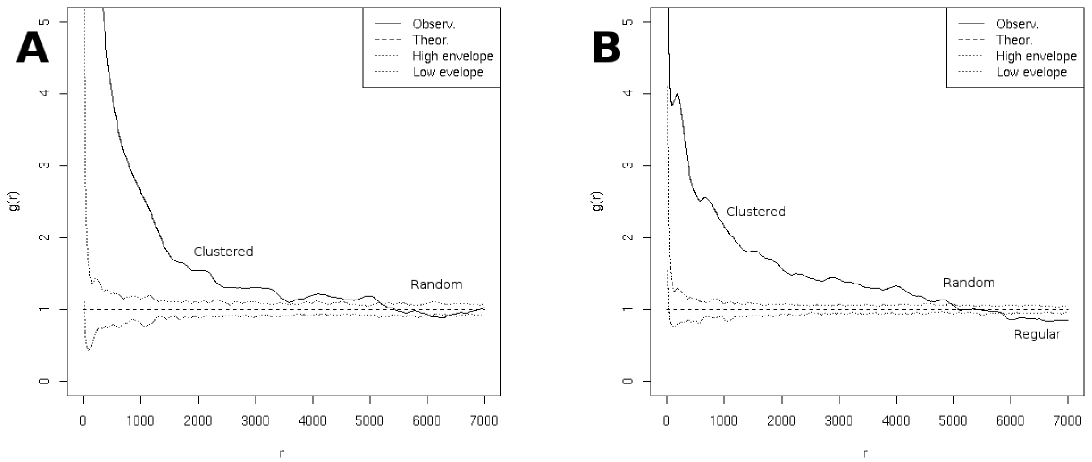

Fig. 2 J function curve (for explanatory notes see text) A) early medieval permanently settled sites, B) early medieval temporarily settled sites.

Figures 2A and 2B present a J function graph for the tested subsets. The J function is a compound of F function – "Empty spaces" and G function – "nearest neighbour distribution" (for details see Baddeley, Turner 2005). Analysis of this graph shows that there is a clustering of permanently settled sites at the distance one to the other ("event-to-event") of about 5 km, and shows especially clearly the clustering of sites which occur within a radius of 2 km. When the distance between two sites exceeds 5 km, it nevertheless takes on a random pattern. In the case of a set of temporarily settled sites the conversion into a (regular) inhabited pattern with a radius of about 6 km can be explained by the presence of vast, empty space which tends to occupy an area with dimensions of 6 km (see: Fig. 1B).

Kernel density estimation

Density estimation is used to determine the spatial variability of frequency in the occurrence of the events within the examined area. Density estimation, depending on the range of the smoothing factor sigma, allows distinction of the more extensive and fuzzy, or more compact clusters of sites. Fig. 3 shows a comparison between the intensity of settlements (A) and settlement sites (B). Measurement of the intensity of function is the number of sites per km^2, with the parameter sigma equal to 2.4 km. Sigma has been determined on the basis of the J function graph as the distance of clustering /2 (4800/2). The number of sites per km^2 exceeding the average + standard deviation, i.e. 0.9 for permanently settled sites and 1.51 for temporary settled sites, provided the basis for definition of the clusters on the density map. Figure 3 illustrates that clusters of temporarily settled sites do not coincide with the clusters of the permanently settled ones.

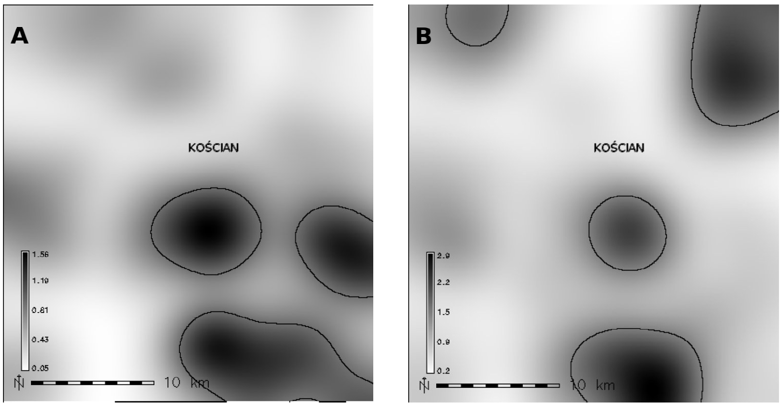

Fig. 3 Kernel density maps (for explanatory notes see text). A) early medieval permanently settled sites, B) early medieval temporarily settled sites

Analysis of multiple point pattern

Analysis of point pattern also allows the correlation between subsets of points to be tested, i.e. whether one subset of points influences another subset of the same set of points. Fig. 4 shows the interrelation between the expected intensity of the number of temporarily settled sites in relation to permanently settled sites relative to the expected value if such an influence did not exist. An example of the "J multi" routine graph (cf. Baddley, Turner 2005), indicates that at the distance of no more than 2 km from the permanently settled sites there are fewer temporarily settled sites than would be the case if there was no interrelation at all. When the distance is greater than 2.4 km, their number is significantly greater. This arrangement of sites may be interpreted as a "pushing out" of temporarily settled sites beyond the zones of concentration of permanently settled sites. This correlates with the model produced by kernel density estimation.

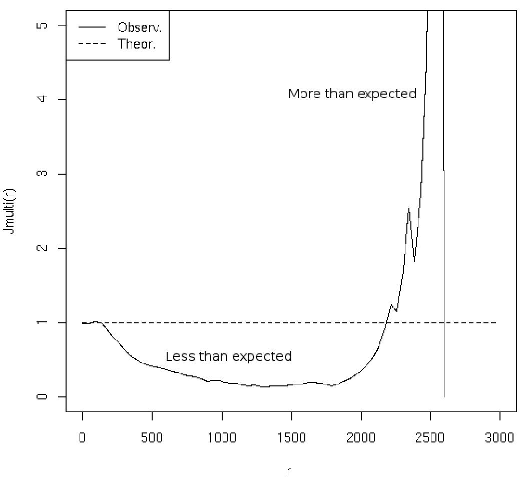

Fig. 4 Interrelation test of early medieval permanently and temporarily settled sites. "J multi" routine (for explanatory notes see text).

Fitting the point process model to data

The possibility of fitting the point process model to the data and testing the model's goodness of fit is a promising tool for point pattern analysis. This paper presents the fitting point process model for both examined subsets of points and models: 3rd degree spatial polynomial (Fig. 5 A, B) and 3rd degree spatial polynomial with additional parameter elevation, used as covariance. Both models have been chosen from sets of models due to their best goodness of fit (Baddeley et al. 2005). In both cases the examined subsets show different trends. The permanently settled sites show a tendency to concentrate in south-eastern part of the area, especially in low topography (Fig. 6 A), whereas the temporarily settled sites are mainly seen "fleeing" towards the borders of the study area. Moreover these sites are less dependant on elevation (Fig. 6B).

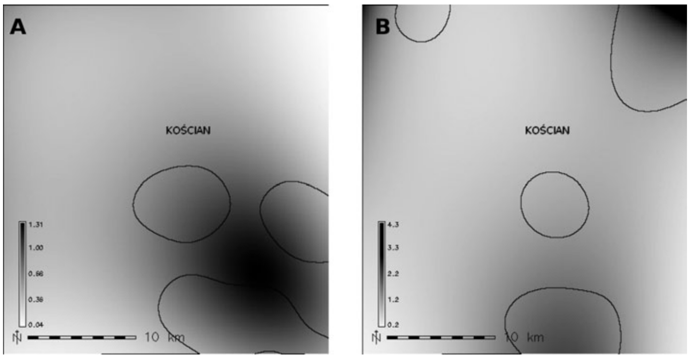

Fig. 4 Polynomial 3rd degree trend (for explanatory notes see text). A) early medieval permanently settled sites, B) early medieval temporarily settled sites

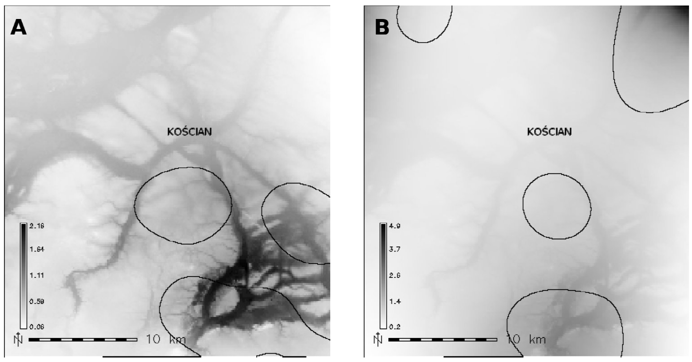

Fig. 5 Polynomial 3rd degree spatial polynomial trend with elevation as covariance (for explanatory notes see text). A) early medieval permanently settled sites, B) early medieval temporarily settled sites

Summary

Results and data are presented in this paper solely with the aim of presenting a new statistical method which can be used in analysing prehistoric settlement processes. These results prove that it is possible to examine settlement using quantitative (numerical) methods and, on the basis of measurable criteria, draw conclusions which until recently have been only subjective or demanded a great amount of effort.

Nevertheless, these data allow only preliminary assumptions to me made concerning the study area:

- Distinct clusters of settlements have been distinguished from early medieval times;

- Permanently settled sites tend to be concentrated in areas of low elevation, in the south-eastern part, while temporarily settled sites tend to be situated at the borders. However, elevation plays a less distinctive role in the latter subset.
- Permanently settled sites influence temporarily settled ones by "pushing" them approximately 2.5 km outwards from the area of their main concentration.

A detailed regional study using this method on settlement in the region of the middle Obra River (Kościan Plain), including complete data and other environmental variables (De Meo et. Al. 2006), will be the subject of a separate in-depth monograph.

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Environmental conditions of the early Medieval fortified settlement in Sopot

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This research covers part of the peripheral zone of the Gdańsk Morainic Plateau, whose characteristic feature is the occurrence of isolated morainic plateaus separated by valley depressions. In the physical-geographical division, this area is a part of the meso-region of the Kashubian Coastland (313.51), included in the macro-region of the Gdańsk Coastland (313.5) (Kondracki J., 2002) (Fig. 1).

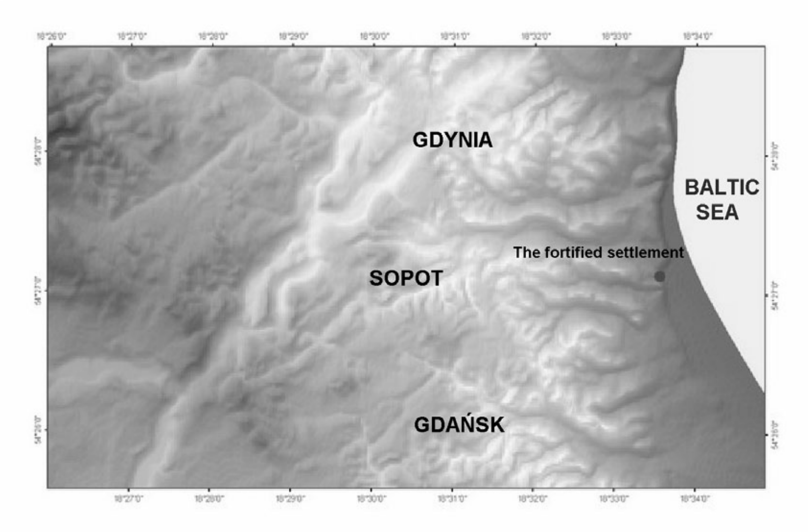

Fig. 1. Location of the study area – numerical model of the terrain

Using the results of archaeological research and all of the available source materials (written sources, historical studies and cartographic sources), the characteristics of the archaeological site – the fortified settlement of Sopot – were established. In the literature on this subject it is known as “Zamkowa Góra” or “Patelnia” (Szymańska A., 1997).

The study area is characterised by a variety of landscapes, resulting in diversity of the terrain morphology and relief, a mosaic pattern of soil cover, and a well-developed hydrographic network, as well as diversity of plant habitats (photo 1). These environmental components influenced the settlement development of the Kashubian Coastland to a high degree. Detailed analysis of cartographic material and topography of the area undertaken during investigation of the archaeological site – i.e. the fortified settlement of Sopot – indicates that the prehistoric settlers selected areas with diverse landscapes, which were the zones of contact between various environmental geo-complexes. Such choices were, however, always determined by environmental factors. On the basis of research and archaeological analyses (Makowiecki D., 1997; Sobociński M., 1990), two phases of its use were revealed in the chronology of the fortified settlement: a stage of the so-called open settlement (from the 8^{th} to mid 9^{th} century) and the establishment of pre-Piast dynasty stronghold (Szymańska A., 1997).

Photo. 1. General view of the settlement

The site was classified as a fortified settlement. Potential natural environmental conditions of the fortified settlement's location were determined by taking into consideration the basic components of the environment: morphology, land relief as determined by the geological structure, hydrographic relationships and soil conditions. Survey and interpretation of the spatial structure of the early Medieval settlement on the Kashubian Coastland and the location of the Sopot stronghold revealed that the location was fundamentally influenced by environmental conditions. Defensive conditions, additionally determined by the shape and hydrography of the terrain, were firstly taken into consideration.

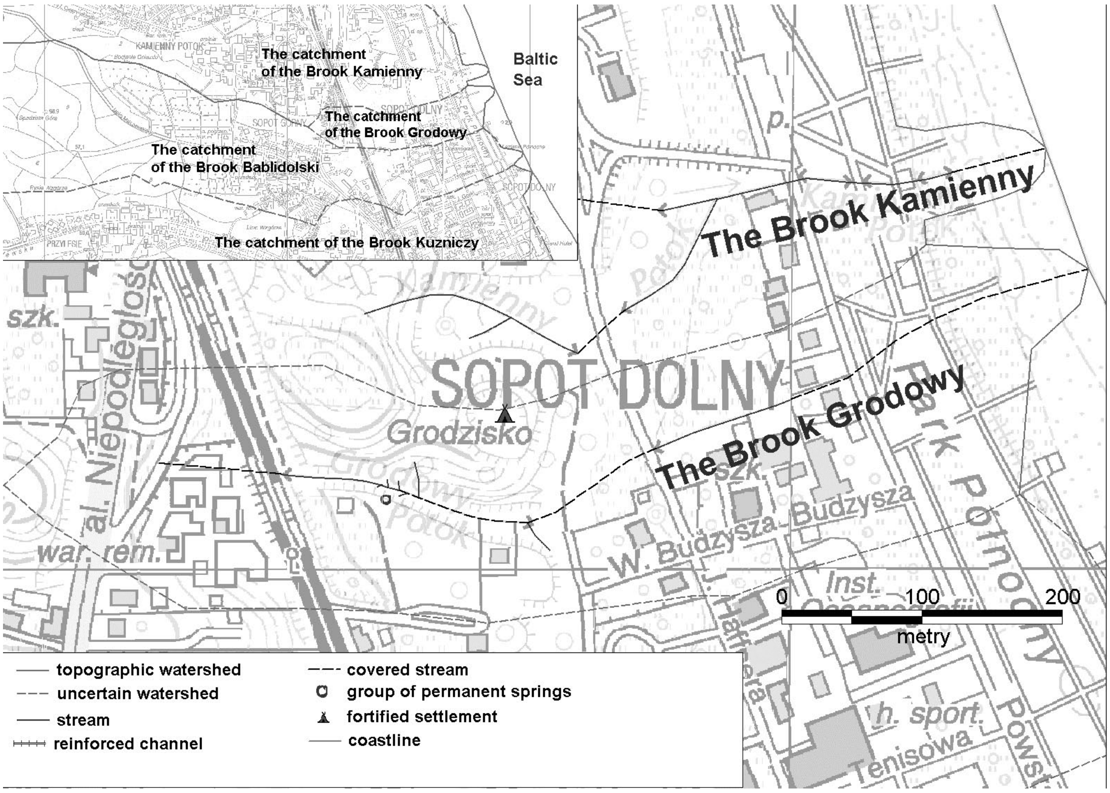

Fig. 2. Hydrographic outline of the Catchment of the Brook Grodowy and its immediate surroundings

The Sopot settlement is a good example of the influence of environmental conditions on the location and further development of the settlement in the Kashubian Coastland. Taking into consideration the natural conditions present in the peripheral zone of the Gdańsk

Morainic Plateau, it can be stated that this area is an ideal location for settlement. These conditions were recognised relatively early by the prehistoric settlers, and a number of settlements was formed within particular valley cuttings, thus contributing to the establishment of the town centre, i.e. present-day Sopot.

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Vascular plants of early medieval earthworks in Chełmno Land (ziemia chełmińska, NW Poland)

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Chełmno Land is situated in the north of Poland. The Vistula, the Drwęca and the Osa rivers mark its borders. 29 earthworks dating back to the early Middle Ages (second half of the 7th cent. – first half of the 13th cent.) have been found there (Chudziakowa 1994). The earthworks are located in fairly defensive places: on the edges of river valleys and hills. The steep slopes of the ramparts protect the earthworks from cultivation. They were used for grazing, or simply left as wastelands and then successively colonised by forest communities.

483 species of vascular plants, which is 16.2% of Poland's flora and 43.9% of the Chełmno Land flora, have been found in the 29 early Middle Ages settlements there. The flora of the material examined is fairly rich. In comparison, 808 species have been found in 233 earthworks in Wielkopolska (Celka 1999, 2004), which is 49% of Wielkopolska's flora. The species found in the flora of the material examined belong to 83 families. The most numerous are the families of *Asteraceae* (58 species), *Poaceae* (50), *Rosaceae* (33) and *Fabaceae* (28), constituting together 35.4% of the flora. Amongst the species found in the early Middle Ages settlements in Chełmno Land 405 are native ones. Archaeophytes (species that arrived before the 15^{th} century) constitute the most interesting group. *Malva alcea* and *Lavatera thuringiaca*, relics of former crops, belong to them. Archaeophytes constitute 8.5% of the flora of the Chełmno Land earthworks. The number is lower than in Wielkopolska (in the centre of an early Middle Ages landscape), which could be due to a smaller intensity of settlement in the borderland.

In the flora of the Chełmno Land earthworks a group of species that have not been found in the thoroughly examined settlements of Wielkopolska is of particular interest. It includes 34 species, among which steppe species attract particular attention. They are connected with the edge of the Chełmińska Highland and the valley of the lower Vistula. These are *Anemone sylvestris*, *Campanula sibirica*, *Carex supina*, *Hieracium echioides*, *Medicago minima*, *Oxytropis pilosa* and *Stipa capillata*. These species are steppe relics, which developed in these areas after the regression of the last glaciation, in the first forest-free climate periods. Survival of these species on the valley sides of the Vistula is undoubtedly connected with the development of settlement. Forest felling, grazing, and burning the pastures that had been created there contributed to the improvement of the development conditions of photophilic steppe species and to their secondary spreading.

The Early Middle Age earthworks in Chełmno Land are the home of rich vascular flora. The flora have an immense diversity but some of the rare, light-demanding species in settlements are, however, endangered due to the fact that traditional forms of cultivation, mainly grazing, have been stopped.

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Horse burials from the Roman Period cemetery in Paprotki Kolonia site 1 in the Masurian Lakeland (NE Poland). Natural and cultural aspects

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The cemetery of the Bogaczewo Culture in Paprotki Kolonia site 1 is one of the best preserved cemeteries from the Roman Period in the Masurian Lakeland. It is accepted that in archaeological sources the Bogaczewo Culture is an equivalent of the Galindai tribe. The name of this tribe was recorded in the 2nd century A.D. in Claudius Ptolemy's Geography. Archaeological research of the cemetery began in 1991. So far, 506 human graves and 11 horse graves have been discovered there.

Horse graves occupied three clearly distinct zones. The largest one was situated in the middle part of the cemetery. On both sides of this zone there were clusters of human graves containing the earliest burials. This confirms that this zone had already been demarcated at the time that the first burials took place in the cemetery. The second zone was located on the south-eastern edge of the cemetery and the third on the south-western edge. A feature which distinguishes the horse graves in Paprotki Kolonia from burials of this type known from other cemeteries is the complete absence of equipment.

All the horse burials from the cemetery in Paprotki Kolonia, contained skeletons of adult males, from young to very old. Horses laid in graves in other cemeteries of the West Baltic Cultural Circle were also male. In morphological terms they are analogous to horses of the tarpan type – forest horses, resembling the contemporary Polish ponies

The natural arrangement of skeletons in the square or oval shape grave pits, in the positions assumed by horses when resting, indicates that horses might have been taken into the grave pits while still alive. The arrangement of the hind legs, close together, in extended position, may suggest that the horses were tied up before being taken into the grave pits. In the case of two graves: 290 and 398, there were clusters of stones above the horse skeleton.

Except for grave No 320 all the horses placed in grave pits are oriented north east – south west or north west – south east with the head in the southern part of the grave pit. This orientation is characteristic for the whole – horse graves from the West Baltic Circle. The horse in grave 320, however, lay east – west with the head oriented to the west.

In grave pits horses lay in two positions:

1. on the abdomen, slightly inclined to the right side, with legs crouched, placed close together, sometimes under the thorax of the animal;
2. on the right or left side, with the front legs crouched and the hind legs in extended position.

The first position may suggest that the horse was put into the grave pit alive. Because there is no evidence that the animal tried to get out from the grave pit it is possible that the horse was completely weakened, intoxicated, or tied up, before being placed into the grave pit. Killing of a horse, probably already inside the grave pit, has been affirmed in the case of grave 215. The animal's neck had been broken, as the unnatural arrangement of the cervical vertebrae indicates: the fifth vertebra was twisted 90 degrees while the sixth was broken.

The possibility of placing dead horses into grave pits is confirmed by grave 290 from the cemetery in Paprotki Kolonia. It contained only the right part of the skeleton. The horse's head had been cut off and placed with the teeth facing the direction of its back. Everything was covered with several layers of stones.

The fundamental questions connected with graves containing horse burials are those concerning the reasons for burying them and the criteria for the selection of specimens.

Hitherto literature indicated sex as the only criterion for selection. It appears that the maturity of the male could have constituted another criterion. The skeletons found in the graves in cemeteries of the Bogaczewo Culture were exclusively those belonging to adult horses, of different ages. From the cemetery in Paprotki Kolonia the youngest horse was 5 years old when it died, and the oldest was very old. The horse from grave No 221 was handicapped in respect of limited movement because of illness, which lead to the hyperplasia of the neck and chest vertebra and the tarsus.

The morphological features do not provide the grounds for determining if these were wild or livestock animals. It is most probable that the horses from the cemetery in Paprotki Kolonia were stallions captured from wild herds. The fact that there are no marks on their teeth, which would indicate the use of a bit, leads to the conclusion that they were not broken in. They were captured solely for the purpose of laying them in the graves. There is also a second possibility, which indicates that these animals were bred only for sacrificial purposes.

The reasons for burying horses in the cemeteries of the Bogaczewo Culture have not yet been explained, despite all attempts. The role of horse burials in the sphere of magical beliefs, and the votive sphere was stressed.

In the case of the cemetery in Paprotki Kolonia it is very possible that horse burials were used for delimitation and division of the sacral space. They were located in three clearly distinct zones defined at the point of establishing the cemetery.

It is important to take note of one more aspect. Assuming that horses were captured from wild herds, it is necessary to indicate the effect that the loss of an adult male would have had on the herd. The herd organisation of contemporary Polish ponies, genetically closest to the horses living in the Masurian Lakeland in the first centuries of our era, is based on the adult male leader and the mares, colts and yearlings gathered around him. The older stallions are driven away by the male leader. A sudden loss of the leader, which is not the result of a fight with another stallion for dominance of the herd, results in the herd being left without a leader. After some time a different stallion takes over the mares – the whole herd or only a part of it. In the second case, the herd is divided. The loss of the leader puts the herd in a difficult situation and sometimes leads to its disintegration. It is almost certain that the people of the tribe of Galindai were aware of this and may have used this fact in their rituals.

The newest aspect of the research of the cemetery in Paprotki Kolonia is the analysis of ancient DNA from the Paprotki horses. The research is still in the initial stages. So far only a single mitochondrial haplotype (Haplotype A4) has been recorded from the Paprotki horses. Haplotype A4 is commonly found across the whole of Europe and Asia and shows little to no phylogeographic structure. Because of that, it is not possible to accurately identify the geographic origin of the Paprotki horses using mitochondrial DNA alone. Therefore the exploration of the potential preservation of nuclear DNA in the Paprotki horses has begun. For amplification of nuclear DNA loci a variety of approaches (including whole genome amplification, genotyping and SNiP typing) were used. Despite the apparent good preservation of the mitochondrial DNA, the research has so far been unsuccessful, however, this work is ongoing.

Traces of human impact in sediments of the flood plain in the Ner river valley near Lutomiersk and in the Rawka river valley in Rawa Mazowiecka (Central Poland)

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This paper presents the results of research on the fill material of palaeochannels discovered in the valley bottoms of the Ner river in Bechcice (near Lutomiersk) and the Rawka river in Rawa Mazowiecka in central Poland. Bedding and covering sediments of sub fossil river channels have been studied as well. The analyses include lithology of the series, geochemistry and pollen analysis. Some probes have been dated by radiocarbon methods. Parts of some deposited layers have been dated by archaeological methods.

Both of the registered sub fossil channels have been discovered in the close vicinity of archaeological sites. In the case of the Ner river, a settlement of the Lusatian culture has been discovered – Bechcice, site 1 – dated to the 3rd and 4th Bronze Age period. In Rawa Mazowiecka two prehistoric settlements (Rawa Mazowiecka sites 3 and 38) are known with the main phases dated to the later pre-Roman period and the early Roman period.

The beginning of the filling of the channel in the Ner river we can correlate with the period about 1340–1150 BC and in the bottom of the filling deposits we have recognized fragments of pottery of the Hallstatt C Period. The initiation of ox-bow accumulation in the channel in the Rawka river must be dated to before 530–380 BC. In both of the valleys thick cover of over-bank deposits exist, represented by organic muddy sands and other sands accumulated in the medieval and modern periods.

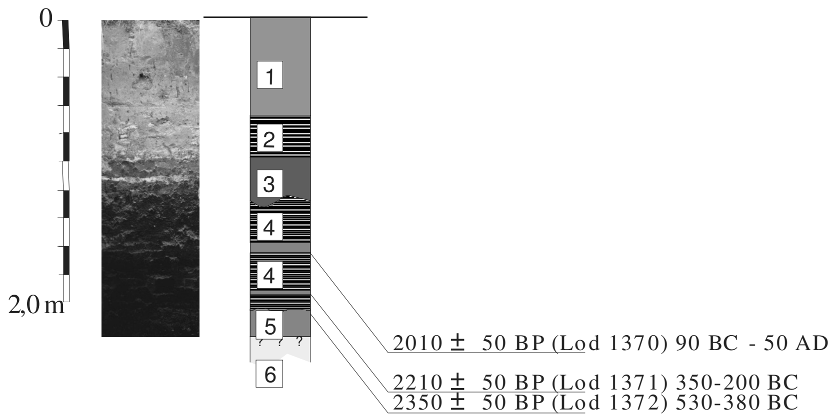

Fig. 1. Profile of Rawka river flood plain sediments in Rawa Mazowiecka
1 – partly organic sands and silty sands with charcoals of overbank deposition; 2 – laminated organic silty sands and sandy silt of overbank deposition; 3 – organic silts with iron of overbank deposition; 4 – organic silts and peats with plant detritus and with sandy laminas, fillings of ox-bow lakes; 5 – plant detritus layers; 6 – sands with organic silt laminas of point bars

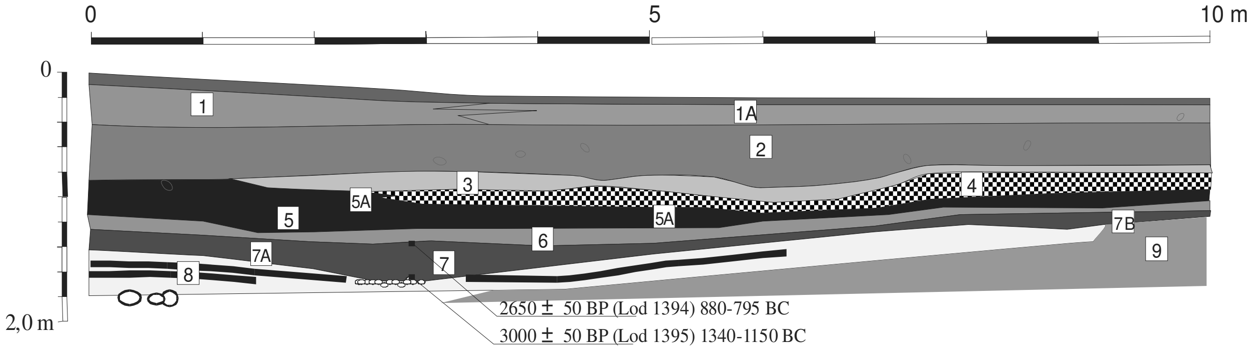

Fig. 2. Deposits of Ner river flood plain in Bechcice

1 – coarse grained sands with gravel partly silty, slope sediments – fragm. of bricks, 1A – coarse grained sands partly silty of overbank deposition; 2 – sands and sandy silts poorly organic with iron of overbank deposition – fragm. of bricks and pottery (11th–13th c.); 3 – fine- and medium grained sands partly slity and poorly organic with charcoals of overbank deposition – fragm. pottery (Bronze Age); 4 – organic silts with iron of overbank deposition; 5 – silty sands and organic silts with iron of overbank deposition – fragm. pottery (4th–5th Period of Bronze Age); 6 – coarse- and medium grained sand of overbank and channel (?) deposition – 1 fragm. pottery (EB); 7 – silty sands and organic silts in the roof, fills of ox-bow – fragm. pottery (5th BA/Halstatt C Period); 7A – sands with organic-mineral lamnias of point bars – fragm. pottery (3rd–4th BA); 7B – layer of semihydrogenic soil; 8 – coarse- and medium grained sand with laminas of organic silts and with gravels and coarse sands in the bottom of channel deposition; 9 – fluvial fine- and medium grained sands poorly slity (Plenivistulian Period)

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Delicacies from the West: The analysis of the 18th century oyster deposit found at Granary Island, Gdańsk

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During the archaeological excavations at Granary Island in Gdańsk (ul. Toruńska) a large deposit of mollusc shells was discovered. The shells were found in two excavation layers defined by excavators as levelling layers under timber yard/sawmill yard 'constructions' dated to the 18th century (L. Lotkowski).

The assemblage consists of 143 shell and shell fragments that belong exclusively to marine bivalves: oysters and mussels. The assemblage was recorded on the basis of number of identified specimens (NISP) where each valve was counted separately (Table 1) and the possible height of the shell was measured.

Table 1. Summary count of shells

Sample no./layer no.	Species	Number of shells	
		left valve	right valve
4/513	*Ostrea edulis*	35	14
6/513	*Ostrea edulis*	38	26
	Mytilus edulis	4	-
7/513	*Ostrea edulis*	5	-
14/513	*Ostrea edulis*	-	1
18.01/513	*Ostrea edulis*	4	3
18/529	*Ostrea edulis*	8	5
		Total =143	

All of the shells belong to two common European species: *Ostrea edulis* (native oyster/european oyster/flat oyster) and *Mytilus edulis* (common mussel).

Ostrea edulis (Linnaeus, 1758) originate from the Atlantic (distributed from Norway to Spain). They are also common in the Mediterranean Sea and the Black Sea. They inhabit shallow water up to 90 m deep in almost every substrata (Samek 1992: 72–72; Poppe & Goto 2000: 78–80). Since the early Holocene (Mesolithic Period) *Ostrea edulis* have not occurred in the Baltic Sea, due to its much lower salinity.

Mytilus edulis (Linnaeus, 1758) is generally considered as a typical species of the Northern hemisphere, living in the Atlantic and the Pacific (Japan). In Europe, it inhabits almost every coast with hard base layers up to 40 m deep. However, the exact geographical range of the species is still unknown due to confusions with other *Mytilus* spp. (Poppe & Goto 2000: 52–53).

Shells of *Ostrea edulis* represent the majority of the deposit: a total of 139 shells and shell fragments. Most of them (90 shells) are the left valves. They measure from 9 to 13.1 cm in height (dimensions of mature specimens). They show characteristic traces of breakages in the umbo, typical of the method of shell opening, as well as some traces inside the shell – a sharp tool (knife?) was probably used to remove the meat. Moreover, some of them have small pieces of wood attached and impressions of structures that they grew on, as well as some bluish traces of iron oxides on the outer surface. Four valves of *Mytilus edulis* measuring 7 to 8 cm in height were also found in the deposit. Their dimensions suggest that they did not derive from the Baltic Sea, where the species occur only in the form of stunted individuals (measuring less than 5 cm). They were found together with the oyster shells.

All of these factors indicate that the oysters and mussels were brought to Poland from areas of their cultivation in Western Europe. Considering the character of the deposit, shells of the two edible species represent waste deposited after shellfish consumption and they are probably refuse brought to the Granary Island from other parts of the city. Most of them show typical traces of their opening. 65% of the assemblage is formed of the left valves of the shells, which in case of oysters is the convex valve in which the mollusc is served. Together with their large size, all of these factors testify to their consumption value. Nowadays it is believed that larger oysters and mussels, as connoisseur finds, have a better taste and obviously provide more flesh, thus they always achieve the highest prices (Stott 2004). Considering their nutritional value they do not have any importance in the overall diet due to their low caloric contribution (Table 2) (Classen 1998: 184). However, we should keep in mind that they contain certain vital minerals such as zinc (Milner 2002: 89–90) and their original taste is definitely an advantage.

Table 2. Nutritional value of one mollusc (after: Classen 1998: 184, Tab. 15)

Nutritional information:	***Ostrea edulis***	***Mytilus edulis***
Energy (Kcal)	59	87
Protein (g)	8.6–13.1	8.9–17.2
Fat (g)	0.9–1.9	1.7–2.0
Carbohydrates (g)	5.9	2.9

The oldest find of an oyster shell as consumption waste derives from the European shell middens dated back to the Upper Palaeolithic period. The Late Mesolithic kitchen middens of the Ertebølle culture (5400–3900 Cal BC) along the Baltic shores in Denmark were exclusively composed of *Ostrea edulis,* which proves the existence of the species in the Baltic Sea at that time. They became popular as a delicacy in Roman times. According to Pliny the Elder, the Roman merchant and hydraulic engineer Sergius Orata, living in the 1st century BC, was the first person to form artificial oyster beds (Pliny the Elder, The Natural History: IX.79.54; Yonge, 1984: 429). It seems that the Romans alone were responsible for the spread of the culinary fashion for oysters in the west. However, the Chinese are considered to have carried out oyster cultivation first, about 457 BC (Stott, 2004: 54). Oysters became quite popular, especially in regions where their cultivation thrives and therefore their price was lower, and they reached the tables of the poor and lost their previous position as a delicacy. Their return to the tables of rich people, as pictured on Dutch still life paintings (*banketgen*) with fruits, vegetables and birds, is dated to the 17th century (e.g. Pieter Claesz 1627, 'Still Life with Turkey Pie', Rijksmuseum Amsterdam SK-A-4646; Willem Claesz, Heda 1635, 'Still Life with Gilt Cup', Rijksmuseum Amsterdam SK-A-4830). Such paintings decorated the houses of the wealthy bourgeoisie at that time. In the 18th century in Western Europe and especially in the British Isles and France a demand for foreign oysters appeared. It was fashionable to eat oysters from famous regions of Europe brought for a much higher price, although the taste was probably not much different to that of local oysters (Stott, 2004: 59–61).

In Poland in the 17th century, oysters as well as mussels became popular, together with other dishes of fashionable French cuisine. A recipe for oysters was even included in the first preserved Polish cookbook (others were only translations of foreign books) *Compendium ferculorum albo zebranie potraw* written by Stanisław Czarniecki, courtier and chef of Prince Aleksander Michał Lubomirski in the Łańcut palace, was published in 1682. Other recipes for oysters occur as well in the 18th century Polish cookbook *Kucharz doskonały, pożyteczny dla zatrudniających się gospodarstwem* of Wojciech Wielądko (published in 1783) that was used as a guidebook to good and fashionable cuisine by the wealthy bourgeoisie and nobility.

Oysters were most probably traded to Gdańsk by sea from the Netherlands, Flanders, the British Isles or France, which in 17th and 18th century were the main suppliers of oysters and mussels to the European markets. In that time, the city of Gdańsk was exporting cereals and importing luxurious items, amongst which were barrels of oysters.

Oysters first appeared in Poland probably in early medieval times; however, an earlier date cannot be excluded. It seems that they became popular in larger cities in early modern times, especially in 17th and 18th century as a western (French) fashion. Always as delicacies brought from Western Europe, they reached the tables of wealthy citizens or foreigners staying in the city. As a result of their remote provenance, their price at that time had to be high.

In the 19th/20th century in many western European regions *Ostrea edulis* was replaced by other species – *Crassostrea angulata* and shortly after by *Crassostrea gigas* – a western Pacific species cultivated since the 17th century in Japan (Yonge 1984: 430). This is the most popular oyster species delivered to Poland from the European Union countries nowadays. Despite the fact that oysters and mussels, as well as other seafoods, are still quite a sophisticated dish in our country, they are served by many restaurants and can be purchased in larger fishmongers or French supermarkets at quite a reasonable price.

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Investigating the palaeohydrological record from the last millennium at a Baltic bog in N Poland using high-resolution replicate peat monoliths

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Our results are based upon two replicate monoliths taken from a Baltic bog located in the northern Poland (Stążki mire). The application of a high-resolution approach to the peat material enabled radiocarbon and lead dating, which resulted in precise palaeoenvironmental reconstruction. We used two proxies – testate amoebae and carbon stable isotopes – for the reconstruction of the peatland moisture. Our aims were:

- To reconstruct environmental changes during the last millennium, with a major focus on climate;
- To develop and apply the local transfer function based on testate amoebae (Protists);
- To improve the methodology of stable isotope analysis from *Sphagnum* material in order to apply this approach to palaeoclimatic studies;
- To compare stable isotope and testate amoebae data from the peat.

Parallel analyses of testate amoebae were carried out in order to infer the palaeohydrological record for the last 1000 years. We wanted to find out if the entire mire responded to water-table changes (the hydrological signal was similar in two cores) or if each of the monoliths recorded different signals, which would suggest that the monoliths do not represent allogenic factors. Our results indicate that the two replicate cores displayed similar (testate amoebae) palaeohydrology. Furthermore, comparison of data from testate amoebae with $\delta^{13}C$ from *Sphagnum* stems showed significant correlation. In this poster, we provide the first high-resolution multi-proxy data concerning hydrological changes in peatland during the last millennium in this part of the Europe.

Multi-proxy high resolution study of human and climatic impact on a peatland – Les Amburnex mire, Swiss Jura Mountains

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A small mire in the Jura Mountains was the matter of a palaeoecological study based on three proxies: pollen, testate amoebae and plant macrofossils. We reconstructed local vegetation and hydrological changes during the last 1000 years (Sjögren and Lamentowicz, 2007). Testate amoebae training set (Lamentowicz et al., in press) was applied for quantitative water table reconstruction.

Caltha and Vaccinium dominated in the vegetation until 1700 AD and then it transformed to more oligotrophic with Sphagnum, Cyperaceae and Potentilla. Deforestation played the most important role in this transformation but also climate change was the important factor. Sphagnum expansion is dated to 1950 AD whereas trampling decreased together with an increase of temperature in the recent warming. The presence of Sphagnum was not only the effect of environmental changes but also Sphagnum itself transformed the soil chemistry changing the habitat. Land-use changes and climatic warming in the AD 1980s and 1990s leaded to considerable changes in the species composition. That is very difficult to distinguish human impact and climate in peat record as the most of European peatlands were drained and exploited.

The use of high resolution multi-proxy data enabled us to reconstruct precisely environmental changes recorded in recently formed Sphagnum mire. Our data are important tool for nature conservation and management purposes. Palaeoecological methods give the opportunity to look into the past of peatland ecosystem and its surroundings as well as it may answer the question: how natural is the landscape and how long it possesses such a structure? The knowledge about the relationships of peatland and woodland pastures (characteristic habitat of Jura Mountains) is the key for the management and active nature conservation (Sjögren, 2005; Vittoz and Hainard, 2002; Willis et al., 2007).

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Archaeobotany as a tool for reconstructing environment and subsistence in the history of Gdańsk, N Poland (10th–18th c.)

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Gdańsk is one of the largest and most ancient cities in the Baltic Sea region. The old historical city-centre, which was not properly rebuilt since the cessation of Second World War hostilities, is now the subject of extensive modernization. This has enabled the uncovering of archaeological features, objects and cultural layers dating back to the origins of the town. Archaeobotanical sampling has now been carried out at a total of 21 sites, revealing perfectly-preserved plant material surviving as a result of waterlogged conditions and charring. The following three topics are currently being investigated:

1. Useful plants in Gdańsk's history.

In this project, data on useful plants preserved in various archaeological features is compared to information contained in written sources. A long list of food-plants, and plants used in medicine and different crafts has been obtained as a result of the examination of plant remains. They represent plants grown locally, those collected from the wild, and a number of species that were traded regionally and over longer distances. Historical documents dating from the 14th c. to modern times indicate the extent and nature of plant use.

2. Natural environment in medieval and modern times in Gdańsk.

Data from plant macro-remains, when supplemented by both on-site and off-site pollen analyses, provide an important background for the reconstruction of ecological conditions during different periods of the town's development.

3. Development of anthropogenic flora and vegetation in historical Gdańsk.

The aim of this project is to reconstruct the process of synanthropization of the flora and vegetation during particular stages of urbanization and economic development of the town. The project is based on archaeobotanical material and historic botanical records.

Stone in Romanesque architecture in the Wielkopolska and Kujawy regions

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In the medieval period stone and wood were the basic building materials in Poland. One of the most often asked questions in the archaeological and architectonical studies of the Romanesque building is: where is the source of this building material? In the case of those buildings that are located in the area of numerous quarries (for example Jura Krakowsko-Częstochowska) the answer is obvious. In the Kujawy and Wielkopolska region, where the thickness of Pleistocene and Holocene sediments is large, the answer is more complicated. For the medieval builders in these regions local building materials were rare. There were only erratics of the postglacial sediments and rare sandstone and limestone quarries.

The aim of this paper is a presentation of the characteristics of the raw building materials used in selected Romanesque churches. In the Kujawy and Wielkopolska regions these stone buildings are located in Kruszwica, Kościelec Kaliski, Kotłów and Kalisz (in this case the ruin of the collegiate church) (Kasprzak 2005 a, b; Mrozek 2005, Skoczylas et al. 2004). All of them were built in the 12th and the beginning of the 13th century (Świechowski 1990, 2000).

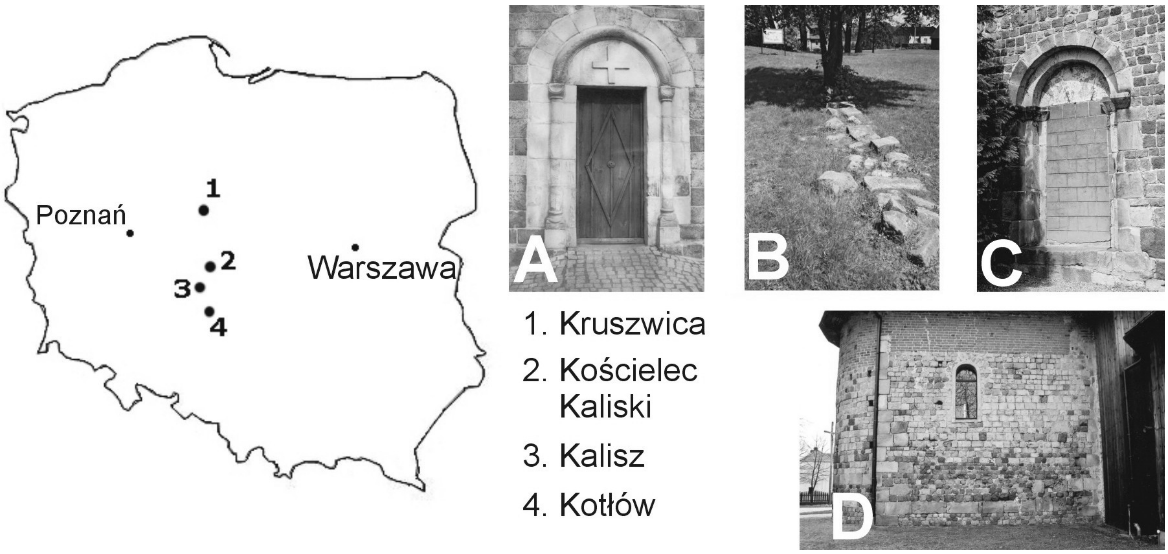

Fig. 1. Localization of the churches; A – portal in Kruszwica church, B – sandstone blocks of the collegiate church's ruins in Kalisz, C – southern portal in Kotłów church, D – apse in Kościelec Kaliski church.

The principle part of the study is a comparison of building material and potential raw material in the Kujawy and Wielkopolska regions. The analysis focused both on qualitative and quantitative aspects. The object of the research was the raw material used in the church's wall and the local sandstone quarries and erratics. Particular emphasis was placed on sandstones and crystalline rocks (Czubla et al. 2006).

Several methods were used in the detailed analysis of the material. Macroscopic description of the stone was employed during the field work. The individual blocks of stone were generally classified on this basis. A detailed microscopic description using a polarizing microscope was the most important stage of the laboratory analysis. This research provided information about the mineral composition and structure of the stone. It was also the basis for choosing other geochemical and phase analyses used in the next stage of studies. These included statistical analysis (Friedman 1958, Friedman et al. 1972) and cathodoluminescence (CL) (Götze et al. 2001; Sikorska 2005) and were the most often used. CL was used in case of sandstone, the provenance of which proved the most problematic.

As a result of this research it is now possible to suggest the provenance of the raw material. In all analyses of the selected buildings, just as in other churches in the Pomorze, Kujawy and Wielkopolska regions, the erratics were the most often used building material. Sandstones were the second choice, but they were transported from a greater distance. Comparative study showed that the source of sandstone is located in the Ostrzeszów and Konin regions in small local quarries.

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Wood and charcoal analysis.
Charcoal from concrete as a dating material

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In the case of wood and charcoal radiocarbon dating there is a risk of over-estimation in relation to the age of a building due to the peculiarities of tree growth. Such a situation is exemplified by the results obtained for the Hippos settlement, Israel. The selection of the charcoal fragments was preceded by an attempt at their identification. It turned out that the investigated wood fragments from the excavations as well as the charcoals come from coniferous trees (Fig.1). Microscopic observations allowed for their identification as wood of Lebanese cedars or firs (it is difficult to provide an unequivocal determination due to their size and state of preservation; Milles, 1978; Wagenführ *and* Scheiber, 1985; Warnock, 2001). The *Cedrus libani* species occurs quite frequently in this geographic region. From historical sources it is well known that in antiquity it was widely used in furniture production, shipbuilding, wooden decorative handicraft, sculptures and religious objects (Liphschitz *and* Gideon, 1991). The second identified species is a fir. In the Mediterranean there are several fir species *(e.g. Abies alba Mill, Abies nordmanndiana Spach*), which may have provided the wood identified here. The Ancient Romans took from the Greeks the cult of fir. Jews used this tree in their buildings of religious character (*e.g.* the tie-beams in the Salomon Temple were made of fir wood).

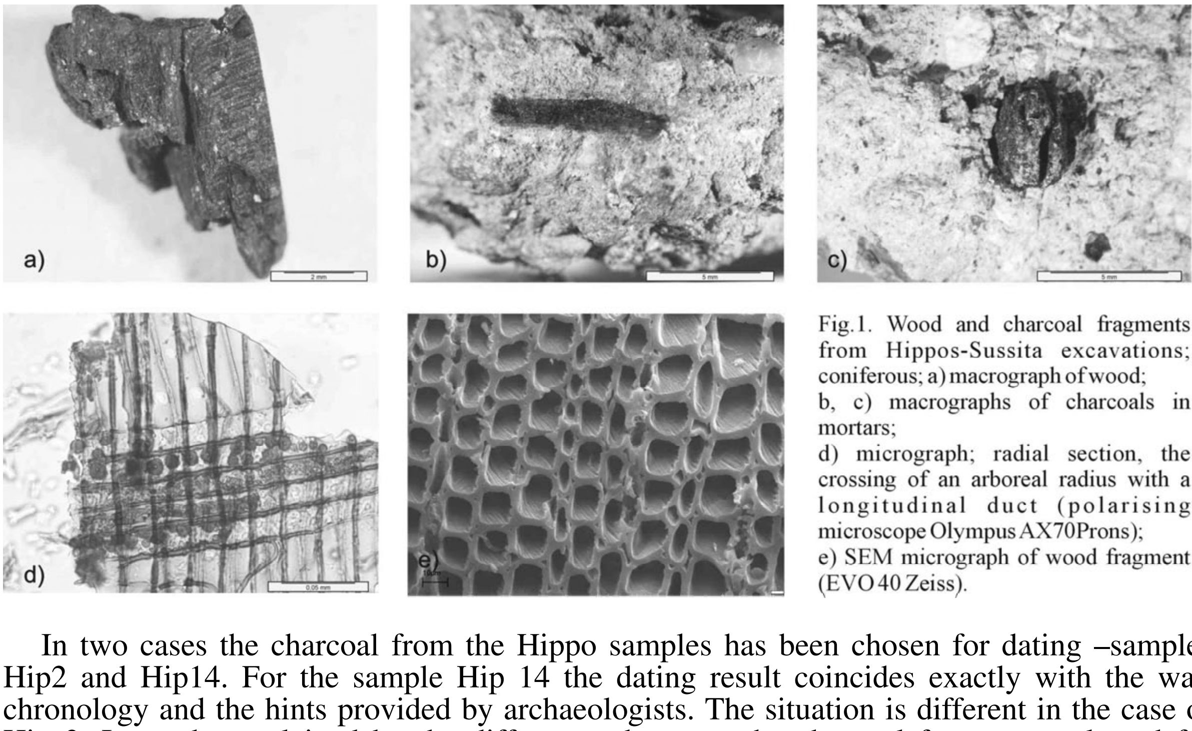

Fig.1. Wood and charcoal fragments from Hippos-Sussita excavations; coniferous; a) macrograph of wood; b, c) macrographs of charcoals in mortars; d) micrograph; radial section, the crossing of an arboreal radius with a longitudinal duct (polarising microscope Olympus AX70Prons); e) SEM micrograph of wood fragment (EVO 40 Zeiss).

In two cases the charcoal from the Hippo samples has been chosen for dating –samples Hip2 and Hip14. For the sample Hip 14 the dating result coincides exactly with the wall chronology and the hints provided by archaeologists. The situation is different in the case of Hip 2. It can be explained by the differences between the charcoal fragments selected for dating. The attempt at their identification indicated two types of charcoals. The first group is formed by the materials from the coniferous trees – firs or Lebanese cedars. To the second one belong oval annual forms (Fig.1c), devoid of an age over-estimation possibility, because it is wood from the trunk centre. Just such an oval charcoal fragment has been dated from the sample Hip 14. In the case of the sample Hip2 the analogical elements have not been found and the dated charcoal was probably a tree trunk fragment.

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Early Iron Age forest communities in the northern part of the Oderská brána (NE Czech Republic)

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Forest communities and their possible exploitation are studied based on analyses of charcoal, pollen and macroplant remains from two archaeological sites and nearby profiles in the Oderská brána region (NE Czech Republic). The results of all paleoenvironmental analyses have shown a very similar course of the vegetation history. The rich species composition indicates only a low settlement level, with an enclave character in the Early Iron Age.

Fir (*Abies alba*) and beech (*Fagus sylvatica*) are dominant; birch (*Betula*), hazel (*Corylus avellana*), hornbeam (*Carpinus betulus*) and lime tree (*Tilia* sp.) are also abundant in the set. The locally low presence of oak and pine are quite unusual for the central European lowlands. Vegetation was probably influenced by the climatic conditions and the position of the region, which is situated near the Silesia lowland and the Carpathians.

Environmental archaeology of deserted medieval villages in Bohemia – pollen profiles from small water reservoirs

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Introduction

Most recent investigations of deserted later medieval and postmedieval villages in Bohemia (13th–17th century AD) have produced extensive amounts of archaeobotanical data. Test pits and excavations of water reservoirs, which have been preserved within the deserted rural sites and include intact sediments, have been carried out in Bohemia since 2005 providing pollen assemblages as well as archaeological artefacts and ecofacts. Pollen profiles dated to the 13th century AD onwards from three sites are presented in this paper.

Localities

Cetkov and Sloupek. These two deserted medieval villages are situated in a large forest complex in the Rokycany region in West Bohemia (about 30 km SE from Pilsen), which was settled as late as the 13th century. This upland reaching from 400–700 m above the sea level has poor soils and did not provide very suitable conditions for agriculture. An archaeological project, carried out since 2005, has produced evidence for extensive non-agricultural production connected with ironore mining and forest crafts (esp. charcoal production and possibly also potash production). Both deserted villages originated in the 13th/14th – the early 14th century and were deserted in the middle of the 15th century. These sites consisted of about ten farmsteads, each having about 200 ha arable land. Cetkov was re-established to a smaller extent in the 16th century and was finally abandoned during the Thirty Years War in the first half of the 17th century.

Pollen profiles have been taken from the water reservoirs of the villages (pollen diagrams based on SW POLPAL; Nalepka and Walanusz 2003). A large number of cisterns is typical for Sloupek, which is situated on the top of a hill and lacking a water source. One of cisterns located in the central part of the village was excavated and has provided one pollen profile. The second pollen profile was obtained from a small deserted pond on the edge of Cetkov.

Aldašín. The deserted village of Aldašín is situated in the Černokostelecko region in Central Bohemia (about 50 km E from Prague). The hilly, largely wooded, region (about 400 m above the sea level) was densely settled during the 13th century, however, about half of the villages were deserted in two phases in the 15th and the 17th centuries (Klápště 1978). The research project has focused on two villages in Černokostelecko, one of which produced a pollen profile taken from a small pond in Aldašín. The village, consisting of the parish church, manor-house, about 10 farmsteads and possibly a mill, was founded in the 13th century and deserted during the 15th century. The second phase of the site can be dated from the 16th century to the early 17th century, when it was finally abandoned.

Results

Sloupek. The pollen assemblage in the depth from 67 to 40 cm pinpoints the period of the village settlement activity in the 13th/14th – the early 15th century. Arboreal pollen is under 50%, grasses and ruderal taxa prevail (*Rumex acetosella*, *Plantago major*, *Polygonum aviculare*). The low representation of cereals is remarkable. The desertion of the village is shown in a decline of anthropogenic indicators and the succession of trees (mainly pine, spruce and silver fir). Some evidence of cereals shows human activities in the surroundings of the former village. The next stage of development led to pasture forest and the last period is represented by the present day spruce monoculture.

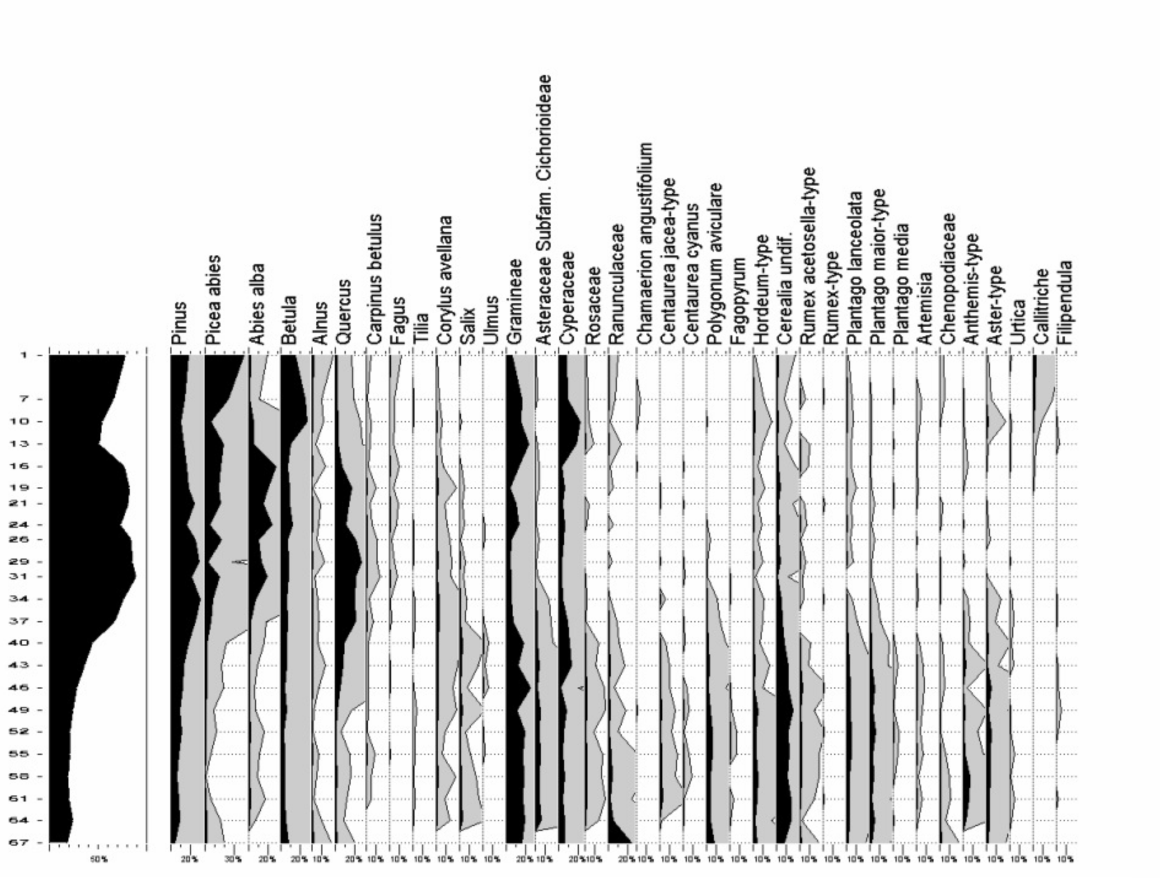

Fig. 1. Sloupek – simplified pollen diagram

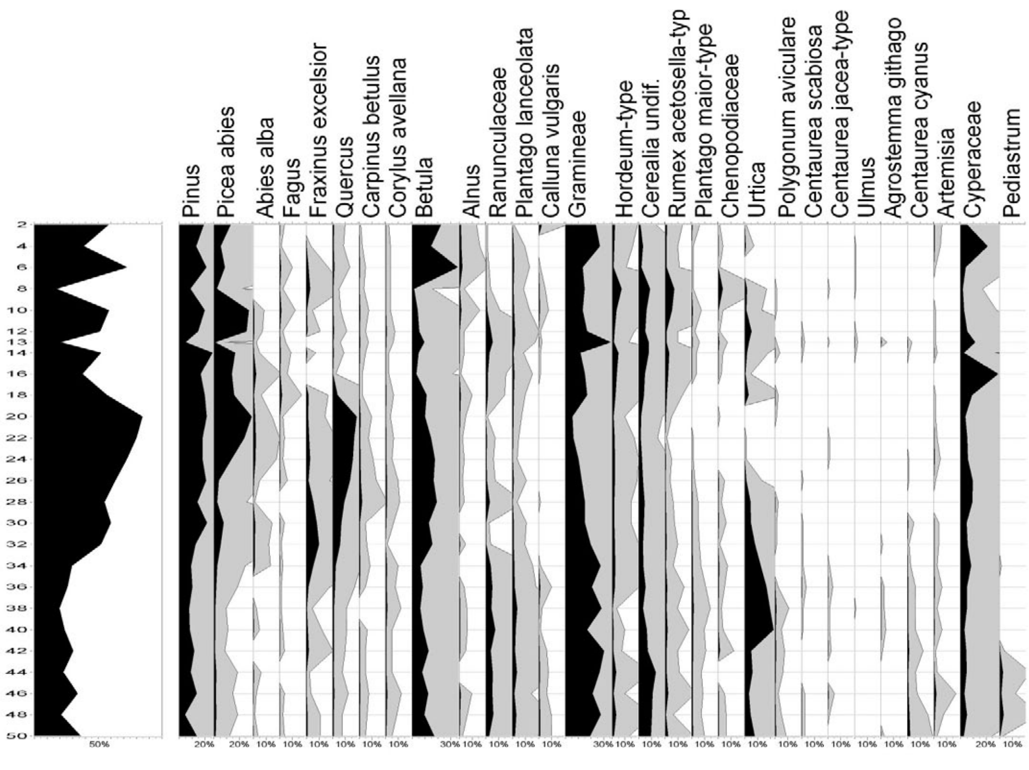

Fig. 2. Cetov – simplified pollen diagram

Cetkov. The first period is connected with the late medieval village (13th/14th–early 15th century; depth from 50 to 34 cm). Tree pollen is under 40%, pine and birch prevailing. Grasses and cereals dominate the herbage pollen spectra. Ruderal species are less common (in comparison with the Sloupek site), excepting *Urtica*. Vegetation succession and low human impact is characteristic for the next period (from 34 to 20 cm). Spruce, oak and silver fir expand and grasses, cereals and ruderal species are less common. The final period (from 20 to 2 cm) is represented by rapid changes in vegetation cover. Without dating we are yet not able to recognize the second settlement phase (16th–the early 17th century). Anthropogenic indicators were slowly disappearing.

Aldašín. The first period (from 36 to 18 cm) can be connected with the later medieval village (13th–15th century). Oak is prevailing in the trees of the pollen spectra and pine, birch and beech are rare. The grasses, cereals, ruderal species and *Urtica* dominate. This profile has not yet been radiocarbon dated, therefore we cannot distinguish the second settlement phase. A decline of settlement and the beginning of vegetation succession appears in the sample from 18 cm. Pine, spruce and ash expand, and anthropogenic indicators disappear.

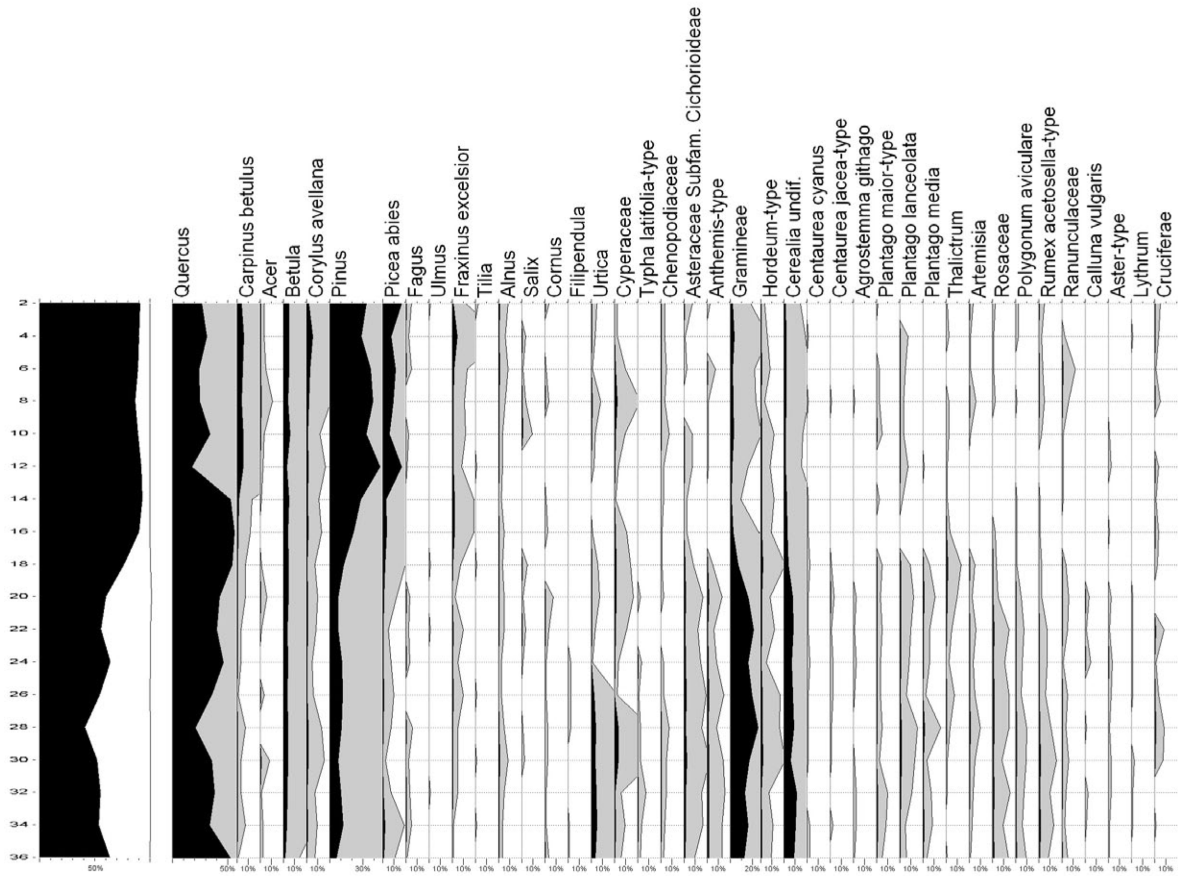

Fig. 3. Aldašín – simplified pollen diagram

Conclusions

Research concerning the later medieval and postmedieval deserted villages (13th–17th century) in Bohemia has demonstrated the great potential of small water reservoirs (cisterns and ponds) for environmental archaeology, especially for pollen analysis. These reservoirs showed similar attributes to natural profiles in many aspects. They provided well preserved sediments but also a large amount of datable archaeological artefacts (including organic material, which is very rare from the later medieval rural milieu) as well as ecofacts. Pollen profiles from the period when each village was in existence reflect the local vegetation within the rural site, and from its immediate surroundings, in great detail. Comparison of the pollen evidence from the investigated localities, Cetkov and Sloupek in West Bohemia on one side and Aldašín from Middle Bohemia on the other, shows large differences that can be interpreted as evidence for divergent vegetation, landscape management and subsistence strategies. Remains of water reservoirs have been preserved in the majority of deserted medieval villages in all parts of Bohemia and for that reason they may represent an unique source for the reconstruction of the later medieval and postmedieval environment, for the study of vegetation changes, agricultural and other human activities and their long-term impacts.

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Beech (*Fagus sylvatica* L.) pollen representation in semi-cultural landscapes of Middle Roztocze (SE Poland)

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Modern pollen deposition of beech has been studied in the Middle Roztocze region (SE Poland) since 1998 within the framework of the Pollen Monitoring Programme (http://pmp.oulu.fi). This international project aims tot study pollen dispersal and deposition of major tree and herb taxa by means of Tauber-type traps placed in different vegetation units in Europe; using the results as a basis for interpreting fossil pollen spectra (Hicks et al. 1996). Average values of pollen accumulation rates obtained from long-term observations reflect the abundance of a particular taxon in the surroundings of the deposition site (Hicks 2001).

In Poland *Fagus sylvatica* L. is the only species of this genus and its expansion during the Late Glacial and Holocene was carefully traced by isopollen maps (Latałowa et al. 2004). It is not quite clear, however, what percentage value of beech pollen in a fossil pollen diagram indicates only local, scattered, presence of *Fagus* trees and which values indicate the occurrence of beech-dominated forests (*vide* Latałowa et al. 2004). Beech belongs to trees under-represented in surface pollen spectra in spite of quite abundant pollen production (Sugita et al. 1999); long-term observations of its pollen deposition are, therefore, of great importance and in future can help in interpreting fossil pollen diagrams.

The presence of natural beech forests in the Roztocze makes this region suitable for the monitoring of pollen deposition of this tree in different vegetation units across transects from beechwood through forest edge to open situations. The Carpathian beech forest – *Dentario glandulosae-Fagetum* association in its sub-mountainous variant, which is very well represented in the Roztocze region, belongs to the most precious forest communities (Izdebski et al.1992, Matuszkiewicz 2001). Two pollen traps were placed in *Dentario glandulosae-Fagetum* association. One of them within a large (100m in diameter) clearing in the beechwood, the other in a very small opening (under-canopy site). Pollen was also collected at seven other sites situated in different forest communities of the Roztocze National Park and its protective zone, as well as in open situations within the semi-cultural landscapes of the Guciów village. The last ones served as "regional" traps and were placed among cultivated and abandoned fields to gather pollen rain from a wider area.

The present study covers a nine year period (1998–2006). The results of pollen monitoring revealed great differences in beech pollen influx values (PI=number of grains/cm^2/year) between single years of deposition. Beech flowers abundantly every few years. The highest peaks of PI values were observed in 2006 at most sites. The PI of the regional trap achieved as high as 2170 grains/cm^2. The year of 2006 seemed to be very good for the flowering of *Fagus sylvatica,* not only in the Roztocze but also within the much wider area of its distribution range in Poland. The aerobiological data from Gdańsk and the data from the Kashubian Lakeland gathered within the Pollen Monitoring Programme strongly supported the statement (Święta-Musznicka, Zimny 2007). The years 2003 and 2000 also belonged to years of abundant beech pollen deposition. 2002 seemed to reflect medium vigorous flowering, while the lowest PI values were noted in 1999 and 2001 (126 and 265 pollen grains/cm^2 respectively in the regional trap).

The average value based on nine years of observations for the whole area under investigation was calculated at ca. 1400 beech pollen grains/cm^2/year. Great differences in the average pollen accumulation rates occurred when beech pollen deposition was compared between the pollen-trapping sites. The "under canopy" site within beechwood always showed the highest peak of PI values and these were not taken into consideration. The site situated within the large clearing in the beechwood was characterized by a four times higher than average PAR value (ca. 3000 beech pollen grains/ cm^2/year) than the so called regional trap (ca. 750 beech pollen grains/cm^2/year). In terms of percentages of AP+NAP sum it means that, on average the pollen of *Fagus* composed ca. 9.1% of the pollen spectrum in beechwood and only 1.8% in open landscape. The great difference in both of these values has proved that pollen grains of beech are not transported over long distances, on account of their large size and mass. First simulations of the relevant source area of pollen for the Roztocze traps showed that the RSAP did not exceed one kilometre from the sampling site (Poska, Pidek 2007).

Acknowledgements

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Environmental archaeology of a pre-Roman Iron Age hillfort at Vladař, Czech Republic

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The large fortified hilltop site of Vladař, northwest Bohemia, Czech Republic, (50º05´ N, 13º13´ E) has recently been intensively studied using environmental archaeological investigations, in which palaeoecological methods have played a crucial role. The latter include the analyses of pollen, green algae, Cladocera, other microfossils, plant macro-remains (including charcoal and wood) and chemical composition, carried out on the wet sediments from an artificial pond situated in the middle of the large citadel, supplemented by charcoal and wood analysis on material from dry deposits. The continuous palaeoecological record is constructed using well-preserved biological remains and covers the period from ca. 400 BC to recent times. The chronology is primarily based on radiocarbon dating, supplemented by archaeological finds. The main focus is on the La Tène period of the Iron Age. During the early to middle La Tène period, the hillfort had a considerable number of permanent inhabitants, and the woodland was almost completely replaced by an agricultural landscape. The site was partially abandoned by the end of the 3rd century BC and then completely abandoned by around 1 BC/AD, after which the area reverted to natural woodland.

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Restoration of moats, ponds and ornamental lakes – the environmental archaeological implications

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Analysis of the Roman Iron Age well at Dražkovice (Eastern Bohemia) using a combination of different archaeobotanical methods

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Extensive archaeological excavations took place during highway construction. This poster focuses on a well from site 1, feature 368. The feature is situated in the north-eastern area of the locality on the northern slope of a river terrace. The location is extremely convenient for the building of a water-source. The well pit, approximately funnel-shaped in profile, was disturbed in the past as a result of amelioration; the timber frame itself was only partially-broken and was dated successfully using dendrochronology.

Only a small number of archaeological finds was recorded within the timber frame. The infilling of the well pit produced much richer archaeological remains, including pottery dated to the Roman Iron Age period. Dendrochronological and $_{14}C$ analyses were also applied to wood used in the construction, producing a date of 190 AD. The well from Dražkovice provides an essential contribution to local palaeoenvironmental reconstruction.

Macro-remains analysis produced 61 different species, including 11 species of useful plants, which is typical for an agricultural village environment of the Iron Age and local synanthropic vegetation. Pollen analysis recorded differences between local and extra-local vegetation in two main stratigraphic positions – the bottom of the well represents an open-woodland landscape strongly influenced by human activity, whereas data from the infilling phase reflects a period of forest regeneration.

Gully deposits and their significance in the past landscape reconstruction: the example of the Suwałki Lakeland (NE Poland)

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Forest clearance and development of agriculture are recorded in colluvial and alluvial deposits. Due to anthropogenic denudation, eroded soil was deposited at footslopes and in valley floors (Starkel 1987, 2005, Klimek 2002). In certain places gullies developed on deforested slopes (Bork 1989, Maruszczak 1991)

Research conducted in the Suwałki Lakeland (NE Poland) on gullies and gully erosion deposits proved that morphology of the gullies and lithology of the deposits are significantly diversified (Smolska 2005). One of the characteristic features of the researched area is the presence of two main gully types of different sizes. Larger forms, longer and more incised, are developed along dry bowl-shaped valleys of melt waters. Smaller gullies, shorter and shallower, are V-shaped and developed on slope surfaces. The age and lithological features of gully erosion deposits were previously researched by Smolska (2005). Phases of gully development were determined in reference to climatic changes and the human settlement history (Smolska 2007). Detailed research was focused on seven gully fans.

Special attention was paid to differentiation of deposits building fans at the mouths of the larger gullies. The oldest deposit series found at floors of the fans resemble alluvium and are represented by sands, sands and gravel with a very little admixture of silt and clay. Upper, younger series include more fine fractions (silt and clay) and dispersed organic material of a humic type. This indicated that most of the younger deposits originated from erosion of the humic soil horizon.

Sandy gravel and sandy deposits at the fans' floors include up to 2–5% of the finer fractions. Silt and clay content increases in the upward direction. In some layers these fractions constitute above 30%.

The deposit transport motion was determined based on the analysis of granulometric curves of Visher (1969). Older deposits were transported mostly in saltation, dragging and rolling. Suspended load constituted several to a dozen or so percent of accumulated material. Floors of dry bowl-shaped valleys were incised and later the initial gullies were gradually widened. Based on five researched fans, it can be concluded that the gully erosion on the researched area started about 3520±70 (*Lo-964*) to 2240±100 (*Gd-4092*) years BP. No significant change in the gully and fan development occurred until the 3rd c. AD. However, in some places in the northern part of the Suwałki Lakeland, this situation persisted until the 15th to 16th c. (Stańczyki village area).

The beginning of the gully development is linked to the cultural transformation from nomadic and seasonal settlement to the permanent settlement system. The Balts (800–700 years BP) introduced agriculture into the researched area, however this process was very slow (Brzozowski et al. 1993). Limited palynological data support gradual and slow spread of land cultivation (Stasiak 1971, Kupryjanowicz 2004, Szwarczewski, Kupryjanowicz 2006).

The younger fan series include increasing amounts of fine material, which was transported, according to the Visher curves, in suspension. These deposits resemble soil colluvia building slope covers at slope bases. At floors of the series, the fine fraction constitutes 20–30% and locally, in the youngest deposits, accumulated after 15th c.–16th c., it reaches 30–40%, sporadically even 50%. Accumulation of such deposits took place simultaneously with aggradation in the gully floors.

Fans at mouths of the smaller gullies are built exclusively with series of the soil colluvium type. Therefore, they must have developed on slopes that previously underwent forest clearance. Two such gullies are dated 1310±60 (*Ki-10366*) and 1070±70 (*Ki-10363*) years BP (the Yadvings culture).

The research on gully erosion deposits conducted in the Suwałki Lakeland area, indicates that the analysis of lithological features of the deposits in the depth profile can be useful in landscape development reconstruction, especially in determining phases of forest clearance.

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Geomorphological response to settlement on loess plateau – Chroberz area (Ponidzie Pińczowskie) case study

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The area of Chroberz (Ponidzie Pińczowskie, Nida River Basin) has undergone complex environmental changes. The records of these changes can be found in geological cross-sections or profiles. Radiocarbon dates and interpretation of archaeological sites give information about their age. Changes in the natural environment were caused mostly by natural processes before the Atlantic period, and due to human activity since Neolithic times up to today. The periods of extreme human activity are recorded in the features of the sediments and the age of deposition. The radiocarbon dates of the sediments are well-correlated with archaeological evidence and indicate major stages of human impact i.e. Neolithic, Bronze Age, Iron Age and Early Medieval Period.

Interdisciplinary research methods, to some extent, have allowed for separation of the environmental changes into two groups – those resulting mainly from climate-vegetation changes and those connected mostly with human impact.

Geomorphological responses to human impact and climate change in the Holocene: an example from the Świder River Valley (Mazovian Lowland)

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Geomorphological evolution in the Mazovian Lowland during the Holocene period was the result of climate change and human impact. Climate change, from the pre-Boreal to the sub-Atlantic, had similar effects on most of the lowland area of Poland (Starkel 1977, 1999). Human impact was diversified and depended on local preferences of the settlers. At the very beginning of the Holocene, when hunting and gathering were common, there were almost no changes in the natural environment as a result of human activity. Later on, when the Neolithic had started, farmers and breeders arrived from the south. This resulted in an increase in population density and an increase in deforestation. A long period of environmental changes commenced from this time, with selective deforestation and vegetation succession occurring one after another. All of these environmental changes resulted either in acceleration or in the cessation of geomorphological processes. Land-use changes caused the development of aeolian processes, aggradation processes in river-valley bottoms and acceleration of soil erosion. Colluvial soil formation also occurred. Soils with a complex morphology formed at the base of slopes – soils consisted of separate humus horizons covered by mineral deposits (Różycki 1969; Maruszczak 1999).

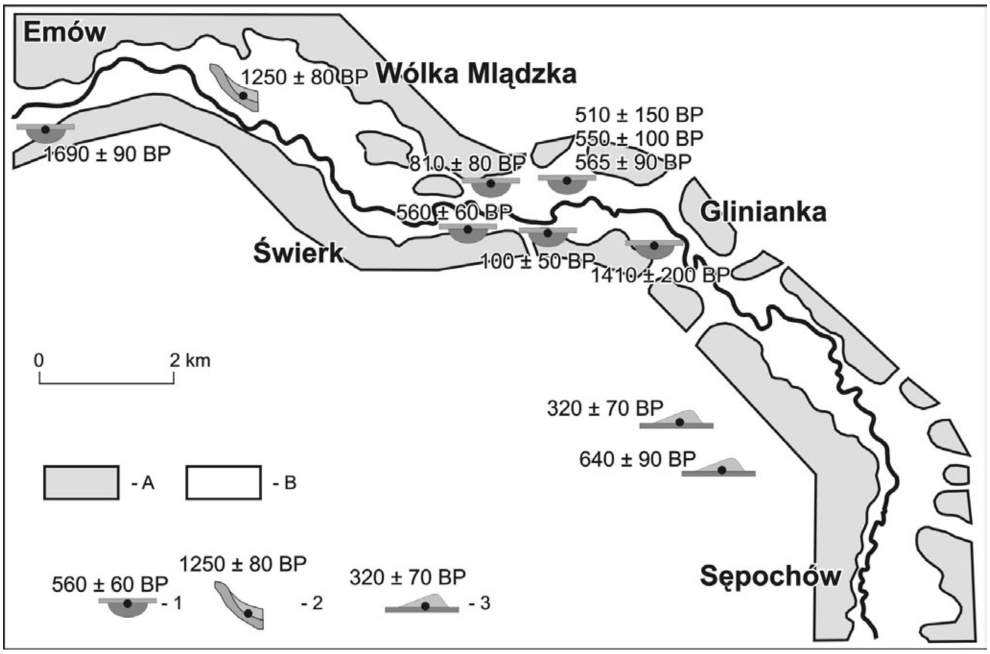

Fig. 1. Radiocarbon age of sedimentation type (facial) changes – shift in: 1 – fluvial, 2 – slope, 3 – aeolian environment. Radiocarbon dates are uncalibrated. A – glacial plateau, B – Świder river valley

The aim of the study in the Świder river valley was to determine the age of the fossil humus horizons and their relationship with human activity in the past. To address this problem, standard geomorphological methods were employed, supported by archaeological and historical investigations. The age of the fossil humus horizons was determined using radiocarbon dating in the laboratories at Minsk (Belarus) and Kiev (Ukraine).

Phot. 1. Świder river-valley bottom in the Glinianka area. Radiocarbon dates indicate the beginning of colonization, deforestation and agriculture in the study area

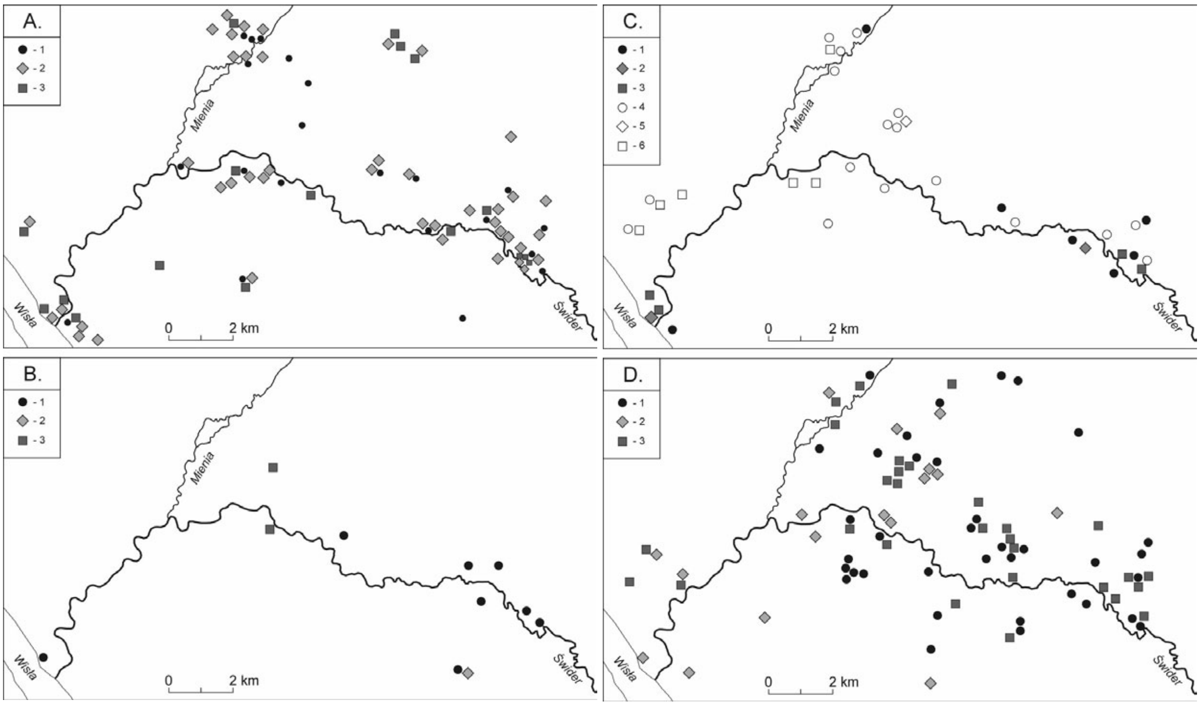

Fig. 2. Archaeological sites in the study area (author's evaluation based on Woyda 1988; 1989a–c; Woyda and Gajewski 1989). A. Medieval sites, B. La Tène-Roman Period, C. Hallstatt-La Tène, D. Bronze Age.

1 – Early Medieval and Medieval – beginning of settlement-network formation, including radiocarbon dates of 1410±200 BP, 1250±80 BP, 810±80 BP; 2 – 14th–16th centuries – location and development of Mazovian towns including Mińsk Mazowiecki (1421), Stoczek Łukowski (1540/1544), Karczew (1548); radiocarbon dates 565±90 BP and 560±60 BP; 3 – Period of the Industrial Revolution and the time preceding it – intensive deforestation and aeolian processes (radiocarbon date 320±70 BP); 4 – Period between the 1st and 2nd World Wars (radiocarbon date 100±50 BP). Due to deforestation, aeolian processes occurred in many sites, enabling the commencement of small dune formation. This period is well-known from local residents' memoirs and newspapers from those times.

Field studies together with radiocarbon dating indicate that there was a human impact in the Świder valley area, which was of a low intensity during the Neolithic and Iron Age periods. Since the Middle Ages, human impact become more extensive, occurring in most of the examined area (fig. 1, photo 1). The above statements are supported by substantial amounts of archaeological and historical data (fig. 2). A number of periods of increasing settlement intensity that have resulted in environmental change can be distinguished during the medieval period (soil morphology transformation and formation of buried humus horizons):

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Woyda S., 1989b, Materiały Archeologicznego Zdjęcia Polski ark. 58–70.

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Distal ulna as an example of the identification of domestic birds

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Introduction

Birds have always been used by people for various purposes – as food, raw materials for tools and clothes, as gifts in burials, and in various other rituals and ceremonies (Benecke 1994; Lasota-Moskalewska 2000). The man hunted wild birds and bred domestic forms, thus in archaeological materials avian remains form an important component consisting of a variety of species. As the remains of domestic birds usually prevail in the materials, distinguishing between the two groups – wild and domestic species – as well as species-specific identification of the latter group is of vital importance for correct analyses of bony remains.

Worldwide, there is a number of works useful in the identification of avian remains. However, these studies usually focus on narrow groups of species, including chosen representatives of some families or genera, or they deal with local fauna of particular regions or sites. Such studies include galliforms (Erbersdobler 1968; Kraft 1972), storks (Gruber 1990), hawks (Schmidt-Burger 1982, Otto 1981), ducks (Woelfle 1967), swans and geese (Bacher 1967), herons (Kellner 1986), falkons (Jollie 1977), pigeons (Fick 1974), owls (Langer 1980), skulls of passerines (Cuisin 1989), passerines of the Iberian Peninsula (Moreno 1986), grebes (Bocheński 1994), corvids (Tomek & Bocheński 2000), hybrids of galliforms (Bocheński & Tomek 2000), turkeys (Bocheński & Campbell 2005, 2006). Two other monographs deal with bird remains often found on archaeological sites: an atlas including European species with special emphasis on those from the British Islands (Cohen & Serjeantson 1996), and a key to the identification of North American bird bones (Gilbert et al. 1985). Neither of them separates domesticated species from the wild ones. So far, there is not a single key to the identification of domestic birds, which would separate them from all other wild European species.

The goal of the project is to create a dichotomous key to the identification of all major skeletal elements of higher systematic units (orders, families, genera) containing domesticated species (goose *Anser anser*, duck *Anas platyrhynchos*, turkey *Meleagris gallopavo*, peacock *Pavo cristatus*, chicken *Gallus gallus*, helmeted guineafowl *Numida meleagris* and pigeon *Columba livia*), and to discriminate them from all other wild species nesting, wintering or migrating in Europe. Because most avian bones at archaeological sites are broken and complete specimens are seldom found, we decided to make separate keys to each of the two articular parts of long bones – the proximal and the distal. This is probable the first time that such an attempt has been undertaken; to our knowledge all other keys deal with complete elements, which makes often problematic to identify a broken bone. In case of complete specimens the advantage of identifying each side of the bone separately is also that one can verify his/her identification.

The present paper presents the first draft of a small portion of the manual (distal ulna) and is intended only to facilitate the identification that should always be done by using real bones from comparative skeletal collections. It cannot replace direct comparisons with modern specimens.

Material and methods

The key is based on the comparative skeletal collection of the Institute of Systematics and Evolution of Animals, Polish Academy of Sciences, and on specimens borrowed from the National Natural History Museum, Bulgarian Academy of Sciences (NNHM), the Zoological Museum of the University of Oulu (ZMUO), Finland, Department of Animal Anatomy and Histology, Wrocław University of Environmental and Life Sciences, Poland (DAAH), and Museum of Natural History, University of Wrocław, Poland (MNH).

Wherever possible, osteological terminology follows Baumel and Witmer (1993) and is additionally illustrated in Figure 1. Measurements follow those of von den Driesch (1982).

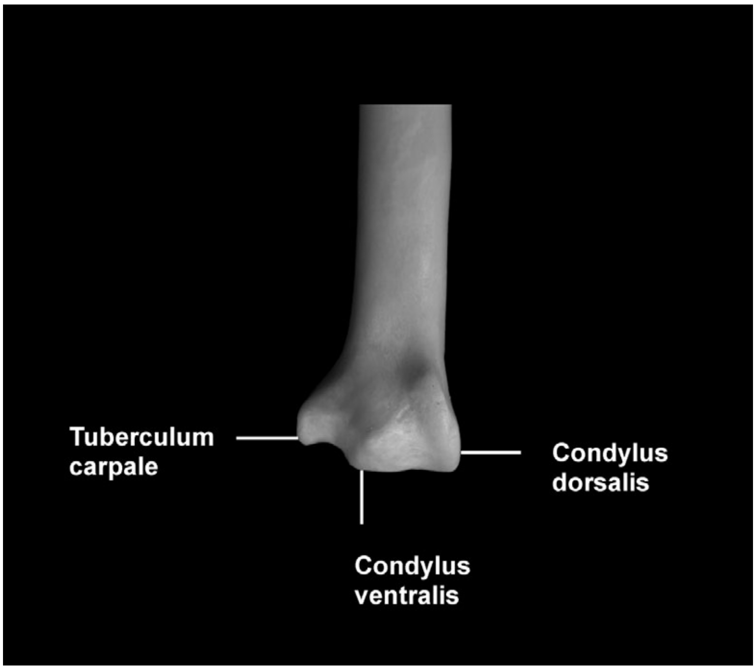

Fig. 1. Scientific nomenclature used in the key (distal, right ulna in cranial view).

Special consideration was paid to the groups including domesticated species and, consequently, their identification is more reliable. On the other hand, the identification of some high systematic units containing exclusively wild species is only a by-product of this key. Therefore caution is advised because in some cases their identification is not univocal and wild representatives of the same group (order, family or genus) may be classified into two or more final steps of the key, depending on the bone and species. More precise (i.e. species specific) identification – whether of domesticated or wild species – should be conducted using a key focusing on particular orders or families.

The number of characters described is kept to the minimum; only more obvious characters which better define certain taxa have been chosen. Many of the characters have already been described elsewhere by other researchers; we often redefined them either on purpose or accidentally. However, we do not acknowledge it in every single case to keep the text of the key as short and simple as possible.

In the key, *italicized* names of taxa – whether scientific or common – denote groups of birds at preliminary stages of identification; they are given for general orientation only. **Bold face** is used to indicate final identification, but even here there are often more than one taxa listed. A question mark that precedes an italicized name (e.g. *?Otis*) indicates that the particular character is not always obvious for the taxon, and consequently it may be classified into various categories. If this happens to groups containing domesticated species, then any decision taken will lead to the correct final identification. For the sake of space the key does not list all the orders or families of birds that occur in Europe; the italicized and bold face taxa are only examples of more common and/or typical groups. There are many other orders and families containing wild species that are not mentioned in the key – they always end up at one of the steps including other wild taxa.

Particular species whose bones are illustrated in the photographs (Figure 2) represent groups of taxa that show a given character. Space limitations did not allow us to present all taxa mentioned in the text of the key. In any case, all groups containing domesticated species have been illustrated. Taxa within Figure 2 are arranged roughly according to the sequence of steps described in the key. Descriptions below bone(s) of exemplary specimens include (i) the scientific name of the *species* (italicized) illustrated in the photograph; and (ii) the number of the final **step** of identification (in bold face)which refers to the appropriate number in the key.

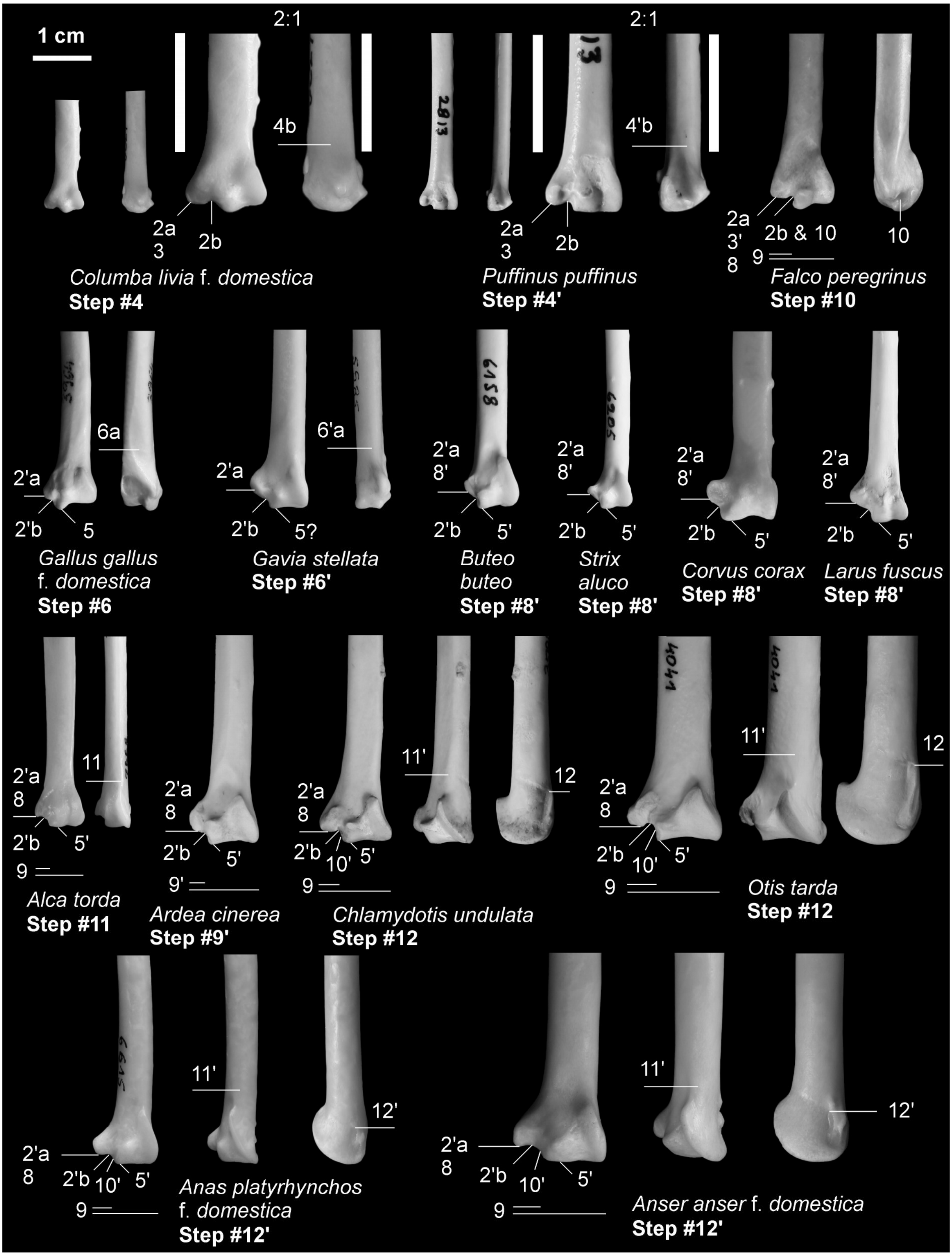

Fig. 2. Distal ulna of chosen species representing groups of birds referred to in the key. Numbers such as 2a or 4'b indicate characters described in particular steps of the key. "Step #" indicates the step of the key with the final identification of the taxon

KEY TO DISTAL ULNA

1 – Distal width larger than 6.8 mm (Minimum size of domestic pigeon, n =50) ..………. → 2
1' – Distal width smaller than 6.8 mm ……….….……..... **All small taxa: Podicipediformes, Charadriiformes, Gruiformes, Strigiformes, Coraciiformes, Piciformes, Passeriformes**.

2 – (a) Tuberculum carpale points distad; (b) There is a groove between tuberculum carpale and condylus ventralis: *Puffinus, Falco, Columbiformes, ?Anser*……………………….. → 3
2' – (a) Tuberculum carpale points proximad or is perpendicular to the shaft; (b) No groove between tuberculum carpale and condylus ventralis: *all others*……………………..… → 5

3 – Distal end of tuberculum carpale reaches as far distad as distal end of condylus dorsalis: *Puffinus, Phalacrocorax, Columbiformes* ……………..……...…………………..…→ 4
3' – Distal end of tuberculum carpale does not reach as far distad as condylus dorsalis: *Falco, ?Anser* ……………………….……………………………………………..…→ 7

4 – (a) Distal width between 6.8 and 8.9 mm; (b) Shaft is not flattened ……. **Columbiformes**
4' – (a) Distal width outside the range; (b) Shaft flattened dorsoventrally ………… **Puffinus**

5 – Condylus ventralis narrow, clearly protrudes distad beyond the distal roughly straight horizontal edge formed by tuberculum carpale and condylus dorsalis: *Gavia, Galliformes* …………………………………………………………………………... → 6
5' – Condylus ventralis not as above; The line (distal margin) between tuberculum carpale and condylus dorsalis is more oblique and/or wavy: *all others* ….……….……………... → 7

6 – (a) Shaft near distal end not flattened; (b) Tuberculum carpale projects ventrad as much as condylus ventralis projects distad ….…………………………………………… **Galliformes**
6' – (a) Shaft near distal end clearly flattened dorsoventrally; (b) Tuberculum carpale projects ventrad much further than condylus ventralis projects distad ..………………………….**Gavia**

7 – Distal width between 9.4 and 20.1 ....……….. → 8
7' – Distal width outside the range ………………………….. **Podicipediformes, Pelicanus, Cygnus, smaller Anseriformes, smaller Falco**

8 – Distal margin of tuberculum carpale is either perpendicular to the longitudinal axis of the bone or it curves distad: *large Podicipediformes, some Ciconiiformes, Anseriformes, Falco, Alcidae, ?Otis, ?Chlamydotis* ……………………………………………………….....→ 9
8' – Distal margin of tuberculum carpale curves proximad: …………… **some Ciconiiformes, Accipitridae without Falco, Charadriiformes, Strigiformes, Corvidae**

9 – Tuberculum carpale makes up about one-third of the distal width: *Anseriformes, Falco, Alcidae, Otis, Chlamydotis* ………………………………..……………………...→ 10
9' – Tuberculum carpale makes up less than one-third of the distal width: …………………. ………..……… **large Podicipediformes, Ciconiiformes (Ardea, Plegadis, Nycticorax)**

10 – In ventral view, posterior margin of condylus ventralis slants anteriad; a clear depression in the posterior side of condylus ventralis is present: …………………………………… **Falco**

10' – In ventral view, posterior margin of condylus ventralis slants proximad or posteriad; the depression in the posterior side of condylus ventralis is missing: *Anseriformes, Alcidae, Otis, Chlamydotis* ………………………..……………………………………..………→ 11

11 – Shaft flattened dorsoventrally (width versus depth)...………..………………….. **Alcidae**
11' – Shaft not flattened: *Anseriformes, Otis, Chlamydotis* …………………...………→ 12

12 – In caudal view the scar near the cranial edge extends further proximad than the proximal end of condylus dorsalis: ...…………………………………………….. **Otis, Chlamydotis**
12' – The scar extends less proximad than the proximal end of condylus dorsalis: …….……………………………………………………………………….. **Anseriformes**

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Late Palaeolithic site Khotylevo-2: the structure of the cultural layers and sedimentation peculiarities

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The Late Palaeolithic site Khotylevo-2 in the Desna river valley, near the town of Bryansk, is one of the most interesting sites of that epoch in Middle Dnieper river basin. Typological characteristics of artefacts allow us to attribute this site to a group of the Eastern Gravettian. The most characteristic "Gravettian" feature of stone implements recovered from Khotylevo-2 is the occurrence of indicative series of Gravettian points and backed blades. It should be noted that Khotylevo-2 is surrounded by sites traditionally attributed to Kostyenki-Avdeevo culture; the famous Krakow-Spadsista occurrence in Poland is considered to be an analogue of this culture.

The Khotylevo-2 site is located on the steep right slope of the Desna river valley. The floodplain at the base of the valley slope bears numerous ox-bow lakes, fans of ravines and flat-bottom valleys (so called balkas). The site itself is located on a cusp between two balkas at about 17 m above the water edge. Smaller erosion landforms (ravines and furrows) dissect the cusp slope into a number of smaller plots. The cultural layer of Khotylevo-2 has been recorded at four points in the central and western parts of the cusp; the points were designated by Cyrillic letters, from A to Г. Numerous artefacts were also found all over the area in the vicinity of the site. Presently only point A has been investigated on a large scale – about 700 m^2 (Gavrilov 1998). An area of 80 m^2 has been studied for Point Б. The greatest potential for further research could be point B, where there are constructions of presumably hieratic purpose; at present it is being investigated.

The radiocarbon data of Khotylevo-2 cultural layer, obtained from bones, mammoth tooth and bone charcoal, span a time interval from 24960±400 (IG RAS-73) to 21680±160 (GIN 8886) BP (Velichko et al. 1999). There is evidence for an earlier presence of humans here, practically from the initial occupation of the East European Plain by Palaeolithic tribes; that is suggested by occurrence of Mousterian tools, known as Khotylevo-1, located 500 m downstream by the Desna River (Zavernyaev 1978).

Sediments enclosing the cultural layer of points A and Б, of thickness 6.35 and 5.3 m respectively, are composed of deluvial loess-like sandy loam accumulated during the last Interglacial-Glacial cycle. The underlying solid rocks are weathered chalk that includes interlayers of flint used by the Palaeolithic people for tool making. The top surface of the chalk is irregular and hummocky. This peculiarity, though, does not affect the position of the horizon with artefacts. These irregularities are smoothed and filled with humified silt and sand – redeposited remains of Mesin paleosol complex and Bryansk paleosol, so the cultural layer occurs sub-horizontally. The lower part of the profile is attributed to the Mikulino (Eemian) Interglacial and Early Weichselian glacial epoch; the small thickness (only 1.5 m) of these deposits suggests active erosion and cryogenic processes occuring just before human settlement here. The properties of the reworked material indicate movement of slope material in hydromorphic conditions with cryogenic deformation.

The remains of slightly humified clay are probably related to Bryansk paleosol affected by slope processes and subsequent frost cracking. The undisturbed Bryansk paleosol remains on the left bank of "Kladbishenskaya" balka (west of the site). The upper part of this paleosol contains the cultural layer of late Paleolithic site Khotylevo-6, chronologically older than Khotylevo-2.

The deposits enclosing the Khotylevo-2 cultural layer are represented by thick series of laminated loess-like silts; some horizons of gleying and of weak soil formation have been determined. The loess-like silt is the parent rock for the modern soil profile. The ortsands lines follow cryptic layering of loess. Ortsands accentuate the relic cryogenic formations (ice-wedge pseudomorphs) of the Yaroslavl' cryogenic horizon (Velichko et al. 1999), which sometimes penetrate down to the cultural layer. At the contact between the ortsand horizon and "clear" loess archaeologists recorded signs of biogenic activity (numerous mole burrows), as well as a reindeer antler and patinated flints and, in the upper part of ice wedge – remains of a hearth pit (excavations in 1994). This evidence probably suggests that Palaeolithic humans visited this place at the final stage of deposition of loess-like sediments and the beginning of permafrost degradation. The considered section is crowned by a profile of gray forest soil with a cultural layer of the Early Iron Age in the humus horizon.

The Khotylevo-2 cultural layer is contained in a light-brown carbonate loam; its upper boundary is marked by separate sand lenses (at depth 4.45–4.55 m). The horizon with artefacts does not bear traces of redeposition, though microstratigraphy is locally somewhat specific. In general, the cultural layer includes bone remains of differing degrees of preservation (mammoth, bison, wolf, reindeer, rodents), as well as flint tools, bone charcoal and ochre.

The point A of Khotylevo-2 is studied over a large area (about 680 m^2), the materials are published (Gavrilov et al. 2001). Several complexes of objects have been determined. The boundaries of the complexes are marked by vertical or inclined mammoth bones, often intentionally cracked. The central parts of the complexes are occupied by hearth pits or accumulations of bone charcoal and ochre. In the marginal parts of complexes there are groups of bones, arranged in a certain pattern in small hollows and coloured by ochre. The complexes of the central part of the Palaeolithic settlement differ from peripheral ones by a greater diversity of findings. There are ancient art objects, such as male and female figurines, spearheads from mammoth tusk, together with ornaments and other items.

Point Б occurs 25 m west of point A and is separated from it by a small ravine. The cultural layer of point B was investigated in 2001–2003 over an area of about 80 m^2. The excavated part appeared to resemble the periphery of point A. Both points have similar stratigraphic position and, probably, belong to one large settlement. The central object of point Б is an irregular concentration of bone charcoal and ash, 4 m^2 in diameter and about 3 cm thick. A hearth pit adjoins this place; numerous fragments of mammoth bones and fragments of wolf tooth have been recovered from the ash mass. At a point 2 m south and 3.5 m south-west an anatomical group of wolf foreleg bones, together with its skull were found. To the north-east and south-west of the ash accumulation two groups of vertically standing mammoth bones were found; one rib and two fragments of cylindrical bone accordingly. A group of unbroken mammoth bones (mainly ribs and vertebrae) were found on the surface of the ash mass and around it. Other mammoth bones occurred as fragments.

Another ash mass, coloured dark by numerous small fragments of bone charcoal, was found in the south-east part of the excavation. That ash mass is distinct for high concentration of small bone fragments and a more clayey composition of sediment. A well-preserved nucleus was recovered from the marginal part.

The area of site, studied in 1994–2003, could be conventionally divided into periphery of settlement and area of active human household activities (Gavrilov 1998). The artefacts of the peripheral part are enclosed in light brown loam; organic rich, carbonate, porous, and locally with signs of secondary ferruginization. Practically all over the open area this horizon is broken with small cracks, the latter form a polygonal net with cells 0.15–0.20 m in diameter, large bones are often found at the points of cracks intersection. On the coloured parts of the cultural layer, within ochre-charcoal masses, the level of initial soil is replaced by charcoal-ash matter. The cracks here are filled with small fragments of bone charcoal, ash and ochre in the upper part and with dark organic-rich loam in the lower part.

16–19 cm above the main level of artefacts there are accumulations of brown degraded bone material occasional larger bones, heavily weathered. This layer is overlain with discontinuous sand lenses that mark the upper boundary of the bone-bearing layer belonging to the Palaeolithic site. It is clear that, in the final period of human habitation here, or just after the ancient men left it, the intensity of loess accumulation, characteristic for the Late Weichselian periglacial zone, strongly increased. The high rate of the burial processes was the cause of the good preservation of findings in the cultural layer.

In conclusion it should be noted that lithology and the rate of sedimentation, in particular, influenced Palaeolithic people in their choice of dwelling place. During the function of this site the intensity of slope processes was relatively low, and the ephemeral horizon of initial soil, corresponded to cultural layer of site, developed. The total area of Khotylevo-2 site is so large that it is hard to assert that its all known points belonged to the same settlement or to different ones. Besides, the peculiarities of points A and Б enable us to determine the "centre" and "periphery". The main evidences of intensive human activity and religious life are connected with the central parts. The occurrence of different Palaeolithic sites in the vicinity of village of Khotylevo could be one more argument for the attractiveness of this place to ancient hunters and gatherers. The natural relief gave good lines of observation of the valley and ravines (migration passage of large animals – subjects for hunting). Furthermore, the inexhaustible supply of flints for tools was provided by outcrops of Cretaceous rocks on the banks of ravines.

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Analyses of plant remains from the Szczepanki Paraneolithic camp-site, North-Eastern Poland

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Szczepanki 8 is a waterlogged archaeological site located on a small island on the former Lake Staświńskie near Wydminy (The Great Mazurian Lake District). Over the last few years, archaeological research revealed the presence of numerous artefacts dating mostly to the Mesolithic and Paraneolitic-Zedmar culture. As the camp-site occupied part of the lakeshore – on the boundary with the littoral zone – constantly wet conditions allowed good preservation of the plant remains. During the archaeological excavations, samples for pollen, charcoal/wood and macrofossil plant-remains analyses were taken directly from the exposed profile on the site and from the former lake area at a distance of 100 m.

We expect that close correlation of the palaeobotanical and archaeological results will allow us to understand the influence of local human society on the natural environment and its modification during the Stone Age. We particularly hope to obtain new data regarding the character of the Paraneolithic economy.

Reconstruction of local and extra-local vegetation, and its disturbance resulting from settlement and economic exploitation of natural sources by man, was based on palynological data supplemented by micro-charcoal analyses. Accumulation of sediment on the archaeological site (profile Sz30E1N) started at the beginning of the Holocene and lasted (with a break off) until ca. 2900 uncal. BP. A more complete and long-lasting pollen record (from the Allerød Oscillation until the Early Mediaeval period) was obtained from the former lake deposits (profile SzI/2005). Human impact on the environment began in the Mesolithic and was noted with differing intensity from that period onwards. The most interesting feature of the study was the occurrence of single cereal pollen grains at the time of the Zedmar culture, from ca. 5100 uncal. BP.

The plant remains found in gyttja and peat sediments mostly represented the local flora. Some of the taxa could have been collected by hunter-gatherers in the vicinity of the site.

Among the charcoal particles, the most frequent were remnants of *Alnus*, *Quercus*, *Tilia*, *Fraxinus* and *Ulmus*. These results reflected quite accurately the composition of woodland communities (confirmed by pollen data) extending over the island and neighbouring lake shores, and suggest the non-selective use of all local trees as fuel.

Macrofossil plant remains were dominated by thelmatophytes and aquatic plant taxa present in the shallow water, and on the shore of the lake, e.g.: *Nuphar lutea*, *Menyanthes trifoliata*, *Nymphaea alba*, *Schoenoplectus lacustris*, *Najas marina*, *Potamogeton natans*, *Trapa natans*?, and *Alisma plantago-aquatica*. The most common were fruits of *Alnus glutinosa* and *Betula* sect. *Albae*. Finds of *Corylus avellana* nuts, *Cornus sanguinea* fruits, as well *Rubus idaeus* seeds, were also regularly noted.

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Holocene climate cycle in the record of the Kórnik-Zaniemyśl lake deposits, Great Poland Lowland

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The Kórnik-Zaniemyśl lakes are located in the central part of the Great Poland Lowland, around 20 km south of Poznań. They are placed in the glacial tunnel valley bordered by the parallel section of the Warsaw-Berlin pradolina to the south and the Warta river valley to the north-west.

The sediments of the Kórnik-Zaniemyśl lakes represent an exceptionally good and clear record of palaeohydrological and palaeoclimatological changes. They allow a detailed reconstruction of water level fluctuations in the Late Glacial and Holocene and clearly reflect global climatic changes occurring in the temperate zone within the last 12,000 years. The climate changes are reflected in the changing lithology of lake and peat deposits, as well as in their geochemistry, changes of assemblages of water and swamp malacofauna, and in the development of Neolithic and Early-Medieval human settlements, situated on lake terraces (Wojciechowski 2000).

The study of the climate cycle over the last 12,000 years has been conducted according to the available lithologic, geochemical, and faunistic record of the following four cores from Kórnik and Zaniemyśl area lakes (see detailed core description in Wojciechowski 2000): Bn-01 and Bn-46 cores of Bnin lake, Ko-66 and Ra-02 for Kórnik and Raczyńskie lakes, respectively. Spectral analysis using the Blackman-Tuckey method has been applied to determine the main climate change cycle of approximately 1,150 years, according to the conventional radiocarbon scale, which reflects an approximately 1,200–1,500 years long cycle in calendar time scale.

In the cycle (Fig. 1), the peaks of Late Glacial and Holocene warm stages were in (dates in ^{14}C conv. BP and calendar years BP, respectively): 900 (approx. 790 cal. BP), 2,050 (1,995 cal. BP); 3,200 (3,420 cal. BP), 4,350 (4,870 cal. BP), 5,500 (6,290 cal. BP), 6,650 (7,530 cal. BP), 7,800 (8,590 cal. BP), 8,950 (10,160 cal. BP), 10,100 (11,650 cal. BP), and 11,250 (13,160 cal. BP).

The peaks of Late Glacial and Holocene cold stages were in: 325 PB (approx. 400 cal. BP), 1,475 (1,350 cal. BP), 2,625 (2,750 cal. BP), 3,775 (4,120 cal. BP), 4,925 (5,650 cal. BP), 6,075 (6,900 cal. BP), 7,225 (8,000 cal. BP), 8,375 (9,400 cal. BP), 9,525 (10,900 cal. BP), 10,675 (12,700 cal. BP), and 11,825 years BP (13,830 cal. BP).

The discovered duration of cycle of the Holocene climate changes in middle Wielkopolska is approximately 1,470 years in calendar time scale (Bond et al. 2001) in the core of sediments which originate in the Atlantic Ocean and reflects the climate change in Mid-Latitude Europe of the last 12,000 years (Barber et al. 2004).

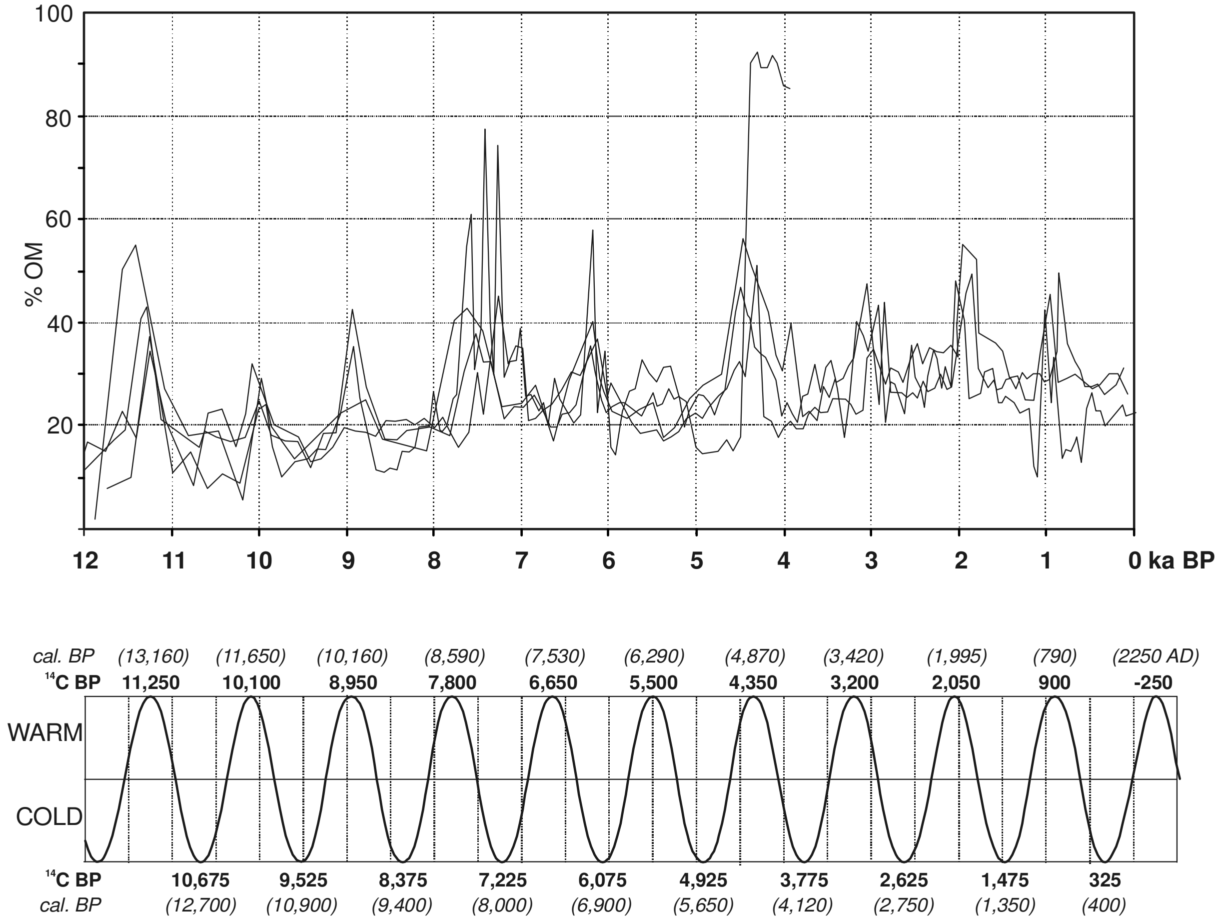

Fig. 1. Top diagram: Late Glacial-Holocene record of lithology changes (as organic matter content) in the four cores from Kórnik-Zaniemyśl Lakes (cores: Bn-01 and Bn-46 from Bnin Lake, Ko-66 from Kórnik Lake, and Ra-02 from Raczyńskie Lake; after Wojciechowski 2000). High values of OM described organic deposits (peat and brown-black detritus gyttja). The radiocarbon time scale is from age-depth model using 31 ^{14}C dates. Bottom diagram: Idealized ~1,150 year climate cycle according to conventional radiocarbon scale. Dates of peaks of warm and cold Holocene phases are in radiocarbon and calendar time scale, respectively.

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