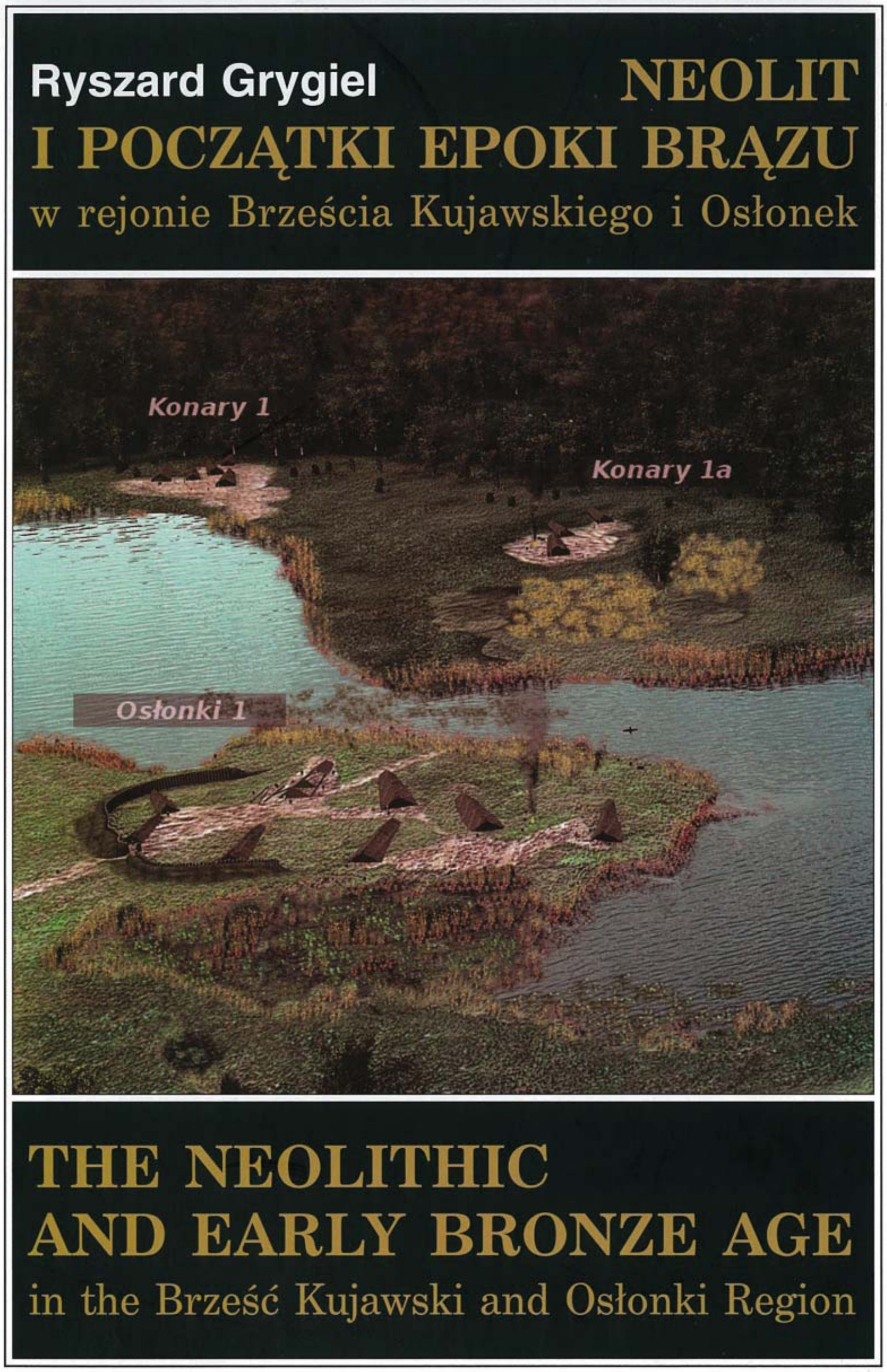
Reprinted from



Ryszard Grygiel

NEOLIT
I POCZĄTKI EPOKI BRĄZU
w rejonie Brześcia Kujawskiego i Osłonek

THE NEOLITHIC
AND EARLY BRONZE AGE
in the Brześć Kujawski and Osłonki Region

Citation:
Bogucki, Peter (2008) "Animal Exploitation by the Brześć Kujawski Group in the Brześć Kujawski and Osłonki Region" in Grygiel, Ryszard, *Neolit i Początki Epoki Brązu w Rejonie Brześcia Kujawskiego and Osłonek* (*The Neolithic and Early Bronze Age in the Brześć Kujawski and Osłonki Region*), volume II/3, pp. 1581-1704. Łódź: Konrad Jażdżewski Foundation for Archaeological Research/Museum of Archaeology and Ethnography.

6.

Animal Exploitation by the Brześć Kujawski Group in the Brześć Kujawski and Osłonki Region*

Fig. 1288. Skull of an elderly sheep from Osłonki, Pit 10.

Ryc. 1288. Czaszka starszej owcy z jamy 10 w Osłonkach, st. 1.

Acknowledgements

Peter Bogucki wishes to acknowledge the large contribution that Daniel Makowiecki made to this report in allowing his unpublished analyses of faunal remains from Konary, Miechowice 4, Miechowice 4a, Pikutkowo, Smólsk, Zagajewice, and the small sample from Osłonki to be included here. Any errors of presentation and interpretation are solely the responsibility of Peter Bogucki. Bogucki's participation in the research at Brześć Kujawski was supported by Harvard University Department of Anthropology graduate student fieldwork funds. His participation in the research at Osłonki was made possible by grants from the National Geographic Society, the Wenner–Gren Foundation for Anthropological Research, Inc., the International Research and Exchanges Board (IREX), and the American Philosophical Society. Richard Meadow generously allowed Bogucki to use his BONECODE faunal database system for the analysis of the bones from Brześć Kujawski. Pam J. Crabtree and Doug Campana generously permitted Bogucki to use their ANIMALS program for the initial recording of the Osłonki faunal assemblage, and Pam Crabtree's advice over many years and especially during the preparation of this report is warmly appreciated. Lisandre Bedault graciously shared with me the text of a forthcoming paper on Neolithic animal use in the Paris Basin (Bedault and Hachem 2008) Lucas Giron assisted in the verification of the bibliography.

---

* Dr Peter Bogucki, Princeton University, USA (with contributions by Daniel Makowiecki).

6.1
Introduction

6.1.1
PREAMBLE: ANIMAL ECONOMIES IN NEOLITHIC CENTRAL EUROPE

Neolithic sites of the “Danubian” tradition in riverine interior central Europe (Bogucki 2003), beginning with the Linear Pottery culture around 5600 cal B.C. and ending about 4000 cal B.C. with regional groups such as Brześć Kujawski in Kuyavia, Jordanów/Jordansmühl in Silesia and Bohemia, and Villeneuve–Saint–Germain in France, often do not yield large assemblages of animal bones. A very large collection of animal bones from a single site would number several thousand identified specimens, whereas the average sample from any one site is usually in the hundreds. Preservation factors and recovery methods determine the relatively small size of these samples. Across much of riverine interior Europe, decalcified loess soils cause bone to disappear, and thus from many sites only teeth are preserved. Sites with good bone preservation are usually found off the loess in areas where settlement was on clay (as in the Polish lowlands) or gravel (as in the Paris Basin). Hand recovery of animal bones during coarse excavation methods has also resulted in the destruction of specimens that managed to survive over six millennia.

The Danubian animal economies were based on the major domestic taxa that came to Europe from the Near East: cattle, sheep, goat, and pig. Hunted wild animals played a relatively small but significant role, as did birds, reptiles, and fish. The domestic livestock have been shown conclusively to have originated from populations in the Near East and Anatolia. Sheep and goat have no native counterparts in Europe, so tracing them back to the Near East is fairly straightforward. Goats were domesticated first in the Zagros Mountains around 8000 B.C. (Zeder and Hesse 2000), with sheep shortly thereafter. Cattle were domesticated in Anatolia between 7000 and 6000 B.C. (Edwards et al. 2007). Claims made over many decades for indigenous independent European domestication of cattle (e.g. Nobis 1975) have been shown by recent DNA analyses to be unsubstantiated (Bollongino et al. 2006), although there is some evidence for ingression of local male aurochs DNA into the domestic cattle lineages (Götherström et al. 2005). DNA analysis has revealed a complicated situation with pigs, however (Larson et al. 2007, Dobney and Larson 2006). Although the earliest European pigs do appear to stem from Near Eastern progenitors domesticated around 7000 B.C., there is fairly clear evidence of interbreeding between domestic and wild pigs over the subsequent millennia. Around 4000–3500 B.C., European pig populations came to be dominated by indigenous DNA derived from wild populations, and wild boar is probably the principal progenitor of all modern European domestic pigs (Larson et al. 2007).

Bogucki (1989) summarized the general state of knowledge about early Neolithic animal economies in central Europe, and except for the addition of the important recent DNA studies, this picture has not changed significantly in its broadest outline over the past two decades. Although the principal domestic taxa appear at almost every site, Linear Pottery faunal assemblages of over a hundred identified specimens are generally dominated by domestic cattle bones, with relatively fewer sheep and goat bones, and a very small proportion of pig bones if present at all. Bones of wild animals are very scarce in Linear Pottery assemblages. Both the low proportion of pigs and the low number of wild animal bones are surprising in light of the forested valley–bottom environment of the Linear Pottery sites and must be attributable to human choices. After about 5000 cal B.C., there is greater variability among Neolithic faunal assemblages in riverine interior central Europe. Some assemblages contain more sheep and goat, while pig bones come to be represented in greater quantities, often comprising 25% or more of an assemblage. In some instances, the number of wild animal bones also increases during the fifth millennium B.C.

Yet there is still quite a bit to be learned from Neolithic animal bones in riverine interior central Europe. The fundamental questions for archaeozoologists working in Neolithic central Europe are the following:

1. Does the faunal assemblage reflect consumption refuse? Is there evidence of other cultural practices that resulted in bone deposition?
2. Does the fundamental ratio of domestic to wild taxa conform to the overall pattern of majority domestic/minority wild and can metrical data assist in the differentiation between wild and domestic cattle and pig?
3. What were the relative proportions of the different domestic taxa present in the faunal assemblage of a given site?
4. Do these proportions vary from feature to feature on a single site and what can this tell us about taphonomic processes and human cultural practices?
5. Do the proportions of anatomical elements differ from feature to feature and what can this tell us about taphonomic processes and human cultural practices?
6. If multiple assemblages are available within a region, how do the proportions of taxa and of anatomical elements differ from one site to another and how might this inform us about human cultural practices?
7. What can the epiphyseal fusion data, tooth eruption data, and metrical data tell us about kill–off patterns and population structures?
8. Is there evidence for butchery techniques and pathology?
9. Is there evidence for bone working, particularly in the selection of specific anatomical elements from particular taxa that might skew the proportions in the consumption refuse?
10. Are any unusual wild mammals present and what can their ecology tell us about human behavior?
11. What species of wild birds, reptiles, and fish are present and in what quantities, and what can their ecology tell us about land use and seasonality?

The goal of such studies, including the one presented here, should be the characterization of the species representation AND the variability of samples of animal bones from as many sites as possible within particular regions. The danger, as Midgley (1985) has noted, in making broad generalizations from the sample of an individual site cannot be overstated. When a region lacks many faunal samples, this is tempting to do, but an increased number of samples brings increased variability, so it is then important to identify the broad similarities and the elements that show the greatest variation.

The evidence from animal bones cannot be considered in isolation, and it is crucial that their study be complemented by knowledge about the plant economies and the prehistoric environments of Neolithic sites. Unfortunately, comprehensive research programs that integrate archaeozoological, archaeobotanical, and palaeoenvironmental data are rare in riverine interior central Europe. In contrast to the relatively thin archaeozoological data across Neolithic central Europe, the corpus of archaeobotanical data is much richer (Bogaard 2004) and has permitted the reconstruction of the Neolithic plant economy in some detail. Palaeoenvironmental reconstruction has been confined to specific localities (e.g. Bakels 1978; Kalis and Meurers–Balke 1997; Kalis, Merkt, and Wunderlich 2003; Nalepka 2005) but holds tremendous promise for understanding Neolithic land use.

The analysis below is framed as a traditional zooarchaeological investigation, with the focus on the role of animals in the Neolithic economy. It does not directly confront the social and symbolic issues regarding Neolithic animal use such as those raised by Russell (1999) and Marciniak (1999, 2005). While it does not deliberately ignore the fact that relationship between animals extended into spheres beyond their use as a resource for food and raw materials, this study reflects the main interests of the principal author. The data presented below certainly can be taken further to consider social and symbolic issues at a later date.

6.1.2
HISTORY OF RESEARCH

In his report on his excavations at Brześć Kujawski that began in 1933, Konrad Jażdżewski mentioned the presence of animal bones in significant quantities (Jażdżewski 1938). The fact that they were recovered systematically testifies to the high quality of Jażdżewski's research methods for the time. Unfortunately, many lots from the 1933–1939 excavations were mixed or lost during World War II, and the materials from only a few features survived intact for subsequent analysis.

When Ryszard Grygiel and Peter Bogucki began their excavations at Brześć Kujawski in 1976, they recognized immediately that the faunal remains from Neolithic features had considerable research potential. As a result, a high priority was placed on the systematic recovery and subsequent analysis of animal bones. In addition to the hand–collection of bones through troweling with an emphasis on intact specimens with minimal damage, wet–sieving of selected features was introduced, which was novel for Polish archaeology at the time. This resulted in the recovery of many small specimens, particularly of fish. Bogucki undertook training in faunal analysis through the newly–established Center for Materials Research in Archaeology and Ethnology in Cambridge, Massachusetts. The analysis of the faunal remains from Brześć Kujawski recovered in 1976–1979 constituted the basic research presented in Bogucki's doctoral dissertation at Harvard University (Bogucki 1981) as well as several other publications (Bogucki 1980, 1982, 1984).

During the 1980s, additional material from Brześć Kujawski was studied by Krystyna Susłowska and Krystyna Urbanowicz of the Institute of Environmental Biology, University of Łódź (Grygiel 1986, table 1). Excavations at Falborz by the Muzeum Ziemi Kujawskiej i Dobrzyńskiej in Włocławek yielded a sample of animal bones that was analyzed by Bogucki and is reported below for the first time. Most importantly, a test trench at Osłonki in 1987 indicated the presence of a significant Neolithic settlement and a copious amount of well–preserved animal bone. The presence of so much animal bone in such a small area was a key factor in the decision to undertake excavations at Osłonki.

In 1989 and continuing through 1994, Grygiel and Bogucki conducted excavations at Osłonki with support from the National Geographic Society, the Wenner–Gren Foundation for Anthropological Research, Inc., and the Komitet Badań Naukowych. This research, which resulted in the exposure of over 12,000 square meters, yielded a sample of over 17,000 bone fragments, which are reported for the first time below. Beginning in 1990 and continuing through 1996, Bogucki identified and recorded the mammal bones from previous excavation seasons using procedures described further below. As a complement to the faunal analysis, palaeobotanical and palynological research was also undertaken concurrently (Bieniek 2002, Nalepka 2005).

After the conclusion of excavations at Osłonki, Grygiel continued excavations through 2004 at Miechowice, Konary, Zagajewice, Smólsk, and Pikutkowo. The faunal remains from these investigations were analyzed by Daniel Makowiecki, who has generously permitted his data to be reported here. In addition, fish bones from Brześć Kujawski and Osłonki were analyzed by Makowiecki (2003). Entry of the Osłonki mammal data into a computer database was completed in February 2007.

The report below represents an initial synthesis of the earlier data from Brześć Kujawski and Falborz with the later data from Osłonki studied by Bogucki and that from Miechowice, Konary, Zagajewice, Smólsk, and Pikutkowo analysed by Makowiecki. The size of the Osłonki assemblage makes it central to this study, for it enables statements to be made about the relative abundance of species, body part representation, livestock population attrition, and metrical data on the basis of a substantial sample. The information on faunal exploitation will be further integrated with the palaeobotanical and palaeoenvironmental data in a series of subsequent publications.

6.1.3
Linear Pottery fauna in Polish Lowlands

A Neolithic farming economy had been present in southeastern Kuyavia for nearly a millennium preceding the settlements discussed in this volume. Sites of the Linear Pottery culture yielded samples of animal bones that were described in detail by Grygiel (2004) drawing on the analyses of Daniel Makowiecki and Peter Bogucki. Bogucki (1982, 1989) discussed the Linear Pottery animal economy in this region, and the results of studies in the last two decades confirm this general picture. A short summary here will characterize the antecedents of the mature Neolithic animal economy described below.

The most striking feature of the Linear Pottery faunal assemblages throughout central Europe is the very high representation of domestic cattle. Sheep and goat are normally represented to a much lesser degree, and normally pig bones are present in very low numbers. Linear Pottery faunal assemblages in southeastern Kuyavia are no exception to this general pattern. A ternary plot[1] of cattle, sheep/goat, and pig in Figure 1289 shows this pattern graphically, using the data presented by Grygiel (2004) which demonstrate a remarkable consistency.

Bogucki (1984, 1986) argued that the high numbers of cattle in Linear Pottery samples and the presence of ceramic sieves point toward a high probability that milking and the production of dairy products was known by the earliest farmers of central Europe. The economic logic of an animal economy in a forested habitat also argues in favor of dairy production. Studies of sherds from western Europe (Copley et al. 2005) indicate that dairying was practiced from early Neolithic times onward, and the case has been made that this was also the case in central and eastern Europe (Craig 2002, Craig et al 2005). Isotopic analysis of cattle bone is also a promising line of evidence (Balasse et al. 1997). A future line of research to be pursued is the analysis of potsherds from Neolithic sites in southeastern Kuyavia for evidence of the lipids that are signatures of dairy products.

Another notable feature of Linear Pottery faunal assemblages is the relatively low proportion of wild animal bones, again a pattern visible across Europe with a few exceptions. In addition to red deer and roe deer, occasional beaver bones document the presence of that species in the habitats settled by the early farmers. This suggests that these environments already had some clear meadows which may have occurred in the shallow valleys such as are found near Linear Pottery settlements at Brześć Kujawski and Miechowice.

Linear Pottery faunal assemblages from elsewhere in Kuyavia conform to a similar pattern. Data reported by Sobociński (1985) with the addition of data from Radziejów (Świeżyński's analysis reported in Gabałówna 1963) provided the basis for Figure 1290 showing Linear Pottery assemblages from western and central Kuyavia. As with the data from southeastern Kuyavia, there is a nearly universal preponderance of cattle bones, in all but one case over 70% of the identified bones of the principal domesticates. An anomalous assemblage is that from Miechowice 7 (a different locality named Miechowice from the one discussed below) where there is a significant proportion of sheep/goat.

---

[1] A ternary, or triangle, plot compares the relative proportions of three variables whose total sums to 100%, which are graphically depicted as positions within an equilateral triangle. Each side of the triangle represents a proportion of 0%, with the point of the triangle opposite that side representing a proportion of 100%. As a proportion increases in any one sample, the point representing that sample moves from the side to the opposite point of the triangle. For example, in Figure 1289, the proportion of pig moves from bottom to top as it increases.

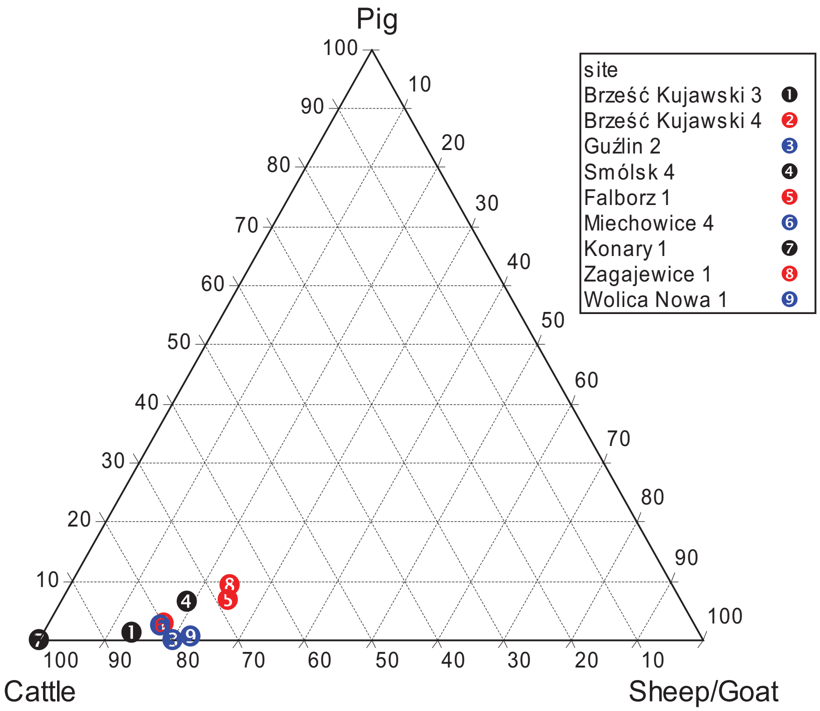


Fig. 1289. Ternary plot of Linear Pottery faunal assemblages from southeastern Kuyavia.

Ryc. 1289. Wykres trójwartościowy zespołów szczątków zwierzęcych kultury ceramiki wstęgowej rytej z terenu południowo–wschodnich Kujaw.

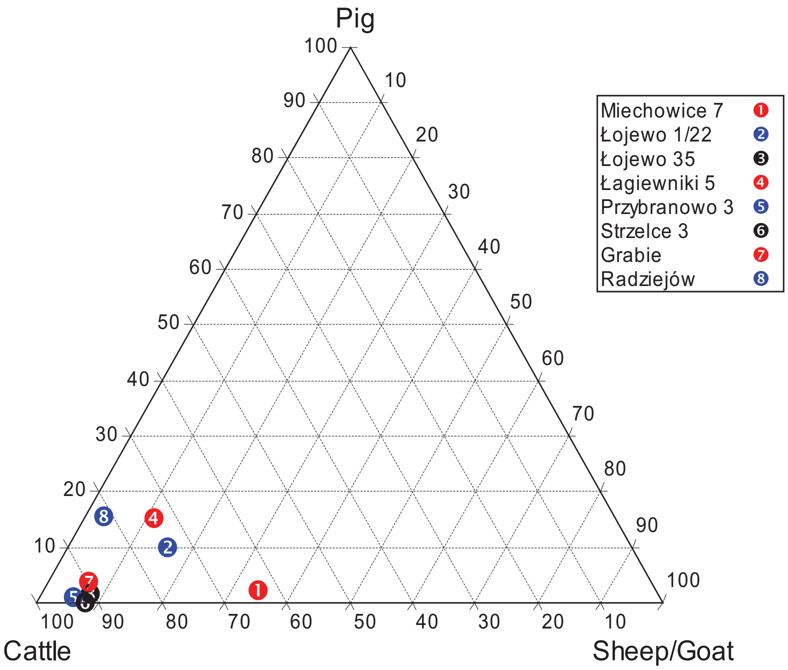


Fig. 1290. Ternary plot of Linear Pottery faunal assemblages from other parts of Kuyavia.

Ryc. 1290. Wykres trójwartościowy zespołów szczątków zwierzęcych kultury ceramiki wstęgowej rytej z innych części Kujaw.

6.2
Sites, Materials, and Methods

The following section discusses the context, recovery, preservation, identification, and recording of the animal bones from Lengyel sites in southeastern Kuyavia, as well as the computerized database systems employed in the study of the materials from Brześć Kujawski and Osłonki.

6.2.1
SITES

The faunal samples reported in this chapter come from nine sites: Brześć Kujawski, Falborz, Osłonki, Miechowice 4, Miechowice 4a, Konary, Zagajewice, Pikutkowo, and Smólsk. A map showing the locations of these sites is found on Fig. 1, 2, and a description of the archaeological context of these faunal samples is found elsewhere in this volume. Although Bogucki identified and analyzed most of the mammalian faunal sample from Osłonki, a smaller portion was identified by Makowiecki. The latter assemblage came from two cultural layers in 360/361 and 370/371. For the sake of accuracy, these collections are reported separately below.

6.2.2
CONTEXT, SAMPLE CONDITION, AND RECOVERY

The faunal remains on the Lengyel sites of southeastern Kuyavia come from a variety of rubbish deposits in trash pits, clay extraction pits, and bedding trenches of houses. Due to the disturbed nature of the plow zone and the cultural layer, the faunal remains from these contexts were not systematically studied unless they were unequivocally associated with a well–defined feature immediately below. While the exclusion of bones from the cultural layer has resulted in the exclusion of a number of specimens from the analyzed sample, it does not significantly affect the total number of identified specimens, since the material in the plow zone and cultural layer is often highly fragmented. Moreover, it does not appear to affect the proportions of identified taxa in the studied sample.

The effects of different types of contexts on the composition of the faunal sample they contain is an important consideration. For example, at Hajji Firuz in Iran, Meadow (1978a: 19) found a difference in the frequency of pig bones between interior and exterior contexts and hypothesized that this might be due to the larger size of pig bones in relation to those of sheep and goat, which would lead to their being easier to spot in housecleaning and tossed outside. In the analysis of the Osłonki bones below, particular consideration will be given to the differences in sample composition between the small trash pits, which often contain a very high density of bone in relation to volume, and the large clay extraction pits, which often have a lower density of bone in relation to volume but larger samples overall.

The animal bones in the rubbish deposits reflect both primary and secondary deposition. Some of the bones were probably discarded directly into the pits, as indicated by units of articulated bones. Others were probably discarded elsewhere and then collected into rubbish deposits. Still others were probably just lying around the settlement and were kicked or thrown into the pits casually. Gnawed bones suggest that dogs carried some of them from the locations where people originally discarded them. Relatively few of the bones are weathered or rodent–gnawed, suggesting that most did not lie unburied for any length of time.

The working assumption in dealing with the faunal samples from Neolithic sites in southeastern Kuyavia is that they provide a proxy record of the animal economy, This assumption must be tempered by the fact that the samples of faunal remains reported below are only a small fraction of the total “potential” sample of animal bones. Figure 1291 graphically depicts the attrition between the number of bones present in living and dead animals present during the life of the settlement and the sample of bones reported in a publication. The outer rings reflect factors that cannot be controlled by the zooarchaeologist and are determined by choices made by the prehistoric inhabitants of the settlement about what animals to hunt and slaughter and by loss to weathering, dogs, decay, and erosion. The inner rings depict factors that are within the control of the archaeologist and zooarchaeologist. These include the selection and size of the excavated areas, the recovery methods, the procedures for the identification and quantification of the animal bones, and the decisions about which bones to include in the published sample.

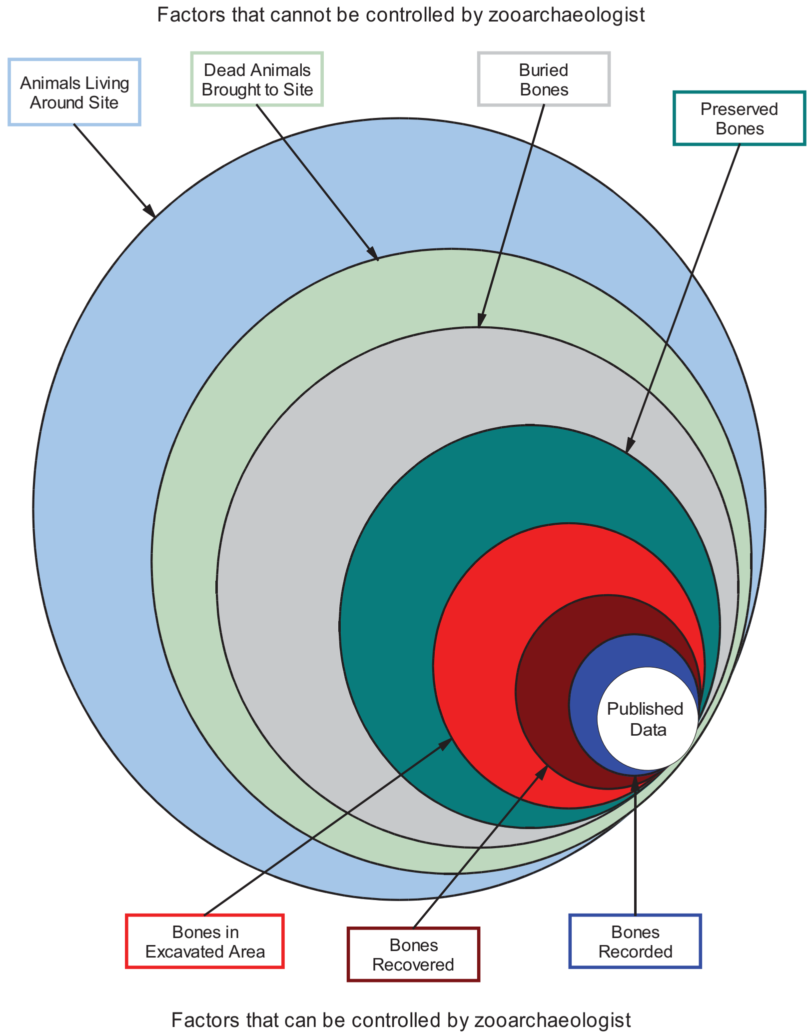


Fig. 1291. Bone attrition between living population and published report.

Ryc. 1291. Proces niszczenia kości zawarty między populacją ówcześnie żyjących zwierząt a niniejszym sprawozdaniem.

Perhaps the major cause of bone attrition between the potential bone population and the deposited fraction is the destruction of post–consumption bones by dogs. Dogs are present in the Mesolithic and Neolithic faunal record of central Europe and were present at the sites discussed in this volume. They probably had to fend for themselves on settlement rubbish. When a dog obtains a bone to gnaw, it is quickly destroyed, or may be hidden outside the archaeological deposits. Guilday (1971: 25–7) argues that if there is evidence that dogs were present at a site, their destruction of bone is the greatest single source of bone loss. Thin–walled trabecular bone, such as that found in the proximal tibia and humerus of large mammals, is particularly susceptible to destruction by dogs.

The standard method of excavation of the sites discussed here involved primarily the hand collection of animal bones during shoveling or trowelling. During excavation some breakage of bone inevitably occurred, and the degree of breakage varied with the experience of the workmen. For example, there was a noticeable decline in breakage at Brześć Kujawski between 1976 and 1979 with largely the same crew of workmen who were untrained at the beginning and experienced after several years of excavation. Most breakage was mendable and did not noticeably alter the ability to identify species or side, although occasionally it rendered bones unmeasurable.

The practice of sieving the contents of archaeological features was introduced at Brześć Kujawski in the 1970s and continued at Osłonki in selected high–yield contexts. The large number of fish bones from these sites, for example, is a product of the wet–sieving of feature fill at Brześć Kujawski 3 that had been motivated initially by the desire to find carbonized grain. Dry sieving of feature fill through 1–cm hardware cloth also enhanced the recovery of faunal specimens, for example from Claypit (Glinianka) 2 at Osłonki.

6.2.3
IDENTIFICATION AND RECORDING

The primary species identification of animal bones from Brześć Kujawski, Falborz, and Osłonki was carried out in the field relying on a corpus of reference illustrations. Among these, the principal authority was the *Atlas of Animal Bones* (Schmid 1972). Specimens that looked potentially identifiable but could not be identified positively the illustrations were taken to the Museum of Comparative Zoology at Harvard University, as were the bird bones from Brześć Kujawski, to be compared with reference collections. Bird bones from Osłonki remain in the possession of Bogucki. Fish bones from Osłonki and Brześć Kujawski were forwarded to Daniel Makowiecki in 1995 and eventually were repatriated to Poland.

6.2.4
COMPUTER DATABASES

From the beginning of the serious study of faunal remains from Brześć Kujawski, it was clear that some sort of computerized system for the recording, tabulation, and analysis of the data would be needed. The first system employed was BONECODE, designed by Richard Meadow (1978b) for the analysis of Near Eastern fauna and adapted to European taxa. BONECODE relied on a numerical coding system that mapped to different faunal attributes and was the state–of–the–art in late–1970s systems. Coded data were recorded in the field on special sheets and then entered onto punchcards in Cambridge, Massachusetts, where they were subsequently read into the mainframe computer for analysis. Original data on datasheets, punchcards, and magnetic tape is in the possession of Peter Bogucki.

By the end of the1980s, the introduction of desktop computers running the MS–DOS operating system led Bogucki to employ the ANIMALS database (Campana and Crabtree 1987) for the analysis of the corpus of data that was emerging from Osłonki. Data were recorded on key attributes such as species, element, side, end, fusion, fragmentation, and measurements. In addition, traces of pathology and butchery were noted. Data were recorded in the field on paper recording sheets and entered into the computer in New Jersey. The entire Osłonki assemblage was recorded for eventual entry into ANIMALS, although only a relatively small percentage was actually entered.

Over the last several years, advances in computer processing speed, the development of the Windows operating system, and the ubstetquity of the Microsoft Office suite resulted in a shift in database when it became clear that the Osłonki data needed to be analyzed much more quickly. A decision was made in 2005 to enter all Osłonki data into the York Faunal Analysis Database (Harland et al. 2003), a customized application for Microsoft Access. A key factor in this decision was the expertise that Bogucki had developed in MS–Access, particularly in the writing of queries and reports as well as the capability of exporting data to MS–Excel for further quantitative analysis and from there to various graphing programs. The York system was also employed because it focused on the same attributes as ANIMALS and noted them in a similar way, thus making it very straightforward for data to be entered.

6.3
Principal Available Species

A wide range of animal species was used by the Neolithic inhabitants of southeastern Kuyavia during the fifth millennium B.C. The domestic animals kept by the inhabitants of Brześć Kujawski, Osłonki, and neighboring sites include cattle, sheep, goats, pigs, and dogs. Among the wild mammals were red deer, roe deer, wild cattle, wild pig, beaver, wild horse, bear, and small fur–bearing animals. Turtles, fish, and shellfish, along with a variety of terrestrial and aquatic birds have also been found. The following section characterizes these species and their ecology before proceeding to the discussion of the faunal samples.

6.3.1
DOMESTIC ANIMALS

The domestic animals available during the fifth millennium B.C. in central Europe included cattle, sheep, goats, pigs, and dogs. All five taxa were present at Neolithic sites in southeastern Kuyavia.

Domestic Cattle

Cattle (*Bos taurus*) had been domesticated in Anatolia by about 7000 B.C., with the first domestic cattle appearing in southeastern Europe by about 6800 B.C. Although the forests of central Europe did contain wild cattle (aurochs, *Bos primigenius*), recent studies have demonstrated that the mitochondrial DNA of European Neolithic cattle remains reflects a Near Eastern origin almost exclusively (Bollongino et al. 2006). Since mtDNA is passed through the maternal line, this means that the female breeding population of European Neolithic cattle was derived from Near Eastern stock. This does not exclude the possibility of introgression of local aurochs genes from males, and indeed the analysis of Y-chromosomes from ancient and modern wild and domestic cattle in temperate Europe supports this (Götherström et al. 2005). Thus, while there appears to have been no bovine maternal line among Neolithic and later domestic cattle that was derived from aurochs, there is a strong possibility of local hybridization from mating between aurochs bulls and domestic cows. Claims for *de novo* independent domestication of cattle in temperate Europe (e.g. Nobis 1975, 1978) cannot be substantiated, however, and appear to be clearly contradicted by the genetic evidence.

Since domestic cattle had been present in central Europe for nearly a millennium prior to the Lengyel occupations of Osłonki, Brześć Kujawski, and neighboring sites, we can assume that the cattle kept at these sites were a population that had become thoroughly acclimated to the conditions of central Europe. Although cattle served in large measure as a source of meat, a strong case can be made that they were also used for dairy production, based on the finding of sieves on Early Neolithic sites (Bogucki 1984) and recent residue analyses that found considerable traces of dairy lipids on Neolithic potsherds in western Europe dating to the fifth millennium B.C. (Copley et al 2005). The first clear evidence for animal traction in central Europe does not appear until the fourth millennium B.C., but an open question is whether it had antecedents. This topic will be discussed below with reference to a specimen from Osłonki.

The presence of substantial numbers of domestic cattle on the North European Plain during the fifth millennium B.C. has important implications for the introduction of domestic cattle to southern Scandinavia. A recent summary of the evidence (Noe–Nygaard, Price, and Hede 2005) points toward a fairly sudden and widespread introduction of domestic cattle to Denmark around 4000 B.C., although there does seem to be a reliably dated domestic cattle bone from Lollikhuse in northern Zealand from around 4600–4700 B.C. (Noe–Nygaard and Hede 2006). The Lollikhuse date is striking because aurochs had been extirpated on Zealand by 6000 B.C., but at the moment it is the only domestic cattle bone in southern Scandinavia before 4000 B.C.

The domestic cattle that were introduced into southern Scandinavia late in fifth millennium B.C. must have come from the North European Plain. Domestic cattle kept by Neolithic farmers in Kuyavia are good candidates for a source population, for there are no other such large concentrations of Neolithic settlements with domestic cattle above 52°N latitude in continental Europe at this time. How these cattle made their way north is a matter of conjecture. I have suggested that feral livestock could have penetrated the porous boundary between foragers and farmers quite easily (Bogucki 1995), and there are no major water barriers between Kuyavia and the Baltic coast.

Sheep and Goat

Sheep and goat were domesticated somewhat earlier than cattle in various parts of the Near East, sheep by about 7500 B.C. in the northern Levant (Russell 2004) and goats around 8000 B.C. in the Zagros Mountains (Zeder and Hesse 2000). Domestic sheep (*Ovis aries*) derive from the Asiatic mouflon (*Ovis orientalis*), while domestic goat (*Capra hircus*) are descended from the Bezoar goat (*Capra aegagrus*). Neither the mouflon nor the Bezoar goat occur naturally in Europe (claims for local domestication of sheep in southwestern Europe are not possible to substantiate) so any sheep and goat found in Neolithic temperate Europe certainly are derived from Near Eastern precursors. Early sheep lacked wool, and since woolen textile remains appear in temperate Europe only around 3000 B.C. The question is whether sheep and especially goats were milked at this date, and there is some evidence from the kill–off profiles to suggest that they had some economic use beyond meat.

The lowland forests of temperate Europe would have been dramatically different habitats from the hilly semi–arid lands of the Near East and the open forests of the Balkans and Mediterranean Europe from whence sheep and goats came. Although they are present in relatively low numbers in Linear Pottery faunal assemblages during the sixth millennium B.C., they did not generally appear in large quantities in Neolithic faunal assemblages in temperate Europe until the fifth millennium B.C. and later.

There is an important dietary difference between sheep and goats. Sheep are grazers that prefer grasses, while goats are browsers who can eat shrubs, low tree leaves, almost any sort of plant matter. The two types of small runinant thus complement each other. The browsing habits of goats contribute to the maintenance of forest clearance by suppressing the regeneration of weeds, shrubs, and eventually saplings (Rollefson and Köhler–Rollefson 1992).

The osteological differentiation of sheep and goat is based on a limited number of diagnostic traits (Boessneck 1969), and most specimens can only be assigned to the general category of "sheep/goat". Zooarchaeologists are comfortable with this nomenclature, but the dietary differences between sheep and goat make it important to remember that "sheep/goat" is an analytical category that masks significant behavior and economic distinctions in the animal economy.

Domestic Pig

Perhaps the most interesting of the domestic taxa in southeastern Kuyavia during the fifth millennium B.C. was the pig (*Sus scrofa domesticus*). Pigs had been domesticated initially in Anatolia, as reflected by a clear size diminution over several millennia, although the date of their earliest domestication is uncertain (Ervynck 2002, Russell 2004). They arrived in Europe alongside domestic cattle around 6800 B.C. Recent DNA studies trace the earliest European Neolithic pigs back to a Near Eastern founder population (Larson et al. 2005; Larson et al 2007).

The domestic pig played a very small role in the animal economy of the Linear Pottery culture during the late sixth millennium, clearly a cultural decision rather than the result of economic or environmental considerations for the pig would have been well suited to the forests of temperate Europe. It was only during the fifth millennium that they came into their own to form a large part of Neolithic faunal assemblages in temperate Europe. Meanwhile, wild pigs, who were conspecific with their domestic counterparts, were present in substantial numbers in the European forests. Given that it is likely that domestic pigs were allowed to forage on their own with minimal confinement, they probably encountered and mated with wild pigs fairly regularly. The likelihood of a continuous pig population that included both wild and domestic individuals was found in Neolithic temperate Europe was advanced by Bogucki (1989). Recent DNA analysis points towards a substantial ingression of wild pig genes around 4000–3500 B.C. (Larson et al. 2007) and advances the idea that most modern European pig populations owe more to the indigenous wild pigs than to Anatolian precursors.

Pigs are economically valuable only for meat, hide, and bristle. They are well suited for this purpose, for they reproduce abundantly and reach their optimal meat weight quickly. Since they eat many of the same foods as people, obtained by scavenging around the settlement and in the nearby forests, pigs are low–maintenance meat producers who could exist in a commensal relationship with their human keepers.

Dogs

Dogs (*Canis familiaris*) were domesticated from wolves in many parts of the world, and they were present in temperate Europe during the Mesolithic (Clutton–Brock 1995). While it is not appropriate to discuss prehistoric dogs in terms of modern breeds, a few general remarks can be made. Neolithic dogs were the size of medium–sized modern dogs, approximately the scale of a modern Shetland sheepdog[2] or border collie, but there was a wide range of variability. For example, British Neolithic dogs ranged between 37 and 62 centimeters at the shoulders (Clark 2006: 33). Since wolves and dogs are conspecific, there is always the possibility of hybridization between wild and domestic canids.

While Mesolithic dogs were hunting partners, Neolithic dogs would have been working dogs in the farming economy (Coppinger and Schneider 1995). Livestock guarding was probably a key duty, while herding of sheep and cattle may have been another. Around the settlement, their barking would have raised an alarm about visitors and predators. Since dog remains are found in consumption refuse, some appear to have been eaten. It can be speculated that these dogs may have resisted training or were behaviorally unsuited to livestock guarding or herding.

6.3.2
WILD UNGULATES

The next major category of mammals available in Neolithic central Europe included the ungulates that comprised the major part of the wild mammalian biomass. These include artiodactyls such as red deer, roe deer, wild pig, and wild cattle, and the perissodactyl wild horse.

Red deer

Red deer (*Cervus elaphus*) constituted the primary game species during the Neolithic throughout much of Europe (Boyle 2006), but with the exception of a few sites, it is rarely the majority species in the faunal assemblage. Red deer have a diversified diet that varies according to habitat and season (Gebert and Verheyden–Tixier 2001). They are classified as "intermediate feeders" (Hofmann 1989), for in addition to grazing on grasses that also eat concentrated food items such as leaves, fruits, grains, and seeds. When good is scarce, they will also eat woody plant material such as tree shoots. Red deer readily also consume crops, and Neolithic farmers would have needed to protect their fields from deer. Such encounters may have led to their opportunistic hunting.

In lowland forests, populations densities of red deer are relatively low, in constrast to the larger herds found in upland and lightly forested areas. In Białowieża Forest in eastern Poland, they averaged between 4.6 in winter and 6.5 in summer per km^2 although in areas with a large coverage of oak–hornbeam forests their average density was over 9 per km^2 (Jędrzejewska and Jędrzejewski 1998: 33–6). During the spring and summer they are generally found either individually or in very small groups of 2–3 individuals (e.g. mother and calf), but during the fall rut and winter they aggregate into larger groups.

The highly–branched antlers of red deer stags are shed in March and April. If there is a calcium deficiency in their diet, deer will mouth and chew shed antlers, so they do not persist long in the landscape. Therefore shed antlers found in archaeological contexts must have been collected during a fairly narrow window of time in the early spring. Antlers of red deer regenerate by late summer in time for the autumn rut. The antler cycle is governed by plasma testosterone levels which in turn are regulated by length of photoperiod (Suttie and Fennessy 1992). Mechanical properties of red deer antler made is an important material for prehistor-

---

[2] Finnian Bogucki and Brodie Bogucki, Shetland sheepdog males aged 17 months, measured on May 17, 2007, stand approximately 47 cm at the shoulder.

ic tool manufacture (Grygiel and Bogucki 1990; Riedel, Pohlmeyer, and von Rautenfeld 2004).

Roe deer

Roe deer (*Capreolus capreolus*), much smaller than red deer, were ubiquitous in the forests of Neolithic central Europe, as they still are today (Andersen, Duncan, and Linnell 1998). They are very adaptive and opportunistic animals, and part of their resilience is due to the fact that they flourish in disturbed habitats such as clearings, field edges, and abandoned settlements. In their feeding habits, roe deer are classified as "concentrate selectors" (Hofman 1989) in that they selectively prefer soft, energy–rich foods such as leaves, seeds, fruits, and other flowering plants over grasses.

The population density and social organization of roe deer depends on the abundance and distribution of food and cover (Sempéré, Sokolov, and Danilkin 1996). During the summer they are either solitary or move in small family groups (often a female with young), but in the winter they aggregate into larger groups. In forested environments, the winter groups are generally small and rarely exceed 10 members. Due to their small size, roe deer rely on cover for protection from predators, so forest edges that provide a mix of rich plants and easy access to cover are preferred.

Roe deer antlers are shed annually in October–November. Unlike those of red deer, roe deer antlers have no physical properties that make them suitable for tool use, so their presence in archaeological deposits is generally the result of hunting of animals with unshed antlers.

Wild cattle (aurochs)

Since the last aurochs died in A.D. 1627 in central Poland, we must presume that wild cattle (*Bos primigenius*) were present in the forests of southeastern Kuyavia during the fifth millennium B.C. Anatomically they are almost identical to domestic cattle, and the differentiation between aurochs and domesticated cattle is based mainly on size. There is, however, no clear distinction because sexual dimorphism results in a size overlap between female aurochs and male domestic cattle, The principal question that will be addressed metrically below is to what extent they played a role in the Neolithic animal economy.

The population density of wild cattle in the forests postglacial Europe must have been relatively low. This can be inferred by the relative ease with which they were known to have been extirpated in closed habitats such as the Danish island of Zealand, where the aurochs was extinct by about 6000 B.C., perhaps the result of overhunting (Aaris–Sørensen 1980).

Stable isotope analysis of aurochs bones from Denmark indicate that the latest population of wild cattle was browsing and grazing from the floor of the closed forest, similar to that of contemporaneous red deer (Noe–Nygaard, Price, and Hede 2005; Noe–Nygaard and Hede 2006), but very different from that of the subsequent domestic cattle introduced to the area around 4000 B.C. who were grazed in open habitats.

Wild pig

Wild pigs (*Sus scrofa scrofa*) had been a major food source for the postglacial foragers of temperate Europe. They are a forest–dwelling species who feed on acorns and other nuts, bulbs, roots of forest plants, eggs, invertebrates, and small vertebrates. Wild pigs also damage crops, both by consuming them and by trampling them (Schley and Roper 2003), which would have brought them into conflict with Neolithic farmers.

Wild pigs were a staple of the Mesolithic diet in northern Europe, and there is no reason to believe that they did not continue to be opportunistically hunted by Neolithic farmers. The fundamental question, which will be addressed metrically below, is the extent to which their bones occur alongside those of domestic pig and, moreover, the extent to which indigenous pig populations became part of the Neolithic breeding stock. The likelihood of a continuous pig population, as proposed by Bogucki (1989), in which there is relatively little biobehavioral significance to a firm distinction between domestic and wild Neolithic pigs, has aleady been mentioned. Recent genetic studies (Larson et al. 2007) indicate that the initial population of Near Eastern domestic pigs brought to Europe in the sixth millennium was largely replaced by pigs derived from wild populations by 4000 B.C.

Wild horse

The Holocene forests of Europe supported populations of wild horses, *Equus caballus*, wild ancestor to modern domestic horses of the same species (also called *Equus ferus*; for a discussion of nomenclature, see Bennett and Hoffman 1999; for justification of *Equus ferus,* see Gentry, Clutton–Brock, and Groves 2004). Indigenous wild horse populations of central Europe were extirpated centuries or even millennia ago, and any modern "wild" horses are either feral domestic stock or animals bred to have certain "primitive" features. There are thus no direct observations of the ecology or behavior of primeval wild horses.

Since the earliest evidence for horse domestication in Eurasia is ca. 3500–3000 B.C. on the steppes of central Asia (Anthony and Brown 2000), it is presumed that any earlier wild horses of the central European forests were killed for food. Abundant horse remains from sites of the Sredni Stog culture of the Black Sea steppes testify to the importance of wild horses as a dietary staple in this during the fifth millennium B.C.

6.3.3
OTHER WILD MAMMALS

Although not highly represented in the consumption remains, the other wild mammal species whose bones are found in small numbers are of great interest to the extent that they reflect the wildlife and ecology of the surrounding forests and stream channels.

Beaver

Beaver (*Castor fiber*) is Europe's largest rodent, weighing up to 30 kilograms. They are semiaquatic animals whose lodges and dams must have been quite numerous on the lakes and along the streams of the lowland hydrological network, for they are reported from many prehistoric sites in central Europe (e.g. Teichert 1999, Schmitzberger and Pucher 2003). In Białowieża Forest, beaver population density is estimated at about 15.2 beavers per 100 km^2 (Jędrzejewska and Jędrzejewski 1998: 57), with the larger the stream, the more beaver settlements. Beavers are "choosy generalist" herbivores who eat the leaves, twigs, and bark of many types of woody plants that grow near water as well as many types of plants (Jenkins and Busher 1979).

The initial Linear Pottery farmers in southeastern Kuyavia would have immediately recognized a key role of the beaver, that of ecosystem engineer (Wright, Jones, and Flecker 2002; Rosell et al. 2005). Dams built by beavers can alter riparian ecosystems significantly and persistently, and their tree felling can create openings in the forest canopy. Wright, Jones, and Flecker (2002) report that in the central Adirondack mountains of New York, USA, beaver ponds are generally extant for fewer than 10 years before the dam is breached, but the meadows that remain can persist for over 50 years. These meadows have nutrient–rich moist soils and high light levels. Beaver–modified habitats increase the species diversity of the riparian zone by allowing the persistence of plant species that would otherwise be excluded (Wright, Jones, and Flecker 2002: 99). Beaver ponds also provide enhanced habitats for turtles and many types of fish and waterfowl, as well as terrestrial fauna who feed in the clearings created along streams (Rosell et al. 2005).

The potential role of beavers in opening the Neolithic landscape has been noted by Brown (1997) who considered them to be a key factor in the creation of glades that were then opportunistically exploited by the first Neolithic farmers and herders. This is in contrast to the usual model of purposive tree felling by axe–wielding farmers. As ecosystem engineers, beavers in the Kuyavian stream valleys would have been able to create meadows that would have been extremely attractive as places to graze livestock and plant small fields. Coles and Orme (1983) also noted the potential role of beavers in land clearance otherwise attributed to human activity.

The other major economic contribution of *Castor fiber* is its fur, and the species was nearly hunted to extinction by the beginning of the 20th Century. Beaver meat is edible, so its role as a source of food should not be discounted, but it was probably of secondary interest to the Neolithic hunter.

European brown bear

One of the more unusual species identified at Neolithic sites in southeastern Kuyavia is the European brown bear (*Ursus arctos*). Brown bears had been restricted to refugia during the last glacial maximum and then rapidly recolonized the forests of postglacial Europe (Sommer and Benecke 2005). Since brown bears have been extirpated from the forests of lowland Europe, we have no data on their population densities in such an ecosystem, but studies elsewhere suggest that their population densities must have been very low.

Adult brown bears are solitary animals but they are not territorial (Pasitschniak–Arts 1993). They tend to avoid each other and have large home ranges. Brown bears are opportunistic omnivores, primarily eating not only shoots, flowers, leaves, roots, tubers, and bulbs but also larvae, grubs, fungi, eggs, nuts, and mice. They will scavenge the carcasses of dead mammals and may attack and kill injured or old deer and wild pigs. Bears are also known to prey on livestock, so the Neolithic herders would have needed to be alert if one was around.

Since bears are notorious for being drawn to the rubbish of human settlements, we can speculate whether the inhabitants of Brześć Kujawski or Osłonki ever encountered a bear foraging on the debris around their houses. If so, we can only imagine the consternation that would have resulted, for the appearance of such a ferocious and hungry animal weighing several hundred kilos would have been alarming. It seems more probable that the capture and killing of a bear, probably using a trap in a pit, would have been an event talked about for years.

The principal economic contribution of *Ursus arctos* was its furry hide. Bearskins could be used whole to insulate the walls of houses or as floor coverings, or they could be made into clothing. This is illustrated no more clearly than in the attire of Ötzi, the famous Iceman of the Tyrolean Alps, whose clothing included a bearskin hat and bearskin–soled shoes (Dickson, Oeggl, and Handley 2003).

Other Mammal Species

The forests of the North European Plain held many other mammal species that could potentially appear in a Neolithic faunal sample. Rather than enumerate all of them here (the discussion in Jędrzejewska and Jędrzejewski 1998 of the fauna of Białowieża Forest provides an excellent initial guide), it is preferable simply to mention several key species that have appeared in Neolithic assemblages.

Among prey species, the European brown hare (*Lepus europaeus*) is more typical of open grasslands and farmlands and is rare in forests except on the margins. Other prey species include small rodents such as mice, shrews, and moles, but it is more likely that these find their way into archaeological faunal assemblages through natural death within prehistoric settlements or during burrowing into archaeological deposits.

Among predator species, a noteworthy one is the river otter (*Lutra lutra*), to which the stream and lake networks of the lowland forests would have been especially congenial. Jędrzejewska and Jędrzejewski (1998: 129) note that of all the predator species in temperate forests, "the otter is the most obligatorily aquatic" and spends almost all of its time in or very near to water. The European wild cat (*Felis sylvestris*) and lynx (*Lynx lynx*) are known to have been present in Holocene temperate Europe (Sommer and Benecke 2006) but their avoidance of humans would cause their appearance in an archaeological faunal assemblage to be unusual. Other predators in the lowland forests during the fifth millennium B.C. would have been foxes, badgers, pine martens, stoats, weasels, and polecats.

6.3.4
FISH AND REPTILES

Holocene Fish of the North European Plain

Very little discussion has taken place on the role of fish in the Neolithic economy of central Europe. The principal reason for this is the fact that high–resolution recovery techniques such as water–screening have rarely been used at many sites where there is good bone preservation. Our knowledge of Neolithic fish exploitation comes from sites in countries where there are preservation conditions that result in sites where careful attention is paid to small remains (e.g. Switzerland, the Netherlands, Scandinavia) and where Neolithic economies still have a considerable component of wild resources, especially where there is an *in situ* transition between the Mesolithic and the Neolithic (e.g. southern Scandinavia, the Iron Gates Gorges). In particular, the role of fish in the economies of communities that are part of the Danubian tradition between 5500 and 4000 B.C. is very poorly known. The fish bone assemblages recovered from Brześć Kujawski and Osłonki and identified by Makowiecki (2003) thus provide important data for our understanding of the Danubian subsistence economy.

The slow–moving low–energy streams of the North European Plain supported a wide variety of fish species which had been important food resources since the beginning of the Holocene. Makowiecki (2003) has compiled the information on the history of fishing in this part of Europe and discusses the various species that were available. The hydrology of southeastern Kuyavia during the Neolithic consisted of a network of small streams that had formed in the post–glacial landscape and which often connected lakes and ponds that resulted from the melting of blocks of "dead ice" left behind by the retreating ice sheet.

Such a habitat of sluggish streams and shallow, weedy lakes would support large numbers of members of the carp family, the Cyprinidae, as well as predatory fishes such as pike and perch. The Cyprinidae include fish of many different sizes, including roach, tench, crucian carp, common carp, rudd, bream, and ide. All of these species prefer slow–flowing or still waters with overgrown banks, often with a clay or mud substrate. Modern anglers refer to such species as "coarse" fish that can tolerate the lower oxygen levels of slow streams and shallow lakes. One would not expect to find significant numbers of "game" species like trout or salmon in such interior habitats, if at all, for they prefer cool, clear, and well–oxygenated water as might be found in the arterial streams of the North European Plain such as the Vistula, Oder, and some of the smaller rivers.

Unknown to us at present is the technology employed in the catching of fish by the Neolithic communities of southeastern Kuyavia during the fifth millennium B.C. Possibilities include hooks, arrows, fish spears, nets, and traps. Based on abundant evidence from elsewhere in northern Europe during the Mesolithic and Neolithic (e.g. Louwe Kooijmans 1993) it is likely that wicker fish traps were widely used (for example, the fish trap found at Bergschenhoek dated 4200 B.C.) Fish weirs, or fences in shallow parts of lakes, have also recently come to light in central and western Europe dated to the early fourth millennium B.C. (McQuade and O'Donnell 2007, Slater 2007). Spearing and shooting (with arrows) of fish visible in the clear waters of the shallow lakes from logboats also would have been possible, although no such boats have yet been found in southeastern Kuyavia.

European pond tortoise

One of the distinctive features of the Neolithic economy during the fifth millennium B.C. in southeastern Kuyavia is the widespread exploitation of the European pond tortoise (*Emys orbicularis*). The pond tortoise was the only turtle species known to have lived in northern Europe in postglacial times, so the assignment of the carapace, plastron, and bone fragments to the species is unequivocal. Pond tortoise remains occur sporadically in faunal samples elsewhere in Europe and from other prehistoric periods, but at Lengyel sites in southeastern Kuyavia they are so numerous as to point toward an important subsistence activity. The recovery of so many pond tortoise remains is also a result of the attention paid to sieving and careful recovery during excavations over the last 30 years in this area.

Pond tortoises eat worms, insects, frogs, and small fish, all of which would have been abundant in the habitats near Neolithic sites in this region. Although they spend most of their time in the water, they emerge to bask on logs and banks and to lay eggs. Females must dig a pear–shaped nest in which to lay their clutches of eggs in late May or early June. This activity is very strenuous and the females are vulnerable during this time. Young tortoises hatch in late summer but often overwinter in their nests (Mitrus and Zemanek 2003, Ultsch 2006) before emerging the following year. Barring predation, wild pond tortoises can live for several decades, with a high adult survival rate (Mitrus and Zemanek 2004).

The pond tortoise is very important as an environmental indicator, providing information about climate and vegetation (Degerbøl and Krog 1951). Today, *Emys orbicularis* is at the northern limit of its range in central Europe, which runs approximately along the 18°C. July isotherm in Germany and the 20°C. July isotherm in France (the difference being due to the sandier and more heat–retentive soils of the German plain.) It is now virtually absent from northern Poland, southern Scandinavia, and the British Isles, where is had been quite common during the Atlantic postglacial climatic optimum. Warm and relatively dry conditions are optimal for pond tortoise populations, and since they appear to have flourished in southeastern Kuyavia during the fifth millennium B.C., it is possible to infer that such conditions prevailed. Moreover, since sunlight is necessary to incubate pond tortoise eggs, it is possible that increasing *Emys* populations could be taken as an indicator of forest clearance or retreat (at least adjacent to bodies of water) that created sunny patches of ground in which to make nests. Finally, pond tortoise remains can provide a general seasonal indicator, for adults hibernate in lake–bottom mud during the cold months and is unavailable for capture by humans. Thus the pond tortoises found in Neolithic rubbish deposits could only have been taken during the late spring, summer, and early autumn.

6.3.5
BIRDS

Europe has hundreds of species of birds, many of which are sufficiently migratory as to have been present at some point in southeastern Kuyavia during the fifth millennium B.C., so the range of possible taxa that could be represented in an archaeofaunal assemblage is immense. In practice, however, the bird bones that are commonly found in archaeological deposits are from species that have significant meat weight. These include both aquatic and terrestrial species. The aquatic species are typically members of the order Anseriformes, most commonly from the Anatidae family which includes the ducks and geese, and the order Charadriiformes, the wading birds. Terrestrial taxa generally are members of the order Galliformes, which includes grouse, partridge, and quail. While it is conceivable that members of the many other orders might find their way into archaeological deposites, their presence rather than their quantity is noteworthy. Noteworthy among these isolated taxa would be members of the order Accipitriformes, which includes raptorial birds such as eagles and hawks that may have had symbolic rather than economic significance for Neolithic society.

Gumiński's recent review of bird bone finds from Mesolithic and Neolithic sites in northern continental Europe and southern Scandinavia supports the contention that we can expect to find primarily Anseriformes, with smaller numbers of members of other bird groups, at Neolithic sites during the fifth millennium B.C. (Gumiński 2005). The abundance of terrestrial fauna at these sites, particularly domestic and wild ungulates with high meat weights, means that birds were probably a secondary food source, hunted opportunistically. Nonetheless, their presence is significant, for it reflects the breadth of the Neolithic diet when considered alongside the evidence for terrestrial and aquatic fauna and the evidence from botanical remains.

6.4
Species Quantification by Site

The quantification of the relative abundance of species represented in a faunal assemblage has two general goals (Gautier 1984). The first is to establish the relative abundance of the animal taxa present, while the second is to assess the relative dietary (or economic) contribution of each taxon. Gautier (1984: 245) makes the key point that all species quantifications are heuristic models that facilitate observation of patterns of similarities and dissimilarities among sites rather than being a direct reflection of the ancient economy at any single site. For this reason, it is significant that ten faunal samples from roughly contemporaneous sites within a small region are being reported below. Patterns observed at any one site, however, can also provide the grounds for hypotheses about herd management and hunting patterns, even if they cannot be regarded as conclusive by themselves.

There are many different ways to quantify the relative abundance of species represented in a faunal assemblage (reviewed fully by many authors, most recently by O'Connor 2000 and 2003). The simplest is simply to assess the percentage contribution of numbers of identified specimens (abbreviated "NISP"). It is a direct reflection of the faunal assemblage and makes no allowance for differences in preservation, recovery, or relative abundance of various body parts. Most important is the problem of interdependence, for using NISP as a measure of species quantification overlooks the fact that different bones may have originated in the same living individual. As a result of this problem if interdependence, it was heavily criticized in the 1960s and 1970s as a primary measure of relative species abundance.

The measure that appeared to supplant NISP in the 1960s and 1970s as a measure of relative species abundance was the calculation of a minimum number of individuals (MNI). MNI was attractive for its conceptual elegance that apparently solved the problem of interdependence. Yet MNI calculations are not as straightforward as might seem to the non–specialist (Marshall and Pilgram 1993). The zooarchaeologist needs to decide whether to treat the assemblage from the site as a single sample or to treat individual features and units as separate samples for the calculation of MNI. Grayson (1973) terms the former approach "minimum distinction" and the latter "maximum distinction". In the latter approach, the numbers of MNI will be very much higher. The aggregation–disaggregation problem is impossible to resolve. Furthermore, mathematical problems with MNI estimates render further quantification based on them, even the percentage representation of different taxa, invalid (Plug and Plug 1990).

An attempt to compromise between NISP and MNI was introduced by Watson (1979) by counting only a specific set of anatomical elements common to all taxa in the same class, which Watson termed "diagnostic zones" This approach is best suited to large, highly fragmented assemblages, such as those found on Neolithic sites. Watson's method was adapted by Bogucki (1981) in his analysis of the fauna from Brześć Kujawski and by Russell in her study of the Neolithic fauna from Opovo in Yugoslavia, but it has not been used more widely. O'Connor (2000: 56) speculates that because the diagnostic zone method is a derived measure like MNI, it is suspected of having the same abstract derived qualities. It indeed is one step removed from a direct quantification of each single bone, but it does mitigate some of the problems with both NISP and MNI.

Gautier (1984: 245) concluded that NISP are actually as good an estimate of relative species abundance as any other method then in use, while Gilbert and Singer (1982) showed through computer simulation that if fragment counts are used judiciously and take into account skeletal complexity they are better approximations of known proportions than MNI. For these reasons, most zooarchaeologists in the 1980s and 1990s came to fall back on NISP as their primary method of species quantification, although often MNI were presented as a comparison (e.g. Crabtree 1989).

At the end of the day, there is no perfect method for assessing the relative proportions of species in a faunal assemblage. The principal form of species quantification in the study below is NISP, which is used to characterize the assemblages studied by both Bogucki and Makowiecki. It was necessary, however, to harmonize the NISP presentations in one key respect. Bogucki, in an effort to speed the identification process of the Osłonki material, did not assign ribs and vertebrae (other than the atlas and axis) to species and instead characterized them as "large mammal" and "medium mammal". Although many ribs and vertebrae can be identified to species, the ability to do so is not consistent across the range of species. Moreover, they are generally not measured nor are they consistently used in measures of relative species abundance. Finally, the sheer number of ribs and vertebrae, and the multiple fragments they produce, have the potential to skew NISP dramatically in favor of larger taxa. Bogucki acknowledges that some osteological information may have been lost as a result of this procedure but stands by his decision to do so. Makowiecki, on the other hand, did assign ribs and vertebrae to species. In the presentation of his analyses below, the ribs and vertebrae are given below the main table of fragment counts, and they are not included when NISP are used to calculate relative species abundance.

Finally, in an effort to validate the NISP analysis of the Osłonki faunal assemblage, Bogucki also undertook an analysis of diagnostic zones, updating the method he used in his 1981 study of the Brześć Kujawski fauna. Thus, the Brześć Kujawski and Osłonki assemblages can compared using a common metric, albeit a more derived measure than NISP.

6.4.1
RELATIVE SPECIES ABUNDANCE AT BRZEŚĆ KUJAWSKI

The Brześć Kujawski faunal assemblage seemed quite large when it was studied by Bogucki in 1977–1981, and compared with the faunal assemblages known at the time from other sites in the Polish lowlands it was indeed substantial. It spans, however, a millennium or more of occupation, and thus the number of specimens from any one of the Linear Pottery occupations or those of the Brześć Kujawski Group of the Lengyel Culture is not very large. Nonetheless, it was the first assemblage from this region to be studied with modern techniques of recovery (explicit attention to the comprehensive collection of animal bones and the introduction of sieving) and to which a variety of techniques of quantification were applied.

Table CLXXV gives an overall profile of the Brześć Kujawski mammal and reptile sample (birds and fish are discussed separately below). "Maximally identified" fragments are those that can be identified to the genus or species level; "minimally identified" fragments are those that are ambiguous at the family level. Although sheep and goat are often impossible to distinguish at the genus level, specimens which were identifiable as "sheep/goat" are considered to have been maximally identified. Most of the unidentified specimens were small fragments weighing a gram or less.

Table CLXXV. Condition of the Brześć Kujawski mammal and reptile sample.
Tabela CLXXV. Ogólna charakterystyka próbki kości z Brześcia Kujawskiego.

Brześć Kujawski		
mammals and reptiles	count	weight
maximally identified	1867	39569.5
minimally identified	971	6190
unidentified	5208	10118.5
total	8046	55878

Brześć Kujawski Mammal NISP

Bogucki (1981) treated NISP as a way of characterizing the assemblage but did not discuss it in depth as a way of assessing the relative abundance of taxa. At the time, derived measures such as minimum numbers of individuals and diagnostic zones were believed to be superior to the raw counts of identified specimens. The discussion here will reflect archaeozoological practice over the intervening 25 years which suggests that NISP are fundamentally as informative as any other measure when it comes to assessing the relative abundance of species in a faunal sample.

Table CLXXVI presents the NISP of the Lengyel bone sample from Brześć Kujawski, broken out by periods defined by the ceramic chronology in use at the time. For the purposes of this study, these periods are pooled into a total NISP for the sample. In addition to wild and domestic mammals, the table also includes the carapace and plastron fragments of European pond tortoise. The bird bones are discussed separately below.

Although cattle are the most abundant taxon, they are not in the dominant majority. Indeed, when cattle, sheep and goat together, and pig are compared, they are very close in the portions of the faunal assemblage they comprise, between 18 and 23%. Red deer are not much lower in abundance. Thus in marked contrast to the Linear Pottery faunal assemblages that are dominated by cattle bones, the Lengyel fauna from Brześć Kujawski provided the first indication of a much more diverse animal economy during the fifth millennium in the Polish lowlands.

Table CLXXVI. Counts of NISP of Lengyel fauna at Brześć Kujawski and overall percentages, plus the relative percentages of wild versus domestic specimens. Key: LL1 – Late Lengyel phase 1; LL2 – Late Lengyel phase 2; LL3 – Late Lengyel phase 3; w/d – wild, domestic.

Tabela CLXXVI. Liczba ogólna i udział procentowy GLS fauny związanej z kulturą lendzielską w Brześciu Kujawskim, oraz względny udział procentowy osobników dzikich i udomowionych. Legenda : LL1 –1 faza kultury późno–lendzielskiej (Late Lengyel phase 1), LL2 –2 faza kultury późno–lendzielskiej (Late Lengyel phase 2), LL3 –3 faza kultury późno–lendzielskiej (Late Lengyel phase 3) ; w/d– dzikie (wild)/domowe(domestic).

Brześć Kujawski NISP	LL 1	LL 2	LL 3	total LL	% of mammal	% w/d mammal
Bos Taurus	5	32	187	224	22.24%	
Ovis/Capra	6	39	98	143	14.20%	
Ovis Aries	0	0	30	30	2.98%	
Capra hircus	8	18	18	44	4.37%	
Sus scrofa	12	56	117	185	18.37%	
Canis familiaris	1	2	2	5	0.50%	62.66%
Capreolus capreolus	5	39	33	77	7.65%	
Cervus elaphus	23	75	67	165	16.39%	
Equus caballus	0	0	2	2	0.20%	
Castor fiber	7	14	106	127	12.61%	
Lutra lutra	0	1	1	2	0.20%	
Ursus arctos	0	1	0	1	0.10%	
Felis sylvestris	0	0	1	1	0.10%	
Mustela nivalis	0	0	1	1	0.10%	37.34%
Emys orbicularis	4	13	133	150		
Total NISP	**71**	**290**	**796**	**1157**		

The high number of beaver bones in the final Lengyel phase is due in large measure to the recovery of five almost–complete but disarticulated beaver skeletons from Pit 820 in 1979. Other beaver bones were found in normal rubbish deposits (Figure 1292). They are clearly not as ubiquitous or fragmented among the consumption debris as are the bones of domestic and wild ungulates, and thus they need to be considered separately, along with the less–abundant wild taxa, as a kind of special case.

When the NISP are reduced to the principal mammal taxa that had major economic significance – cattle, sheep, goat, pig, red deer, and roe deer – the proportions make a slight shift. These proportions are depicted graphically in Figure 1293. Cattle and the combined sheep and goats occupy relatively equal positions of 25–27%, with pig standing at 21%. The interesting aspect of this data reduction is that red deer and roe deer comprise over a quarter of the bones of the principal economic mammal species.

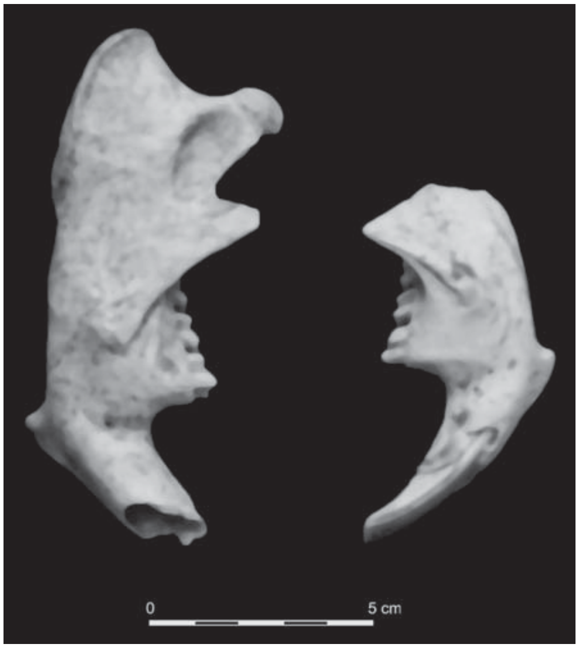


Fig. 1292. Beaver mandibles from Pit 773 at Brześć Kujawski Site 3.

Ryc. 1292. Kości żuchwy bobra z jamy nr 773 w Brześciu Kujawskim, st. 3.

Brześć Kujawski Mammal Diagnostic Zones

The Brześć Kujawski mammal bone assemblage was also quantified using the diagnostic zones (DZ) approach, using a modification of the method proposed by Watson (1979). Bogucki (1981) reported these diagnostic zones according to phase in the Lengyel occupation of the sites. These are presented in Table CLXXVII below.

The most striking aspect of the quantification by diagnostic zones is that the proportion of cattle in the Lengyel assemblage is relatively low, just as in the NISP tabulation, while the proportion of sheep and goat is dramatically higher. This is at the expense of red deer, roe deer, and beaver, all of which have their representation reduced significantly by the use of the DZ approach, while pig holds relatively constant with its percentage representation among NISP. The high number of sheep/goat DZ is found in all Lengyel phases, contradicting the picture presented by the NISP in which cattle are marginally more numerous in the final phase.

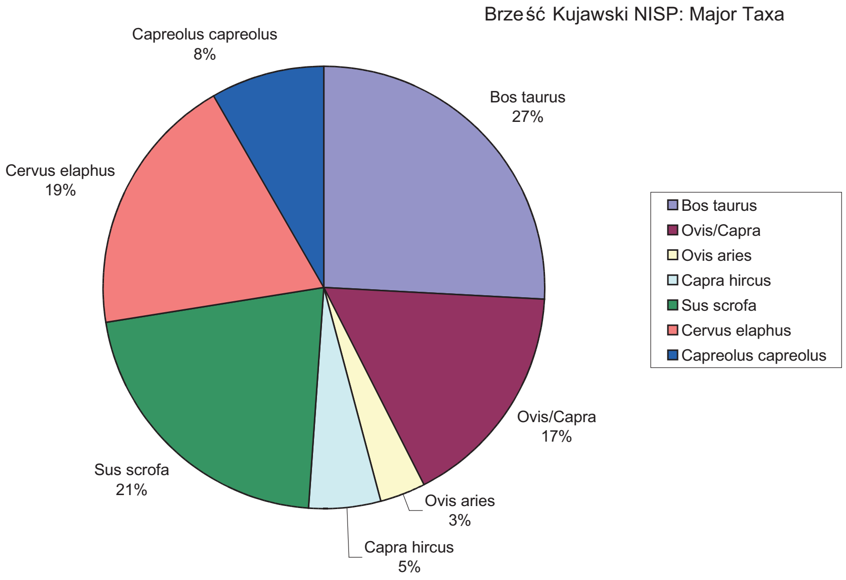


Fig. 1293. Brześć Kujawski NISP of major economic taxa.

Ryc. 1293. Globalna liczb szczątków głównych gatunków zwierząt gospodarczych w Brześciu Kujawskim.

Table CLXXVII. Counts of diagnostic zones of Lengyel fauna at Brześć Kujawski and overall percentages. Key: LL1 – Late Lengyel phase 1; LL2 – Late Lengyel phase 2; LL3 – Late Lengyel phase 3

Tabela CLXXVII. Liczba stref diagnostycznych fauny związanej z kulturą lendzielską w Brześciu Kujawskim, oraz ogólny udział procentowy. Legenda : LL1 – 1 faza kultury późno–lendzielskiej; LL2 –2 faza kultury późno–lendzielskiej ; LL3 –3 faza kultury późno–lendzielskiej.

Brześć Kujawski Diagnostic Zones	LL 1	LL 2	LL 3	total	%
Bos Taurus	1	11	60	72	22.71%
Ovis/Capra	8	19	65	92	29.02%
Sus scrofa	5	17	43	65	20.50%
Cervus elaphus	2	15	25	42	13.25%
Capreolus capreolus	2	12	4	18	5.68%
Canis familiaris	0	0	2	2	0.63%
Equus caballus	0	0	2	2	0.63%
Castor fiber	7	8	5	20	6.31%
Ursus arctos	0	1	0	1	0.32%
Lutra lutra	0	1	1	2	0.63%
Felis sylvestris	0	0	1	1	0.32%
Total DZ	**25**	**84**	**208**	**317**	**100.00%**

When reduced to the five major economic taxa – cattle, sheep/goat, pig, red deer, and roe deer – the picture comes into somewhat sharper focus but still clearly different from the NISP presentation. These percentages are presented graphically in Figure 7. In the DZ quantification of major taxa, sheep/goat are significantly more abundant than cattle, unlike their relative equality in the NISP scheme.

What does this mean? Which is more reliable, NISP or DZ? In the early 1980s, Bogucki was more interested in establishing the striking difference between the Linear Pottery concentration on cattle and the more diverse Lengyel animal economy, which both techniques showed very clearly. At issue here is the relative abundance of the principal taxa within the Lengyel faunal assemblages, and on this point the techniques simply do not have a fine enough resolution to establish the relative abundance conclusively. It can be said with certainty, however, that despite the variation in the proportions of cattle to sheep and goats, pig occupies a relatively constant position, whichever technique is applied. It is also clear that the number of red deer and roe deer bones in the Brześć Kujawski assemblage was non–trivial, for under both methods they together comprise over 20% of the sample of major taxa.

Bogucki also applied the minimum numbers of individuals (MNI) quantification technique at Brześć Kujawski. Due to the fact that this method has fallen from general use in archaeozoology, it will not be discussed further here except to note that its results track those of the DZ except that the problem of overrepresentation of less–abundant taxa and underrepresentation of more abundant species was reflected in a tightening of the percentage standings of the major domestic taxa.

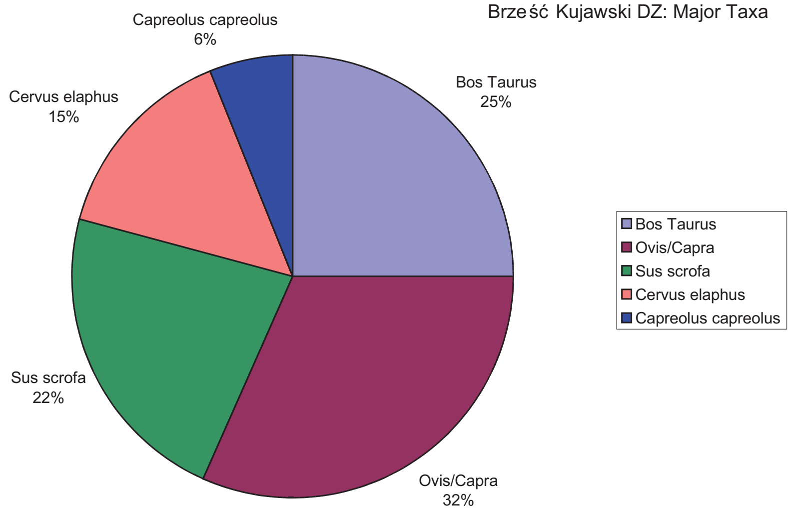


Fig. 1294. Brześć Kujawski diagnostic zones (DZ) of major economic taxa.

Ryc. 1294. Strefy diagnostyczne głównych gatunków zwierząt gospodarczych w Brześciu Kujawskim.

Bird NISP and MNI at Brześć Kujawski

The assemblage of bird bones from Brześć Kujawski was analyzed by Bogucki (1980, 1981) and remains the largest collection of avifauna from a site in the Polish lowlands (see comparative sample sizes given by Gumiński 2005) until the assemblage from Osłonki is analyzed and reported (see below). The largest comparable assemblage is the collection from Hüde am Dümmer in Germany reported by Boessneck (1978). Use of water screening was responsible for the large number of bird bones at Brześć Kujawski. A selection of bird bones from Brześć Kujawski is shown in Figure 1295.

Bogucki identified 170 bird bones from nine Lengyel features using the collections of the Museum of Comparative Zoology at Harvard University. Use of the expression "cf." indicates that the closest match was made when compared with specimens from a particular species, although it is not possible to rule out closely related taxa. Earlier publications on the bird bones from Brześć Kujawski (Bogucki 1980, 1981) treated the Linear Pottery and Lengyel bird bones as a single sample. Only the Lengyel bird bones are reported here, accounting for minor discrepancies between this and the earlier publications.

Table CLXXVIII presents the species attribution of identified bird bones. In light of the lakeside setting of the Brześć Kujawski settlements, it is not surprising that most of them are from waterfowl, although some raptors, a grouse, and a scavenger were also identified. Among the aquatic species, mallards are represented by the most specimens, followed by geese and ducks. Isolated bones of wading birds including curlew, ruff (inaccurately called "sandpiper" in Bogucki 1980, 1981), and lapwing were also identified. Raptors include eagle (the single specimen most closely corresponded to the great spotted eagle) and marsh hawk (also known as a hen harrier), while the capercaillie and carrion crow complete the list of identified birds.

Fig. 1295. Sample of bird bones from Lengyel contexts at Brześć Kujawski.

Ryc. 1295. Próbka kości ptaków z obiektów lendzielskich w Brześciu Kujawskim.

Most of the identified bones came from the breast and wing area, which is not surprising in light of the meat found on bones in this region. The frequency of identified elements from this area is further amplified by the fact that the meat can be removed as a unit with the bones, whereas the dismemberment of other parts of the bird skeleton probably resulted in a higher degree of bone fragmentation and loss.

In this instance, the use of minimum numbers of individuals made sense as a comparison with NISP in the assessment of relative species abundance. The only major difference exists between mallard and geese, with the former represented by more specimens and fewer individuals and the latter represented by slightly fewer specimens and more individuals. The difference does not affect the overall character of the assemblage in terms of the dominance of waterfowl.

Based on modern seasonal migration patterns observed in the Polish lowlands (Bednorz 1976), Bogucki made the case that the majority of the Anseriformes in the Brześć Kujawski assemblage were most common in the area between December and May (Bogucki 1981: 273–4), from which it could be inferred that the winter and spring were the time for hunting waterfowl. Moreover, he pointed to the fact that the raptorial birds require open space as part of their environment, and thus their presence could be taken as evidence of the opening of the vegetation for cultivation during the fifth millennium B.C. The capercaillie also prefers a mixed landscape with forests interspersed with fields and wetlands.

Table CLXXVIII. Lengyel bird bones from Brześć Kujawski as NISP and MNI.
Tabela CLXXVIII. Kości ptaka z Brześcia Kujawskiego jako GLS i MinLo (minimalna liczba osobników).

	mallard	**tufted duck**	**Goose**	**eagle (great spotted?)**	**marsh hawk**	**capercaillie**	**lapwing**	**curlew**	**ruff**	**carrion crow**
	Anas platyrynchos	*Aythya* cf. *fuligula*	*Anser* cf. *anser*/cf. *fabalis*	*Aquila* cf. *clanga*	*Circus cyaneus*	*Tetrao urogallus*	*Vanellus vanellus*	*Numenius arquata*	*Philomachus pugnax*	*Corvus corone*
scapula	2	1	1							
coracoid	3	3	1			1		1		
clavicle	1		4							
sternum			1						1	
humerus	2	3	2				1			
radius	2		2							
ulna	2		2							
carpo–metacarpus	1	4	1		1	2				
lumbosacrale										
femur		1								
tibiotarsus	4									
tarso–metatarsus					1					1
1 phalanx dig. II			1							
4 phalanx				1						
total NISP	17	12	15	1	2	3	1	1	1	1
% NISP	31.5%	22.2%	27.8%	1.9%	3.7%	5.6%	1.9%	1.9%	1.9%	1.9%
MNI	5	4	6	1	1	2	1	1	1	1
% MNI	21.7%	17.4%	26.1%	4.3%	4.3%	8.7%	4.3%	4.3%	4.3%	4.3%
Total identified	**54**									
Unidentified	**116**									
Grand total	**170**									

Fish NISP at Brześć Kujawski

Makowiecki (2003: table 31) identified the fish bones recovered at Brześć Kujawski during excavations in the late 1970s, presented as NISP in Table CLXXIX. The fish bones came from six features at site 3 at Brześć Kujawski, and especially from one pit in particular, Pit 784 (Figure 1296). Pit 784 was a relatively small and shallow pit, about a meter in diameter, which had an extraordinary concentration of several thousand fish bones, in addition to mammals and birds. Of the 4297 fish bones recovered at Brześć Kujawski, 2484 (57.8%) could be identified to the level of order, in the case of Cyprinidae, or species (Figure 1297).

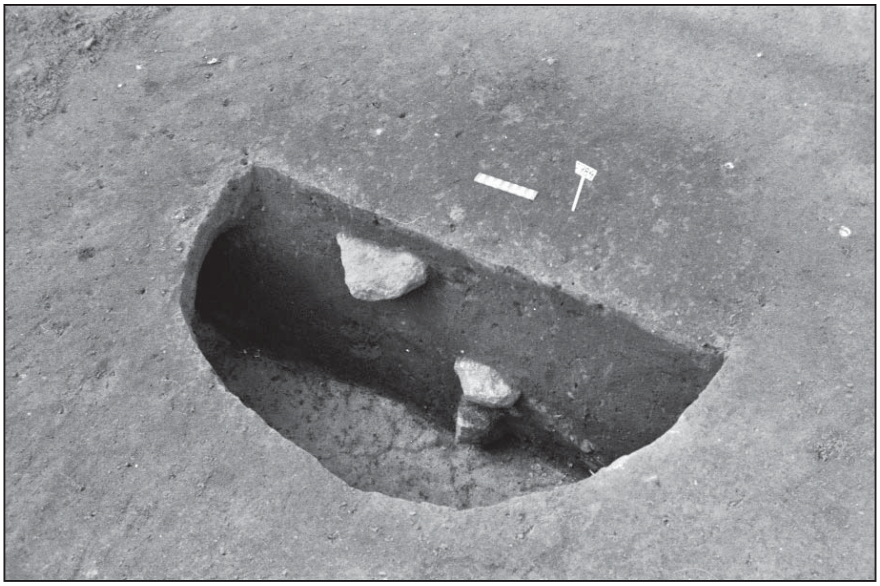


Fig. 1296. Pit 784, source of many of the fish bones at Brześć Kujawski 3. Markings on scale are 1 cm.

Ryc. 1296. Jama nr 784, miejsce pozyskania wielu rybich ości w Brześciu Kujawskim, stanowisko 3. Oznaczenia na podziałce wielkości 1 cm.

Table CLXXIX. Brześć Kujawski fish NISP (after Makowiecki 2003: table 31).
Tabela CLXXIX. GLS ości ryb z Brześcia Kujawskiego (wg D. Makowieckiego 2003: tabela 31).

Brześć Kujawski Fish NISP		**Pits**							
Common Name	**Taxon**	**773**	**775**	**776**	**782**	**784**	**808**	**total**	**%**
Northern Pike	*Esox lucius*	5	7	10	0	232	0	254	10.2
Carp	*Cyprinidae*	35	137	144	6	1286	1	1609	64.8
Roach	*Rutilus rutilus*	0	3	1	0	136	0	140	5.6
Ide	*Leuciscus idus*	0	0	0	0	7	0	7	0.3
Rudd	*Scardinius erythrophthalmus*	0	0	3	0	6	0	9	0.4
Asp	*Aspius aspius*	0	2	1	0	23	0	26	1.0
Tench	*Tinca tinca*	21	77	19	0	188	0	305	12.3
Carp Bream	*Abramis brama*	0	0	0	0	8	2	10	0.4
Blue Bream	*Abramis ballerus*	2	0	0	0	0	0	2	0.1
Crucian Carp	*Carassius carassius*	0	0	1	0	8	0	9	0.4
European Perch	*Perca fluviatilis*	5	7	14	0	85	2	113	4.5
Total Identified		**68**	**233**	**193**	**6**	**1979**	**5**	**2484**	**100.0**
Unidentified		**49***	**210****	**256****	**0**	**1265********	**0**	**1813**	
Total		**147**	**443**	**449**	**6**	**3244**	**5**	**4297**	

The relative proportions of the different species are shown graphically in Figure 1298. By far the most numerous are members of the carp family, from which numerous pharyngeal arches were found among the fish bones. In addition to the generic carp classed as Cyprinidae, other cyprinids included roach, ide, rudd, asp, and tench, and bream. In total, over 85% of the fish NISP came from some form of cyprinid. Despite this preponderance of cyprinids, the two non–cyprinid taxa, pike and perch, must also have been significant due to their size and meat yield.

Fig. 1297. Sample of cyprinid pharyngeal arches from Brześć Kujawski.

Ryc. 1297. Próbka łuków gardłowych ryb karpiowatych *(cyprinidae)* z Brześcia Kujawskiego.

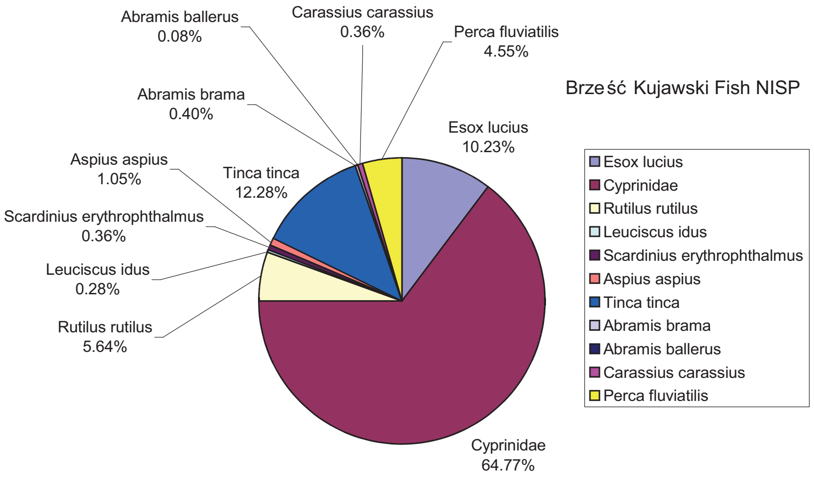


Fig. 1298. Relative abundance of Brześć Kujawski fish taxa by NISP.

Ryc. 1298. Względna liczebność gatunków ryb w Brześciu Kujawskim, określona za pomocą GLS.

Brześć Kujawski Pond Tortoise NISP

A total of 150 carapace and plastron fragments of the European pond tortoise (*Emys orbicularis*) were recovered from Lengyel features at Brześć Kujawski. These were found as isolated fragments of carapace and plastron bones (e.g. costals, neurals, peripherals, etc.), as disarticulated concentrations within features, or as articulated shells. An example of the disarticulated concentration is seen below in the material from Pit 775 (Figure 1299), while an example of an articulated carapace, with a significant portion missing presumably as the result of butchery, from Pit 773 is seen in Figure 1300.

Fig. 1299. Fragments of tortoise shell from Pit 775 at Brześć Kujawski 3.

Ryc. 1299. Fragmenty pancerza żółwia z jamy 775 w Brześciu Kujawskim, stanowisko 3.

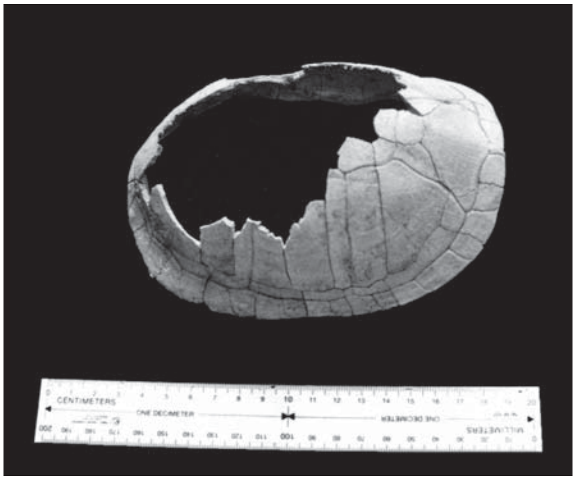


Fig. 1300. Tortoise carapace from Pit 773 at Brześć Kujawski 3.

Ryc. 1300. Tarcza górna pancerza żółwia (karapaks) z jamy 773 w Brześciu Kujawskim, stanowisko 3.

An important aspect of the pond tortoise remains at Brześć Kujawski is their dramatic increase over time. Of the 150 NISP, 133 come from the final occupation phase, whereas earlier they occurred in relatively small numbers. Many of these bones came from a relatively small number of features on Brześć Kujawski 3.

6.4.2
RELATIVE SPECIES ABUNDANCE AT OSŁONKI

As at Brześć Kujawski, the faunal sample at Osłonki included mammals, birds, fish, and pond tortoise. Each of these categories is discussed separately below. Osłonki is the largest of the faunal assemblages reported in this study, and represents one of the largest collections of identified animal bones from a site of the Danubian tradition in northern central Europe during the fifth millennium B.C.

Osłonki Mammal NISP

Table CLXXX characterizes the Osłonki mammal bone assemblage. Specimens are considered to be "maximally identified" when they can be assigned to a genus or species, or in the case of sheep/goat, to the genus of *Ovis* or *Capra*. "Minimally identified" bones were those assigned to "large mammal" or "medium mammal 1" in the York Faunal Analysis System. "Large mammal" is cattle–red deer–horse sized, while "medium mammal 1" is sheep–goat–roe deer–pig sized. Most of the bones in the minimally–identified group were vertebrae and ribs, thus relatively heavy but usually not diagnostic elements. The unidentified mammal bones were generally shaft fragments of long bones and other such splinters that were recovered by meticulous excavation. Perhaps it might have been possible to assign these to minimally–identified categories, but the information so gained would have been trivial.

Table CLXXX. General characterization of the Osłonki mammal sample.

Tabela CLXXX. Ogólna charakterystyka próbki ssaków z Osłonek.

Osłonki		
mammal bone	**count**	**weight**
maximally identified	5420	197231
minimally identified	1461	61154
unidentified mammal	10770	41260
total	**17651**	**299645**

The 5420 maximally–identified mammal bones are listed in Table 7 below by anatomical element. For the record, tortoise and bird bones are noted at the bottom of this table as well. The range of species present is very similar to that observed at Brześć Kujawski. Greater effort was made to differentiate wild pig bones by observation, although the metrical analysis below will indicate that the number of wild pigs reported in Table CLXXXI may under–represent the actual component of this taxon in the assemblage.

Table CLXXXI. Osłonki mammal NISP, by anatomical element, and bird and turtle bones.
Tabela CLXXXI. GLS ssaków z Osłonek, ustalona zgodnie z fragmentami anatomicznymi, oraz kości ptaków i żółwi.

Oslonki NISP	Domestic Mammal						Wild Mammal									
ELEMENT	cattle	sheep/ goat	goat	sheep	pig	dog	bear	beaver	horse	red deer	roe deer	wild pig	tortoise	bird	totals	percent
antler										59	7				66	1.22%
cranial fragment	37	29	1	1	37						1	2			108	1.99%
skull	47	47	98	49	49	1				4	1				296	5.46%
maxilla	40	33			104	3					6	1			187	3.45%
loose maxillary teeth	53	72			14				1	2	2				144	2.66%
mandible	135	197		1	141	7		2		3	10	2			498	9.19%
loose mandibular teeth	107	94			35				1	2	3				242	4.46%
DP3	4	4			1										9	0.17%
canine					56							1			57	1.05%
incisor	15	9			46							4			74	1.37%
atlas	26	18			17	1						1			63	1.16%
axis	14	22			3	1				1					41	0.76%
cervical vertebra	5	1			1	1				1					9	0.17%
thoracic vertebra	6														6	0.11%
lumbar vertebra	5	1													6	0.11%
caudal vertebra	1														1	0.02%
vertebra	7	1			1										9	0.17%
sacrum	1	1													2	0.04%
scapula	81	96			110	1			2	6	5	1			302	5.57%
humerus	108	145	1		56	5				2	7	3			327	6.03%
radius	84	178	1	1	74					7	6	1			352	6.49%
ulna	57	57		1	80	3				2	7				207	3.82%
carpal	85	7	1		7					2	0				102	1.88%
metacarpal	90	123	2	1						1	6				223	4.11%
metacarpal 2					5										5	0.09%
metacarpal 3					28										28	0.52%
metacarpal 4					18										18	0.33%
metacarpal 5					9										9	0.17%
pelvis	91	74			43	2					2				212	3.91%
femur	100	108	1		31	1				5	3	2			251	4.63%
patella	9				4					1					14	0.26%
tibia	83	133			72	2				6	12	3			311	5.74%
fibula	3				25										28	0.52%
calcaneus	61	42			52		1		1		1	4			162	2.99%
astragalus	46	37		1	20	1			2	2	2				111	2.05%
tarsal	25	14								2	2				43	0.79%
metatarsal	106	65	4	5	2		2			8	14				206	3.80%
m/t2					13	1	1								15	0.28%
m/t3					28	1	1								30	0.55%
m/t4					20	1	2								23	0.42%
m/t5					4	1	1								6	0.11%
metapodial	22	29			22	1	1		1	5	11				92	1.70%
phalanx I	132	69			51				1	3	2				258	4.76%
phalanx II	102	27			19				1	5	5				159	2.93%
phalanx III	71	5	2	1	16				1	6					102	1.88%
other elements	6														6	0.11%
total mammals	1865	1738	111	61	1314	34	9	2	11	135	115	25			5420	100.00%
carapace + plastron													235		235	
bird bones														276	276	
total NISP	1865	1738	111	61	1314	34	9	2	11	135	115	25	235	276	5931	

Relative NISP of Major Economic Species

At Osłonki, the principal mammalian taxa which had a major economic role are the four main domesticated species – cattle, sheep, goat, and pig – and the two most abundant wild herbivore species, red deer and roe deer. Together, these species make up 98.5% of the total mammal NISP. Other mammal species, while still of interest, are effectively "noise" in the overall economic system at Osłonki.

In the following analysis, the NISP of these six species (including sheep/goat and the differentiated sheep and goat) are compared for the site as a whole, with the results presented graphically in Figure 1301. Cattle and sheep/goat each account for about a third of the total NISP, and among the differentiated specimens the ratio of 2:1 goat:sheep continues to be observed. Pig bones comprise a quarter of the total NISP, while red deer and roe deer together contribute about 5%.

The overall picture is of an economy with a balanced portfolio comprised of three major components: cattle, sheep, goat, and pigs. Wild herbivores are incidental, perhaps killed opportunistically. Indeed, as noted above, many of the red deer NISP are antlers, while many of the roe deer bones have been selected for tool manufacture and thus are not strictly consumption debris. The economic implications of this will be discussed on a regional scale below.

Mammal NISP Variation by Feature and Sample Size

The animal bones from Osłonki came from a total of 322 separate contexts, which could then be collapsed into the major archaeological units. These include 11 large clay–extraction pits (*glinianki*), five house trenches, 69 pits, the fortification ditch (fossa), and several miscellaneous contexts. The distribution of mammal NISP by feature and by species is given in Table CLXXXII.

It is clear that the large clay pits produced the largest absolute samples of animal bones, which comprised 61.44% of the NISP. These are enormous features, so the sample sizes may not reflect a particularly high density of bone per unit of feature fill, with the exception of GL2, GL3, GL5, and GL9. In these features, particular sections contained concentrations of bone, while other parts were relatively barren. For example, the part of GL2 that lay in excavation units (*odcinki*) 113 and 114 produced the largest quantity of bone.

Pits yielded 36.24% of the mammal NISP at Osłonki. Some pits, however, contained very high concentrations of bone in proportion to

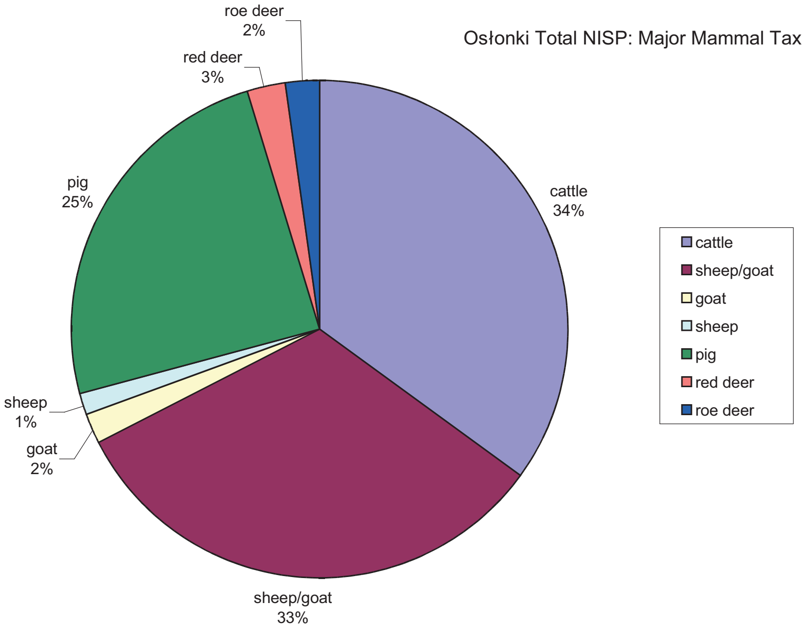


Fig. 1301. Osłonki NISP (total sample): major economic taxa.

Ryc. 1301. GLS z Osłonek (cała próbka): główne zwierzęta gospodarcze.

their size. Particularly noteworthy are pits 53, 116, 137, 204, and 208. The fortification ditch and house trenches contained very small quantities of bone, which is not surprising since their taphonomy is very different from that of the open features that were used as rubbish dumps.

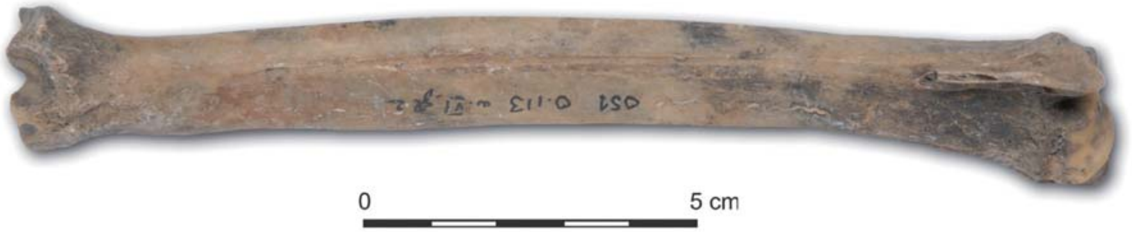


Fig. 1302. Roe deer radius from Osłonki, Clay Pit 2.

Ryc. 1302. Kość promieniowa sarny, Osłonki, glinianka 2.

Table CLXXXII. Osłonki NISP by context.
Tabela CLXXXII. GLS z Osłonek ustalona zgodnie z kontekstem kulturowym.

OSŁONKI MAMMALS MAX ID NISP		Domestic						Wild					
CONTEXT TYPE	**SAMPLE**	**cattle**	**sheep/goat**	**goat**	**sheep**	**pig**	**dog**	**wild pig**	**bear**	**beaver**	**horse**	**red deer**	**roe deer**
Fortification ditch													
	Fossa	12	10			5		2				2	
Clay Pits (Glinianki)													
	GL 2	250	201	9	6	160		2		1	3	22	27
	GL 3	322	188	12	8	155	2				2	12	4
	GL 5	221	122	9	9	112			1			23	6
	GL 6	111	181	8	4	74	1	6	8			13	2
	GL 7	34	29	1	1	29		1				3	1
	GL 8		7			6						1	3
	GL 9	206	197	23	7	176	6	4			1	18	6
	GL 10	11	14	2	0	31		1				1	20
	GL 11	38	6	1	1	19		4				5	1
	GL 12	49	11			5							
	GL 13	12	11			30							
Houses													
	house 1	1											
	house 2	9	2			4							
	house 3	4			2								
	house 22–3	7	5			1							
	house 26		1										
Pits													
	pit 8	3	3	2		4							
	pit 10	12	11		3	23							
	pit 11	3	1			2						1	
	pit 12	3	3			1							
	pit 16	4	10			1							

OSŁONKI MAMMALS MAX ID NISP		Domestic						Wild					
CONTEXT TYPE	SAM-PLE	cattle	sheep/ goat	goat	sheep	pig	dog	wild pig	bear	beaver	horse	red deer	roe deer
	pit 29	1				2							
	pit 33	4	3			1							
	pit 34	2	8										
	pit 38	1											
	pit 40	4				2				1			
	pit 41	2				1						1	
	pit 42	3	1			1							
	pit 47	17	30	3	1	8							
	pit 48	1	1			1						1	
	pit 53	10	40	3	3	11	1						3
	pit 54		7	2									
	pit 59					1							
	pit 73	2	1	1		1							
	pit 75	1	11			7	1						1
	pit 76	2			1								
	pit 77												
	pit 78					1							
	pit 95	6	1			59							17
	pit 101	2	3			3	1	1					
	pit 102	2	5			2							1
	pit 103	1	2			5							1
	pit 105	2	1			15					2		
	pit 106	8	7	1		2					1		
	pit 108	3				1							
	pit 109	1				8							1
	pit 111												
	pit 112		3										
	pit 116	25	79	3	1	65	4				1		5
Pits													
	pit 120	1	1			1							
	pit 127	21	54	6	1	34						5	
	pit 128		1										
	pit 130	17	51	6	3	7						10	6
	pit 131	2											
	pit 137	53	39			61						1	2
	pit 138	1	1			1							
	pit 148	1											
	pit 149	1	2	2		2						1	
	pit 150	5	1			5						2	
	pit 151	4	3			1						1	
	pit 152	15	9			4							
	pit 153	17	61			13						1	
	pit 154	24	5	1		8	3	1				1	
	pit 155	7	5			1	2					1	
	pit 156	1											
	pit 157		1				1						1
	pit 177a	1	2			4							
	pit 179	7	8			8							
	pit 193	30	14	1	3	10	11						
	pit 194	1	3			5		1					
	pit 204	77	129	3	7	35						3	1
	pit 208	81	54	6		23		1					1
	pit 209		1			1	1					1	
	pit 211	3											
	pit 229	9	6	1		10		1				2	2

OSŁONKI MAMMALS MAX ID NISP		**Domestic**						**Wild**					
CONTEXT TYPE	**SAM-PLE**	**cattle**	**sheep/ goat**	**goat**	**sheep**	**pig**	**dog**	**wild pig**	**bear**	**beaver**	**horse**	**red deer**	**roe deer**
	pit 248	1	10	1		8							2
	pit 250												
	pit 257	1											
	pit 260	2	2			3							
	pit 265					6							
	pit 272	49	38	3		6						2	
	pit 276	1											
	pit 277	2	2										
	pit 278					1					1		
	pit 280	1											1
Misc. Contexts													
OS1–0100		6	6	1		4						1	
OS1–0101						2							
OS1–0322	94/384	10	12			13							
OS1–0050	odc 78	1											
OS1–0046	pit ?		1			2							
TOTALS		1865	1738	111	61	1314	34	25	9	2	11	135	115
		cattle	shep/ goat	goat	sheep	pig	dog	wild pig	bear	beaver	horse	red deer	roe deer
Total domestic mammal	5123												
Total wild mammal	297												
Total mammal	5420	34.41%	32.07%	2.05%	1.13%	24.24%	0.63%	0.46%	0.17%	0.04%	0.20%	2.49%	2.12%
%domestic	94.52%												
%wild	5.48%												

NISP of the principal mammalian taxa (cattle, pig, sheep, goat, red deer, and roe deer) were compared between the large clay pits (*glinianki*) and the smaller trash–filled pits. These results are presented graphically in Figures 1303 and 1304. An interesting result emerges in that the percentage of cattle is higher in the clay extraction pits at the expense of sheep/goat, while the pattern is reversed in the regular pits. It is significant that the percentages of the other taxa, including differentiated sheep and goat, are consistent between the two sub–samples, indicating that there probably is some significance to this difference between cattle and sheep/goat. The probable explanation lies in the processes of the formation of the different types of deposit. The larger cattle bones may have been differentially better–preserved in the more active depositional environment of the clay extraction pits, while the quickly–closed pit features trapped sheep and goat bones better for eventual recovery.

From a focus on the various features with samples larger than 100 NISP, a combination of five clay pits (GL2, GL3, GL5, GL6, and GL9) and six pits (116, 127, 130 137, 204, and 208), a consensus view of the proportions of the major mammal taxa emerges (Fig. 1305). These 11 features contained 72.36% of the Osłonki NISP. The consistency of this subsample with the total sample is established by the 2:1 ratio of goat to sheep and the proportions of deer. Cattle comprise 36% of the NISP, sheep/goat 33%, and pig 23%. Such a calculation may control the effects of taphonomic bias between the high–concentration clay pits and pits one hand, and the sparse bone finds in the other features, and thus may be the best characterization of the relative NISP proportions of the major taxa.

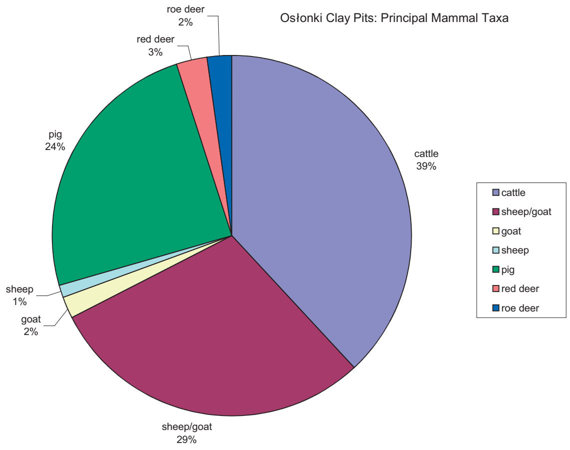


Fig. 1303. Representation of principal economic species in samples from clay extraction pits.

Ryc. 1303. Udział głównych gatunków zwierząt gospodarczych w próbkach kości, pochodzących z glinianek.

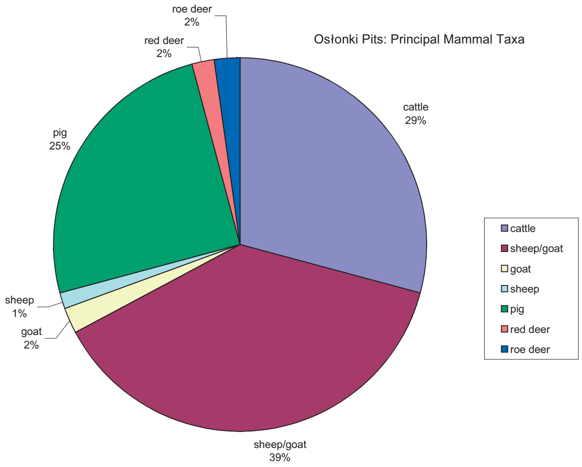


Fig. 1304. Representation of principal economic taxa in samples from smaller pits.

Ryc. 1304. Udział głównych gatunków zwierząt gospodarczych w próbkach kości, pochodzących z mniejszych jam.

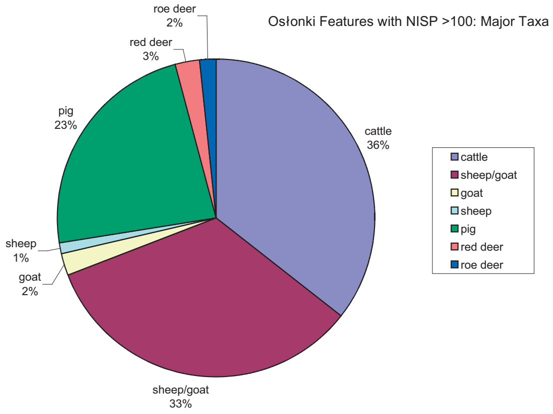


Fig. 1305. Representation of principal economic mammal species in features with sample sizes over 100 NISP.

Ryc. 1305. Udział głównych gatunków ssaków gospodarczych w obiektach o wielkości próbek większej niż 100 GLS.

Counts of Mammal Diagnostic Zones

As an exercise to validate the assessment of relative species abundance based on NISP, the Osłonki mammal bones were also quantified using a diagnostic zones method. The diagnostic zones were essentially the same as used by Bogucki (1981) in his analysis of the Brześć Kujawski assemblage but different in two key respects. First, due to an inability to differentiate anterior and posterior phalanges across all species, the six zones based on phalanges the Brześć Kujawski analaysis were compressed to three in the Osłonki study. Second, due to the fact that artiodactyls have two phalanges on each right and left limb whereas the other sided elements in the analysis only are represented once on each side, the counts of diagnostic zones 23, 24, and 25 (see table CLXXXIII below) were divided in two. To be counted as a diagnostic zone, the specimen had to be able to be assigned to a side and in the case of long bones it was necessary for enough of the articular end to be preserved to assess its fusion status. Thus the distal shaft of a long bone would not be counted in this analysis even if it could be assigned to species.

Table CLXXXIII. Diagnostic zone counts for Osłonki mammal bones. Counts shaded in yellow are one–half actual counts to correct for twice the number of phalanges in relation to long bones in the ungulate skeleton.
Tabela CLXXXIII. Liczba stref diagnostycznych kości ssaków z Osłonek.

Element	Diagnostic Zone	*Bos taurus*	*Ovis/Capra*	*Ovis aries*	*Capra hircus*	*Sus scrofa (domestic)*	*Sus scrofa (wild?)*	*Cervus elaphus*	*Capreolus capreolus*	*Castor fiber*	*Canis familiaris*	*Equus sp.*	*Ursus arctos*	Total
mandible	**1–R**	42	82	1		64	1	2	3		3			198
mandible	**1–L**	61	104			62	2	1	7	2	4			243
maxilla	**2–R**	19	19			43			2		1			84
maxilla	**2–L**	19	13			58	1		3		1			95
d.scapula	**3–R**	17	28			31		3	4					83
d.scapula	**3–L**	15	27			29		3	1			2		77
p.humerus	**4–R**	10	14			3	1		1					29
p.humerus	**4–L**	5	12			5			2		1			25
d.humerus	**5–R**	22	31			14	2	1	2		2			74
d.humerus	**5–L**	24	41		1	17		1	1		2			87
p.ulna	**6–R**	3	9			10	1	2	2		1			28
p.ulna	**6–L**	8	9			12			2		1			32
p.radius	**7–R**	25	44	1	1	21	1	1	3					97
p.radius	**7–L**	22	44			16			3					85
d.radius	**8–R**	10	27		1	17		3						58
d.radius	**8–L**	15	24			13		1	2					55
carpal int.	**9–R**	11						1						12
carpal int.	**9–L**	7	1		1									9
prox.mc3	**10–R**	29	36		1	14		1	3					84
prox.mc3	**10–L**	17	23			13			3					56
dist.mc3	**11–R**	13	33	1	1	10								58
dist.mc3	**11–L**	27	26		1	10								64
acet	**12–R**	6	4			5			1		1			17
acet	**12–L**	8	4			5					1			18
p.femur	**13–R**	15	16			3								34
p.femur	**13–L**	17	17			6	1	1	1		1			44
d.femur	**14–R**	9	26		1	7		1						44
d.femur	**14–L**	9	22			4	1	1						37
patella	**15–R**	4				3		1						8
patella	**15–L**	3				1								4
p.tibia	**16–R**	13	19			7		2	2					43
p.tibia	**16–L**	13	18			6			1		2			40

Element	Diagnostic Zone	*Bos taurus*	*Ovis/Capra*	*Ovis aries*	*Capra hircus*	*Sus scrofa (domestic)*	*Sus scrofa (wild?)*	*Cervus elaphus*	*Capreolus capreolus*	*Castor fiber*	*Canis familiaris*	*Equus sp.*	*Ursus arctos*	Total
d.tibia	**17–R**	24	36			19	2		6					87
d.tibia	**17–L**	25	42			25	1	2	2					97
astr	**18–R**	27	19			7		1	1					55
astr	**18–L**	18	18			11		1	1		1	2		52
calc	**19–R**	34	20			25	2		1					82
calc	**19–L**	27	22			26	2					1	1	79
tcen	**20–R**	12	5					1	1					19
tcen	**20–L**	7	7						1					15
prox.mt3	**21–R**	19	17	2	2	13		4	1				1	59
prox.mt3	**21–L**	17	28	1		13		2	4		1			66
dist.mt3	**22–R**	21	7	2	2	7							1	40
dist.mt3	**22–L**	20	6			4					1			31
rl/lm ph.1	**23–R**	32	18			11		1	1			1		64
ll/rm ph.1	**23–L**	34	16			14		1	1					66
rl/lm ph.2	**24–R**	23	8			5		1	1			1		39
ll/rm ph.2	**24–L**	26	6			5		2	2					41
rl/lm ph.3	**25–R**	13	2		1	3		1				1		21
ll/rm ph.3	**25–L**	20	1	1	1	5		3						31
TOTALS		917	1051	9	14	702	18	46	72	2	24	8	3	2866
%		32.0%	36.7%	0.3%	0.5%	24.5%	0.6%	1.6%	2.5%	0.1%	0.8%	0.3%	0.1%	100.0%

Table CLXXXIII shows the diagnostic zones used in the analysis, the counts by species, and the resultant percentages of the total count of diagnostic zones. The orders of magnitude of the percentages are very similar to those obtained from NISP, and the causes of the variation can be immediately identified. First, the percentage of pig bones is virtually identical between the NISP and diagnostic zones. Second, the relationship between cattle and sheep/goat is affected by the fact that far more sided mandible fragments could be attributed to sheep/goat than cattle, probably due to the greater smashing of cattle mandibles for marrow than those of sheep and goats, as well as the fact that the raw NISP counts are not adjusted for the representation of ungulate phalanges at twice the number of long bones. But the most important observation is that the *order of magnitude* of the representation of the various species, even the incidental wild taxa and dogs, is very similar between NISP and diagnostic zones, thus increasing our confidence that the relative percentages of taxa in the archaeological faunal assemblage do have some degree of correlation with their relative economic importance.

This observation is strengthened by the relative percentages of the major economic taxa – cattle, sheep, goat, pig, red deer, and roe deer – that are depicted in Figure 1306. Again, the percentages do not differ significantly from those derived from the various NISP analyses presented above, and they fall somewhere between the pit NISP and the large sample NISP. Thus, a in a large highly fragmented assemblage, there is strong correlation between the raw counts of individual specimens and a simple derived measure like counts of diagnostic zones.

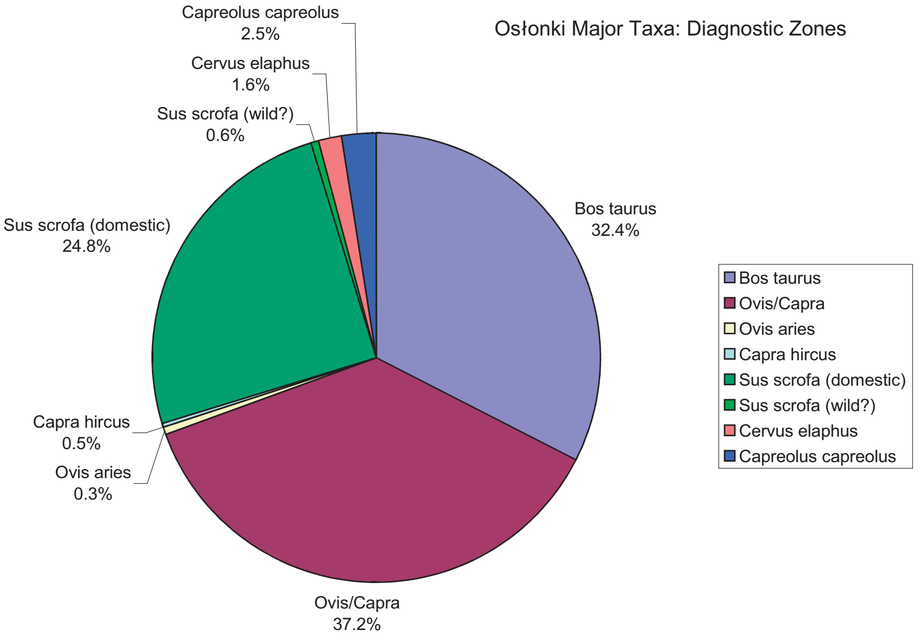


Fig. 1306. Relative percentages of diagnostic zones of principal economic taxa at Osłonki.

Ryc. 1306. Względny udział procentowy stref diagnostycznych głównych gatunków zwierząt gospodarczych w Osłonkach.

Osłonki Bird Bones

During his analysis of the Osłonki faunal assemblage, Bogucki segregated 240 bird bones. An additional 36 bird bones were segregated by Makowiecki during his analysis of the Osłonki fish bone assemblage due to their inclusion on the water–screened bone fraction. At 276 specimens, this would be the largest Neolithic bird bone assemblage from the Polish Lowlands. Competing demands on time and resources have caused the Osłonki bird bone assemblage to remain unanalyzed at the current time, a situation that should be rectified in the near future. A general inspection of the assemblage by Bogucki suggests that it has a character similar to that of the Brześć Kujawski bird bone assemblage described above, with the majority of the specimens coming from Anseriformes such as mallards, ducks, and geese.

Osłonki Fish NISP

The fish bones from Osłonki were identified by Makowiecki (2003: table 36) and are presented below as Table CLXXXIV. They came from eleven features, three clay pits and eight smaller pits, with the majority coming from one of the large clay pits, number 10, and one of the smaller pits, number 179. Of the 1905 fish bones, 515 (27%) were identifiable at least to the level of order. This percentage is significantly lower than at Brześć Kujawski despite generally the same methods of recovery being applied. Instead, it appears to indicate a taphonomic difference between the context in which the majority of the Brześć Kujawski fish bones were found (a single very small pit, densely concentrated) and the less–dense contexts in which the Osłonki fish bone samples were recovered. Of the bones in Clay Pit 10, only 16.7% could be identified, while of the bones in Pit 179, 24.4% could be identified. There appears to be a direct correlation between density of fish remains per volume of feature fill and the percentage that can be identified.

The relative proportions of fish NISP from Osłonki are shown graphically in Figure 1307. As at Brześć Kujawski, the assemblage is dominated by cyprinids, both generic carp classed as Cyprinidae as well as members of specific species. Of the non–cyprinid taxa, pike are the most abundant, in somewhat greater quantity than at Brześć Kujawski although not dramatically so, while perch are surprisingly insignificant.

Table CLXXXIV. Osłonki fish NISP (after Makowiecki 2003: table 36).
Tabela CLXXXIV. GLS ości ryb z Osłonek (za Makowieckim 2003: tabela 36).

Osłonki		Clay Pits			Pits								Total	
Common Name	Taxon	2	9	10	53	75	95	103	116	127	131	179	n	%
Northern Pike	*Esox lucius*	0	0	55	0	1	0	0	1	0	0	36	93	18.1
Carp	Cyprinidae	3	3	72	102	12	4	2	19	0	2	165	384	74.6
Roach	*Rutilus rutilus*	0	0	1	0	1	0	0	0	0	0	1	3	0.6
Rudd	*Scardinius erythrophthalmus*	0	0	1	0	1	0	0	0	0	0	6	8	1.5
Asp	*Aspius aspius*	8	0	0	0	0	0	0	0	0	0	0	8	1.5
Tench	*Tinca tinca*	0	0	1	1	0	0	0	0	0	0	14	16	3.1
Carp Bream	*Abramis brama*	1	0	0	0	0	0	0	0	0	0	0	1	0.2
Crucian Carp	*Carassius carassius*	0	0	0	0	0	0	0	0	0	0	1	1	0.2
European Perch	*Perca fluviatilis*	0	0	0	1	0	0	0	0	0	0	0	1	0.2
Identified		12	3	130	104	15	4	2	20	0	2	223	515	100
Unidentified		8	0	650	8	24	0	4	4	1	1	690*	1390	
Total		20	3	780	112	39	4	6	24	1	3	913	1905	

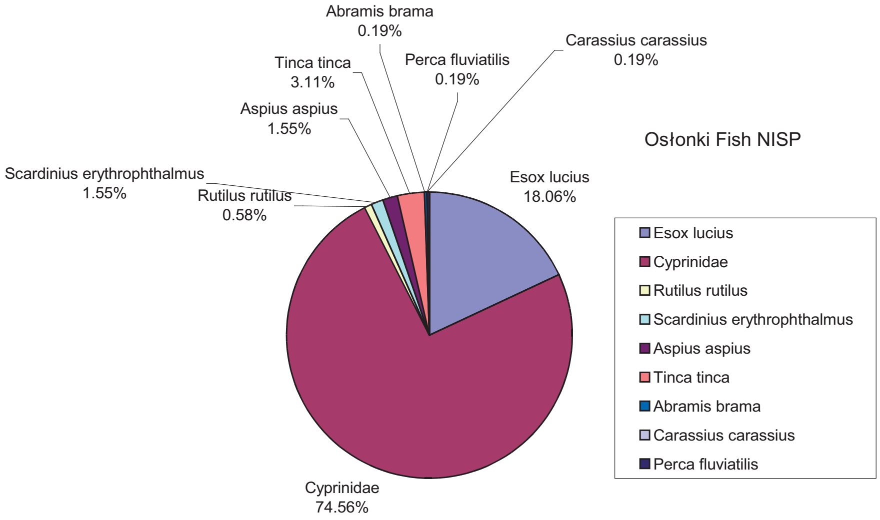


Fig. 1307. Relative abundance of Osłonki fish taxa by NISP.

Ryc. 1307. Względna liczebność gatunków ryb w Osłonkach, określona za pomocą GLS.

Osłonki Pond Tortoise NISP

A total of 235 bone fragments of pond tortoise were recovered from 14 features at Osłonki, six large clay pits and eight smaller pits (Table CLXXXV). The majority came from one of the small pits, Pit 137, along with two smaller concentrations in Clay Pits 3 and 9. The remainder were isolated fragments. At least one articulated segment of carapace was observed *in situ* in the northern part of Clay Pit 3 (Figure 1308.) Of these fragments, 220 were carapace and plastron elements identified by Bogucki in his work, while another 15 were segregated by Makowiecki from the water–sieved fish bone samples. Bogucki weighed the fragments that he studied, which totaled 475 grams.

Table CLXXXV. Pond tortoise remains from Osłonki by context.
Tabela CLXXXV. Szczątki żółwia błotnego z Osłonek, zgodne z kontekstem kulturowym.

Osłonki tortoise NISP	**Clay Pits**						**Pits**								**Total**
element	2	3	5	9	10	11	53	75	103	127	130	137	179	**208**	
carapace	5	35	1	21	0	4		1	0	1	0	87	0	6	**161**
plastron	4	0	0	6	6	0		2	4	0	1	34	1	1	**59**
cara/plas/other	0	0	0	0	6		5	2	0	2	0	0	0	0	**15**
total	**9**	**35**	**1**	**27**	**12**	**4**	**5**	**3**	**4**	**1**	**1**	**121**	**1**	**7**	**235**
weight (g)	19	41	4	40	17	4		6	6	1	3	320	3	11	**475g**

Although the Osłonki tortoise NISP were not as abundant in relation to the rest of the faunal sample as at Brześć Kujawski, they clearly were present in a significant quantity across the site. Their presence in such quantity in the faunal assemblage also reflects their occurrence in the area surrounding the site. This may have relevance for our understanding of the Neolithic landscape, a subject which will be discussed further below.

Fig. 1308. Osłonki, Site 1. Articulated segments of a carapace *in situ* in Clay Pit 3, next to a pottery fragment.

Ryc. 1308. Osłonki, st. 1. Wyodrębnione części tarczy górnej pancerza żółwia, znalezione in situ, glinianka 3, obok fragmentu ceramiki.

6.4.3
OSŁONKI SAMPLE ANALYZED BY MAKOWIECKI

A sample of animal bones from Osłonki that had not been part of the material analyzed by Bogucki in 1990–1996 was examined by Makowiecki in 2002. It came from two cultural layers associated with 360/361 and 370/371. Of the 472 bones, 79% could be identified. In addition to the mammal bones, 4 bird bones were noted.

The mammal bones from this sample are tabulated in Table CLXXXVI. They consist exclusively of the major economic taxa without the minor wild species that are found in most of the other samples. Figure 1309 depicts the proportional representation of these species, after the removal from consideration of ribs and vertebrae for comparability with the main Osłonki sample. The principal difference between this sample and the main Osłonki assemblage is the much larger number of cattle. Since the small sample comes from cultural layers, the taphonomic difference identified above between clay pits and smaller pits that resulted in a larger proportion of cattle in the clay pits may be amplified even further for bones from a cultural layer. As in the main Osłonki faunal assemblage, goat outnumber sheep, indicating that this was a uniform characteristic at Osłonki.

Table CLXXXVI. NISP in sample of animal bone from Osłonki studied by Makowiecki in 2002.
Tabela CLXXXVI. GLS w próbce kości zwierząt z Osłonek, opracowana przez D. Makowieckiego w 2002 r.

Element	Cattle	Pig	Sheep/ Goat	Sheep	Goat	Red Deer	Roe Deer	Total
Horn Core	0	0	0	0	2	0	0	**2**
Skull + Horn Core	1	0	0	0	0	0	0	**1**
Antler	0	0	0	0	0	1	0	**1**
Skull	28	7	1	0	0	0	0	**36**
Mandible	13	7	3	0	0	0	1	**24**
Lower Canine	0	1	0	0	0	0	0	**1**
Upper Teeth	6	0	1	0	0	0	0	**7**
Lower Teeth	1	1	1	0	0	0	0	**3**
Hyoid	1	0	0	0	0	0	0	**1**
Scapula	13	2	5	0	0	1	1	**22**
Humerus	7	2	1	0	1	0	0	**11**
Radius	4	2	4	0	0	0	0	**10**
Ulna	7	1	2	0	0	0	0	**10**
Radius+ Ulna	0	0	0	0	1	0	0	**1**
Carpals	3	0	0	0	0	0	0	**3**
Metacarpal	7	1	1	2	3	1	0	**15**
Metacarpal III	0	1	0	0	0	0	0	**1**
Pelvis	3	2	1	2	1	0	0	**9**
Femur	6	4	5	0	0	1	0	**16**
Tibia	20	1	10	3	2	1	0	**37**
Fibula	0	3	0	0	0	0	0	**3**
Calcaneus	2	1	1	0	0	0	0	**4**
Astragalus	2	0	0	0	0	0	0	**2**
Centrotarsal	1	0	0	0	0	0	0	**1**
Metatarsal	5	1	6	2	1	0	0	**15**
Metatarsal III	0	1	0	0	0	0	0	**1**
Metatarsal IV	0	2	0	0	0	0	0	**2**
Metapodial	1	0	0	0	0	0	0	**1**
Phalanx I	2	1	3	0	0	0	0	**6**
Phalanx I Anterior	1	0	0	0	0	0	0	**1**
Phalanx I Posterior	2	0	0	0	0	0	0	**2**
Phalanx II Anterior	2	0	0	0	0	0	0	**2**
Phalanx II Posterior	2	0	0	0	0	0	0	**2**
Phalanx III	3	0	0	0	0	0	0	**3**
Total	**143**	**41**	**45**	**9**	**11**	**5**	**2**	**256**

Element	Cattle	Pig	Sheep/ Goat	Sheep	Goat	Red Deer	Roe Deer	Total
% w/o ribs, vertebrae	**55.86%**	**16.02%**	**17.58%**	**3.52%**	**4.30%**	**1.95%**	**0.78%**	**100.00%**
Cervical Vertebrae	10	1	0	0	0	0	0	**11**
Thoracic Vertebrae	16	1	1	0	0	0	0	**18**
Lumbar Vertebrae	7	2	0	0	0	0	0	**9**
Ribs	43	17	15	0	0	0	0	**75**
Total ribs + vertebrae	76	21	16	0	0	0	0	**113**
Grand Total	219	62	61	9	11	5	2	**369**
% grand total	59.35%	16.80%	16.53%	2.44%	2.98%	1.36%	0.54%	**100.00%**

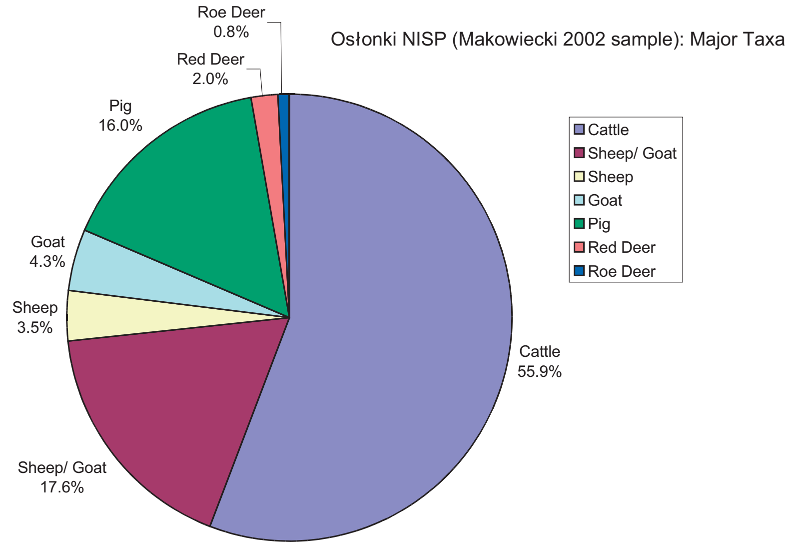


Fig. 1309. Proportions of NISP of major economic taxa in assemblage from Osłonki studied by Makowiecki in 2002.

Ryc. 1309. Proporcje GLS głównych gatunków zwierząt gospodarczych w zespole z Osłonek, opracowane przez D. Makowieckiego w 2002 r.

In addition to the fish bones from Osłonki reported above, an additional sample was recently reported by Makowiecki as part of the same 2002 research. These fish bones came from three features: a niche in the bottom of Clay Pit 10, and two smaller pits, 149 and 272. The fish bones recovered through water sieving are presented in Table CLXXXVII below and are overwhelmingly dominated by cyprinids with only a small number of pike.

Table CLXXXVII. Additional fish bone sample from Osłonki identified by Makowiecki in 2002.
Tabela CLXXXVII. Dodatkowa próbka ości ryb z Osłonek określona przez D. Makowieckiego w 2002 r.

Common Name	Taxon	Clay Pit 10C	Pit 149	Pit 272	Total	% total
Northern Pike	*Esox lucius*	4	0	7	11	3.25%
Carp	Cyprinidae	26	14	283	323	95.56%
Ide	*Leuciscus idus*	1	1	0	2	0.59%
Tench	*Tinca tinca*	0	0	1	1	0.30%
Crucian Carp	*Carassius carassius*	0	0	1	1	0.30%
Total Identified		31	15	292	338	100.00%

6.4.4
FALBORZ

The multiperiod site of Falborz , located approximately 3 kilometers NW of Brześć Kujawski, was excavated by Mgr. Janina Dąbrowska of the Muzeum Ziemi Kujawskiej i Dobrzyńskiej in 1976–1979. Dr. Ryszard Grygiel subsequently conducted small rescue excavations in 1983. In addition to features from later periods, Neolithic occupations of the Linear Pottery culture (ca. 5400–4900 cal BC) and the Brześć Kujawski Group of the Lengyel culture (ca. 4500–4200 cal BC) were documented. Peter Bogucki studied the faunal remains from these two occupations in 1988 at the request of Ryszard Grygiel.

Excavation conditions at Falborz were very difficult. The archaeological remains were embedded in a rock–hard clay matrix, and the extraction of the animal bones from this matrix resulted in damage and breakage of a number of specimens. Feature fill was not sieved. Thus the Falborz faunal sample consisted primarily of large hand–collected specimens. Small mammal, bird, and fish bones are absent, as are the smaller elements of larger animals, such as the phalanges of sheep/goat and roe deer. In the interest of expediency of analysis, most vertebrae, ribs, and long bone shaft fragments that lacked diagnostic characteristics to permit identification to the genus level were left unidentified. Certain diagnostic specimens that were still equivocal but which seemed likely to belong to a taxon were characterized as “Bos–sized” or “Ovis/Capra–sized”, or “probably Bos” and “probably Ovis/Capra”.

Twenty–one contexts attributed to the Brześć Kujawski Group of the Lengyel culture yielded 1029 animal bones, of which 289 could be identified to the genus level or nearly so. Table CLXXXVIII gives the distribution of these specimens by species and element. A wide range of species is present, including domestic cattle, sheep and goat, pig, dog (*Canis familiaris*), red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), beaver (*Castor fiber*), hare (*Lepus europaeus*), wild horse (*Equus* sp.), and pond tortoise (*Emys orbicularis)*. The pig bones are presumed to be primarily those of domesticated individuals, although the possibility of an admixture of bones from individuals living in the wild cannot be excluded.

This range of species is consistent with the pattern observed at nearby contemporaneous Lengyel settlements, including Brześć Kujawski and Osłonki. As with the Brześć Kujawski and Osłonki samples, the NISP of the major economic species – cattle, sheep, goat, pig, red deer, and roe deer – are isolated and graphed in Figure 1310. The proportions of the principal domestic taxa conform generally to the pattern noted at Brześć Kujawski and Osłonki, perhaps more closely to Brześć Kujawski.

Red deer and roe deer were more abundant at Falborz during the Lengyel occupation than during the Linear Pottery occupation, which may have been the result of hunting to defend fields of grain against these crop–robbing species (Uerpmann 1977). It should be noted that 11 of the roe deer bones were found in a single pit excavated in 1983 and probably belong to a single individual. They include right and left femurs, a left tibia, right and left scapulae, and a left articulated humerus–radius–ulna, all high meat–bearing elements. These appear to be the remains of a single kill and a single consumption episode. The varying representation of anatomical elements at Falborz is discussed further below.

Table CLXXXVIII. Lengyel NISP from Falborz.
Tabela CLXXXVIII. GLS związana z kulturą lendzielską z Falborza.

	Cattle	Probably cattle	Cattle–sized	Sheep/Goat	Sheep	Goat	Sheep/Goat–sized	Probably Sheep/Goat	Red deer	Roe deer	Beaver	Hare	Pond tortoise	Horse	Pig	Dog	Totals	Percent
Horn/antler	2			1		3			11								17	6%
cranium	1	1		2											4		8	3%
maxilla		1		2											7		10	3%

	Cattle	Probably cattle	Cattle–sized	Sheep/Goat	Sheep	Goat	Sheep/Goat–sized	Probably Sheep/Goat	Red deer	Roe deer	Beaver	Hare	Pond tortoise	Horse	Pig	Dog	Totals	Percent
loose max teeth	5			11													16	6%
mandible	5		2	8	3					1	1				4		24	8%
loose mand teeth	9			8													17	6%
loose teeth	5			4							2				4		15	5%
atlas				1											5		6	2%
axis	2			4													6	2%
vertebra	1		1				2										4	1%
scapula	4			5				2	1	2					3		17	6%
humerus	4	1	2	4			1			2					1		15	5%
radius				4			1			1					5		11	4%
ulna										1	1				6		8	3%
carpal	2						1										3	1%
metacarpal	4			3											4		11	4%
pelvis	2	1	1	1			1			1					3		10	3%
patella									1	1							2	1%
femur				2			1			3					1		7	2%
tibia	2			1			1			3					4	1	**12**	4%
fibula															1		1	0%
calcaneus	2						1			3							6	2%
astragalus	5														1		6	2%
tarsal	2																2	1%
metatarsal	2			2			1		1			1			2		9	3%
metapodial			1	5			1		1								8	3%
phalanx I	6	1		1					2	2	1						13	4%
phalanx II		1							2					1	2		6	2%
phalanx III	2														4		6	2%
carapace/plastron													9				9	3%
other elements			2												2		4	1%
TOTALS	67	6	9	69	3	3	11	2	19	20	5	1	9	1	63	1	289	
Percentage	23%	2%	3%	24%	1%	1%	4%	1%	7%	7%	2%	0%	3%	0%	22%	0%		

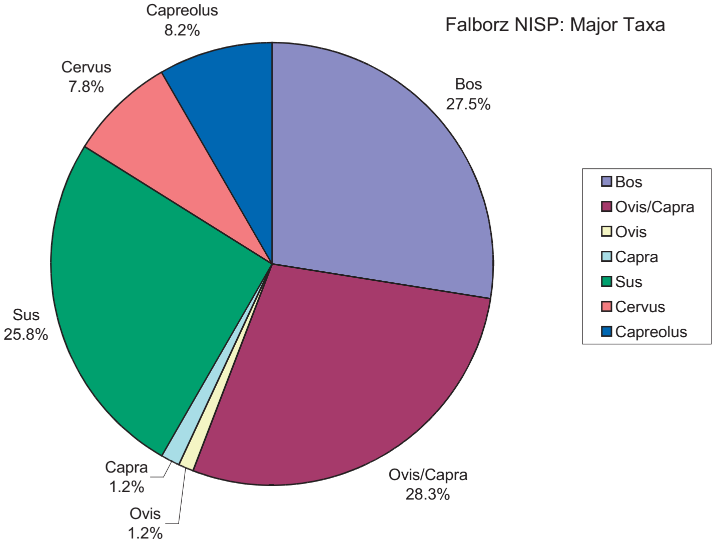


Fig. 1310. Proportions of NISP of major economic taxa at Falborz.

Ryc. 1310. Proporcje GLS głównych gatunków zwierząt gospodarczych z Falborza.

6.4.5
MIECHOWICE 4

The sample of animal bones from Miechowice 4 was analyzed by Makowiecki in 2002. The distribution of mammal bones by anatomical element and species is shown in Table CLXXXIX. As noted earlier, for the purposes of this analysis, vertebrae (other than the atlas and axis) and ribs, have been tabulated separately in order to facilitate comparison with the Osłonki sample. It conforms generally to the pattern seen at the neighboring sites of Konary and Miechowice 4a. Most major meat–bearing bones are abundant, although the relatively low number of scapulae, radii, and ulnae, along with sheep/goat and pig humeri, is notable. This may be an artifact of the relatively small size of the sample.

Proportions of the NISP of the principal economic taxa have been determined on the basis of the totals without vertebrae and ribs and are presented graphically in Figure 1311. In this chart, the category of "wild or domestic cattle" has been added alongside the domestic cattle since it comprised a significant percentage of the NISP. The pattern in Figure 1311 is similar to that seen at the neighboring sites of Konary and Miechowice 4A, although it differs in the relatively low number of bones assignable to goat compared with the number of sheep bones, and in its smaller proportion of roe deer. Again, these variations are probably caused by sample size, and they do not alter the overall similarity of the proportions of principal economic taxa at Miechowice 4 to that seen at the neighboring sites.

Table CLXXXIX. Mammal bone NISP at Miechowice 4 based on analysis by Makowiecki, 2002.
Tabela CLXXXIX. GLS kości ssaków z Miechowic, stanowisko 4, w oparciu o analizę D. Makowieckiego, 2002 r.

Miechowice 4 (2002)										
Element	**Cattle**	**Pig**	**Sheep/ Goat**	**Sheep**	**Goat**	**Horse**	**Red Deer**	**Roe Deer**	**Wild/ Domestic Cattle**	**Totals**
Horn Core	2	0	0	0	0	0	0	0	0	**2**
Skull + Horn Core	2	0	0	0	2	0	0	0	0	**4**
Antler	0	0	0	0	0	0	3	0	0	**6**
Skull	12	7	3	0	0	1	1	0	1	**25**
Mandible	10	10	2	0	0	1	0	1	1	**25**
Teeth	11	0	0	0	0	0	0	0	0	**50**
Upper Teeth	1	0	0	0	0	0	0	0	0	**1**
Lower Teeth	1	0	0	0	0	0	0	0	0	**1**
Lower M3	1	0	1	0	0	0	0	0	0	**2**
Atlas	1	0	0	0	0	0	0	0	0	**1**
Axis	0	0	1	0	0	0	0	0	0	**1**
Hyoid	0	0	1	0	0	0	0	0	0	**2**
Scapula	2	1	1	0	0	1	0	0	2	**7**
Humerus	16	4	3	0	0	0	0	0	1	**24**
Radius	6	0	6	1	0	0	0	0	0	**31**
Ulna	3	0	1	0	0	0	0	0	0	**4**
Radius + Ulna	0	0	0	3	0	0	0	0	0	**3**
Carpals	2	0	0	0	0	0	0	0	0	**7**
Metacarpal	7	0	3	2	1	0	1	0	1	**15**
Pelvis	8	3	4	0	0	0	0	0	1	**16**
Femur	5	4	6	1	0	0	1	0	0	**31**
Patella	0	0	1	0	0	0	0	0	0	**1**
Tibia	8	5	17	0	0	0	0	0	1	**31**
Fibula	0	2	0	0	0	0	0	0	0	**2**
Calcaneus	0	0	1	1	0	0	1	0	1	**2**
Astragalus	0	0	0	1	0	0	0	0	0	**1**

Miechowice 4 (2002)										
Element	**Cattle**	**Pig**	**Sheep/ Goat**	**Sheep**	**Goat**	**Horse**	**Red Deer**	**Roe Deer**	**Wild/ Domestic Cattle**	**Totals**
Centrotarsal	1	0	0	0	0	0	0	0	0	**1**
Metatarsal	4	0	4	3	0	1	0	0	2	**2**
Metapodial	1	0	1	0	0	0	0	0	0	**2**
Phalanx I	3	0	3	0	0	0	0	0	0	**6**
Phalanx II	0	0	1	0	0	0	0	0	0	**8**
Phalanx II Anterior	1	0	0	0	0	0	0	0	0	**1**
Phalanx II Posterior	1	0	0	0	0	0	0	0	0	**1**
Phalanx III	2	0	0	0	0	0	0	0	0	**2**
Totals	**111**	36	60	12	3	4	7	1	11	245
% w/o ribs, vertebrae	45.31%	14.69%	24.49%	4.90%	1.22%	1.63%	2.86%	0.41%	4.49%	100.00%
Cervical vertebrae	11	0	2	0	0	0	0	0	0	**13**
Thoracic vertebrae	23	1	2	0	0	0	0	0	0	**26**
Lumbar vertebrae	3	5	3	0	0	0	0	0	0	**39**
Ribs	34	5	17	0	0	0	0	0	1	**57**
total ribs + vertebrae	71	11	24	0	0	0	0	0	1	**107**
grand total	**182**	**47**	84	12	3	4	7	1	12	352
% grand total	51.70%	13.35%	23.86%	3.41%	0.85%	1.14%	1.99%	0.28%	3.41%	100.00%

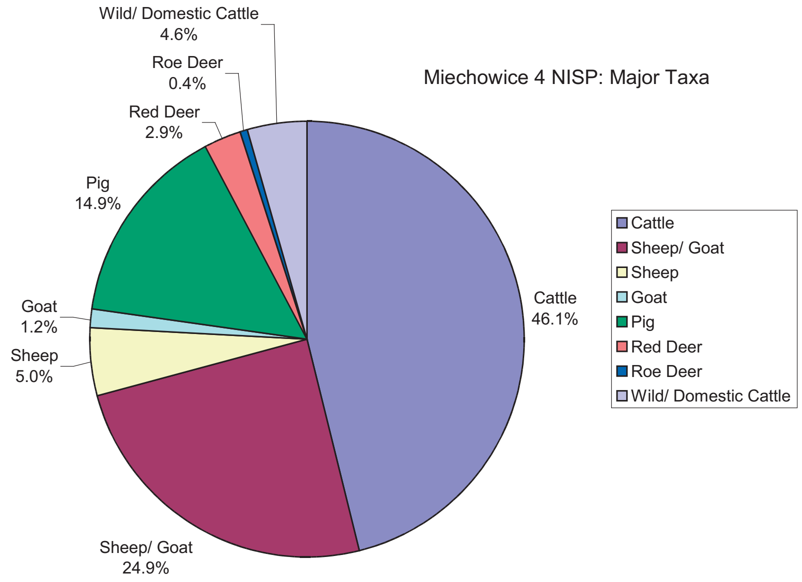


Fig. 1311. Proportions of NISP of major economic taxa at Miechowice 4.

Ryc. 1311. Proporcje GLS głównych gatunków zwierząt gospodarczych z Miechowic, stanowisko 4.

Water–sieving of fill from three features at Miechowice 4 produced a small sample of fish bones which were identified by Makowiecki. The species represented are a subset of those found at Brześć Kujawski and Osłonki (Table CXC). In keeping with the typical pattern, the assemblage is dominated by cyprinids, while the predatory pike and perch are represented in small numbers.

Table CXC. Fish NISP from Miechowice. Site 4.
Tabela CXC. GLS ryb z Miechowic, st. 4.

Miechowice 4 fish NISP						
Common Name	**Taxon**	**Clay Pit 4**	**Pit 30**	**Pit 35**	**n**	**%**
Northern Pike	*Esox lucius*	1	1	7	9	14.06%
Carp	Cyprinidae	6	8	36	50	78.13%
Carp Bream	*Abramis brama*	0	0	3	3	4.69%
European Perch	*Perca fluviatilis*	0	0	2	2	3.13%
Identified		**7**	**9**	**48**	**64**	**100.00%**
Unidentified		4	5	35	44	
Total		11	14	83	108	

6.4.6
MIECHOWICE 4A

Neolithic features at Miechowice 4a yielded a relatively large sample of fauna that was analyzed by Makowiecki in 2002 (Table CXCI). Bones came from three large clay pits (including one subdivided into its basal niches) and ten smaller pits. 65% of the bones could be identified. In addition to the mammal bones, 8 bird, 4 pond tortoise, and 2 fish bones were noted, along with 39 fragments of freshwater mollusc shells.

The distribution of mammal bones by anatomical element and species is shown in Table CXCII. As noted earlier, for the purposes of this analysis, vertebrae (other than the atlas and axis) and ribs, have been tabulated separately in order to facilitate comparison with the Osłonki sample. The sample from Miechowice 4a conforms generally to the pattern seen at the neighboring sites of Konary and Miechowice 4. Most major meat–bearing bones are abundant, with no glaring deficiencies evident, in contrast to the low numbers of certain elements at Miechowice 4.

The proportions of the NISP of major economic taxa are illustrated graphically in Figure 1312. In general, they do not show a marked divergence from the samples from Konary and Miechowice 4. Sheep outnumber goats, while the percentage of deer is relatively low overall. The percentage of pig is robust, although less than that seen at Osłonki.

Table CXCI. Faunal assemblage from Miechowice 4a by feature and taxon; analysis by Makowiecki 2002.
Tabela CXCI. Zespół szczątków zwierzęcych z Miechowic, stanowisko 4a, określony gatunkowo, w kontekście obiektu; analiza D. Makowieckiego 2002.

Feature	**Layer**	**Cattle**	**Pig**	**Sheep/Goat**	**Sheep**	**Goat**	**Horse**	**Wild Pig**	**Red Deer**	**Roe Deer**	**Wild/ Domestic Cattle**	**Bird**	**Pond Tortoise**	**Fish**	**Mussels**	**Identified**	**Unidentified**	**Total**
Clay Pit 1		58	6	14	2	2	1	0	1	1	0	0	0	0	0	85	95	**180**
Clay Pit 3		34	10	17	3	0	0	1	0	0	0	2	0	0	2	69	19	**88**
Clay Pit 3	Niche 1	8	1	1	1	0	0	0	0	0	0	0	0	0	0	11	3	**14**
Clay Pit 3	Niche A	43	2	14	0	1	0	0	2	2	0	2	1	1	35	103	29	**132**
Clay Pit 3	Niche B	39	14	22	0	1	0	0	3	2	0	1	0	0	0	82	27	**109**
Clay Pit 3	Niche D	39	10	14	1	2	0	0	1	0	0	0	1	0	1	69	50	**119**
Clay Pit 3	Niche E	9	3	6	0	1	1	0	0	0	0	0	0	0	0	20	3	**23**
Clay Pit 4		37	9	4	1	1	0	0	0	0	0	0	0	0	0	52	53	**105**
Pit 1		8	4	9	1	1	0	0	1	0	1	1	0	0	1	27	7	**34**
Pit 4		3	1	13	0	2	0	0	0	0	0	0	0	0	0	19	2	**21**
Pit 6		17	2	4	0	0	1	0	1	0	0	0	2	0	0	27	15	**42**
Pit 12		8	1	10	3	2	1	0	0	1	0	1	0	0	0	27	7	**34**
Pit 13		5	1	14	2	1	0	0	0	0	0	0	0	0	0	23	9	**32**
Pit 15		32	7	17	4	3	1	0	0	0	0	0	0	0	0	64	2	**66**
Pit 16		15	1	4	0	2	0	0	2	0	0	1	0	0	0	25	43	**68**

Feature	Layer	Cattle	Pig	Sheep/Goat	Sheep	Goat	Horse	Wild Pig	Red Deer	Roe Deer	Wild/ Domestic Cattle	Bird	Pond Tortoise	Fish	Mussels	Identified	Unidentified	Total
Pit 17		8	2	1	0	0	1	0	0	0	0	0	0	0	0	12	6	**18**
Pit 22		13	4	16	2	1	0	0	0	0	0	0	0	0	0	36	2	**38**
Pit 30		76	74	53	10	3	1	0	1	0	1	0	0	1	0	220	151	**371**
Total		**452**	**152**	**233**	**30**	23	7	1	12	6	2	8	4	2	39	971	523	1494

Table CXCII. Mammal bone NISP at Miechowice 4a based on analysis by Makowiecki, 2002.
Tabela CXCII. GLS kości ssaków z Miechowic, stanowisko 4a, w oparciu o analizę D. Makowieckiego, 2002.

Miechowice 4a (2002)											
Element	**Cattle**	**Pig**	**Sheep/ Goat**	**Sheep**	**Goat**	**Horse**	**Wild Pig**	**Red Deer**	**Roe Deer**	**Wild/ Dom. Cattle**	**Total**
Horn Core	3	0	0	2	10	0	0	0	0	0	**15**
Skull + Horn Core	3	0	0	1	3	0	0	0	0	0	**7**
Antler	0	0	0	0	0	0	0	6	0	0	**6**
Skull	21	13	8	2	2	0	0	0	0	0	**46**
Mandible	25	11	26	0	0	0	0	0	2	1	**65**
Teeth	3	1	0	0	0	1	0	0	0	0	**5**
Upper Teeth	4	0	4	0	0	0	0	0	0	0	**8**
Lower Teeth	8	1	2	0	0	0	1	0	0	0	**12**
Upper M2	1	0	0	0	0	0	0	0	0	0	**1**
Upper M3	1	0	0	0	0	0	0	0	0	0	**1**
Lower M3	2	0	0	0	0	0	0	0	0	0	**2**
Atlas	5	2	2	1	0	0	0	0	0	0	**10**
Axis	1	0	1	4	0	0	0	0	0	0	**6**
Sacrum	1	2	1	0	0	0	0	0	0	0	**4**
Scapula	30	7	4	1	0	0	0	1	0	0	**43**
Hunerus	21	6	11	1	0	0	0	0	0	1	**40**
Radius	18	5	12	7	1	2	0	1	1	0	**47**
Ulna	8	4	4	0	0	0	0	1	1	0	**18**
Radius + Ulna	2	0	0	0	1	0	0	1	0	0	**4**
Carpals	2	0	0	0	0	0	0	0	0	0	**2**
Metacarpal	23	3	6	0	1	0	0	0	0	0	**33**
Metacarpal III	0	2	0	0	0	0	0	0	0	0	**2**
Metacarpal IV	0	2	0	0	0	0	0	0	0	0	
Pelvis	10	7	4	0	0	1	0	0	0	0	**22**
Femur	24	15	16	2	0	2	0	1	0	0	**60**
Patella	3	0	0	0	0	0	0	0	0	0	**3**
Tibia	24	9	33	3	3	1	0	0	1	0	**74**
Fibula	0	3	0	0	0	0	0	0	0	0	**3**
Calcaneus	6	4	1	0	1	0	0	0	0	0	**12**
Astragalus	5	3	4	0	0	0	0	0	0	0	**12**
Centrotarsal	1	0	0	0	0	0	0	0	0	0	**1**
Metatarsal	22	2	11	6	1	0	0	0	1	0	**43**
Metatarsal III	0	1	0	0	0	0	0	0	0	0	**1**
Metatarsal IV	0	1	0	0	0	0	0	0	0	0	**1**
Metapodial	5	1	1	0	0	0	0	0	0	0	**7**
Phalanx I	6	2	1	0	0	0	0	0	0	0	**9**
Phalanx I Anterior	7	0	0	0	0	0	0	0	0	0	**7**
Phalanx I Posterior	7	0	0	0	0	0	0	0	0	0	**7**
Phalanx II	9	1	0	0	0	0	0	0	0	0	**10**
Phalanx II Anterior	6	0	0	0	0	0	0	0	0	0	**6**
Phalanx II Posterior	2	0	0	0	0	0	0	0	0	0	**2**
Phalanx III	5	1	0	0	0	0	0	1	0	0	**7**

Miechowice 4a (2002)											
Element	Cattle	Pig	Sheep/ Goat	Sheep	Goat	Horse	Wild Pig	Red Deer	Roe Deer	Wild/ Dom. Cattle	Total
Sesamoids	0	0	1	0	0	0	0	0	0	0	**1**
Totals	**324**	**109**	**153**	**30**	**23**	**7**	**1**	**12**	**6**	**2**	**667**
% w/o ribs, vertebrae	**48.58%**	**16.34%**	**22.94%**	**4.50%**	**3.45%**	**1.05%**	**0.15%**	**1.80%**	**0.90%**	**0.30%**	**100.00%**
Cervical Veretebrae	18	1	4	0	0	0	0	0	0	0	**23**
Thoracic Veretebrae	21	7	15	0	0	0	0	0	0	0	**43**
Lumbar Vertebrae	10	6	1	0	0	0	0	0	0	0	**17**
Ribs	79	29	60	0	0	0	0	0	0	0	**168**
Total ribs+ vertebrae	128	43	80	0	0	0	0	0	0	0	**251**
Grand Total	452	152	233	30	23	7	1	12	6	2	**918**
% grand total	49.24%	16.56%	25.38%	3.27%	2.51%	0.76%	0.11%	1.31%	0.65%	0.22%	**100.00%**

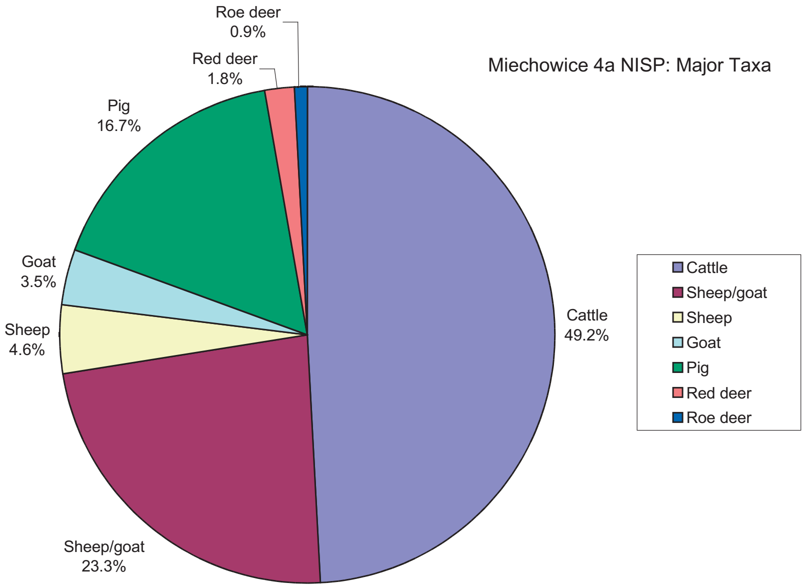


Fig. 1312. Proportions of NISP of major economic taxa at Miechowice 4a.

Ryc. 1312. Proporcje GLS głównych gatunków zwierząt gospodarczych z Miechowic, stanowisko 4a.

Table CXCIII. Fish NISP from Miechowice 4a.
Tabela CXCIII. GLS ryb z Miechowic, stanowisko 4a.

Miechowice 4a fish NISP									
Common Name	Taxon	Clay Pit 3A	Clay Pit 3B	Clay Pit 3C	Clay Pit 3D(N)	Pit 4	Pit 6b(S)	n	%
Northern Pike	*Esox lucius*	2	0	0	1	0	1	**4**	4.12%
Carp	Cyprinidae	26	17	1	6	33	3	**86**	88.66%
Roach	*Rutilus rutilus*	3	2	0	0	0	0	**5**	5.15%
Rudd	*Scardinius erythrophthalmus*	1	0	0	0	0	0	**1**	1.03%
European Perch	*Perca fluviatilis*	1	0	0	0	0	0	**1**	1.03%
Identified		**33**	**19**	**1**	**7**	**33**	**4**	**97**	**100.00%**
Unidentified		7	6	0	3	15	0	**31**	
Total		40	25	1	10	48	4	**128**	

Water–sieving of fill from three features (with one clay pit divided into its basal niches) at Miechowice 4 produced a small sample of fish bones which were identified by Makowiecki. The species represented are a subset of those found at Brześć Kujawski and Osłonki (Table CXCIII). In keeping with the typical pattern, the assemblage is dominated by cyprinids, at over 90% of the sample when the roach are included with the genereic Cyprinidae, while the predatory pike and perch are represented in small numbers.

6.4.7
KONARY

The animal bones from Konary, site 1, were identified by Daniel Makowiecki in 2002 (Table CXCIV). They come from 11 features, seven large clay pits and four smaller pits, with the largest samples coming from two of the clay pits. 71% of the bones could be identified. The mammal bone assemblage is comprised predominantly of the major domestic taxa, along with wild artiodactyls. Among the rarer wild species, horse and beaver are represented by a small number of bones. In addition to the mammal bones, nine bird, two pond tortoise, and two fish bones were noted.

Table CXCIV. Faunal assemblage from Konary 1 by feature and taxon; analysis by Makowiecki 2002.
Tabela CXCIV. Zespół szczątków zwierzęcych ze stanowiska 1 w Konarach, określony gatunkowo w kontekście obiektu; analiza D. Makowieckiego 2002.

Konary 1																				
Feature	**Cattle**	**Pig**	**Sheep/Goat**	**Sheep**	**Goat**	**Horse**	**Dog**	**Beaver**	**Wild Pig**	**Red Deer**	**Roe Deer**	**Wild Cattle**	**Wild or Dom. Cattle**	**Birds**	**Pond Tortoise**	**Fish**	**Molluscs**	**Identified**	**Unidentified**	**Total**
Clay Pit 5	172	22	18	2	1	1	0	0	1	4	3	0	0	5	0	0	0	229	111	340
Clay Pit 6	14	1	3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	19	15	34
Clay Pit 7A	181	15	12	2	1	0	0	0	1	6	0	0	0	0	0	0	0	218	108	326
Clay Pit 8	19	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	22	40	62
Clay Pit 10	33	8	11	1	3	0	0	0	2	1	1	0	0	0	1	0	0	61	16	77
Clay Pit 11	8	3	6	1	0	0	0	0	0	0	1	0	0	0	0	0	0	19	3	22
Clay Pit 13	68	14	22	1	2	3	0	0	2	2	0	0	0	0	1	0	0	115	48	163
Pit 2	14	33	34	8	5	0	2	0	0	0	0	0	0	0	0	0	0	96	10	106
Pit 5	3	34	56	0	12	0	0	0	0	5	0	0	0	2	0	2	0	114	0	114
Pit 9	37	14	42	7	3	0	0	1	0	2	0	0	0	1	0	0	0	107	11	118
Pit 19	29	2	30	0	10	0	0	0	1	1	15	1	0	1	0	0	1	91	80	171
Total	**578**	**147**	**234**	**22**	**37**	**4**	**3**	**1**	**7**	**21**	21	1	1	9	2	2	1	1091	442	1533

The distribution of the Konary mammal bones by anatomical element and species is shown in Table CXCV. As noted earlier, for the purposes of this analysis, vertebrae (other than the atlas and axis) and ribs, have been tabulated separately in order to facilitate comparison with the Osłonki sample. Major meat–bearing bones are abundant.

Proportions of the NISP of the principal economic taxa have been determined on the basis of the totals without vertebrae and ribs and are presented graphically in Figure 1313. Cattle play a strikingly greater role in the Konary assemblage in contrast to their role at Osłonki, while sheep/goat and pig are present in smaller numbers. The proportions of red deer and roe deer at 2.8% each of the assemblage and the consistent majority of goat over sheep are very similar to the pattern seen at Osłonki.

Table CXCV. Mammal bones from Konary 1, identified by Daniel Makowiecki, 2002.
Tabela CXCV. Kości ssaków z Konar, stanowisko 1, określone przez D. Makowieckiego, 2002.

Konary 1														
Element	**Cattle**	**Pig**	**Sheep/ Goat**	**Sheep**	**Goat**	**Dog**	**Horse**	**Beaver**	**Wild Pig**	**Red Deer**	**Roe Deer**	**Wild Cattle**	**Wild or Dom. Cattle**	**Totals**
Horn Core	2	0	0	0	7	0	0	0	0	0	0	0	0	9
Skull + Horn Core	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Antler	0	0	0	0	0	0	0	0	0	5	1	0	0	6

Konary 1													
Element	Cattle	Pig	Sheep/ Goat	Sheep	Goat	Dog	Horse	Beaver	Wild Pig	Red Deer	Roe Deer	Wild Cattle	Wild or Dom. Cattle	Totals
Skull + Antler	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Skull	19	13	7	0	0	0	0	0	0	0	0	0	0	39
Mandible	65	10	15	0	1	1	0	0	0	0	1	0	0	93
Teeth	3	0	0	0	0	0	0	0	0	0	0	0	0	3
Upper Teeth	5	0	2	0	0	0	0	0	0	0	1	0	0	8
Lower Teeth	11	0	5	0	0	0	0	0	0	0	0	0	0	16
Upper M3	0	0	3	0	0	0	0	0	0	0	0	0	0	3
Lower M3	1	0	2	0	0	0	0	0	0	0	0	0	0	3
Atlas	1	0	3	0	0	0	0	0	0	0	0	0	0	4
Axis	0	0	3	0	0	0	0	0	0	0	0	0	0	3
Hyoid	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Scapula	42	8	8	0	0	0	0	0	0	0	2	0	0	60
Humerus	30	10	16	3	6	0	0	1	1	1	2	1	1	72
Radius	19	5	18	0	4	1	0	0	0	1	1	0	0	49
Ulna	13	4	6	0	0	0	0	0	0	0	0	0	0	23
Radius and Ulna	2	1	0	0	4	0	0	0	0	1	0	0	0	8
Carpals	4	0	0	0	0	0	0	0	0	0	0	0	0	4
Metacarpal	28	0	7	1	4	1	1	0	0	2	1	0	0	45
Metacarpal IV	0	2	0	0	0	0	0	0	0	0	0	0	0	2
Pelvis	26	6	2	4	1	0	0	0	3	1	2	0	0	45
Femur	18	6	13	3	1	0	0	0	0	3	4	0	0	48
Patella	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Tibia	29	13	29	6	3	0	2	0	1	3	4	0	0	90
Fibula	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Malleolus	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Tarsals	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Calcaneus	1	2	5	0	0	0	0	0	0	1	0	0	0	9
Astragalus	2	1	1	0	0	0	0	0	0	0	0	0	0	4
Centrotarsal	2	0	0	0	0	0	0	0	0	0	0	0	0	2
Metatarsal	23	1	4	5	3	0	1	0	0	1	1	0	0	39
Matatarsal IV	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Matatarsal V	0	1	0	0	0	0	0	0	1	0	0	0	0	2
Metapodial	6	2	0	0	0	0	0	0	1	0	0	0	0	9
Phalanx I	11	1	9	0	0	0	0	0	0	1	0	0	0	22
Phalanx I Anterior	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Phalanx I Posterior	5	0	0	0	0	0	0	0	0	0	0	0	0	5
Phalanx II	4	0	0	0	0	0	0	0	0	1	0	0	0	5
Phalanx II Anterior	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Phalanx II Posterior	2	0	0	0	0	0	0	0	0	0	0	0	0	2
Phalanx III	9	0	0	0	2	0	0	0	0	0	0	0	0	11
Sesamoid	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Totals	388	89	159	22	37	3	4	1	7	21	21	1	1	754
% w/o ribs, vertebrae	**51.46**	**11.80**	**21.09**	**2.92**	**4.91**	**0.40**	**0.53**	**0.13**	**0.93**	**2.79**	**2.79**	**0.13**	**0.13**	**100.00%**
Cervical vertebrae	14	3	0	0	0	0	0	0	0	0	0	0	0	17
Thoracic vertebrae	17	6	13	0	0	0	0	0	0	0	0	0	0	36
Lumbar vertebrae	37	4	3	0	0	0	0	0	0	0	0	0	0	44
Ribs	122	45	59	0	0	0	0	0	0	0	0	0	0	226
Total of ribs+vertebrae	190	58	75	0	0	0	0	0	0	0	0	0	0	323
Grand Total	**578**	**147**	**234**	**22**	**37**	**3**	**4**	**1**	**7**	**21**	**21**	**1**	**1**	**1077**
% grand total	**53.67**	**13.65**	**21.73**	**2.04**	**3.44**	**0.28**	**0.37**	**0.09**	**0.65**	**1.95**	**1.95**	**0.09**	**0.09**	**100.00%**

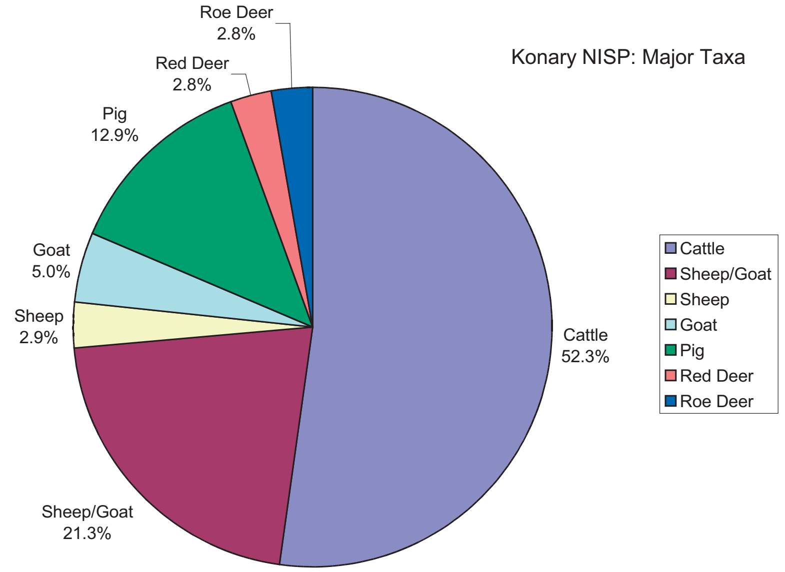


Fig. 1313. Proportions of NISP of major economic taxa at Konary.

Ryc. 1313. Proporcje GLS głównych gatunków zwierząt gospodarczych z Konar.

6.4.8

PIKUTKOWO

The animal bones from Pikutkowo site 6, were identified by Daniel Makowiecki in 2005, and their distribution by anatomical element and species is shown in Table CXCVI. . As noted earlier, for the purposes of this analysis, vertebrae (other than the atlas and axis) and ribs, have been tabulated separately in order to facilitate comparison with the Osłonki sample. Major meat–bearing bones are abundant. The mammal bone assemblage is comprised predominantly of the major domestic taxa, along with wild artiodactyls. Horse and beaver are represented by a small number of bones.

Proportions of the NISP of the principal economic taxa have been determined on the basis of the totals without vertebrae and ribs and are presented graphically in Figure 1314. As at Konary and Miechowice, cattle play a strikingly greater role in the faunal sample assemblage in contrast to their role at Osłonki. Pikutkowo has the lowest percentage of pig NISP of the sites in this study, although their presence is certainly significant. The proportions of red deer at 2.7% of NISP is consistent with the overall regional pattern, but the proportion of roe deer is unusually low. As at the other sites, goat bones are more numerous than sheep when it is possible to differentiate them.

Table CXCVI. Mammal bones from Pikutkowo 6a, identified by Daniel Makowiecki, 2005.
Tabela CXCVI. Kości ssaków z Pikutkowa, stanowisko 6a, określone przez D. Makowieckiego, 2005.

Pikutkowo 6a														
Element	**Cattle**	**Pig**	**Sheep/ Goat**	**Sheep**	**Goat**	**Horse**	**Dog**	**Beaver**	**Wild Pig**	**Red Deer**	**Roe Deer**	**Wild or Dom. Pig**	**Wild or Dom. Cattle**	**Totals**
Horncore	6	0	1	3	17	0	0	0	0	0	0	0	1	28
Skull + Horncore	2	0	0	0	2	0	0	0	0	0	0	0	0	4
Skull	34	12	13	0	0	0	0	0	1	0	0	0	0	60
Antler	0	0	0	0	0	0	0	0	0	9	0	0	0	9
Mandible	25	7	15	0	0	0	2	0	4	0	0	0	0	53
Teeth	4	0	6	0	0	0	0	2	0	0	0	0	0	12

Pikutkowo 6a

Element	Cattle	Pig	Sheep/ Goat	Sheep	Goat	Horse	Dog	Beaver	Wild Pig	Red Deer	Roe Deer	Wild or Dom. Pig	Wild or Dom. Cattle	Totals
Lower canine	0	2	0	0	0	0	0	0	0	0	0	0	0	2
Upper tooth	11	1	8	0	0	0	0	0	0	0	0	0	0	20
Lower tooth	5	3	7	0	0	0	0	0	0	0	0	0	0	15
Atlas	6	0	2	0	0	1	0	0	1	0	0	0	0	10
Axis	8	0	2	0	0	0	0	0	0	0	0	0	0	10
Sacrum	2	0	1	0	0	0	0	0	0	0	0	0	0	3
Scapula	16	1	4	0	0	1	0	0	1	0	0	1	0	24
Humerus	23	1	11	3	0	1	0	0	2	0	0	0	0	41
Radius	17	1	12	1	0	0	0	0	1	0	0	0	0	32
Ulna	5	3	3	0	0	0	0	0	0	1	0	0	1	13
Radius and Ulna	2	0	0	1	0	0	0	0	1	0	0	0	0	4
Carpals	2	0	0	0	0	0	0	0	0	0	0	0	0	2
Metacarpal	18	0	9	1	1	1	0	0	0	1	0	0	0	31
Pelvis	13	3	5	0	1	0	0	0	1	0	1	0	0	24
Femur	20	3	8	0	1	1	0	0	0	0	0	0	1	34
Patella	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Tibia	21	10	6	4	2	1	1	2	0	1	1	0	0	49
Calcaneus	8	0	2	0	0	0	0	0	0	1	0	0	0	11
Astragalus	9	0	3	0	0	1	0	0	0	0	0	0	0	13
Centrotarsal	4	0	0	0	0	0	0	0	0	0	0	0	0	4
Fibula	0	2	0	0	0	0	0	0	0	0	0	0	0	2
Metatarsal	21	1	11	6	5	1	0	0	0	1	1	0	0	47
Metapodial	4	0	1	0	0	0	0	0	3	0	0	0	0	8
Phalanx I	6	0	8	0	1	0	1	0	0	1	0	0	0	17
Phalanx I Anterior	3	0	0	0	0	0	0	0	0	0	0	0	0	3
Phalanx I Posterior	2	0	0	0	0	1	0	0	0	0	0	0	0	3
Phalanx II	6	0	1	0	0	0	0	0	0	0	0	0	0	7
Phalanx II Anterior	2	0	0	0	0	0	0	0	0	0	0	0	0	2
Phalanx II Posterior	3	0	0	0	0	0	0	0	0	0	0	0	0	3
Phalanx III	4	0	2	0	0	0	0	0	0	1	0	0	0	7
Sesamoids	2	0	0	0	0	0	0	0	0	0	0	0	0	2
Total	**315**	**50**	**141**	**19**	**30**	**9**	**4**	**4**	**15**	**16**	**3**	**1**	**3**	**610**
% w/o ribs, vertebrae	**51.64**	**8.20**	**23.11**	**3.11**	**4.92**	**1.48**	**0.66**	**0.66**	**2.46**	**2.62**	**0.49**	**0.16**	**0.49**	**100.00%**
Cervical vertebrae	21	2	0	0	0	0	0	0	0	0	1	0	0	24
Thoracic vertebrae	11	0	4	0	0	0	0	0	0	0	0	0	0	15
Lumbar vertebrae	7	4	3	0	0	0	0	0	0	0	0	0	0	14
Ribs	57	7	9	0	0	0	1	0	0	0	0	0	0	74
Total of ribs+vertebrae	96	13	16	0	0	0	1	0	0	0	1	0	0	127
Grand Total	**411**	**63**	**157**	**19**	**30**	**9**	**5**	**4**	**15**	**16**	**4**	**1**	**3**	**737**
% Grand Total	55.77	8.55	21.30	2.58	4.07	1.22	0.68	0.54	2.04	2.17	0.54	0.14	0.41	100.00%

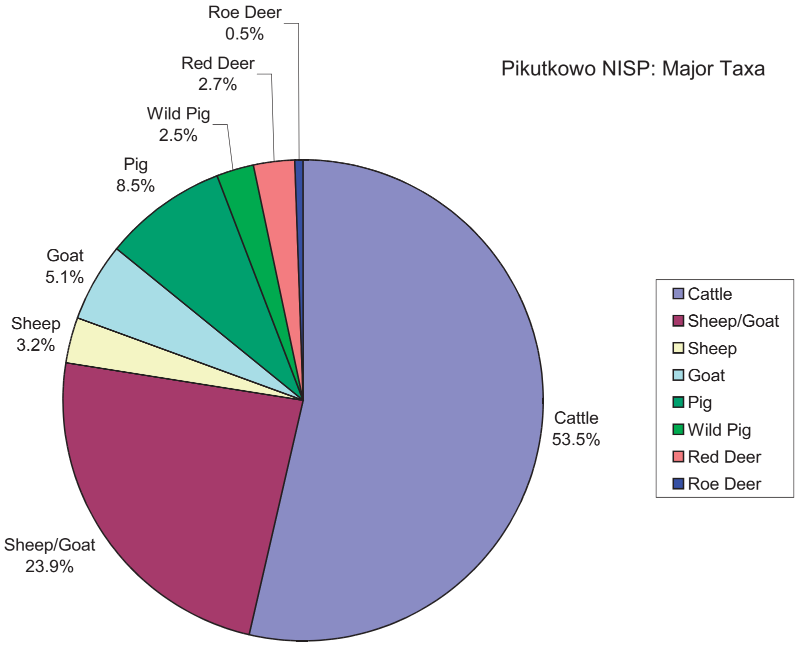


Fig. 1314. Proportions of NISP of major economic taxa at Pikutkowo.

Ryc. 1314. Proporcje GLS głównych gatunków zwierząt gospodarczych z Pikutkowa.

6.4.9
SMÓLSK

The animal bones from Smólsk, site 4, were identified by Daniel Makowiecki in 2003. (Table CXCVII). A relatively small sample comes from three features, all large clay pits. 56% of the bones could be identified. The mammal bone assemblage is comprised predominantly of the major domestic taxa, along with wild artiodactyls. Among the rarer wild species, only horse is represented by four bones. In addition to the mammal bones, one bird bone was noted.

The proportions of the major economic taxa, illustrated graphically in Figure 1315, approximate most closely those of Pikutkowo, which among the sites in this study is perhaps the closest neighbor. Key points of comparison, besides the basic proportions of cattle, sheep/goat, and pig, include the relatively low representation of roe deer. A slightly anomalous feature of the Smólsk assemblage is that sheep outnumber goat among the ovicaprid bones that can be differentiated.

Table CXCVII. Mammal bones from Smólsk 4, identified by Daniel Makowiecki, 2003.
Tabela CXCVII. Kości ssaków ze Smólska, stanowisko 4, określone przez D. Makowieckiego, 2003.

Smólsk											
Element	Cattle	Pig	Sheep/ Goat	Sheep	Goat	Horse	Wild Pig	Red Deer	Roe Deer	Wild Cattle	Wild or Dom. Pig	Totals
Horn Core	0	0	0	1	0	0	0	0	0	0	0	1
Antler	0	0	0	0	0	0	0	1	0	0	0	1
Skull	4	2	0	0	0	0	0	0	0	0	0	6
Mandible	4	0	3	0	0	0	0	1	0	0	0	8
Teeth	0	0	2	0	0	1	0	0	0	0	0	3
Upper Teeth	1	0	3	0	0	0	0	0	0	0	0	4
Lower Teeth	1	0	0	0	0	0	0	0	0	0	0	1
Scapula	4	2	0	0	0	0	0	0	0	0	0	6
Humerus	3	3	4	0	0	0	0	0	0	0	1	11
Radius	1	0	2	0	1	0	0	0	0	0	0	4
Ulna	1	0	0	0	0	0	0	0	0	0	0	1
Matacarpal	2	1	0	0	0	0	0	1	1	0	0	5

Smólsk											
Element	**Cattle**	**Pig**	**Sheep/ Goat**	**Sheep**	**Goat**	**Horse**	**Wild Pig**	**Red Deer**	**Roe Deer**	**Wild Cattle**	**Wild or Dom. Pig**	**Totals**
Pelvis	4	1	1	0	0	0	0	0	0	0	0	6
Femur	3	1	2	0	0	0	0	0	0	0	0	6
Tibia	13	1	5	3	1	1	0	0	0	0	0	24
Calcaneus	0	0	0	0	0	1	1	1	0	1	0	4
Astragalus	3	0	0	0	0	0	0	0	0	0	0	3
Centrotarsal	1	0	0	0	0	0	0	0	0	0	0	1
Metatarsal	5	0	0	1	0	0	0	1	0	0	0	7
Phalanxl	0	0	1	0	0	0	0	0	0	0	0	1
Phalanx I Anterior	1	0	0	0	0	0	0	0	0	0	0	1
Phalanx I Posterior	5	0	0	0	0	0	0	0	0	0	0	5
Phalanx II Anterior	1	0	0	0	0	0	0	0	0	0	0	1
Phalanx III	1	0	0	0	0	0	0	0	0	0	0	1
Total	58	11	23	5	2	3	1	5	1	1	1	111
% w/o riibs, vertebrae	**52.25%**	**9.91%**	**20.72%**	**4.50%**	**1.80%**	**2.70%**	**0.90%**	**4.50%**	**0.90%**	**0.90%**	**0.90%**	**100.00%**
Cervical Vertebrae	2	0	0	0	0	0	0	0	0	0	0	2
Thoracic Vertebrae	2	0	0	0	0	0	0	0	0	0	0	2
Lumbar Vertebrae	1	0	0	0	0	0	0	0	0	0	0	1
Ribs	6	0	2	0	0	1	0	0	0	0	0	9
Total of ribs + vertebrae	11	0	2	0	0	1	0	0	0	0	0	14
Grand Total	**69**	**11**	**25**	**5**	**2**	**4**	**1**	**5**	**1**	**1**	**1**	**125**
% Grand Total	55.20%	8.80%	20.00%	4.00%	1.60%	3.20%	0.80%	4.00%	0.80%	0.80%	0.80%	100.00%

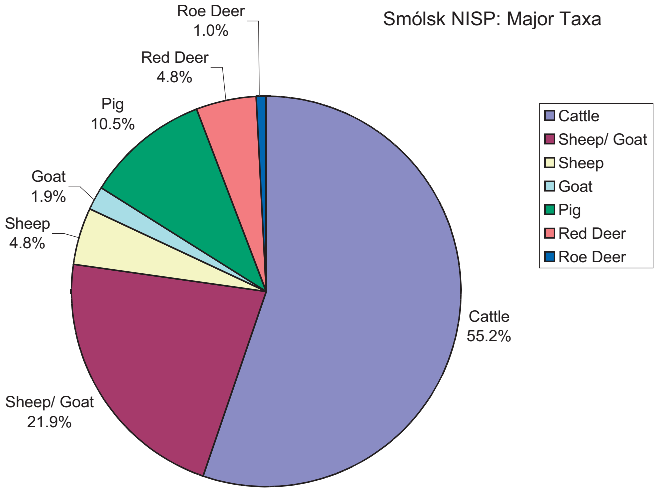


Fig. 1315. Proportions of NISP of major economic taxa at Smólsk.

Ryc. 1315. Proporcje GLS głównych gatunków zwierząt gospodarczych ze Smólska.

6.4.10
ZAGAJEWICE

A small faunal assemblage from Zagajewice was analyzed by Daniel Makowiecki in 2002. The animal bones came from four large clay pits and two smaller pits, mostly from one of each type of feature, and 82% could be identified to genus or species. In addition to the mammal bones, two bird, two fish, and two pond tortoise bones were noted. The distribution of the Zagajewice bones by species and element is given in Table CXCVIII.

As the smallest assemblage under consideration in this study, the Zagajewice animal bones do not contribute substantially to the discussion other than to support a general regional pattern, conforming especially to the Konary–Miechowice distribution of NISP for the principal economic taxa (Figure 1316). The distribution of anatomical elements is probably an artifact of the small sample size, although it is noteworthy that there are very few scapulae, radii, and pelves which are normally abundant meat–bearing bones.

Table CXCVIII. Mammal bones from Zagajewice 1, identified by Daniel Makowiecki, 2003.
Tabela CXCVIII. Kości ssaków z Zagajewic, stanowisko 1, określone przez D. Makowieckiego, 2003.

Zagajewice 1												
Element	**Cattle**	**Pig**	**Sheep/ Goat**	**Sheep**	**Goat**	**Dog**	**Horse**	**Wild Pig**	**Red Deer**	**Roe Deer**	**Wild Cattle**	**Totals**
Skull + Horncore	1	0	0	0	0	0	0	0	0	0	0	**1**
Antler	0	0	0	0	0	0	0	0	1	0	0	**1**
Skull+Antler	0	0	0	0	0	0	0	0	0	1	0	**1**
Skull	6	1	1	0	0	0	0	0	0	0	0	**8**
Mandible	12	3	1	0	0	2	0	0	0	0	0	**18**
Upper Tooth	1	0	0	0	0	0	0	0	0	0	0	**1**
Lower Tooth	1	0	1	0	0	0	0	0	0	0	0	**2**
Hyoid	3	0	0	0	0	0	0	0	0	0	0	**3**
Atlas	0	0	0	0	0	0	0	0	0	0	1	**1**
Axis	0	0	1	0	0	0	0	0	0	0	0	**1**
Scapula	1	0	0	0	0	0	0	0	0	0	0	**1**
Humerus	3	2	2	1	0	0	1	0	0	1	0	**10**
Radius	0	1	0	0	1	0	0	0	0	0	0	**2**
Ulna	2	0	0	0	0	0	0	0	0	0	0	**2**
Metacarpal	3	0	2	0	0	0	0	0	0	0	0	**5**
Pelvis	1	0	1	0	0	0	0	0	0	0	0	**2**
Femur	2	3	1	0	0	0	0	0	2	0	0	**8**
Tibia	2	5	6	1	0	0	0	1	1	0	0	**16**
Fibula	0	2	0	0	0	0	0	0	0	0	0	**2**
Astragalus	1	0	0	0	0	0	0	0	0	0	0	**1**
Centrotarsal	1	0	0	0	0	0	0	0	0	0	0	**1**
Metatarsal	3	0	0	0	0	0	0	0	0	0	0	**3**
Phalanx I	1	0	0	0	0	0	0	0	0	0	0	**1**
Total	**44**	**17**	16	2	1	2	1	1	4	2	1	91
% w/o ribs, vertebrae	**48.35%**	**18.68%**	**17.58%**	**2.20%**	**1.10%**	**2.20%**	**1.10%**	**1.10%**	**4.40%**	**2.20%**	**1.10%**	**100.00%**
Cervical Vertebrae	1	0	0	0	0	0	0	0	0	0	0	**1**
Thoracic Vertebrae	5	0	1	0	0	0	0	0	0	0	0	**6**
Lumbar Vertebrae	2	0	0	0	0	0	0	0	0	0	0	**2**
Ribs	16	2	4	0	0	0	0	0	0	0	0	**22**
Total of ribs + vertebrae	24	2	5	0	0	0	0	0	0	0	0	**31**
Grand Total	**68**	**19**	**21**	**2**	**1**	**2**	**1**	**1**	**4**	**2**	**1**	**122**
% grand total	55.74%	15.57%	17.21%	1.64%	0.82%	1.64%	0.82%	0.82%	3.28%	1.64%	0.82%	100.00%

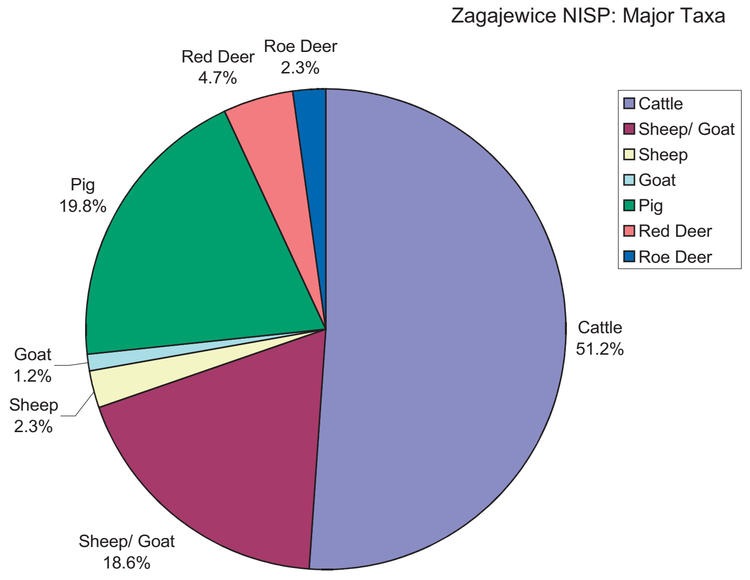


Fig. 1316. Proportions of NISP of major economic taxa at Zagajewice.

Ryc. 1316. Proporcje GLS głównych gatunków zwierząt gospodarczych z Zagajewic.

6.4.11
SUMMARY OF SPECIES QUANTIFICATION

The following section summarizes the general proportion of domestic livestock to wild mammals, the proportions of the principal domestic taxa, and the representation of wild mammals, reptiles, fish, and birds in the Lengyel faunal samples from southeastern Kuyavia.

Domestic versus Wild Mammals

The quantification of the Lengyel animal bones from southeastern Kuyavia shows the overwhelming abundance of domestic animals in the faunal samples, although the range of wild species present does represent an increase over those identified at earlier Linear Pottery sites. In the largest sample, at Osłonki, 94.5% of the mammal bones identified as being from domestic animals, although the metrical analysis of the pig bones could reduce that percentage by a few points. At Brześć Kujawski, there was the largest proportion of wild mammals (37.34%). While there does seem to have been a greater number of red deer and roe deer in the Brześć Kujawski assemblage, it should also be noted that the number of wild specimens is inflated by the large number of beaver bones from Pit 820 which in themselves constitute 12.61% of the Lengyel faunal assemblage. In all other samples, the overall number of wild animals was also very low.

When the samples are reduced to the principal economic mammals – cattle, sheep, goats, pigs, red deer, and roe deer – it is also clear that the bones of livestock are overwhelmingly numerous. Red deer and roe deer constitute more than 5% of the NISP only at Brześć Kujawski and at Falborz, and even in the Brześć Kujawski DZ analysis, their proportion is diminished.

Principal Domestic Taxa

The major domestic taxa – cattle, sheep, goat, and pig – were the major components of all ten samples studied for this analysis. In order to compare them, a ternary plot was constructed from the NISP of the principal domestic taxa of the ten samples, as presented in Figure 1317.

The ternary plot of the ten Lengyel faunal samples from southeastern Kuyavia shows a remarkable consistency among the assemblages but also an interesting anomaly. In general, cattle comprise between 30 and 60% of any given sample, sheep and goat between 20 and 40%, and pig between 10 and 30%. Large areas of the graph, particularly the corners which would reflect a preponderance of any one species, are vacant. This can be compared with the ternary plot of Linear Pottery faunal assemblages from this area in Figure 1289 above, where the overwhelming number of cattle bones leads the points to cluster in the lower left corner.

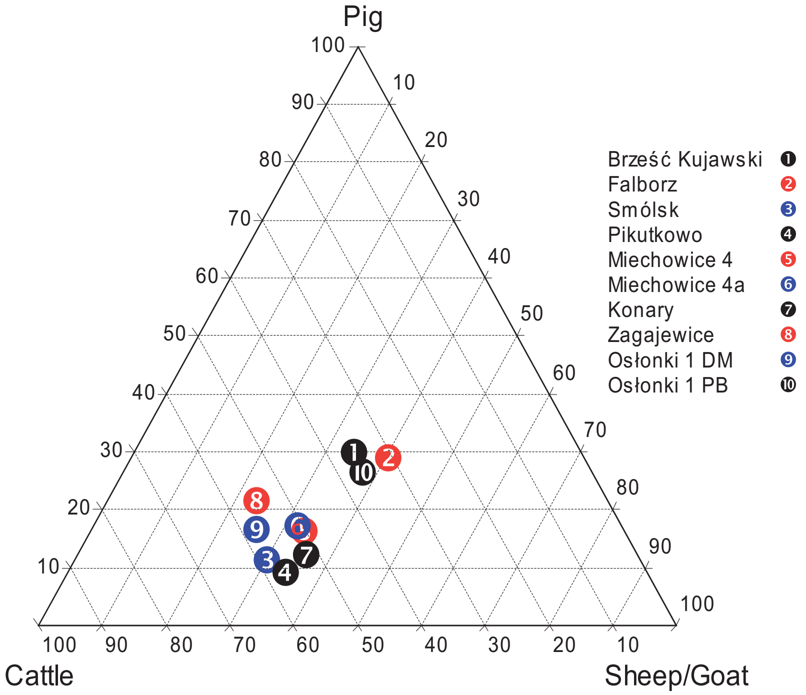


Fig. 1317. Ternary plot of the ten Lengyel faunal samples from southeastern Kuyavia.

Ryc. 1317. Wykres trójwartościowy dziesięciu próbek szczątków zwierzęcych kultury lendzielskiej z południowo–wschodniej części Kujaw.

This graph depicts the varied nature of the regional animal economy during the fifth millennium B.C., which will be discussed further below. It also shows what might be some form of analytical bias between the two principal archaeozoologists involved in the study of these samples, Peter Bogucki and Daniel Makowiecki. The samples that were analyzed by Bogucki – Brześć Kujawski, Falborz, and the majority of the Osłonki assemblage – all cluster with between 20 and 30% pig and between 30 and 40% cattle, while the remaining assemblages that were identified and quantified by Makowiecki all show higher percentages of cattle and lower percentages of pig, with sheep/goat constant between 20 and 40%. Diagnosis of the reason for this difference has not been possible within the time allowed for the completion of this report, and in the larger picture it does not change the overall regional picture of diversified livestock holdings. It is, however, important to keep in mind and to remember not to draw dramatic conclusions based on minor variations in numbers and proportions of NISP.

The discovery of dog bones at six of the sites indicates that dog was present but not commonly consumed. The presence of dog, however, is important for its role in bone attrition, as mentioned above. We can assume that only a fraction of the potential bone population at these sites survived to join the archaeological record.

The wild taxa

The bones of wild taxa at the Lengyel sites of southeastern Kuyavia can be divided into several major categories: wild ungulates, other forest and riverine mammal species, turtles, fish, and birds. Individually, none of these taxa makes up more than a small percentage of any given sample, but collectively they represent a signficant range of resources.

Wild Ungulates

Among the wild ungulates, red deer and roe deer are the most common taxa. Metrical analysis below will show that aurochs is not represented in any significant amount among the cattle bones, while wild pig formed a small, but significant, portion of the pig sample. Somewhat more abundant are red deer and roe deer. Red deer and roe deer were most numerous in the sample from Brześć Kujawski, where together they constituted 28% of the major taxa and 16% of the whole assemblage. We now can see that the Brześć Kujawski assemblage is somewhat anomalous in the regional picture and that deer constitute a minor component of the other assemblages.

Of some note is the presence of wild horse at almost every site, albeit represented by only a small number of specimens at each one (Figures 1318 and 1319). Clearly there were sufficient wild horses in the forests of southeastern Kuyavia to produce such isolated specimens, but they were not hunted in any great quantity to provide a concentration of their bones at any one site.

Fig. 1318. Third phalanx of wild horse from Osłonki, Clay Pit 9.

Ryc. 1318. Trzeci człon palcowy dzikiego konia z Osłonek, glinianka 9.

Fig. 1319. Astragalus and calcaneus of wild horse from Osłonki, Pit 105.

Ryc. 1319. Kość skokowa i kość piętowa dzikiego konia z Osłonek, jama 105.

Other Forest and Aquatic mammals

As noted above, the bones of beaver at Brześć Kujawski come in large measure from the concentration of five almost–complete beavers in Pit 820. Aside from these, the representation of beavers is relatively low, although they occur at five of the sites. This is presumably due to the fact that with the exception of the episode represented by Pit 820 at Brześć Kujawski, most skinning of beaver for their pelts took place away from the settlements.

European brown bear was identified at Brzść Kujawski and Osłonki, in very small numbers. Most of the bear bones at Osłonki came from a single individual, especially its right hind paw. The other specimens are so scarce as to confirm that the killing of a bear must have been a memorable event in the lives of Neolithic people.

River otter was found only at Brzesc Kujawski, and these isolated specimens, from two different phases, serve only to confirm its presence in the local ecosystem. Similarly, hare, wild cat, and weasel are only present as isolated specimens at a single site.

Turtles

Fragments of the carapace and plastron of the European pond tortoise are found at almost all of the sites, but their greatest abundance was at Brześć Kujawski and Osłonki, where in addition to isolated fragments, whole or partial carapaces and plastrons were either found in situ or could be reconstructed. Bogucki (1981: fig. 31; also see Grygiel 1986) showed the dramatic increase by weight of pond tortoise fragments in the final Lengyel phase at Brześć Kujawski. The Osłonki faunal sample has not been subdivided by phase in this study, so it is not possible to show whether a similar increase occurred over time. Nonetheless, the Lengyel sites of southeastern Kuyavia collectively have perhaps the largest local representation of this species of any group of Neolithic sites in central Europe.

Fish

The analysis of the fish assemblages from Brześć Kujawski and Osłonki by Makowiecki shows the predominance of Cyprinidae, identified both at the family and the species level. At Brześć Kujawski, 85.3% of the fish were cyprinids, while at Osłonki, 81.7% belonged to this family. Of the non–cyprinid species, northern pike were the most abundant at both sites. Although perch constituted 4.5% of the Brześć Kujawski NISP, they were not numerous at Osłonki.

Birds

The bird bone assemblage from Brześć Kujawski studied by Bogucki remains the only analyzed collection from southeastern Kuyavia over 25 years after it was studied, although the collection of 276 specimens from Osłonki will someday complement it. The majority of the 168 Lengyel bird NISP at Brześć Kujawski come from waterfowl, while the contribution of non–aquatic birds is relatively small. The presence of bird remains at most of the other sites is noted but their quantities do not contribute significantly to our understanding of bird exploitation at these sites, although eventually they may extend the range of species exploited.

6.5
Age–at–Death Profiles by Site and Species

The mortality structure of the prehistoric animal population represented by a sample of animal bones is of interest for the way in which it reflects the management of the animal population by its human keepers. While this line of investigation has limitations, it provides a way in which sites can be compared. The two principal methods of ageing bones involve the assessment of epiphyseal fusion, for which the timing and sequence vary by species but which are generally established, and mandibular tooth eruption and wear, which occurs in a known sequence but which varies depending on diet and habitat. Epiphyseal fusion was recorded at Brześć Kujawski and Osłonki for each limb bone (including the scapula and pelvis) as unfused, fusing (epiphyseal line), and fused. Tooth eruption and wear were recorded using the stages defined by Grant (1975, 1982).

6.5.1
EPIPHYSEAL FUSION PROFILES

One of the principal methods used in the study of the structure of an animal population represented by a faunal sample is through the analysis of patterns of epiphyseal fusion. The first application of this method to a Neolithic faunal sample in the Polish lowlands was in Bogucki's analysis of the epiphyseal fusion of the Brześć Kujawski sample (Bogucki 1981). In this work, Bogucki followed the approach of Wilson (1978) who grouped the bones in their order of fusion and then calculated the percentage fused for each group that fused at approximately the same time. The percentages are then graphed against time, deriving a linear plot that provides a proxy measure for the proportion of individuals who survive past certain milestones. The measure is useful only until all the bones of any taxon are fused, whereupon it is necessary to rely on other age indicators for older individuals.

The Brześć Kujawski sample of Lengyel fauna produced linear plots that indicated that most cattle were allowed to reach their 36th month, but a number were then killed off such that fewer than half survived their 48th month. Many of the Lengyel sheep and goat were slaughtered fairly young, some before their 12th month and about half by 36 months. The Lengyel pig pattern is typical of an animal whose only use is for meat and hide. In Bogucki's 1981 analysis, 30% of the pigs did not reach their 12th month, and only 16% (probably a breeding population or old feral and wild individuals) survived their 42nd month.

For this report, the Brześć Kujawski data were tabulated, and the fusion ages were reordered slightly, based on the model of Crabtree (1989) and an example given by O'Connor (2000). This takes into account the small differences in fusion order among the principal domestic ungulates. The reordered version is given in Table CXCIX below: The plot of these revised data, shown as Figure 1320, indicates that the kill–off of cattle begins slightly earlier, around 30 months and that the initial kill–off of sheep and goats is somewhat more dramatic than indicated by the earlier analysis. The new linear plot for pig is identical to the 1981 version.

Table CXCIX. Epiphyseal fusion data for Lengyel cattle, sheep/goat, and pig from Brześć Kujawski.
Tabela CXCIX. Dane dotyczące zrośnięcia nasady kości z trzonem dla bydła, owcy/kozy i świni kultury lendzielskiej z Brześcia Kujawskiego.

Cattle				Sheep/Goat				Pig			
	fused	fusing	unfusd		fused	fusing	unfusd		fused	fusing	unfusd
scapula	3		0	scapula	4		0	scapula	4		0
pelvis	2		0	pelvis	2		1	pelvis	1		2
d. humerus	3		0	d. humerus	5		0	d. humerus	0	1	2
p. radius	0	0	0	p. radius	7		0	p. radius	2		1
phalanx I	7		0	phalanx I	6		0	phalanx II	4		0
phalanx II	6		0	phalanx II	1	2	0	phalanx I	1		2
d. metacarpal	1		1	d. metacarpal	2		0	d. metacarpal	0	1	2
d. tibia	3		0	d. tibia	3		2	d. tibia	3	1	1
d. metatarsal	6		0	d. metatarsal	1		2	d. metatarsal	2	1	1
calcaneus	1		3	ulna (olecranon)	2		3	calcaneus	1		4
p. femur	3		0	calcaneus	4		2	d. fibula	0	0	0
d. radius	0		1	p. femur	3		3	ulna (olecranon)	1		3
p. humerus	0		1	d. radius	2	1	2	d. ulna	0	0	0
ulna (olecranon)	2		0	p. humerus	1		0	p. femur	0	0	0
d. femur	1		0	d. femur	2		3	d. radius	0		1
p. tibia	3		2	p. tibia	2		4	p. humerus	0		1
								d. femur	0		0
								p. tibia	0		0

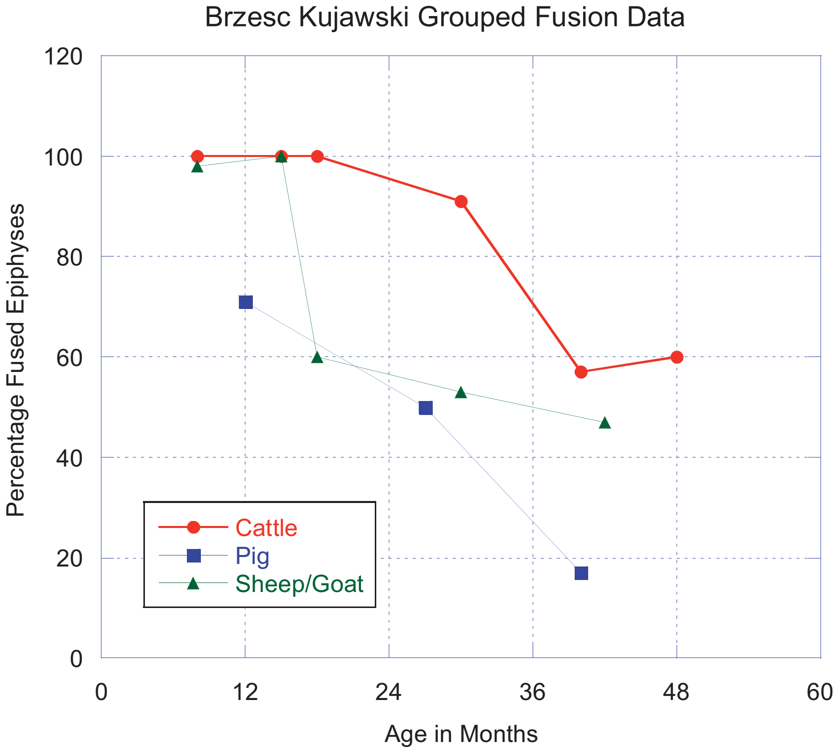


Fig. 1320. Brześć Kujawski mortality profiles based on grouped fusion data.

Ryc. 1320. Profile śmiertelności zwierząt z Brześcia Kujawskiego, w oparciu o zebrane dane zrośnięcia nasady kości z trzonem.

The fusion data from Osłonki were analyzed in the same fashion and are presented in Table CC. Because Osłonki has a larger sample of articular ends for which fusion could be recorded, it was possible to place a higher level of confidence in the measures that are derived from these data. The percentages of fused epiphyses for each of the principal domestic taxa are presented as histograms in Figures 1321–1323.

Grouped fusion data was used to construct the linear plots of percentage of fused specimens against the time for each of the principal domestic taxa, as shown in Figure 1324. The results are roughly similar to those obtained from the Brześć Kujawski sample. There is a slightly higher degree of culling of juvenile cattle at Osłonki, and despite a slightly more gradual kill–off of sheep and goat, the line ends in exactly the same place as at Brześć Kujawski. Pig shows the same steep decline, and the number of animals who survive beyond 36 months is virtrually identical to Brześć Kujawski at 17%.

Table CC. Epiphyseal fusion data for Lengyel cattle, sheep/goat, and pig from Osłonki.
Tabela CC. Dane dotyczące zrośnięcia nasady kości z trzonem dla bydła, owcy/kozy i świni kultury lendzielskiej z Osłonek.

Cattle				Sheep/Goat				Pig			
	fused	fusing	unfusd		fused	fusing	unfusd		fused	fusing	unfusd
scapula	36	1	0	**scapula**	53	1	1	**scapula**	53	1	7
pelvis	14	0	0	**pelvis**	8	0	0	**pelvis**	9	0	2
d. humerus	47	0	3	**d. humerus**	73	2	1	**d. humerus**	27	4	2
p. radius	45	1	3	**p. radius**	92	0	0	**p. radius**	29	1	7
phalanx I	108	2	8	**phalanx I**	49	1	13	**phalanx II**	11	2	5
phalanx II	90	1	3	phalanx II	22	1	3	**phalanx I**	20	2	25
d. metacarpal	37	0	3	**d. metacarpal**	43	2	21	**d. metacarpal**	9	2	36
d. tibia	37	5	7	**d. tibia**	48	9	24	**d. tibia**	26	4	22
d. metatarsal	37	1	8	**d. metatarsal**	11	0	6	**d. metatarsal**	5	3	30

Cattle				Sheep/Goat				Pig			
	fused	fusing	unfusd		fused	fusing	unfusd		fused	fusing	unfusd
calcaneus	24	1	11	**ulna (olecranon)**	6	1	11	**calcaneus**	6	2	30
p. femur	18	9	14	**calcaneus**	20	0	11	**d. fibula**	2	0	10
d. radius	15	3	7	**p. femur**	17	2	22	**ulna (olecranon)**	4	0	18
p. humerus	8	4	7	**d. radius**	23	0	32	**d. ulna**	0	0	12
ulna (olecranon)	8	2	3	**p. humerus**	8	8	10	**p. femur**	2	2	6
d. femur	16	4	7	**d. femur**	17	7	24	**d. radius**	2	0	29
p. tibia	17	1	12	**p. tibia**	10	6	22	**p. humerus**	3	2	4
								d. femur	2	3	8
								p. tibia	0	0	13

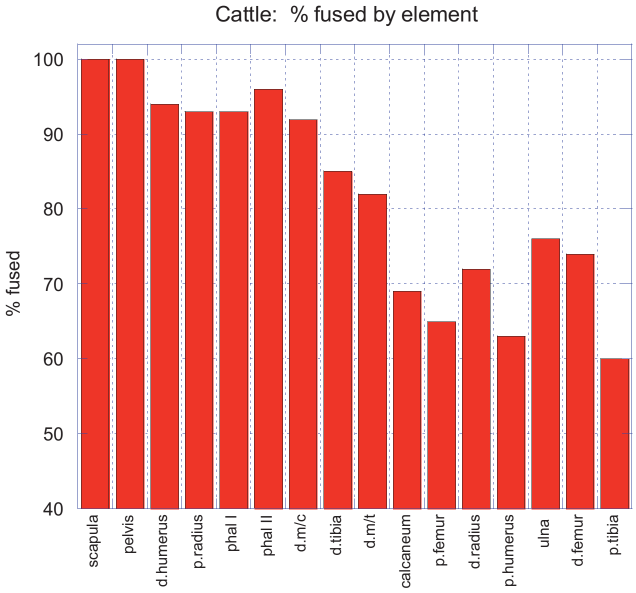


Fig. 1321. Percentages of cattle bones with fused epiphyses arranged in general sequence of fusion.

Ryc. 1321. Udział procentowy kości bydła o zrośniętej nasadzie, w porządku kolejności zrastania nasady kości z trzonem.

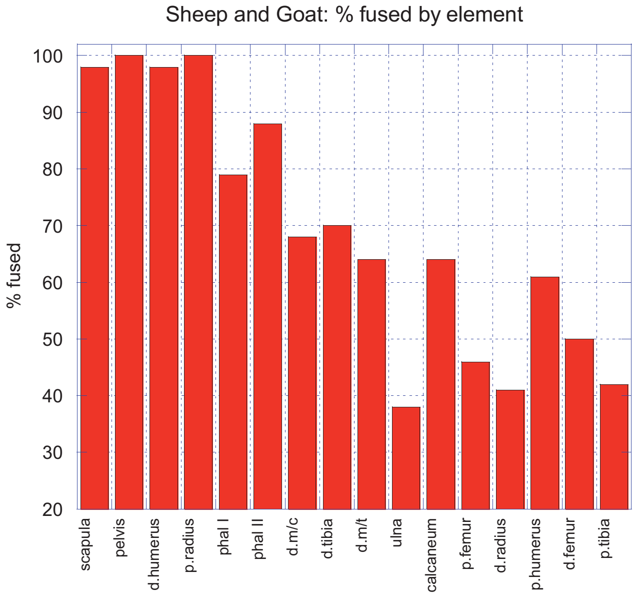


Fig. 1322. Percentages of sheep/goat bones with fused epiphyses arranged in general sequence of fusion.

Ryc. 1322. Udział procentowy kości owcy/kozy o zrośniętej nasadzie, w porządku kolejności zrastania nasady kości z trzonem.

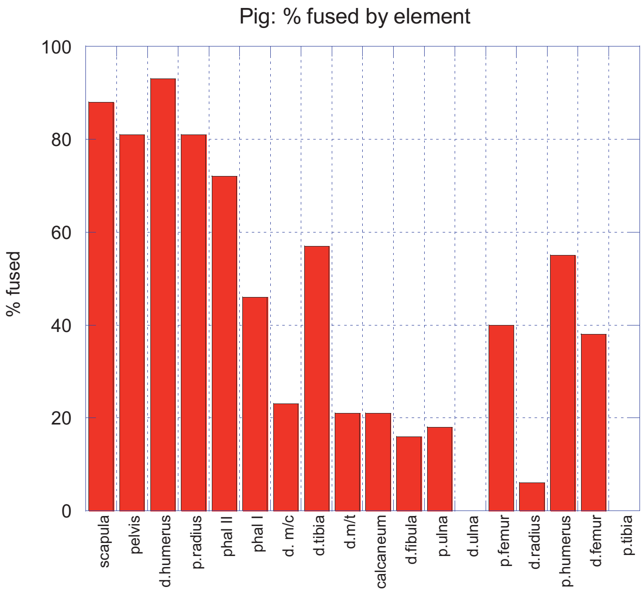


Fig. 1323. Percentages of pig bones with fused epiphyses arranged in general sequence of fusion.

Ryc. 1323. Udział procentowy kości świni o zrośniętej nasadzie, w porządku kolejności zrastania nasady kości z trzonem.

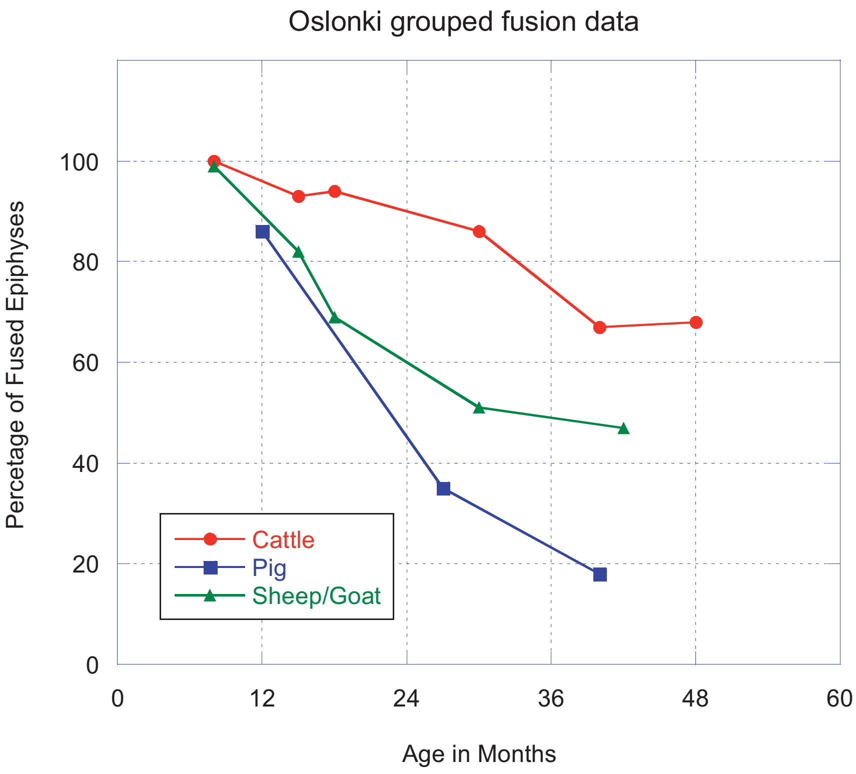


Fig. 1324. Osłonki mortality profiles based on grouped fusion data.

Ryc. 1324. Profile śmiertelności zwierząt z Osłonek, w oparciu o zebrane dane zrośnięcia nasady kości z trzonem.

Although it is tempting to correlate linear plots of percentages of fused epiphyses with various specialized economic strategies such as meat or dairy production, it would be naïve to assume that Neolithic people had such a specialized animal economy that they would have

Fig. 1325. Osłonki, Site 1. Strongly–fused sheep/goat radius and ulna from Clay Pit 2.

Ryc. 1325. Osłonki, st. 1. Mocno zrośnięta kość promieniowa i łokciowa owcy/kozy z glinianki 2.

used animals such as cattle, sheep, and goat that provide multiple products for only one of them. The interpretation of the age profile of the pig sample is clear and straightforward: pigs reach their maximum meat weight quickly, and there is no point in keeping them any longer, even if they have not reached osteological adulthood. Finding that fewer than 20% survive beyond 36 months is consistent with a population of domestic pigs who are fattened on settlement refuse and what they can find in the nearby forests and slaughtered when there was a demand for their meat.

The cattle and sheep/goat profiles are a bit more difficult to interpret, but it seems clear that neither was being raised only for meat. Since over 60% of the cattle survive beyond the attainment of their maximum meat weight at about 42 months, and since over 40% of the sheep and goats survive their 42nd month as well, it seems that while some juveniles and subadults of these species were culled when young, there was clearly a purpose other than meat that contributed to the economic value of these species. In the case of cattle, milk is the most likely value, as may also be the case for sheep and goats.

The earliest evidence for wool is later, toward the end of the third millennium B.C., and it is related to the timing and selection for changes in the sheep hair that made it wooly, so it would be a remote possibility that eventually the origins of wool use might eventually be documented earlier. Another reason may lie in the household investment in these species that might have given them a value greater than simply their meat. These possibilities will be discussed in the final section of this report.

6.5.2
OSŁONKI MANDIBULAR TOOTH ERUPTION PROFILES

In the analysis of the Osłonki faunal sample, the eruption and wear of the mandibular teeth of cattle, sheep/goat, and pig were recorded using the method of Grant (1982) by assigning them to eruption and wear stages. These were then entered into the York faunal database system. The assessment of tooth wear stages is very difficult, however. Grant (1982: 95–6) converted tooth wear stages into numerical equivalents which could then be summed to produce an approximation of the age structure of the animal population represented by the assemblage of mandibles. The problem is that this only works effectively when whole mandibular tooth rows are available. Neolithic mandibles are generally fragmentary, however, with the entire tooth row rarely being available.

It thus posed a challenge to find a way to make sense of the comparatively rich sample of tooth wear data from Osłonki. A solution was to adapt the methods of Rolett and Chiu (1994) and O'Connor (2003) and to crosstabulate the wear stages of M1 and M2 when the two teeth occur together in the same mandible. The result is Tables CCI–CCIV which show these crosstabulations for cattle, sheep/goat, and pig and Figures 1326–1329 which depict the tabular data graphically.

Table CCI. Cattle M1/M2 eruption and wear crosstabulated
Tabela CCI. Zestawienie wyrzynania się i ścierania zębów M1/M2 u bydła.

cattle		M2 eruption and wear																			
		C	V	E	U	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p
M1 eruption and wear	V																				
	E																				
	U																				
	a																				
	b																				
	c									1											
	d																				
	e																				
	f									1											
	g										1				1						
	h																				
	i																				
	j												1								
	k											2			1	2					
	l															1					
	m																				
	n																				
	o																				
	p																				

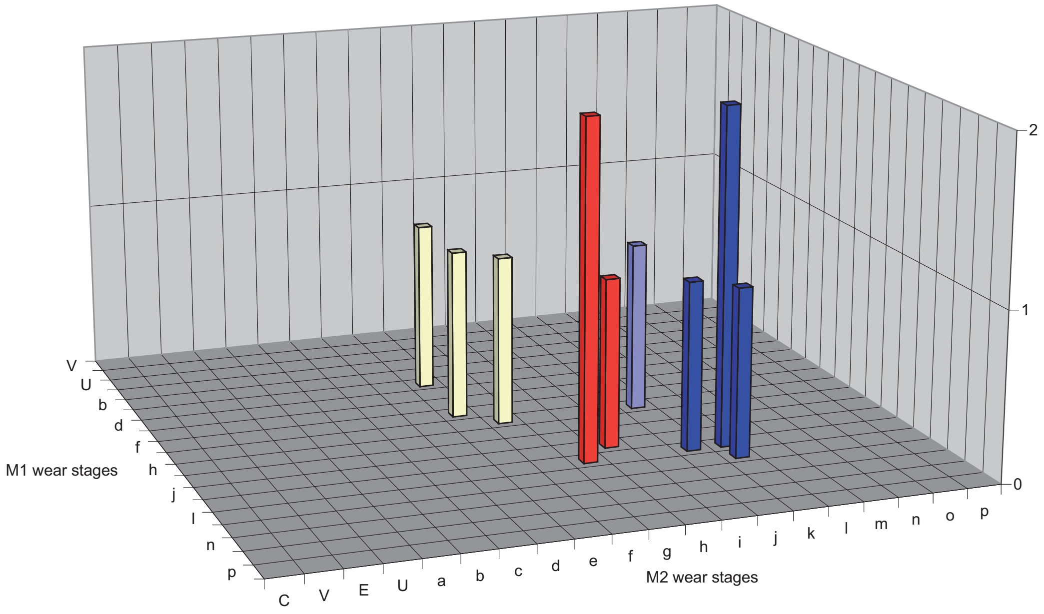


Fig. 1326. Graphical depiction of cattle M1/M2 eruption and wear crosstabulation.

Ryc. 1326. Graficzne ujęcie zestawienia wyrzynania się i ścierania zębów M1/M2 u bydła.

The tooth eruption data for cattle are relatively thin, perhaps owing to the greater frequency with which the cattle mandible is broken apart resulting in loose teeth and alveolar fragments. It is clear, however, that with several exceptions (yellow on Figure 1326), the cattle teeth are mostly in a fairly advanced state of wear, stage "j" and greater for M1 and stage "g" and greater for M2. When put together with the evidence from epiphysial fusion (Table CC and Fig. 1324), it appears that the tooth eruption data are picking up the slaughter of cattle beyond the 48–month point, but exactly how old these animals were is difficult to say. Two separate clusters of mature adults can be identified impressionistically, noted in red and dark blue on Fig. 1326, with an anomalous specimen shown in light blue.

A similar exercise was undertaken to cross-tabulate cattle M2 and M3 eruption and wear, again with relatively meager data due to the lack of surviving mandibles with both M2 and M3 intact. The results are presented in Table CCII and Figure 1327. It suggests that the principal slaughtering of mature cattle took place sometime just beyond the 48th month, and few if any animals were permitted to survive to very advanced stages of M3 wear.

Table CCII. Cattle M1/M2 eruption and wear crosstabulated.
Tabela CCII. Zestawienie wyrzynania się i ścierania zębów M1/M2 u bydła.

cattle		M3 eruption and wear																			
		C	V	E	U	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p
M2 eruption and wear	V																				
	E																				
	U																				
	a																				
	b																				
	c																				
	d																				
	e																				
	f			1																	
	g								1												
	h											1									
	i																				
	j											1	1								
	k											1									
	l																				
	m																				

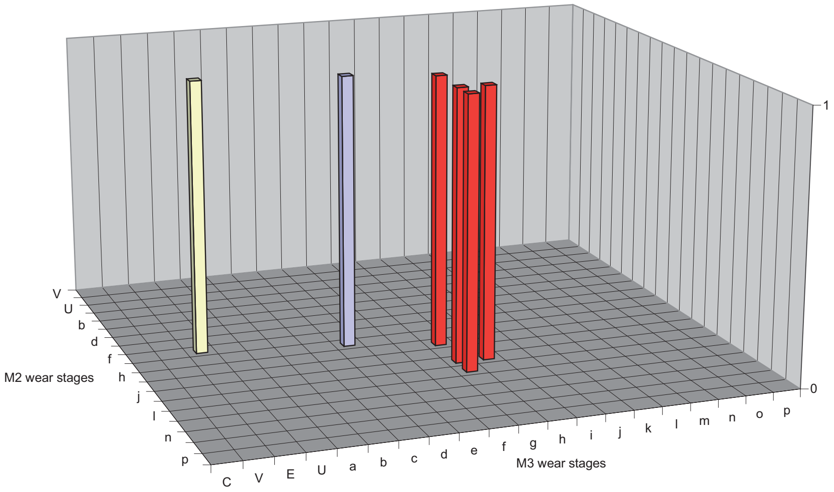


Fig. 1327. Graphical depiction of cattle M2/M3 eruption and wear crosstabulation.

Ryc. 1327. Graficzne ujęcie zestawienia wyrzynania się i ścierania zębów M2/M3 u bydła.

Table CCIII. Pig M1/M2 eruption and wear crosstabulated.
Tabela CCIII. Zestawienie wyrzynania się i ścierania zębów M1/M2 u świni.

pig		M 2 eruption and wear																			
		C	V	E	U	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p
M1 eruption and wear	V																				
	E			1																	
	U																				
	a	2																			
	b																				
	c	3																			
	d				1	2															
	e		1	1		3	3	1													
	f						3														
	g						1	1		3											
	h							1	1	3	1										
	i																				
	j										1										
	k								1	1	1	1									
	l										2										
	m												1		2						
	n											1	1								
	o																				
	p																				

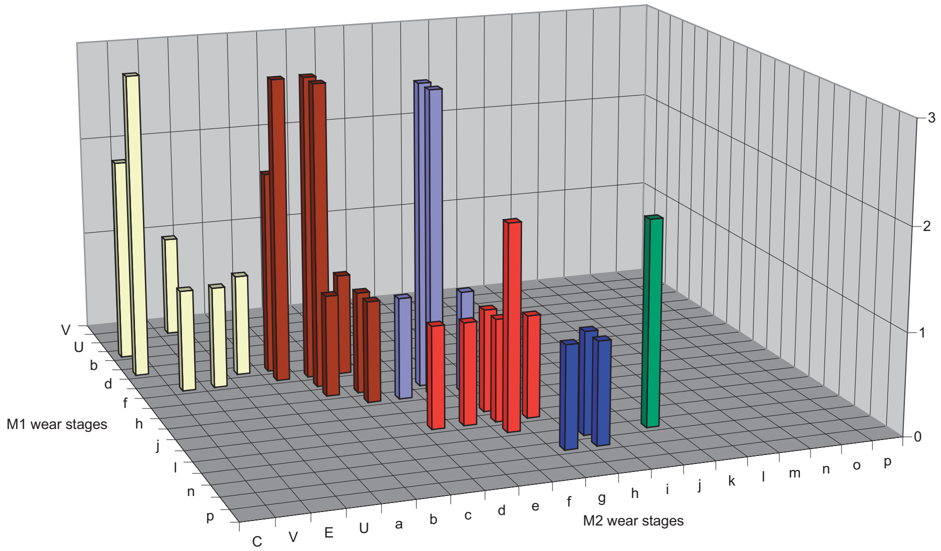


Fig. 1328. Graphical depiction of pig M1/M2 eruption and wear crosstabulation.

Ryc. 1328. Graficzne ujęcie zestawienia wyrzynania się i ścierania zębów M1/M2 u świni.

The pig data (Table CCIII and Fig. 1328) are fairly continuous, suggesting that there was relatively little seasonal slaughter. Since the epiphyseal fusion data show that only a small number of pigs survived beyond about their 38th month, the tooth eruption and wear data generally track this same steep mortality profile. The colors in Figure 1328 represent an attempt to perceive some groupings visually, but these are generally impressionistic. Yellow bars are piglets younger than 1 year of age, while the dark red bars are probably between 12 and 24 months. We might conclude that the mandibles with M1 in stage "m" and greater and M2 in stage "g" and greater (dark blue and green in Fig. 1328) belong to the elderly pigs who were killed beyond their 38th month, although how far beyond is difficult to say.

Table CCIV. Sheep/goat M1/M2 eruption and wear crosstabulated.
Tabela CCIV. Zestawienie wyrzynania się i ścierania zębów M1/M2 u owcy/kozy.

sheep–goat		M2 eruption and wear																			
		C	V	E	U	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p
M1 eruption and wear	V																				
	E																				
	U																				
	a																				
	b			1																	
	c	1																			
	d		1	1																	
	e		1	1																	
	f			3						2											
	g			1				1	2	2	10	1									
	h									1	3	1	1		1						
	i																				
	j												2								
	k												3								
	l											3	2								
	m												5		3	1					
	n																				
	o																				
	p																				

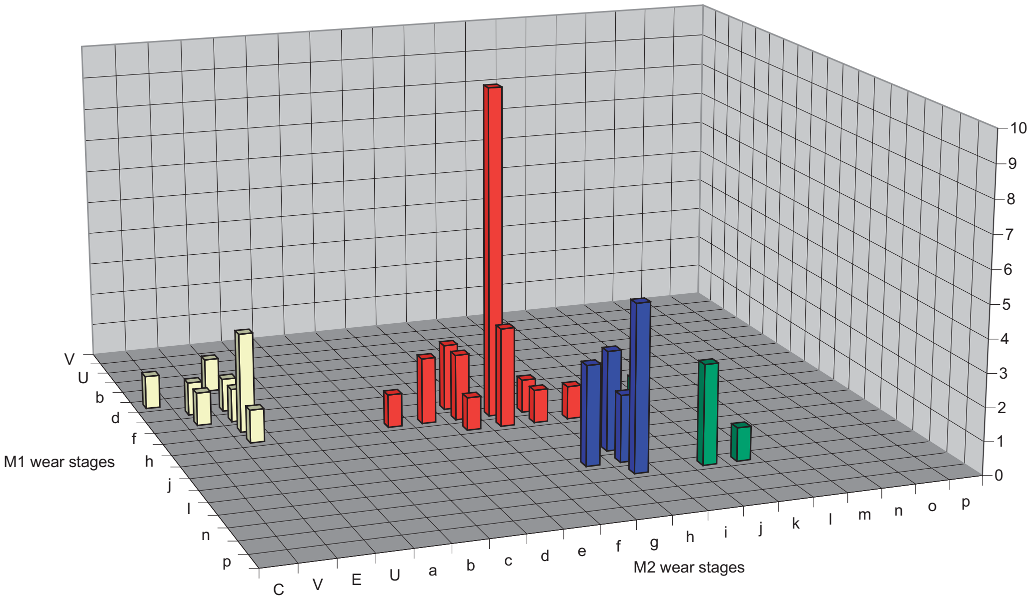


Fig. 1329. Graphical depiction of sheep/goat M1/M2 eruption and wear crosstabulation.

Ryc. 1329. Graficzne ujęcie zestawienia wyrzynania się i ścierania zębów M1/M2 u owcy/kozy.

The eruption and wear data for sheep/goat are the most rich, complex, and interesting, although it must be noted that sheep and goat were probably subject to different management practices, so combining them introduces some degree of uncertainty. As can be seen in Figure 1329, and sheep/goat crosstabulations of M1 and M2 eruption and wear form distinct clusters that can be easily differentiated visually. Those with M2 not fully erupted, shown in Figure 1329 in yellow, represent lambs under 6–10 months. The next group, shown in red on Figure

1329, are probably between 18 and 48 months and represent the slaughter inferred from the epiphyseal fusion data shown in Figure 1324 above.

The remaining two groups of mature and elderly sheep/goat, shown on Figure 1329 in dark blue and green, lie beyond the range of the epiphyseal fusion data. It is possible to estimate their ages by reference to the data provided by Moran and O'Connor (1994) on tooth eruption and wear of a modern sheep population, with the caveat that modern rates of tooth wear may be very different from prehistoric rates. Nonetheless, the group shown with dark blue bars, with M1 stages between "k" and "m" and M2 stages of "g" or "h" are 5–6 years of age, while those shown in green bars with an M1 stage of "m" and M2 stages of "j" or "k" are older than 6 years.

6.5.3

MANDIBULAR TOOTH ERUPTION AND WEAR FROM OTHER SITES IN THE BRZEŚĆ KUJAWSKI – OSŁONKI REGION

Makowiecki pooled data from mandibular tooth eruption from Konary, Miechowice 4, Miechowice 4a, Pikutkowo, Smólsk, Zagajewice, and the sample from Osłonki that he analyzed and grouped them into age groups, which are shown in Tables CCV–CCVII and depicted graphically in Figures 1330–1332. The graphs were developed by Bogucki on the basis of the tabular data and omit the equivocal subadult/adult classification based on premolar and incisor eruption and wear that are included at the bottom of each table.

Table CCV. Age at death of cattle in the Brześć Kujawski–Osłonki region (on the basis of research of D. Makowiecki 2002, 2003, 2005).

Tabela CCV. Wiek w momencie śmierci osiągany przez bydło w rejonie Brześcia Kujawskiego i Osłonek (na podstawie badań D. Makowieckiego 2002, 2003, 2005).

	Age group	Eruption/wear stage	Age class	n
I.	juvenile	Deciduous teeth erupted	do 3 months	3
II.		M1 erupting	4–6 months	3
III.		M1 erupted	7–14 months	3
IV.	subadult	M2 erupting	15–18 months	7
V.		M2 erupted	19–24 months	7
VI.		M3 erupting	25–28 months	2
VII.		dp2/dp4 being exchanged for P2/P4	19–34 months	1
VIII.	adult	M3 light wear (+/+)	about 3.5 years	2
IX.		M3 light wear (+/++)	about 3.5 years	3
X.		M3 light wear (+/+++)	about 3.5 years	3
XI.		M3 erupted	> 3.5 years	3
XII.		M3 light–medium wear (++)	3.5–5 years	12
XIII.		M3 mediium wear (+++)	5–7 years	1
XIV.		M3 medium–heavy wear (++++)	7–10 years	0
XV.	Subadult/adult	P4 erupted, in wear	over 34 months	0
XVI.		I1 erupted, in wear	over 25 months	0
		Total cases		**50**

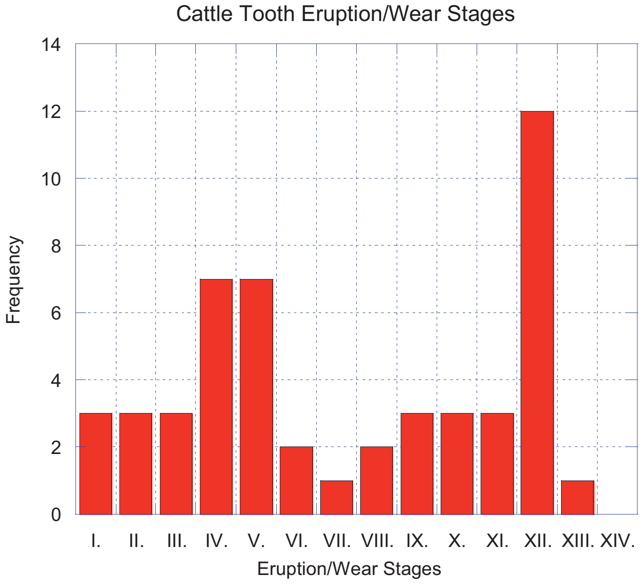


Fig. 1330. Cattle tooth eruption and wear stages as determined by Makowiecki for multiple sites in the Brześć Kujawski – Osłonki region. Stages as in Table CCV.
Ryc. 1330. Etapy wyrzynania się i ścierania zębów u bydła, wyróżnione przez D. Makowieckiego na licznych stanowiskach w rejonie Brześcia Kujawskiego i Osłonek. Etapy jak w tabeli CCV.

The pooled cattle data provide a valuable complement and extension to the data from the epiphyseal fusion and mandibular tooth eruption and wear data from Osłonki. They reflect a steady attrition of the cattle population between birth and about 42 months, with some greater intensity of slaughter between 15 and 24 months. There is then a peak in the slaughter between 42 and 60 months, with few animals surviving into their sixth year and beyond. This correlates especially well with the crosstabulation of M2 and M3 wear shown above in Figure 1330. Thus, we can infer that shortly after completion of the fusion sequence at about 48 months, the cattle population was intensively culled of mature animals.

The pooled eruption and wear stages for sheep and goat are strikingly parallel to the ones observed at Osłonki, with a significant group of younger animals in the sample, an intensive culling in the 36–48 month range, and then a handful of older individuals. These data complement and refine the analysis based on the M1/M2 crosstabulations in the Osłonki data, although they are subject to the same caution expressed above concerning the likelihood of different management strategies for sheep and goats. Nonetheless, it seems clear that sheep and goat had a well–defined life expectancy in Neolithic Kuyavia!

The pooled eruption and wear data for pigs from the various Kuyavian sites also tracks the pig eruption and wear data from Osłonki as well and shows the expected continuous attrition of the pig population, although not especially heavy in the first year. Of particular note is the peak in culling between 12 and 24 months, which matches closely with the data from the M1/M2 crosstabulations shown in Figure 1328 above. The pooled data do not contain, however, the few very old pigs who may have survived into their fourth year that were found in the Osłonki assemblage.

Table CCVI. Age at death of sheep and goat in the Brześć Kujawski–Osłonki region (on the basis of research of D. Makowiecki 2002, 2003, 2005).

Tabela CCVI. Wiek w momencie śmierci osiągany przez owcę i kozę w rejonie Brześcia Kujawskiego i Osłonek (na podstawie badań D. Makowieckiego 2002, 2003, 2005).

	Age group	Eruption/wear stage	Age class	n
I.	juvenile	M1 erupting	about 3 months	1
II.		M1 erupted	4–8 months	4
III.		M2 erupting	about 9 months	5
IV.	subadult	M2 erupted	10–17 months	11
V.		M3 erupting	18–24 months	3
VI.	adult	M3 erupted	over 2 years	1
VII.		M3 light wear (+/+)	2–3 years	2
VIII.		M3 light wear (+/++)	2–3 years	5
IX.		M3 light wear (+/+++)	2–3 years	1
X.		M3 light–medium wear (++)	3–4 years	16
XI.		M3 medium wear (+++)	4–5 years	4
XII.		M3 medium–heavy wear	5–7 years	1
XIII.	Adult/subadult	P4 erupted, in wear	over 18 months	1
Total cases				55

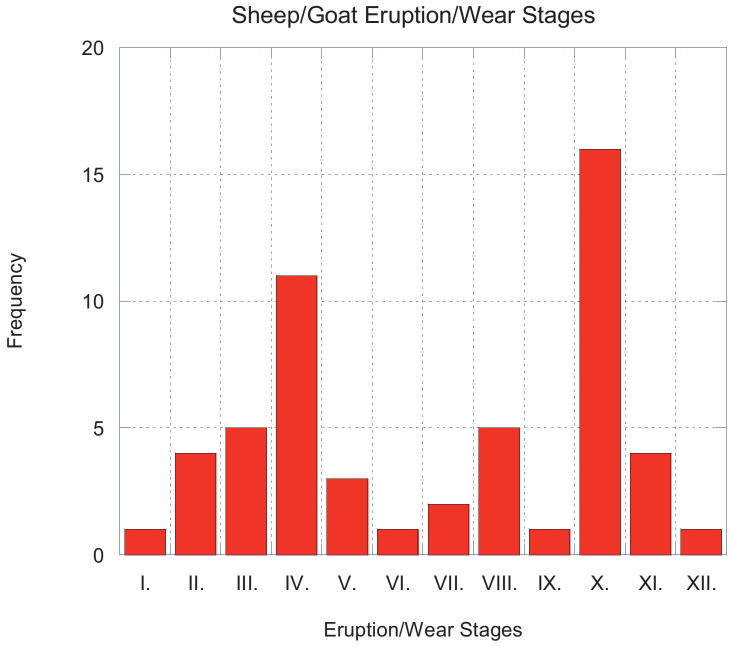


Fig. 1331. Sheep and goat tooth eruption and wear stages as determined by Makowiecki for multiple sites in the Brześć Kujawski – Osłonki region. Stages as in Table CCVI.

Ryc. 1331. Etapy wyrzynania się i ścierania zębów u owcy/kozy, wyróżnione przez D. Makowieckiego na licznych stanowiskach w rejonie Brześcia Kujawskiego i Osłonek. Etapy jak w tabeli CCVI.

Table CCVII. Age at death of pigs in the Brześć Kujawski–Osłonki region (on the basis of research of D. Makowiecki 2002, 2003, 2005).

Tabela CCVII. Wiek w momencie śmierci osiągany przez świnię w rejonie Brześcia Kujawskiego i Osłonek (na podstawie badań D. Makowieckiego 2002, 2003, 2005).

	Age grade	Eruption/wear stage	Age class	n
I.	Juvenile	Deciduous teeth erupted	over 7 weeks	1
II.		M1 erupting	4–6 months	0
III.		M1 erupted	6–10 months	3
IV.		M2 erupting	10–12 months	1
V.	Subadult	M2 erupted	12–16 months	6
VI.		M3 erupting	16–24 months	4
VII.	Adult	M3 erupted	>2–3.5 years	1
VIII.		M3 light wear (+/+)	2–3.5 years	3
IX.		M3 light wear (+/++)	2–3.5 years	1
X.		M3 light wear (+)	2–3.5 years	2
XI.		M3 light–medium wear (++)	3.5–5 years	0
XII.		I1 erupted. in wear	over 16 months	2
XIII.	Subadult/adult	P4 erupted. in wear	over 16 months	7
XIV.		I2 erupted. in wear	over 22 months	2
Total cases				33

6.5.5
SUMMARY OF MORTALITY DATA

The data from epiphyseal fusion and mandibular tooth eruption and wear provide a general characterization of the livestock management practices of the inhabitants of southeastern Kuyavia during the fifth millennium B.C. As was pointed out earlier, there is no logical reason to assume that they pursued a specialized animal economy, and the mortality data confirm that animals probably yielded many different products.

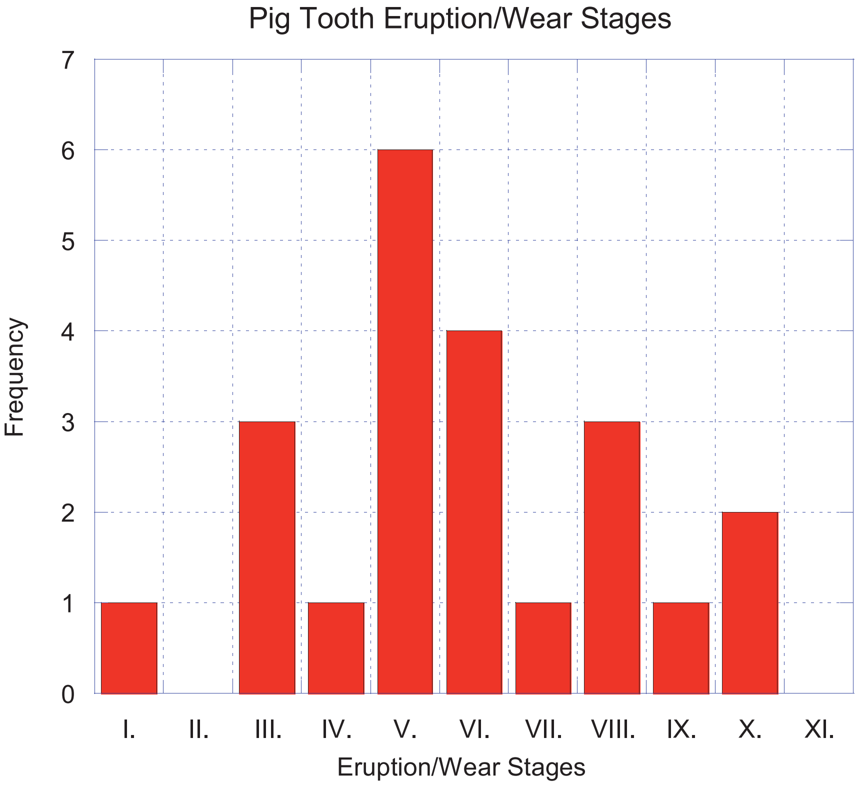


Fig. 1332. Pig tooth eruption and wear stages as determined by Makowiecki for multiple sites in the Brześć Kujawski – Osłonki region. Stages as in Table CCVII.

Ryc. 1332. Etapy wyrzynania się i ścierania zębów u świni , wyróżnione przez D. Makowieckiego na licznych stanowiskach w rejonie Brześcia Kujawskiego i Osłonek. Etapy jak w tabeli CCVII.

The pig mortality data from Brześć Kujawski and Osłonki, along with the pooled data from the other Kuyavian sites, are quite straightforward, but interesting nonetheless. Although the pig mortality curve is relatively steep, and few animals survived their third year, both the epiphyseal fusion and tooth wear data indicate that a significant number of pigs survived into their second year and beyond. The mortality curve for these Neolithic pigs is thus much more gradual than it would be for modern commercial pig production, suggesting that there was little marginal cost to allowing a pig to survive through its second year, which in turn suggests that there was no shortage of suitable food within the settlement and in the surrounding fields and forests. It also suggests that pigs served as an important dietary reservoir and were not intensively slaughtered during their first year or 18 months to maximize the ratio between meat yield and nutritional input.

The sheep and goat mortality data, despite the fact that there may have been different management strategies pursued for each species, also suggests a primary use for meat. Of particular note is the intensive culling of the herds that took place between 24 and 48 months, with a probable concentration on animals in their third year. This suggests that secondary products from sheep and goat were not major economic factors, if at all. Of course, it is not possible to exclude them completely, for their subsequent use in prehistoric central Europe did not spring fully developed without antecedent.

Although the fusion percentages for cattle leave open the possibility for a substantial portion of the herd living an extended life, and thus consistent with the expectation that this may reflect their exploitation for secondary products, the mandibular tooth eruption and wear data from Osłonki and from other Kuyavian sites suggests that there was a pattern of intensively culling the herd, which would include both the females and any surviving males and castrates, when animals reached their fifth year or not much thereafter. While the use of secondary products from cattle is likely during the fifth millennium B.C., particularly in light of the accumulating evidence for lipid residues on pottery from many parts of Europe, it does not appear that the Kuyavian herd was managed to optimize milk production. Instead, it seems that milk may have been a byproduct of a cattle raising strategy that was focused ultimately on meat production.

6.6
Metrical Analysis

The fauna from the Lengyel sites in southeastern Kuyavia was measured consistently using the standards published by von den Driesch (1976) and constitute one of the largest sets of measurements for Neolithic ungulates before 4000 B.C. in temperate Europe. A full metrical analysis of the fauna from these ten sites would far exceed the space available here, and thus the presentation below focuses on key issues of domestication status of cattle and pig, using primarily the measurements available from the Osłonki sample. Time constraints also prevent the adequate presentation of the full corpus of measurements for every species from every site. Eventually, these will be published fully in a document–of–record, and in the meantime they can be obtained from the author.

6.6.1
DOMESTIC AND WILD CATTLE AT OSŁONKI

The problem of the osteological distinction between domestic cattle and aurochs has been a topic of discussion for decades. Since domestic cattle are smaller than their wild counterparts (see Figure 1333), standard osteological techniques rely on the analysis of a sample of measurements. The problem lies in where to separate wild from domestic in the faunal assemblage and to determine their relative representation. Furthermore, the problem is compounded by the continuum of sizes from female domestic cattle on the small end of the scale to male aurochs on the large end, while in the middle there is substantial overlap in size between male domestic cattle and female aurochs. Since different faunal analysts draw the line in different places, the result can be wildly varying estimates of the relative numbers of aurochs and domestic cattle.

Another problem is that since most faunal samples from Neolithic sites are relatively small and fragmented, most assessments of whether a specimen is wild or domestic are based on the comparison of single measurements to the known size range of postglacial aurochs. Single measurements can sometimes be misleading, as Boessneck (1977: 156) noted, and it is better to use multiple dimensions in assessing whether a specimen is from a wild or domestic animal. For example, at Burgäschisee–Süd, overall lengths of metacarpals as well as their distal breadths were combines in distinguishing wild from domestic specimens. At Neolithic sites in southeastern Kuyavia, however, large numbers of whole measurable specimens are simply not available, and the comparison of individual specimens to general size ranges was characterized by Bogucki (1981: 193) as "in reality a very inexact, subjective, and error–prone undertaking."

A potential solution to this problem was developed by Uerpmann in the late 1970s (Uerpmann 1979), which was then employed by Bogucki (1981) in his analysis of the cattle from Brześć Kujawski. Uerpmann devised a method that combined measurements from different skeletal parts by converting them to stan-

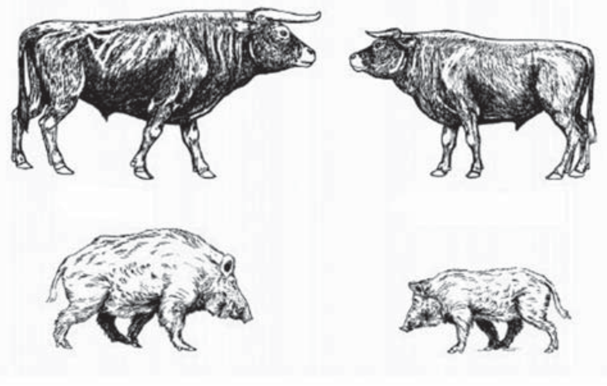


Fig. 1333. Relative sizes of wild cattle and pig (left) and their early domestic counterparts (right). After Bartosiewicz et al. 2006, in turn after Uerpmann 1979.

Ryc. 1333. Wielkości względne dzikiego bydła i świni (po lewej stronie), oraz ich udomowionych odpowiedników (po prawej stronie). Wg Bartosiewicza et al. 2006.

dard scores which were then used to measure how much the measurements deviated from those of a complete skeleton of known attribution, the "standard individual". Certain assumptions about animal morphology are implicit in this method, especially that animals of the same species will vary in the same proportions for each of their bones. This may not be always the case, the lengths of long bones in particular may be susceptible to influences of sex, age, and environment. Thus, as Russell (1993: 112) notes, "standard animal scores should be used to construct a general picture of variability in a taxon, not as a precise method for separating individual specimens."

The first step in applying this method is to choose a "standard individual" to which the measurements can be compared. Since modern specimens of aurochs are not available, Bogucki chose to use a subfossil female aurochs skeleton from a bog in Denmark dated to the Boreal period, known as the "Ullerslev Cow" (Degerbøl and Fredskild 1970:10). The Ullerslev Cow is a small aurochs, thus probably equal in size to male domestic cattle, and thus her measurements may approximate the metrical border between wild and domestic. The fact that it predates the Lengyel fauna of the fifth millennium B.C. by several millennia should pose no problem, for Grigson (1969: 281) notes that the aurochs did not decrease in size in northern Europe between the Mesolithic and the Bronze Age.

Uerpmann used an algebraic method to normalize the measurements. In order to evaluate their deviation from those of the standard individual, he established a scale of 0–100 in which 50 equal to the dimension of the standard individual. The results were plotted graphically, with specimens with scores under 50 being smaller than the corresponding measurements of the standard individual, and those with scores over 50 being larger. From this, it can be further extrapolated that specimens larger than the standard individual can be presumed to be wild, while those smaller can be hypothesized to be domestic. In reality, there certainly could be wild specimens with scores under 50 and domestic specimens with scores of over 50, but establishing where this boundary lies in the sample provides a rough indication of the relationship between wild and domestic animals in the sample.

Bogucki's analysis of the Brześć Kujawski sample using the Uerpmann technique pro-

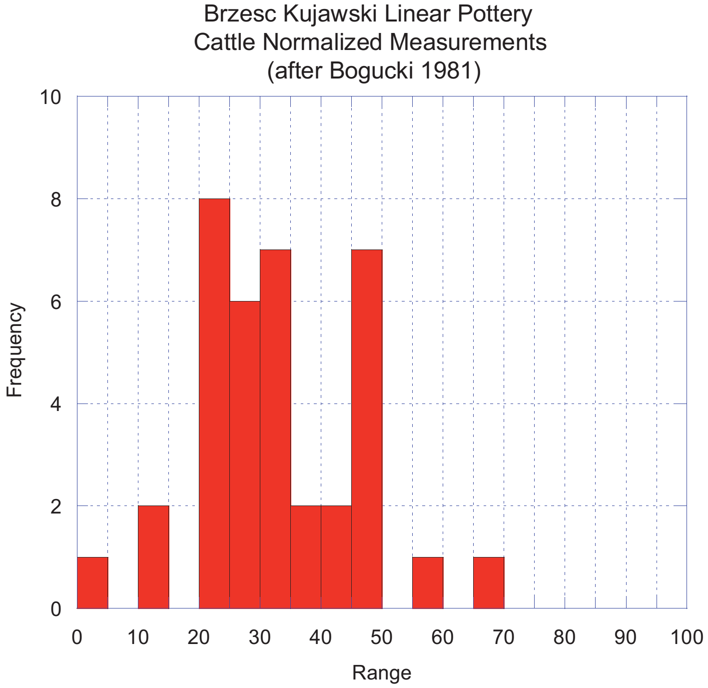


Fig. 1334. Measurements of Linear Pottery cattle bones from Brześć Kujawski normalized using the Uerpmann technique (after Bogucki 1981).

Ryc. 1334. Pomiary kości bydła z okresu kultury ceramiki wstęgowej rytej z Brześcia Kujawskiego, znormalizowane przy użyciu techniki Uerpmanna (wg Boguckiego 1981).

duced an interesting result, shown graphically as Figures 1334 and 1335. Figure 1334 depicts the Linear Pottery sample, while 1335 shows the Lengyel sample, which is of greater interest in this report. The Linear Pottery sample shows a greater size range, but most of the specimens lie below 50 with the exception of two, which may be wild individuals but which could also be large domestic males. The slight bimodality in the main body of Linear Pottery scores can be interpreted as indicating domestic males and females. The Lengyel sample is more concentrated but uniformly smaller than the Ullerslev Cow and thus can be presumed to be effectively all domesticated individuals.

At the same time Bogucki was applying Uerpmann's algebraic method to the Brześć Kujawski fauna, Meadow (1981, 1999) developed the much simpler logarithmic method which he then used in his analysis of the faunal from Mehrgarh in Pakistan (Meadow 1983). The measurements of the archaeological specimens and the standard individual are converted to natural logarithms. The log of the standard individual measurement is then subtracted from the log of the archaeological specimen, producing a logarithmic scale on which zero represents the standard individual and thus the boundary between wild and domestic. This is expressed by the following equation:

$$d = \log_x - \log_{\text{standard}}$$

in which x is the measurement of the archaeological specimen and *d* is the difference of logs. Positive numbers represent specimens larger than the standard individual, while negative numbers represent those that are smaller. These are then graphed as histograms. The logarithmic method was also used by Russell (1993) in her analysis of the Neolithic fauna from Opovo in Yugoslavia.

In the current analysis, the logarithmic method was applied to both cattle and pig measurements from Osłonki. Pigs are discussed in detail in the following section. Again, the Ullerslev Cow was used as the standard cattle individual. In the 1990s, Steppan re–measured the Ullerslev Cow in accordance with the conventions of von den Driesch (Steppan 2001), and his measurements are used here instead of Degerbøl's as the standard measurements. The analysis had already been carried out using the Degerbøl measurements before Bogucki became

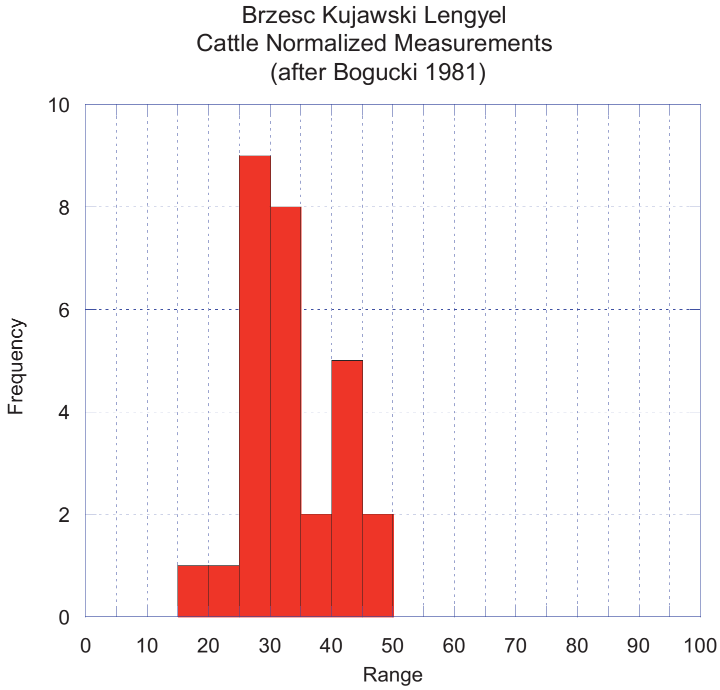


Fig. 1335. Measurements of Lengyel cattle bones from Brześć Kujawski normalized using the Uerpmann technique (after Bogucki 1981).

Ryc. 1335. Pomiary kości bydła z okresu kultury lendzielskiej z Brześcia Kujawskiego, znormalizowane przy użyciu techniki Uerpmanna (wg Boguckiego 1981).

aware of the Steppan re–measurement, but the differences in results were trivial.

Measurements were exported from the York Faunal Database into Microsoft Excel, converted to logarithms from which the log of the standard measurements were subtracted, and then exported to Kaleidagraph™ in which the histograms were produced. The much larger size of the Osłonki sample made it possible to concentrate on a limited number of key measured elements, which are given in Table CCVIII:

A total of 256 measurements were used in this analysis which produced the histogram shown as Figure 1336. Virtually all of the measurements fall to the left of the 0 point, which means that they are smaller than the Ullerslev Cow. A small number, fewer than 20, fall immediately to the right, meaning that they are either aurochs, in which case they are female, or large domestic male cattle. On the other hand, it is possible that some very small female aurochs specimens are included among those to the left

Table CCVIII. Measurements used from Ullerslev Cow (Steppan 2001).

Tabela CCVIII. Pomiary w oparciu o krowę Ullerslev (Steppan 2001).

Element	Measurement	Value for Ullerslev Cow	Number of measurements from Osłonki
Scapula	SLC	68.73	16
Humerus	BT	90.68	32
Radius	Bp	99.27	20
Metacarpal	Bd	72.00	33
Pelvis	LA	88.30	20
Femur	DC	56.08	13
Femur	Bd	119.00	5
Tibia	Bd	77.91	29
Astragalus	GLI	82.60	36
Calcaneus	GL	165.76	18
Metatarsal	Bd	67.25	34

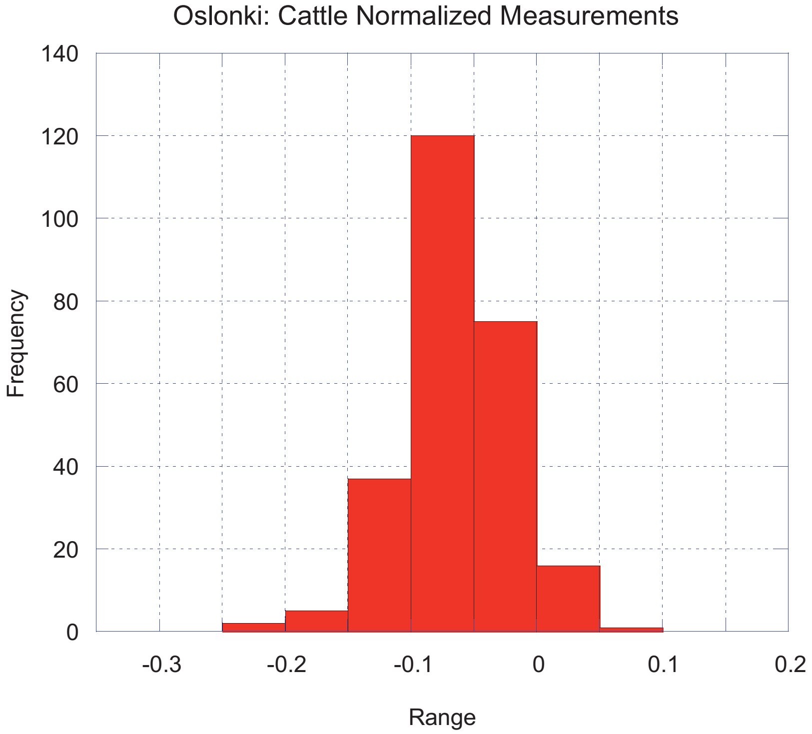


Fig. 1336. Histogram of normalized cattle measurements from Osłonki; specimens to the right of zero are presumed to represent wild individuals.

Ryc. 1336. Histogram znormalizowanych pomiarów bydła z Osłonek; okazy na prawo od zera mają reprezentować osobniki dzikie.

of the 0 point. The clear indication of this analysis, however, is that virtually all of the Lengyel cattle at Osłonki are domestic, confirming the finding from Brześć Kujawski reached over 25 years ago.

Individual cattle measurements, often used to supplement the standard–individual technique, are equivocal on the distinction of wild and domestic populations. They generally show a more continuous distribution of measurements rather than a few large outliers. They are more useful in the study of the distinction between male and female cattle and are discussed further below. In general, however, cattle bones from Osłonki with measurements in the size ranges for Polish prehistoric wild cattle reported by Lasota–Moskalewska and Kobryń (1990) are very rare. One notable outlier, almost certainly from an aurochs, is the distal humerus from the foundation trench of House 23 (Figure 1337), with a trochlear breadth of 95 mm

6.6.2

DOMESTIC AND WILD PIGS AT OSŁONKI

The same technique was applied to the differentiation of domestic and wild pigs. In this case, the standard individual used was a mature female wild pig shot in 1979 at the foot of the Carpathians, Hungarian Agricultural Museum specimen 79.2, reported by Russell (1993: table 6.2). Russell believes that this skeleton is on the larger side of the wild–domestic border in the Carpathian Basin, and thus using it as the standard individual may underrepresent the relative proportion of wild animals if 0 is taken as the boundary. Nonetheless, it provides a starting point for this discussion, which can be repeated if a more appropriate skeleton of a Polish wild pig can be found.A total of 133 measurements were employed in this analysis, as shown in Table CCIX:

Fig. 1337. Distal humerus of wild cattle from Osłonki, House 23, south foundation trench.

Ryc. 1337. Dalsza część kości ramieniowej dzikiego bydła z Osłonek, dom 23, południowy rów fundamentowy.

Table CCIX. Measurements used from Hungarian Wild Pig measured by Russell (1993).
Tabela CCIX. Pomiary w oparciu o węgierską dziką świnię, wykonane przez Russela (1993).

Element	Measurement	Value for Hungarian wild pig (Russell 1993	Number of measurements from Osłonki
Scapula	SLC	29.4	62
Calcaneus	GL	92.3	7
Radius	Bp	32.8	21
Tibia	Bd	33.7	29
Astragalus	GLl	48.2	14

The analysis produced the histogram shown in Figure 1338. These results are somewhat more interesting than the cattle, in that they show more activity to the right of the 0 point, presumably mainly specimens of wild pig, as well as a small number of specimens just to the left of the 0 point that are larger than the majority of the other pig bones. These could represent either large domestic boars or small wild sows. The conclusion to be drawn from this graph is that there is a much larger wild component among the *Sus scrofa* remains from Osłonki than with cattle. Indeed, the subjective field observation that led to a small number of specimens being counted as "wild pig?" among the NISP may actually underrepresent the wild component in the pig population. The implications of this, when viewed in light of recent genetic evidence, is discussed further below.

The measurements of individual pig elements provide somewhat more evidence of wild pig. For example, the radius proximal breadth shows one outlying large individual, definitely wild (Figure 1339), alongside an amazingly symmetrical distribution of the domestic individuals. The single large specimen falls within the size range for prehistoric wild pigs in Poland defined by Lasota–Moskalewska, Kobryń, and Świeżyński (1987).

The smallest length of the collum scapulae, shown in Figure 1340, provides perhaps the clearest illustration of the role of wild pigs. Four large specimens over 29 mm are set apart clearly from the majority of the measurements that are in the 15–24 mm range. The three largest specimens fall within the size range for prehistoric Polish wild pigs defined by Lasota–Moskalewska, Kobryń, and Świeżyński (1987), while the fourth falls just below it, but still beyond the range for domestic pigs. At the same time, it would correspond well to the range for Mesolithic wild boar in southern Scandinavia described by Magnell (2004). Collum scapulae lengths are often used to demarcate the distinction between wild and domestic pigs (Rowley–Conwy 1995), although they do exhibit post–fusion growth (Payne and Bull 1988) which introduces age as a potential complicating factor. The factor of post–fusion growth complicates the differentiation of domesticated individuals within a population that is overwhelmingly wild, but it should be much less of a problem when differentiating

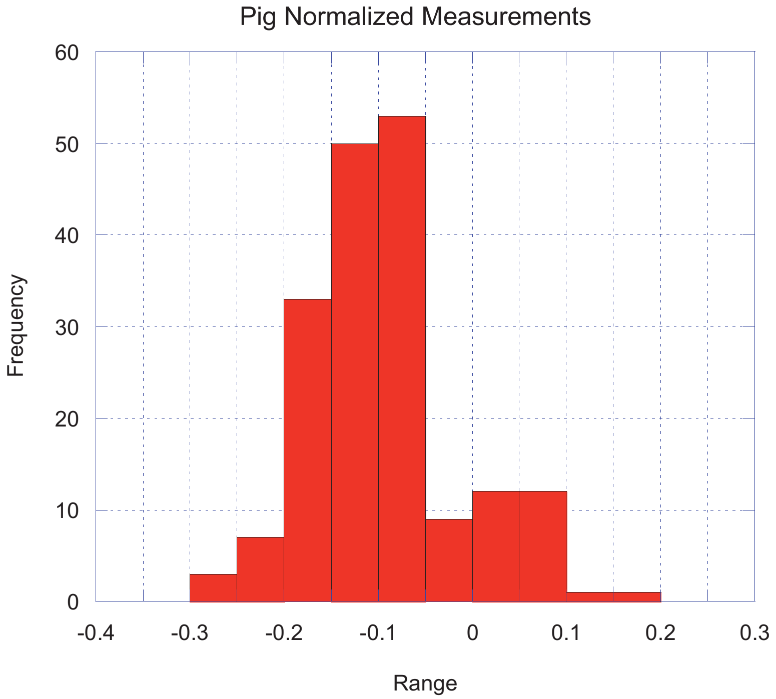


Fig. 1338. Histogram of normalized pig measurements; specimens to the right of zero are presumed to represent wild individuals.

Ryc. 1338. Histogram znormalizowanych pomiarów świni; okazy na prawo od zera mają reprezentować osobniki dzikie.

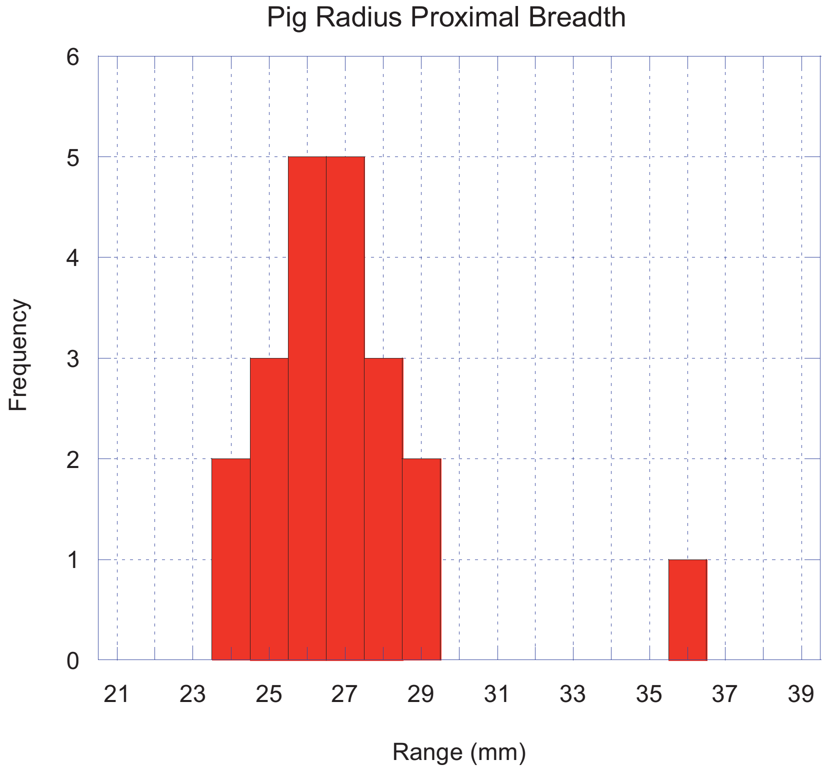


Fig. 1339. Histogram of greatest proximal breadth (Bp) of pig radii.

Ryc. 1339. Histogram największej szerokości końca bliższego kości promieniowych świni.

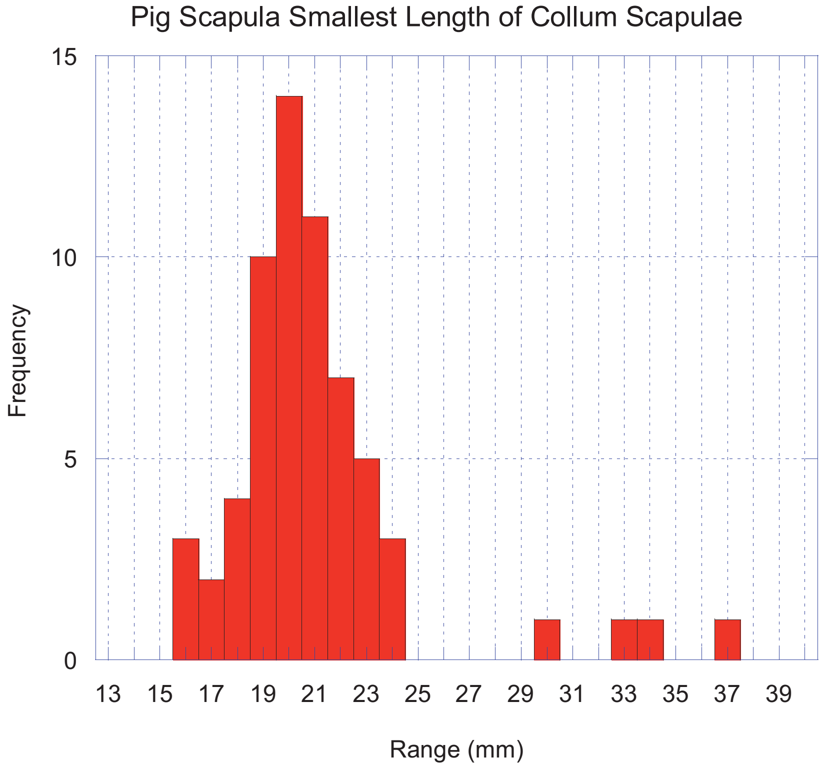


Fig. 1340. Histogram of smallest length of collum scapulae of pig.

Ryc. 1340. Histogram najmniejszej długości szyjki łopatki świni.

wild individuals in a sample that is overwhelmingly domesticated.

A potentially more reliable element for differentiating wild from domestic pigs is the astragalus, which reaches its full size at a young age and is relatively dense and thus well preserved (Payne and Bull 1988). The graph of the greatest lateral length of the Osłonki pig astragali produces a histogram fairly similar to that of the collum scapulae, as shown in Figure 1341. Assignment of the four largest specimens to wild pig is supported by the measurement data presented by Magnell (2004) for Mesolithic wild pigs in Denmark and Sweden.

Additional unmeasurable specimens are also attributable to wild pig, and most of these were listed as "wild pig?" in the original recording of the data. Several of these are pictured below (Figures 1342–1345). Some are astonishingly large individual specimens, such as mandibles from Clay Pits 10 and 11, a radius from Pit 101 and a calcaneus from Clay Pit 2, clearly from wild boars. The presence of multiple wild pig mandibles from different features points toward a consistent level of exploitation of the wild pig populations in the surrounding forests.

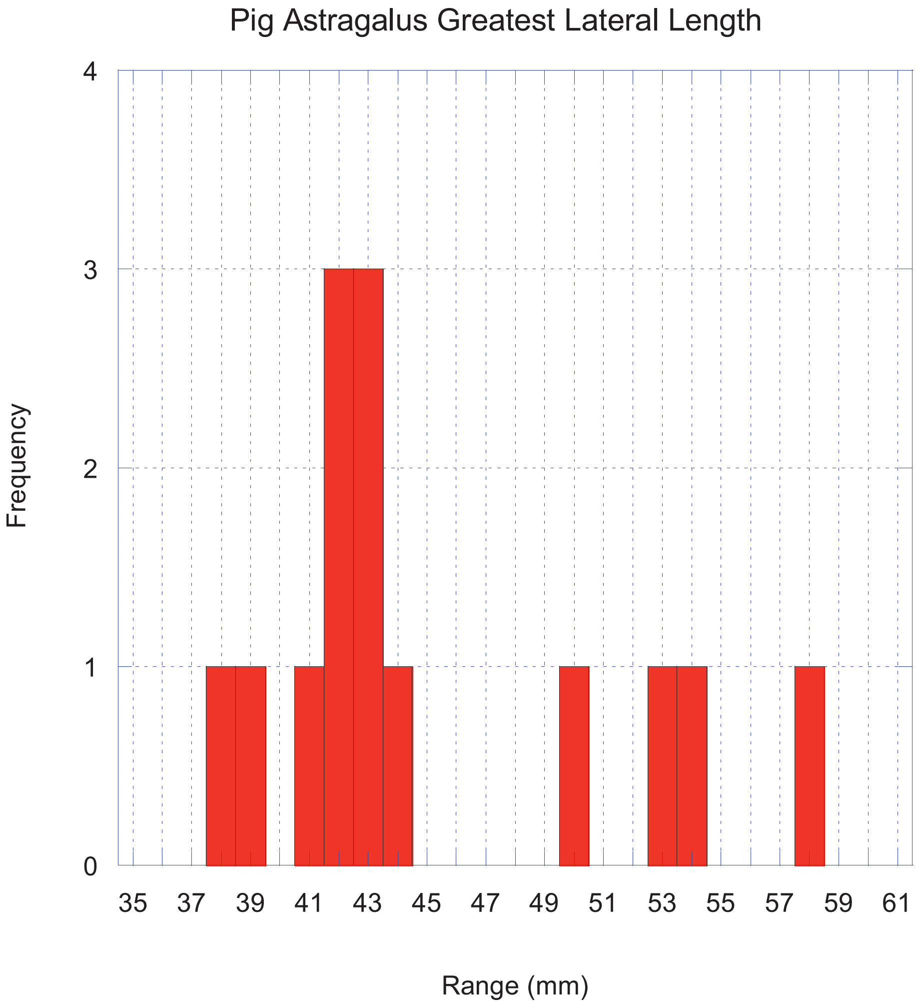


Fig. 1341. Histogram of greatest lateral length of pig astragali.

Ryc. 1341. Histogram największej długości bocznej kości skokowych świni.

Fig. 1342. Wild pig mandible from Osłonki, Clay Pit 11.

Ryc. 1342. Żuchwa dzikiej świni z Osłonek, glinianka 11.

Fig. 1343. Anterior portion of wild pig fused mandible from Osłonki, Clay Pit 10.

Ryc. 1343. Przednia część żuchwy dzikiej świni złożonej z fragmentów, Osłonki, glinianka 10.

Fig. 1344. Wild pig radius from Osłonki, Pit 101.

Ryc. 1344. Kość promieniowa dzikiej świni z Osłonek, jama 101.

Thus the metrical data and observations of unmeasurable elements from the pig sample at Osłonki consistently shows a representation of wild pig, including some very large specimens which cannot be considered to be borderline cases. It is probably the case that among the NISP wild pig are somewhat underrepresented in the data presented in Tables CLXXXI and CLXXXII. The consequences of this for our understanding of the Lengyel animal economy during the fifth millennium B.C. are discussed further below.

6.6.3

MALE AND FEMALE CATTLE AT OSŁONKI

If we can assume that the cattle sample at Osłonki is composed largely of the bones of domestic cattle, then the analysis of individual measured elements can provide some indication of the relative sizes and numbers of males and females. Anatomical elements with large numbers of comparable measurements were chosen for study.

Attempts to differentiate male and female cattle generally begin with the metapodials, specifically measurements of the distal articulation. Histograms of the distal breadth of cattle metacarpals and metatarsals from Osłonki are shown in Figures 1346 and 1347, with annotations suggesting which ones can be attributed to males and females (along with a couple of possible large wild specimens). These data do suggest a degree of size differentiation within the cattle population which may correspond to sexual dimorphism among the mature animal population. In general, these histograms seem to show somewhat more females than males, suggesting a degree of attrition among the male cattle prior to maturity.

The astragalus yields two measurements which when graphed in a scatter plot can provide an indication of the relative sizes of an animal population. As a hard and dense element, the astragalus is usually well–preserved and most specimens are measurable. Figure 1348 shows the greatest lateral length (GLl) and distal breadth (Bd) of the cattle astragali from Osłonki. A gap in the distribution as indicated by the dotted line is interpreted as differentiating males and females.

Fig. 1345. Calcaneus of a wild pig from Clay Pit 2.

Ryc. 1345. Kość piętowa dzikiej świni z glinianki 2.

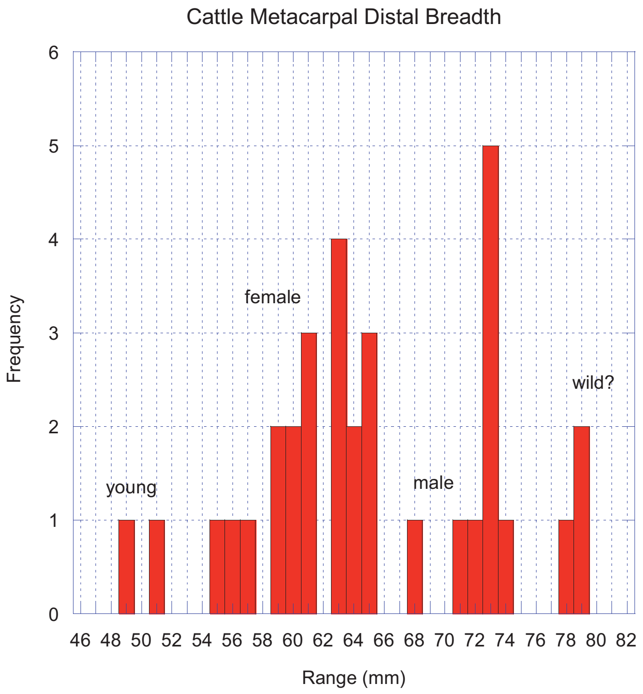


Fig. 1346. Histogram of distal breadth of Osłonki cattle metacarpals.

Ryc. 1346. Histogram szerokości dalszej części kości śródręcza u bydła.

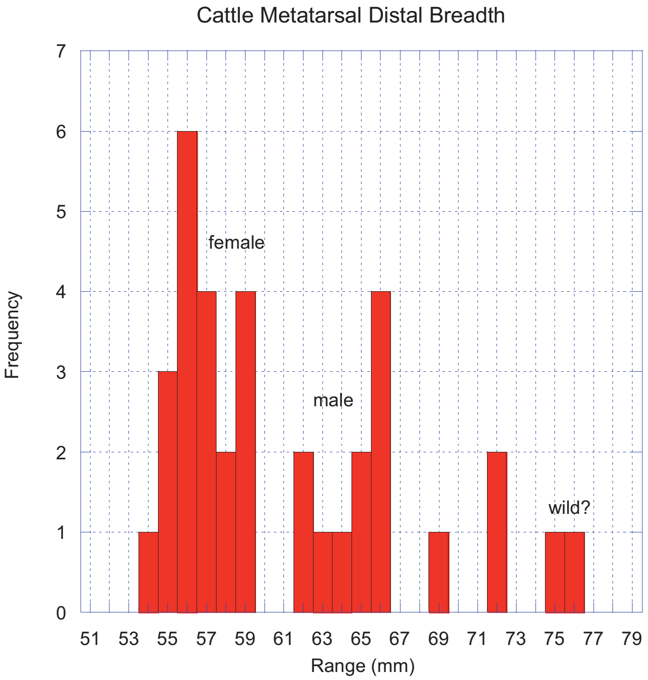


Fig. 1347. Histogram of distal breadth of Osłonki cattle metatarsals.

Ryc. 1347. Histogram szerokości dalszej części kości śródstopia u bydła.

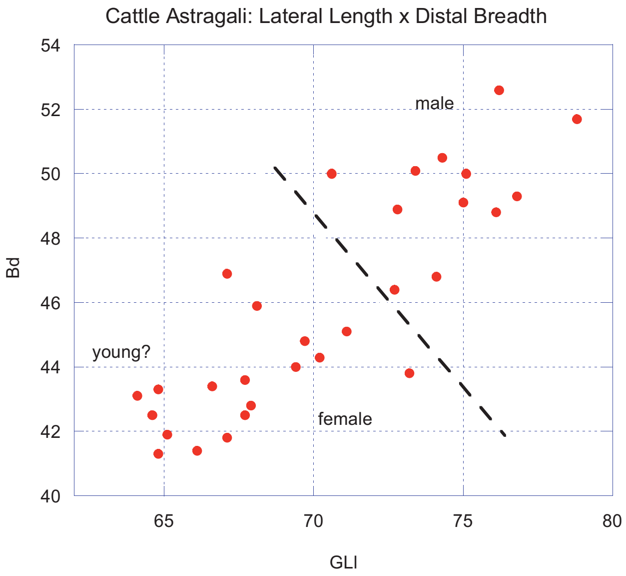


Fig. 1348. Distal breadth of cattle astragali graphed against lateral length.

Ryc. 1348. Szerokość bliższej części kości skokowych bydła zestawiona z ich długością boczną.

The distal tibia articulates with the astragalus, and a histogram of distal breadth (Bd) results in Figure 1349, which can be interpreted as showing the separation between male and female cattle very distinctly. As with the astragali, there appear to be slightly more female specimens than male, perhaps an artifact of the early culling of males for meat. The specimen that is separated at the high end can be interpreted as a wild individual, while the one at the bottom end may be immature.

It appears, then, that there was a clear sexual size dimorphism between male and female cattle kept by the Neolithic inhabitants of Osłonki. The question of castration is not addressed here, and it clearly might complicate this neat picture. The small males in Figure 1349 may represent steers, but this would be difficult to prove.

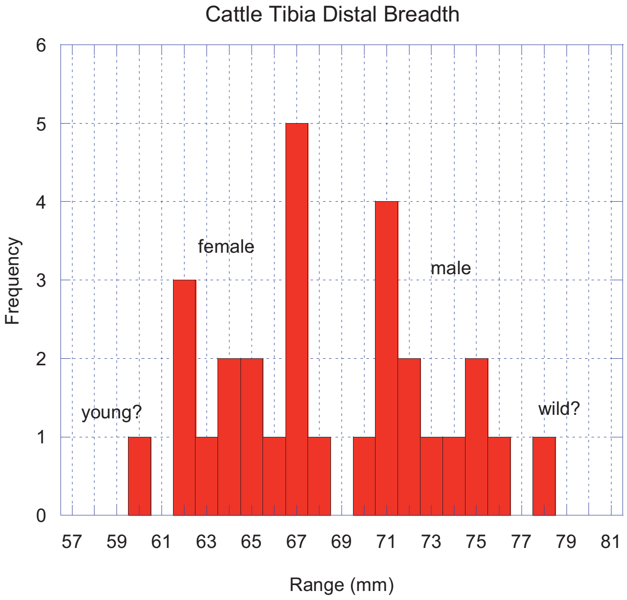


Fig. 1349. Histogram of distal breadth of cattle tibiae.

Ryc. 1349. Histogram szerokości dalszej części kości piszczelowych u bydła.

6.7
Pathology, Butchery, and Burning

Evidence for butchery, pathologies, and burning was noted during the analyses of animal bones by Bogucki and Makowiecki. These characteristics are not the central focus of this report and could be discussed in greater detail separately, especially after further examination of the Osłonki assemblage. They are mentioned here to note their presence and to highlight some particular features, especially the suggestions of biomechanical stress that may reflect evidence for animal traction.

6.7.1
TRACES OF BUTCHERY PRACTICES

Fragmentation

The faunal assemblages on Neolithic settlement sites in central Europe are the final result of a long sequence of carcass dismemberment, sorting and distribution of carcass parts, cooking, bone fragmentation for marrow extraction, selection of bones for tool production, discard, carnivore attrition, and *in situ* mechanical fragmentation. As a result, many of the long bones are preserved at less than 50% of their original size, while the smaller, harder bones of the autopodium are preserved whole or nearly whole. Such assemblages are not the product of what might be called "craft butchery" (O'Connor 2003: 81) in which cultural and economic norms dictate a specific and consistent method of dividing the carcass and the portioning of joints of meat. Instead, the Neolithic carcass was reduced to the maximum extent possible, which resulted in the initial fragmentation of bones, and then the bones were fractured further to obtain their marrow.

In the recording of the bones from Osłonki, bone fragments were assessed as being 1–20%, 21–40%, 41–60%, 61–80%, and 81–100% of the original whole bone from which they came. The proportions of these fragment sizes are depicted in Figure 1350, separated by major contexts and then the overall proportion for the site. It can be seen clearly that most of the bones were in the 21–40% size range, and very few in the 41–80% size ranges. Whole bones were primarily the hard and dense bones of the autopodium.

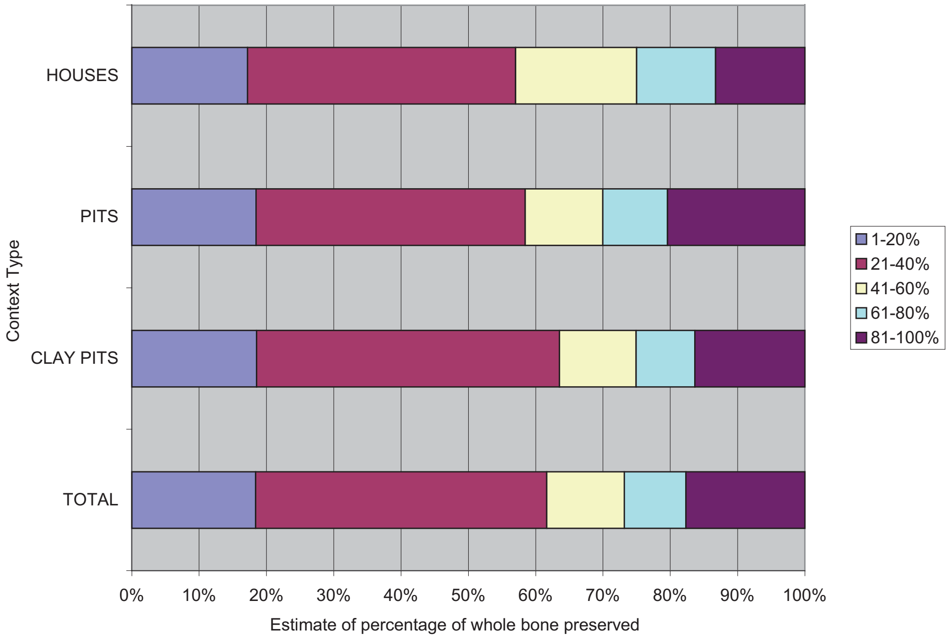


Fig. 1350. Proportions of different size classes in the Osłonki faunal assemblage.

Ryc. 1350. Proporcje różnej wielkości klas pośród zespołów szczątków zwierzęcych z Osłonek.

The degree to which different elements is further demonstrated in Figure 1351 below, showing what proportion of each type of bone fell into the different size classes. The graph is sorted by the ratio of bones smaller than 40% of the original whole bone to bones 41% of the original bone and larger. The largest long bones – the femur, humerus, and tibia – were the most severely fragmented, followed by the mandible. Smaller long bones of the forelimb, including the scapula, radius, and ulna, were often preserved in longer fragments, often the shaft plus an articular end.

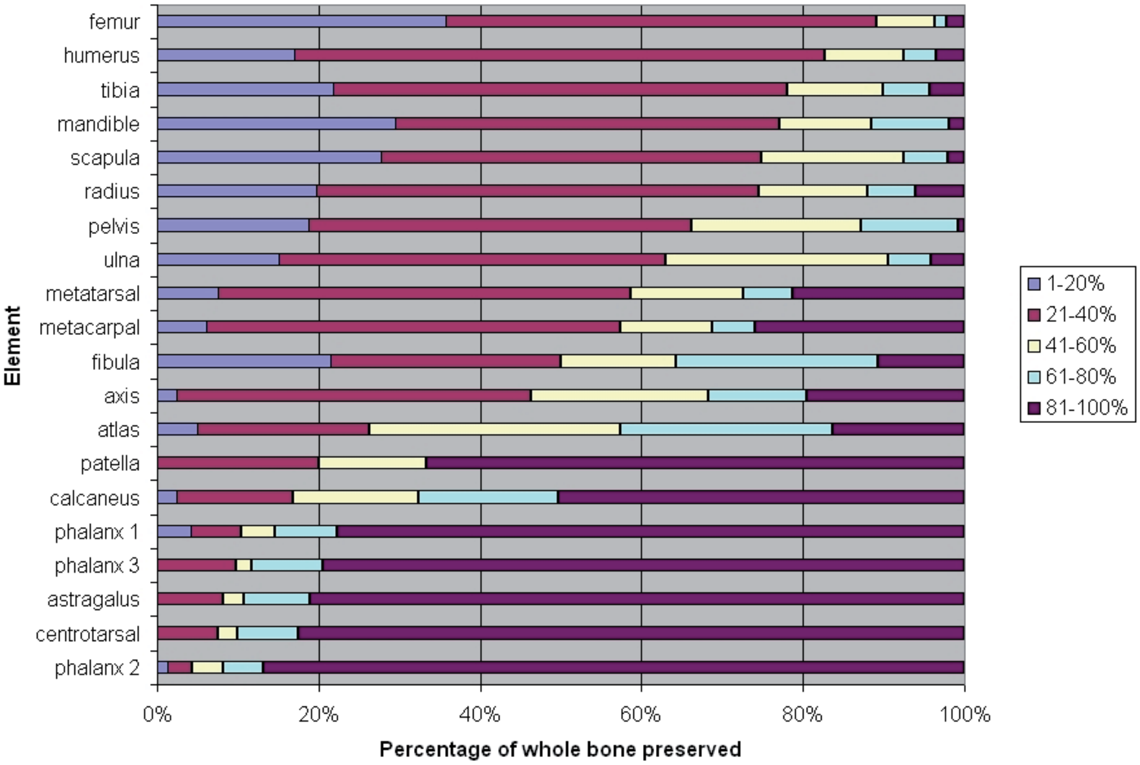


Fig. 1351. Proportions of size classes of bones in the Osłonki faunal assemblage by element, sorted as the proportion of fragments < 40% of the original bone to fragments > 41%.

Ryc. 1351. Proporcje wielkości klas, według jednostek anatomicznych, uporządkowane w stosunku do zachowanych fragmentów kości od < 40 % zachowanych jednostek anatomicznych (fragmentów kości) do > 41%.

Cut Marks

Aside from the overall fragmentation of the bones, the most visible physical manifestations of butchering activity are cut marks, made presumably with the sharpest implements available to Neolithic people: flint blades. These are actually few in number in relation to the overall number of bones, for they would have been left only were the blade cut through the surrounding tissue not only to contact the bone but to do so with sufficient pressure to leave a groove. Unlike metal knives which produce numerous cut marks on bones from the Iron Age onward, Neolithic flint blades probably were used to cut parallel to the bone to remove meat, and were only used perpendicular to the bone at certain points to disarticulate the carcass. A few examples of cut marks from the Neolithic assemblages discussed here are illustrated in Figure 1352.

Table CCX summarizes the cut mark data from Osłonki. Of particular note is the fact that among cattle, many of the cut marks are found

Fig. 1352. Examples of cut marks. Left: Pig calcaneus from Miechowice 4a with transverse cutmarks. Right: cattle horncore from Zagajewice with cut marks at base.

Ryc. 1352. Przykłady nacięć. Z lewej: kość piętowa świni z Miechowic, stanowisko 4a ze śladami poprzecznych nacięć. Z prawej: możdżeń bydła z Zagajewic z nacięciami u podstawy.

on the astragalus, particularly its dorsal side and distal end, right at the major joint in the hind leg where the relatively meatless autopodium is separated from the meaty bones above. There also appears to be a greater concentration of cut marks on the forelimb bones – humerus, radius, ulna – than on those of the hind limb in all livestock species.

Table CCX. Cut marks on bones from Osłonki
Tabela CCX. Nacięcia na kościach z Osłonek.

	cattle	sheep/goat	pig	dog
mandible	1			
atlas	1			
humerus	3	2	1	2
radius		3	1	
ulna	1	1	2	
metacarpal	1	1		
pelvis	1			
tibia	1	1		1
astragalus	5	1		
calcaneus	1			

The dog bones with cut marks, two humeri and a tibia, all came from Pit 193 and presumably belong to the same individual whose disarticulated and fragmented bones were found in this feature. It is clear from this find that dogs were butchered and eaten by the Neolithic inhabitants of Osłonki.

The Hole in the Goat Skull

An especially remarkable specimen is a goat cranium from Clay Pit 3 in which a circular hole 43 mm in diameter was punched, either as the cause of death or immediately post mortem, in the right parietal (Figure 1353). This skull belonged to an old individual, heavily fused, and the combination of its fusion and the surrounding soft tissue prevented the fragmentation of the cranium upon impact. The purpose in punching the hole would either have been the killing of the animal or the extraction of the brain after the animal was killed another way.

The question can be asked, what sort of tool produced this circular hole? One possibility is a sharp, round pole, but wood does not seem like the sort of material that would have been able to produce such a clean, round hole unless it was very hard and dense. A tool that would have had the right combination of circular cross–section, sharp end, and density to punch through thick cranial bone would have been an antler–beam mattock, also known as a T–axe, of which many are found at sites of the Brześć Kujawski Group (Grygiel and Bogucki 1990). The function of the T–axes has long been a topic of discussion (e.g. Childe 1942). Experimental research in Denmark shows that T–axes would have been suitable for working wood (Jensen 1996), but it is possible that this find of a skull with a circular hole points to an alternate use for the T-axe as an instrument of animal slaughter or butchery.

Fig. 1353. Goat cranium from Clay Pit 3 with hole 43 mm in diameter caused by blow from object with circular cross–section.

Ryc. 1353. Czaszka kozy z glinianki 3, z otworem o przekroju 43 mm, powstałym na skutek uderzenia narzędziem o okrągłym przekroju.

6.7.2
PATHOLOGY

While pathological specimens were noted in the faunal samples discussed here, they were not especially numerous and gave no indication of any systematic osteological infirmities. Most involved exostoses, which in the sheep and goats would reflect the fact that some were kept to a relatively advanced age and which when found in the autopodia of cattle, may suggest biomechanical stresses (discussed further below). In addition, several badly–healed fractures were noted. When the number of individual animals represented by these faunal samples is considered, the actual frequency of pathological specimens is surprisingly low.

Animal Traction?

The use of animals for pulling wagons and ploughs emerged as a significant new development in the relationship between people and livestock during the fourth millennium B.C. (Bogucki 1993), Perhaps the most vivid demonstration of this is the discovery of a ceramic vessel of the Funnel Beaker culture at Bronocice in southern Poland dated ca. 3500 B.C. (Milisauskas 1999). Since these finds predate the appearance of domestic horses in central Europe, the only possible animals that could have been used for traction are domestic cattle, specifically oxen. Archaeologists have sought evidence for biomechanical modification of cattle bones that reflect the stresses of pulling loads and have identified a number of indicators which, when they occur consistently in a faunal assemblage, can be taken as indicating the use of cattle for traction (Bartosiewicz, van Neer, and Lentacker 1997; Cupere et al 2000). These indicators are primarily abnormal biomechanical alterations of the phalanges and metapodials. The analysis of faunal assemblages in search of such indicators has provided strong evidence for Neolithic animal traction. For example, Johannsen (2006) has clearly identified evidence for animal traction and draft cattle in Funnel Beaker faunal assemblages in southern Scandinavia during the fourth millennium B.C.

Due to the association of animal traction with the fourth millennium B.C., Bogucki was not especially conscious of seeking such indicators during his analysis of the Osłonki assemblage that dated to the previous millennium. Makowiecki was more alive to the possibility of animal traction in his study of the assemblages from other sites in southeastern Kuyavia. The assemblage from Brześć Kujawski was studied prior to the popularization of the "secondary products revolution" model by Andrew Sherratt (1981) and thus no attempt was made to look for evidence of animal traction. Nonetheless, several interesting specimens from fifth millennium sites in southeastern Kuyavia provide a suggestion that the use of cattle for traction began before the fourth millennium B.C. Such a suggestion is not novel, for Döhle (1997) argued that Linear Pottery cattle were used for traction during the sixth millennium B.C.

Two metacarpals from Osłonki show the development of a band of bone growth just below the proximal articular surface (Figures 1354 and 1355) on all aspects of the bone. This additional bone appears to be a reaction to biomechanical stress with the goal of underpinning the articular surface. While it would be premature to offer this as conclusive proof of the use of the animals from which these bones came for traction, they nonetheless present a pathology that does not appear to be the result of a degenerative condition but rather a mechanical stress such as would be expected under traction.

Finally, a first phalanx from Osłonki also shows abnormal bone growth around the base of its proximal articular surface (Figure 1356) which would also be consistent with the sort of bone growth that Bartosiewicz, van Neer, and Lentacker (1997) identify as a possible signature of animal traction.

Fig. 1354. Cattle metacarpal from Osłonki, Clay Pit 9, with bone remodeling beneath proximal articular surface.

Ryc. 1354. Kość śródręcza bydła z Osłonek, glinianka 9, z odkształceniem kości poniżej bliższej powierzchni stawowej.

Fig. 1355. Cattle metacarpal from Osłonki, Clay Pit 6, part K, with bone remodeling beneath proximal articular surface.

Ryc. 1355. Kość śródręcza z Osłonek, glinianka 6, część K, z odkształceniem kości poniżej bliższej powierzchni stawowej.

Fig. 1356. Cattle phalanges from Osłonki, Pit 137, with abnormal bone growth around proximal articular surface.

Ryc. 1356. Człony palcowe bydła z Osłonek, jama 137, z nadmiernym rozrostem kości wokół bliższej powierzchni stawowej.

Makowiecki recorded two metacarpals from Konary that exhibit pathological development of the distal shaft on their plantar aspect just above the condyles (Figure 1357). He specifically attributes this to the use of the animal for traction, in one case from an early age before the condyle was fused. Again, these pathologies do not appear to be the result of a degenerative condition and instead seem to reflect biomechanical adaptations. Makowiecki also noted a first phalanx from Pikutkowo with the initial stages of pathological bone growth (Figure 1358) similar to the one noted above.

Any future re–study of the Brześć Kujawski and Osłonki faunal assemblages should include a thorough inspection for other indicators of biomechanical stresses on metapodials and phalanges. For now, we will have to be content to note these isolated indicators of possible use of draft cattle during the fifth millennium B.C. and hope that they will lead to the recording of similar pathologies in the future.

Fig. 1357. Cattle metacarpals from Konary with pathological changes on plantar aspect of distal articulations (a – Clay Pit 7; b – Clay Pit 10) attributed to use for traction.

Ryc. 1357. Kości śródręcza bydła z Konar o patologicznych zmianach na dalszej części stawowej podeszwy (a– glinianka 7; b– glinianka 10) przypisywanych wykorzystaniu zwierząt w celu sprzężaju.

Fig. 1358. Phalanx 1 from Pikutkowo with initial stages of additional bone growth below proximal articulation.

Ryc. 1358. Człon palcowy nr 1 z Pikutkowa ze wczesnymi stadiami dodatkowego rozrostu kości poniżej bliższej części stawowej.

6.7.3
BURNING

Burnt bones were relatively rare and were confined to specific features. At Osłonki, only 11 of the features contained burnt bone (Table CCXI). A substantial concentration of bone was found on the bottom levels of Pit 208, which also contained a substantial amount of burnt wall daub from the adjacent house. The 92 fragments of burnt bone in Pit 208 may reflect a single event in which bone that was present within the burnt house was charred during the conflagration and then swept in a single activity into the rubbish pit. In the larger clay pits, burnt bone appears in a relatively low density in proportion to the size of these features and their faunal samples, reflecting the relatively low frequency of burnt bone within the overall faunal assemblage.

Table CCXI. Frequency of burnt bone at Osłonki by feature and taxon.
Tabela CCXI. Częstotliwość występowania spalonych kości w Osłonkach, określonych gatunkowo, w kontekście obiektu.

Feature	Total burnt bone	cattle	sheep/ goat	goat	pig	dog	red deer	large mammal	medium mammal	pond tortoise
Clay Pit 2	12	4	2		4			1	1	
Clay Pit 3	5	1	1		1	1		1		
Clay Pit 5	6	1	1		1		2	1		
Clay Pit 6	4	3					1			
Clay Pit 7	1	1								
Clay Pit 9	10	9			1					
Pit 106	2	1							1	
Pit 204	1		1							
Pit 208	92	42	16	1	7			12	13	1
Pit 229	1		1							
Pit 248	11		7		3				1	

6.8
The Animal Economy of the Brześć Kujawski Group

The following section attempts to synthesize the information provided by the ten faunal assemblages discussed in this study with the goal of characterizing the animal economy of the Brześć Kujawski Group. First, the variation among the faunal samples is discussed, including the appearance of minor but interesting species not already discussed, such as bear and beaver. Then, the role of various taxa in the regional animal economy is discussed, including ubiquitous non–mammal taxa such as tortoise, fish, and birds. Finally, comparative data from elsewhere in central Europe that date to the fifth millennium B.C. are presented for comparison.

6.8.1
INTER–SITE VARIATION AND ITS SIGNIFICANCE

The themes of "diversity in uniformity" (Modderman 1988) and "tradition, uniformity, and variability" (Coudart 1989) are often applied to Neolithic communities of the Danubian tradition, and the faunal assemblages from the sites of the Brześć Kujawski Group can be considered within this perspective. A specific level of quantitative variability masks what in reality is a general qualitative uniformity among the ten faunal assemblages discussed here.

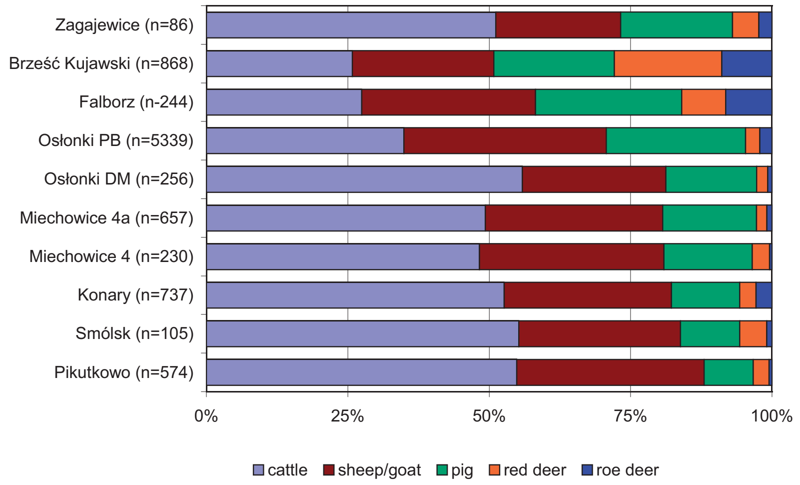


Fig. 1359. Bar chart showing NISP of major economic taxa at Neolithic sites in southeastern Kuyavia, sorted by proportion of sheep/goat to pig.

Ryc. 1359. Tabela ukazująca GLS głównych zwierząt gospodarczych na stanowiskach neolitycznych południowo–wschodniej części Kujaw, wg proporcji kości kozy/owcy i świni.

Consistency and Variability Among Assemblages

At the most general level, the ten faunal samples discussed in this report are remarkably similar. By this is meant that they include the same major economic species – domestic cattle, sheep/goat, pig, red deer, and roe deer – and the relationship between domestic and wild taxa is also very consistent. Only at Brześć Kujawski and Falborz does the percentage of cervids exceed 10%, whereas at the other sites it is usually between 4 and 8%. Despite the metrical evidence for wild cattle and wild pig as a component of the NISP attributed to *Bos* and *Sus*, it is possible to assert that the animal economy of the Brześć Kujawski Group was based primarily on domestic animals, although wild taxa certainly played a non–trivial role.

Another way of visualizing the relative consistency of the ten Lengyel faunal assemblages in southeastern Kuyavia reported in this study is to present the proportions of the major economic taxa as a bar chart in Figure 1359. The somewhat anomalous character of Brześć Kujawski is apparent, but it can also be seen that it is similar to the pattern seen at Falborz. Moreover, the consistency between the adjacent sites of Miechowice 4, Miechowice 4a, and Konary is also apparent.

The data for Figure 1359 are sorted by the ratio of sheep/goat to pig, ranging from relatively equal percentages at Zagajewice to a marked imbalance in favor of sheep/goat at Smólsk and Pikutkowo. Whether or not this has any significance is difficult to establish, but it does point to some additional consistencies. For example, despite the differences in the proportion of cattle between the assemblages from Osłonki identified by Bogucki and Makowiecki, the ratio of sheep/goat to pig is consistent between the two assemblages. Similarly, it is an additional point of similarity between Brześć Kujawski and Falborz and among the sites in the Miechowice–Konary complex.

Another approach to the regional comparison of faunal assemblages is to treat the entire regional assemblage as a single composite sample by summing the NISP of the principal taxa to derive overall regional proportions. Then, these percentages can be applied to the total NISP in a sample to determine how many bones of a species might be expected if the assemblage conformed exactly to the overall regional percentages. For example, in Table CCXII below, the assemblages yielded a total of 3539 bones assigned to domestic cattle, or 38.91% of the regional sample. If the 574 NISP of principal taxa at Pikutkowo conformed to this regional proportion, we would expect there to be about 223 cattle bones in the sample. But there are really 315 cattle bones observed in the assemblage, significantly greater than the expected number. At the same time, the expected number of sheep/goat specimens at Pikutkowo would be approximately190, and there are indeed 190 sheep/goat specimens recorded. On the other hand, the 50 pig bones at Pikutkowo are significantly fewer than the 121 or so that would be expected.

Table CCXII. Observed and expected NISP based on the regional representation of the major economic taxonomic units.
Table CCXII. Zaobserwowana i oczekiwana GLS oparta na reprezentacji w danym regionie głównych gospodarczo jednostek taksonomicznych.

	cattle		sheep/goat		pig		red deer		roe deer		
	O	E	O	E	O	E	O	E	O	E	total
Pikutkowo	315	223.3	190	189.6	50	120.8	16	24.5	3	15.6	574
Smólsk	***58***	40.9	30	34.7	11	22.1	5	4.5	1	2.9	105
Konary	***388***	286.7	218	243.5	89	155.2	21	31.5	21	20.1	737
Miechowice 4	111	89.5	75	76.0	36	48.4	7	9.8	1	6.3	230
Miechowice 4a	***324***	255.6	206	217.0	109	138.3	12	28.1	6	17.9	657
Osłonki DM	143	99.6	65	84.6	41	53.9	5	10.9	2	7.0	256
Osłonki PB	1865	2077.3	1910	1763.8	***1314***	1124.0	135	228.3	115	145.6	5339
Falborz	67	94.9	75	80.6	63	51.4	***19***	10.4	***20***	6.7	244
Brześć Kujawski	224	337.7	217	286.8	185	182.7	***165***	37.1	***77***	23.7	868
Zagajewice	***44***	33.5	19	28.4	17	18.1	4	3.7	2	2.3	86
Totals	3539	3539.0	3005	3005.0	1915	1915.0	389	389.0	248	248.0	9096
% totals	38.91%		33.04%		21.05%		4.28%		2.73%		100.00%

The first interesting observation is that the observed sheep/goat NISP are remarkably close to the expected number at almost every site. The exception is Brześć Kujawski where they are significantly lower than expected. This similarity supports the contention that the role of sheep and goat, again with the caveat that their management strategies were probably very different, was very constant from one site to another.

Observed cattle NISP, on the other hand, are uniformly higher than expected in the sample analyzed by Makowiecki than in the samples analyzed by Bogucki, while the observed pig NISP are generally the opposite. Sometimes these are significantly higher, as at Konary and Miechowice 4a. Yet the constancy of sheep/goat leads Bogucki to discount an analytical bias in the cattle and sheep/goat and to maintain that these differences are the result of prehistoric human decisions about animal use. There really does appear to be a difference, both qualitative and quantitative between the animal economy at Osłonki, Falborz, and Brześć Kujawski and the rest of the sites.[3]

Thus the general regional homogeneity at the very broad scale, as shown in the ternary plot of the principal domestic taxa on Fig. 1317 and the bar chart above of the principal economic species masks a somewhat greater heterogeneity at a somewhat more granular level of analysis. Time constraints prevent the statistical analysis of this heterogeneity, but it does seem apparent in Table CCXII based simply on observation. This heterogeneity, however, is at the scale of local decisions about herd culling and opportunistic hunting of deer, probably at the level of the individual households that comprised each of the settlements.

Beavers at Brześć Kujawski and Pikutkowo

The streams and lakes of southeastern Kuyavia must have supported thriving beaver populations. Lake Smętowo in particular was probably the site of a number of beaver colonies, and this is reflected in two notable finds from Brześć Kujawski 3 and Pikutkowo 6. At both sites, concentrations of beaver bones from the deposit of carcasses in rubbish features reflect the activity of hunting and skinning of these animals for their pelts. Additional isolated beaver bones

Fig. 1360. Concentration of beaver bones in Pit 820 at Brześć Kujawski 3. Note articulated carcass segments and blunt bone tool made from red deer metapodial.

Ryc. 1360. Koncentracja kości bobra w jamie 820, w Brześciu Kujawskim, stanowisko 3. Na szczególną uwagę zasługują wyodrębnione części tuszy, oraz tępe narzędzie kościane wykonane z kości śródręcza/śródstopia jelenia.

---

[3] Removal of the Brześć Kujawski sample from this analysis produced only trivial changes in the differences between expected and observed NISP, and thus the proposition that the anomalous Brześć Kujawski sample is skewing the regional pattern can be discounted.

were found in other features on many of the sites in this study.

At Brześć Kujawski, the remains of five individuals, totaling 98 cranial and postcranial elements, were found in a concentration of bones in Pit 820 excavated in 1979 (Figure 1360). After being recorded in 1979, this material was briefly restudied by Bogucki in 1996. After further re–examination of this collection, it will be published separately with measurements.

The postcranial material included 43 diagnostic elements, of which most could be assigned to one of the five individuals (Table CCXIII). The fact that both proximal and distal fusion could be recorded for so many of the bones indicates at many of these are complete specimens. Beavers 1 and 4 were relatively mature individuals, while Beavers 2 and 3 were younger animals. Beaver 5 was a very small subadult individual. Beaver 3 was produced the most elements, including both sides of the front and hind limbs, while the other beavers were in somewhat more fragmentary condition.

Table CCXIII. Diagnostic postcranial elements of five beavers at Brześć Kujawski 3.

Tabela CCXIII. Pozaczaszkowe, diagnostyczne fragmenty kości pięciu bobrów z Brześcia Kujawskiego, stanowisko 3.

Element	Side	Individual	Proximal Fusion	Distal Fusion
scapula	left	Beaver 1		fused
ulna	left	Beaver 1	fused	fused
ulna	right	Beaver 1		fused
femur	right	Beaver 1	fused	fused
tibia	left	Beaver 1		fused
tibia	right	Beaver 1		fused
calcaneus	right	Beaver 1	fused	fused
pelvis	left	Beaver 1		
radius	right	Beaver 2	fused	unfused
ulna	left	Beaver 2	fused	unfused
tibia	left	Beaver 2		unfused
tibia	right	Beaver 2	unfused	
m/t3	right	Beaver 2	fused	fused
m/t4	left	Beaver 2	fused	fused
scapula	left	Beaver 3		fused
scapula	right	Beaver 3		fused
humerus	left	Beaver 3	unfused	fused
humerus	right	Beaver 3	unfused	fused
ulna	left	Beaver 3	unfused	unfused
ulna	right	Beaver 3		unfused
pelvis	right	Beaver 3		
femur	left	Beaver 3	unfused	unfused
femur	right	Beaver 3	unfused	unfused
tibia	left	Beaver 3	unfused	unfused
tibia	right	Beaver 3	unfused	unfused
m/t3	left	Beaver 3	fused	fused
scapula	left	Beaver 4		fused
humerus	left	Beaver 4	fused	fused
ulna	right	Beaver 4		
pelvis	right	Beaver 4		
femur	right	Beaver 4	fused	fusing
m/t2	left	Beaver 4	fused	fused
scapula	right	Beaver 5		fused
humerus	left	Beaver 5	unfused	fused
ulna	right	Beaver 5	unfused	
pelvis	left	Beaver 5		
m/t4	right	Beaver 5	fused	fused
phal3	indet.			
phal1	indet.		fused	
phal1	indet.		fused	
phal1	indet.		fused	
phal1	indet.		fused	
phal1	indet.		fused	

The bones in Pit 820 were not heavily fragmented as would be expected from butchery for meat, many were articulated with adjacent elements, and entire anatomical structures such as a vertebral column could be observed intact *in situ*. With the bones were two small flint blades and a blunt bone point made from a red deer metapodial (visible in Figure 1360). Such a blunt point may have been useful in the separation of the pelt from underlying tissue without the risk of puncturing it. The overall impression is that this deposit is the result of a single session of the skinning of beaver carcasses, with the partially–disarticulated skeletons deposited in the rubbish pit. Presumably they were quickly buried, for they do not show the effects of scavenging by dogs.

Another indication of the fact that the bone concentration in Pit 820 may have been the product of the skinning of beaver carcasses is the lack of almost all phalanges, particularly third phalanges, despite a concerted effort during the excavation of this feature to recover all fragments. A beaver skeleton should yield 16 third phalanges, and thus five individuals would have produced 80 such elements, along with 80 second phalanges, and 80 first phalanges. Yet in Pit 820, a total of five first phalanges, no second phalanges, and a single third phalanx were recovered. Two possibilities exist to explain this: either primary butchering took place elsewhere and carcasses without feet were brought back to the site, or pelts with the phalanges still attached were stripped from the carcasses and carried away. The presence of numerous cranial elements in the feature would contradict the first possibility, so the more likely explanation for the absence of the phalanges is that they were kept with the pelts.

In 2004, excavations at Pikutkowo site 6 yielded fragments of the skeletons of three beavers within Clay Pit 1. They were not as densely concentrated as the beaver bones at Brześć Kujawski excavated 25 years earlier, nor did they have the evidence for articulated anatomical structures. Nonetheless they represent a cluster of beaver bones in a single feature, in contrast to the usual occurrence of beaver bones as isolated specimens. These bones were studied by Makowiecki in 2005. Since Pikutkowo lies on the opposite side of the Lake Smętowo basin from Brześć Kujawski 3, it is likely that these were drawn from the same local beaver population. Some of the Pikutkowo beaver bones were more fragmented than those in Pit 820, suggesting a somewhat different method of deposition, and damage during excavation is also reported. Yet there are enough complete or nearly–complete elements to suggest that they were also the consequence of pelt removal followed by discard of major carcass elements.

Table CCXIV summarizes the Pikutkowo beaver skeletons, showing how the number of three beavers was determined. The major elements are also illustrated in Figure 1361. Of interest is the consistent appearance of cut marks on the distal tibia, suggesting that this was an important point for dismembering the beaver carcass (Figure 1362). As at Brześć Kujawski, phalanges are virtually absent, reinforcing the conclusion of pelt removal. This does not preclude the use of the beavers for their meat, simply that the meat appears to have been of secondary interest.

Although it comes as no great surprise that the Neolithic inhabitants of southeastern Kuyavia hunted beavers for their pelts, discoveries of concentrations of beaver bones that reflect the discard of carcasses that were not butchered so thoroughly as those of domestic and wild ungulates provides a glimpse of a prehistoric activity not commonly detected archaeologically. It also indicates that a thriving beaver colony, or multiple colonies, existed on Lake Smętowo over a millennium after the first appearance of farmers on its shores. The surface of the shallow lake must have been dotted with beaver lodges, while the vegetation on its banks would have shown the effects of the beavers' landscape engineering.

Table CCXIV. Pikutkowo 6a, Clay Pit 1; skeletal elements of 3 beavers (identified by D. Makowiecki, 2005).
Tabela CCXIV. Pikutkowo st. 6a, glinianka 1; elementy szkieletowe trzech bobrów (określone przez D. Makowieckiego 2005).

Elements	n	Description
Skull	26	26 fragments from 2 individuals
Cervical vertebrae	1	
Thoracic vertebrae	2	
Lumbar vertebrae	8	
Ribs	14	Small fragments
Scapula	2	left, proximal end and shaft
Humerus	1	left, whole (damaged during excavation)
Humerus	1	left, whole, Bd=28,7
Humerus	1	left shaft
Humerus	1	right, shaft and distal end Bd=28,5
Humerus	1	right, whole bone
Radius	1	
Ulna	10	10 small fragments from 3 individuals
Carpals	1	
Pelvis	16	16 fragments of at least 2 individuals (right and left)
Femur	10	From 2 individuals, 2 right and 2 left
Tibia	1	Cut marks on distal shaft, left, whole bone, GL=128,2
Tibia	1	Cut marks on distal shaft, left, shaft
Tibia	1	One cut mark on distal shaft, left, whole bone
Tibia	1	3 fragments, right, whole bone
Fibula	1	
Calcaneus	1	right, distal end and shaft
Calcaneus	2	left, distal end and shaft
Astragalus	1	right
Astragalus	2	left
Metapodials	17	
Phalanx 1	4	
Total	128	

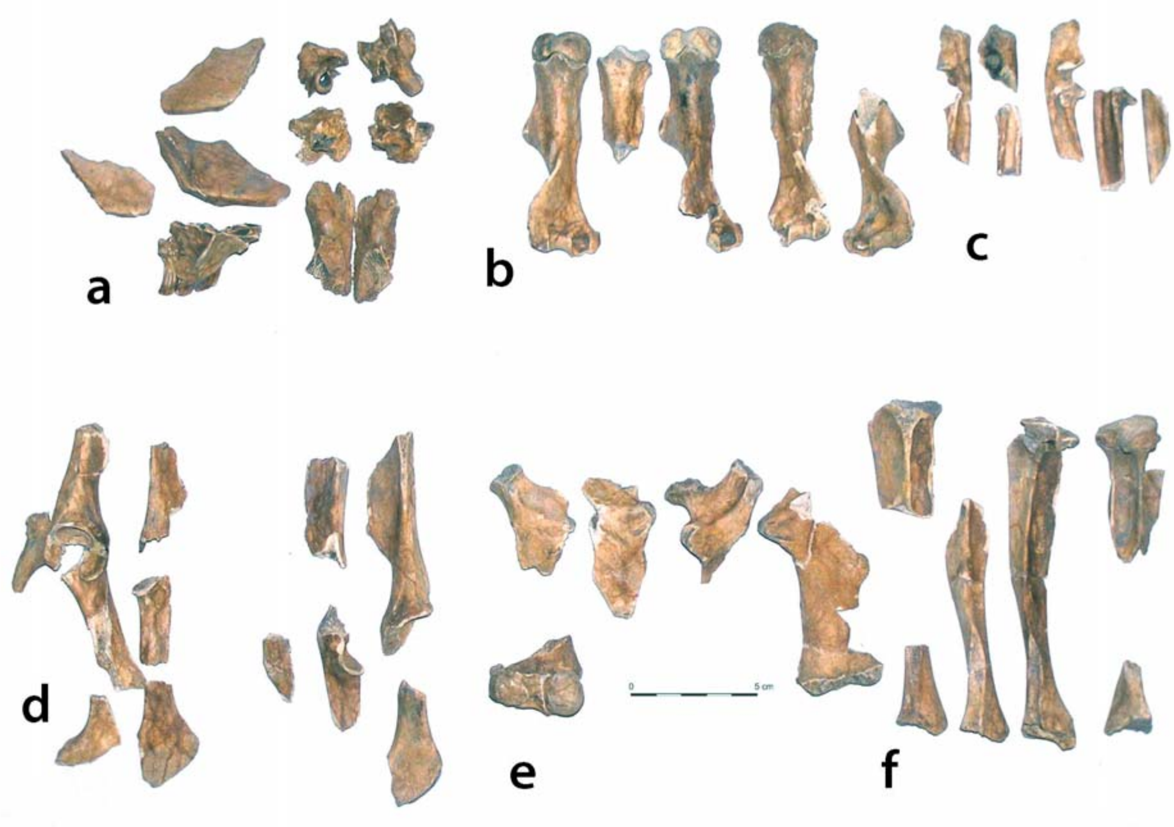


Fig. 1361. Pikutkowo, Site 6a, clay pit 1. Elements of 3 beaver skeletons: a) cranial elements, b) humeri, 3 left and 2 right, c) ulnae – 2 left, 3 right, d) elements of pelves – 2 left, 3 right, e) femora – 2 left, 2 right, e) tibiae – 3 left, 1 right.

Ryc. 1361. Pikutkowo, stanowisko 6a, glinianka 1. Fragmenty szkieletów trzech bobrów : a) fragmenty kości czaszki; b) kości ramienne, 3 lewe i 2 prawe; c) kości łokciowe– 2 lewe, 3 prawe; d) fragmenty kości miednicy – 2 lewe, 3 prawe; e) kości udowe – 2 lewe, 2 prawe; f) kości piszczelowe – 3 lewe, 1 prawa.

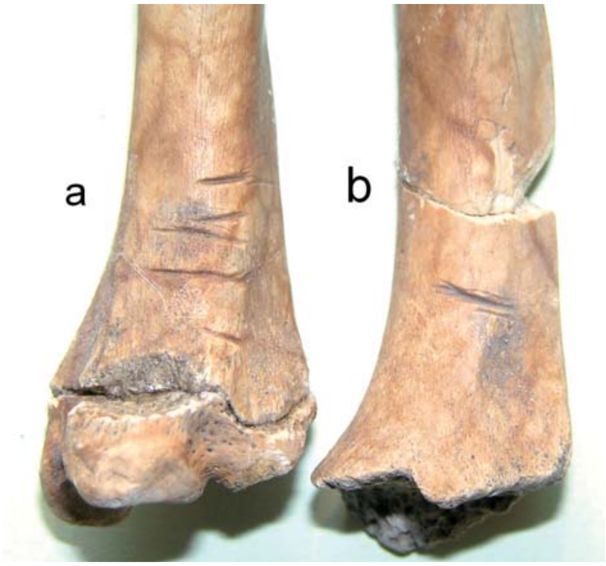


Fig. 1362. Cutmarks on distal tibiae of beavers from Pikutkowo.

Ryc. 1362. Nacięcia na dalszej części kości piszczelowej bobrów z Pikutkowa.

Bears at Osłonki

Perhaps the most unusual mammal species identified at Osłonki was the European brown bear, *Ursus arctos*. It was represented by seven relatively complete metatarsals, a metapodial fragment (probably also a metatarsal), and a calcaneus (Figures 1363–1365). Special care was taken with the identification of the calcaneus due to the morphological similarities between bear and human calcanea but the Osłonki specimen can be conclusively attributed to bear.

The metatarsals and the metapodial fragment came from the same context, Clay Pit 6. Four of them were found *in situ* adhering to each other with an unknown substance that also formed a concretion on the dorsal aspect, while the others showed traces of having been stuck together with the same substance. Figures 1363 and 1364 show the dorsal and plantar views of this metatarsal complex.

We can assume that the principal reason for bear parts to be in the Neolithic settlement was either as residue of the removal of the bearskin from the carcass or as bones that remained in the extremities of the bearskin. Perhaps the metatarsals were removed from a bearskin and discarded, or perhaps a deteriorating bearskin that still contained the metatarsals was thrown into the clay pit. The absence of phalanges, which would have been easily recognizable and large enough not to escape collection, suggests that these bear paws were not intact when they were deposited in the clay pit.

Fig. 1363. Dorsal view of bear metatarsals from Osłonki, Clay Pit 6.

Ryc. 1363. Widok z góry kości śródstopia niedźwiedzia z Osłonek, glinianka 6.

Fig. 1364. Plantar view of bear metatarsals from Osłonki, Clay Pit 6.

Ryc. 1364. Widok podeszwowy kości śródstopia niedźwiedzia z Osłonek, glinianka 6.

Fig. 1365. Bear calcaneus from Osłonki, Clay Pit 5.

Ryc. 1365. Kość piętowa niedźwiedzia z Osłonek, glinianka 5.

The Unusual Character of Falborz

For many years, we have considered the Lengyel occupation at Falborz to have been a "satellite" of Brześć Kujawski, possibly serving as a field camp or other specialized activity location (e.g. Bogucki 1979, 1982; Grygiel 1986), perhaps associated with the grazing of livestock on the meadows of the nearby Bachorza and Zgłowiączka valleys. As was noted above, the anatomical elements represented in the Falborz assemblages appeared to have an unusual representation. Bogucki's initial impression was that the number of major meat–bearing elements seemed too low and thus some distinctive cultural behavior must have been taking place, such as the provisioning of the nearby larger settlement at Brześć Kujawski.

A fairly simple analysis of whether or not primary butchery of the animal carcass is taking place on the site or away from it was used by Rosenberg et al. (1998) in their study of Hallan Çemi in Turkey. Limb bones were divided into meat–bearing (scapula, humerus, radius, ulna, pelvis, femur, patella, tibia, and fibula) and non–meat–bearing (metapodials, podials, and phalanges). The expected proportion of meat–bearing to non–meat–bearing elements for bovids and cervids if whole carcasses are butchered on site is 37% meat–bearing and 63% non–meat–bearing. For pigs, the more numerous metapodials cause the expected percentages to change to 30% and 70% respectively.

Table CCXV. Meat–bearing and non–meat–bearing bones at Falborz.
Tabela CCXV. Kości „mięsne" i „bezmięsne" z Falborza.

FALBORZ	Cattle	Sheep/Goat	Red Deer	Roe Deer	Bovid/Cervid Expected Value		Pig	Pig Expected Value
meat–bearing								
scapula	4	5	1	2			3	
humerus	4	4	0	2			1	
radius	0	4	0	1			5	
ulna	0	0	0	1			6	
pelvis	2	1	0	1			3	
patella	0	0	1	1			0	
femur	0	2	0	3			1	
tibia	2	1	0	3			4	
fibula	0	0	0	0			1	
	12	17	2	14			24	
%	**32.43%**	**60.71%**	**25.00%**	***73.68%***	**37.00%**		***64.86%***	**30.00%**
non–meat bearing								
carpal	2	0	0	0			0	
metacarpal	4	3	0	0			4	
calcaneum	2	0	0	3			0	
astragalus	5	0	0	0			1	
tarsal	2	0	0	0			0	
metatarsal	2	2	1	0			2	
metapodial	0	5	1	0			0	
phalanx I	6	1	2	2			0	
phalanx II	0	0	2	0			2	
phalanx III	2	0	0	0			4	
	25	11	6	5			13	
%	**67.57%**	**39.29%**	**75.00%**	***26.32%***	**63.00%**		***35.14%***	**70.00%**
totals	37	28	8	19			37	

The tabulation of meat–bearing to non–meat–bearing bones in the Falborz assemblage is tabulated in Table CCXV and produced some surprising results. Cattle bones match very closely the proportions of each category that would be expected for on–site primary butchery, and red deer bones are also present in similar proportions. The percentages for sheep/goat, roe deer, and pig, however, are almost the opposite of the expected values for on–site primary butchery, with very high proportions of meat–bearing bones and very low proportions of non–meat–bearing bones. These suggest that in many instances, these animals were killed and butchered elsewhere, with the meat–bearing bones being preferentially being brought to the Falborz settlement and the non–meat–bearing bones left behind.[4]

Thus, rather than being a provisioning camp as Bogucki had originally envisioned, Falborz itself appears to have been supplied with meat from small stock that had been killed elsewhere and from roe deer kills in the surrounding hinterland. Meanwhile, a small number of cattle and deer were butchered and consumed on the site. Eventually, such an analytical approach could be extended to other sites in this sample, although an inspection of the distribution of elements in the larger assemblages suggests that they can be expected to conform more to the model of on–site primary butchery.

6.8.2
COMPOSITE REGIONAL ANIMAL ECONOMY

The principal elements that make up the regional animal economy of southeastern Kuyavia during the fifth millennium B.C. are domestic ungulates, wild ungulates, pond tortoises, fish, and birds. Other taxa, while often not trivial (as in the case of beaver), are of minor significance in the overall picture.

Domestic Ungulates

The Neolithic animal economies of southeastern Kuyavia were dominated by domestic animals, usually amounting to over 90% of the faunal assemblages. Such an observation may seem obvious and trivial, but it is important to record it, for it contradicts earlier statements based on the Brześć Kujawski faunal assemblage alone that suggest to a higher proportion of wild animal bones on Kuyavian sites. Bogucki (1989, 1996, for example) is responsible for a large measure of this misconception, having strongly emphasized the higher proportion of wild ungulates in the Brześć Kujawski faunal assemblage in contrast to the pattern observed elsewhere in the early Neolithic of central Europe. It can now be stated, however, that the more common pattern is for sites of the Brześć Kujawski Group to yield faunal assemblages that are very closely aligned with the general pattern observed (with some exceptions) during the early Neolithic of central Europe, almost completely composed of the major domestic artiodactyls: cattle, sheep, goats, and pigs.

Let us go deeper than this general observation, however, and try to understand what it means. Perhaps the most obvious statement is that domestic livestock were able to satisfy the meat demands of the inhabitants of southeastern Kuyavia during the fifth millennium B.C. without much recourse to hunting. To judge from mortality curves at Osłonki and Brześć Kujawski, and supported by tooth eruption data from the other sites, all livestock species were used in a generalized meat–production strategy, with secondary products a secondary consideration. Pig were most definitely used this way, but so were the ruminants – cattle, sheep, and goat. Again, this is part of a general European early Neolithic pattern, as documented by Döhle (1993, 1997) and Benecke (1994) among others.

The use of four different livestock species, however, would imply that the animal economy was organized and internally differentiated. In other words, each of these species has different requirements for food and care and thus has a different relationship with their human keepers and to other aspects of the agricultural economy. Although the interplay between Neolithic com-

---

[4] In the case of roe deer, it is indeed possible that the proportion is skewed by the use of metapodials, especially metatarsals, for tool manufacture, but even allowing for the diversion of the metapodials, the low number of non–meat–bearing bones still suggests off–site butchery.

munities and their livestock will be discussed much further in several subsequent publications, a few general remarks can be made here.

Cattle and sheep occupy similar niches in that both are grazers who would have been able to feed on fallow fields and on other grassy patches such as in the floodplains of small streams. Bogucki (1982) proposed that Neolithic cattle were also grazed at relatively low stocking rates in the surrounding forests, based on abundant literature about modern forest grazing of cattle (e.g. Adams 1975). Sheep can also graze in forests. Recently, Vera (2000) has proposed that wild herbivore populations in pre–Neolithic Europe maintained a park–like forest rather than the dense wildwood that is usually reconstructed. Vera's hypothesis has been criticized by Mitchell (2005) but it has contributed to a reopening of the discussion of the natural character of the forest in which Neolithic farmers dwelt (e.g. Kreuz 2008). In any event, since cattle– and sheep–raising communities had been present in southeastern Kuyavia for several centuries prior to the establishment of the settlements discussed here, it is likely that there was ample open grazing space as well as forests in which the undergrowth was also conducive for low–density grazing. This mosaic would have been further refined during the several centuries of occupation by the Brześć Kujawski Group.

The role of goats in modifying the environment around these sites cannot be overstated. As browsers, goats do not compete with sheep and cattle for food but rather consume a different set of plants, including the vegetation of shrubs and saplings that would be part of the regeneration of plant cover from cultivated fields and other cleared land. Thus, the presence of goats in significant numbers can be cited as one of the causes of the long–term changes in vegetation observed in the pollen record from the Osłonki area reported by Nalepka (2005). Whereas the impact of sheep and cattle may have been softened by forest grazing in habitats whose vegetation may already have been pre–adapted to such activity by wild herbivores (per the Vera hypothesis), goats would have consumed a different range of plants that would have been hitherto only modestly affected by livestock. Goats would have played a role in the suppression of the regeneration of vegetation on abandoned fields, thus amplifying the changes seen in the regional pollen diagrams.

Of special interest is the proportion of goats to sheep. In the assemblages discussed in this report, goats outnumber sheep among the specimens that can be differentiated at many of the sites, particularly in the larger samples that could be presumed to provide a more accurate measure of relative species abundance in the living herd. For example, there are more goats than sheep at Brześć Kujawski, Osłonki, Konary, and Pikutkowo, in sheep:goat ratios between 1:1.6 to 1:2. At Falborz the ratio is 1:1, while at Miechowice 4a it is 1.3:1 sheep:goat. Miechowice 4 has 4.17:1 sheep:goat, 2.5:1 at Smólsk, and 1.9: 1 at Zagajewice.

Redding (1985, 1991) has discussed the significance of the sheep:goat ratio and the cattle: sheep/goat ratio with respect to the Near East and to Egypt, and while not wanting to overstretch his analysis too much to the very different environment of central Europe, there are some general observations that can be based on his reasoning. In Redding's view, a mixed caprine population in which energy and protein offtake is the major goal should have a sheep:goat ratio of between 5:1 and 1:0 depending on the environmental conditions. On the other hand, if the goal is herd security, defined as the minimization of fluctuations in herd size, the ratio of sheep:goats should be somewhere between 1.7:1 and 1:3, with goats either equal to the number of sheep or outnumbering them. This is due to the ability of goats to reproduce more abundantly than sheep over time and the differential ability of sheep and goat herds to rebound from losses

The samples from Brześć Kujawski, Osłonki, Konary, Pikutkowo, Falborz, and Miechowice 4a would fall into the herd–security model according to Redding, with the other three lying farther in the direction of energy or protein offtake. Given the relatively small size of the Miechowice 4, Smólsk, and Zagajewice samples, the regional consensus seems to point in the direction of the management of the herds of sheep and goat with the goal of maximizing long–term security, or sustained yield (per usage of Redding 1984: 239). Again, this interpretation is based on a degree of modeling against ideal expectations, but it points toward an interesting hypothesis that bears further testing with data from Neolithic Kuyavia.

Much can be said about pigs, far more than the space available here. At a minimum, it is necessary to consider the possible ways in which they could be managed. Bogucki (1989) proposed a system in which pigs were essentially allowed to roam freely in the environs of the settlement with minimal human oversight, which would have brought them into contact with indigenous wild pigs with the resultant interbreeding. New evidence of a significant introgression of wild pig genes into the domestic pig population around 4000 B.C. (Larson et al 2007) provides some measure of credibility to this model. Grigson (1982: 305) pointed out that efficient pig management lies in the ability of people to maintain a portion of the pig population, especially the pregnant sows) in captivity for farrowing. This results in the necessity to provide shelter for the domestic pigs during the winter and feeding them on stored grains and on rubbish.

Redding and Rosenberg (1998) have proposed a model of Neolithic pig breeding in which all managed pigs are the result of matings between wild boars and domestic sows, which they call the "female breeding model". Thus the managed pigs consist of domestic females and their young. Human breeders do not have to care for large, hungry, and possibly aggressive males, and it is only necessary to provide shelter and food for farrowing females and their young through the winter. Redding and Rosenberg developed their model of female breeding with regard to very early Neolithic sites in the Near East, and they indicate (1998: 68) that with the advent of grain agriculture it would be expected to be abandoned due to the difficulty of keeping the pigs away from the cereals. Nonetheless the presence of evidence for large wild pigs among the pig samples from sites like Osłonki, the co–occurrence of pigs and grains at these sites, and the evidence of Larson et al (2007) for significant inflow of wild pig genes around this time suggest that such a female–breeding model may have been employed in southeastern Kuyavia in the fifth millennium B.C. The next challenge would be to test it archaeologically against large samples such as the one from Osłonki, which Bogucki hopes to do at a future date.

Marciniak (2005) has advanced the hypothesis that cattle and pig were consumed in a highly–structured ceremonial fashion at early Neolithic sites in Kuyavia, while sheep and goat were consumed in a more typical manner. He bases this argument on his meta–analysis of a number of Kuyavian Neolithic faunal assemblages, in particular the differential representation of anatomical elements. Bogucki did not have an opportunity to assess Marciniak's methods fully before the deadline for this report, but it is his intention in the future to test them with the Osłonki assemblage to see whether or not it is possible to sustain this argument.

Wild Ungulates

The corollary to the fact that the animal economy of southeastern Kuyavia during the fifth millennium B.C. was based overwhelmingly on domestic ungulates is that the hunting of wild herbivores is very low indeed. Only at Brześć Kujawski and to a lesser degree Falborz do red deer and roe deer appear as significant components in the faunal assemblage. Elsewhere, they are present in small quantities. When the number of shed antlers is taken into account, the representation of hunted red deer shrinks even further. Wild cattle and pig are indeed present at all sites and cannot be overlooked completely, but there appears to be no systematic effort to harvest these species. Even the removal of bones of wild animals, such as roe deer metapodials, from the faunal samples for tool manufacture does not account for the generally low percentages recorded at these sites.

The relatively low level of hunting does not contradict the fact that in the forests and fields surrounding the Neolithic settlements of southeastern Kuyavia there was a substantial resource base of wild ungulates. For one reason or another, the inhabitants of these sites chose not to exploit it more than they did. The abundance of red deer and roe deer at Brześć Kujawski illustrates the potential level of its exploitation, but this was not the level chosen by the inhabitants of the sites elsewhere in the region, most notably at Osłonki.

Fig. 1366. Heavily–weathered shed roe deer antler from Osłonki, Clay Pit 6.

Ryc. 1366. Zrzucone poroże kozła sarny, mocno zwietrzałe, pochodzące z Osłonek, glinianka 6.

So why did the inhabitants of these sites bother to hunt at all? One possibility, raised by Bogucki (1981, 1982) in his analysis of the Brześć Kujawski fauna, is that the hunting of wild herbivores was done to protect crops from damage. Uerpmann (1977) was the first to raise the possibility of Neolithic hunting for crop protection, and in other parts of the world such "garden hunting" was of crucial importance for prehistoric people (e.g. Linares 1976). In light of the view that Neolithic farming was an intensive, concentrated activity (Bogaard 2004), crop protection from wild herbivores would have been very important. It seems to be a very strong possibility that many of the wild ungulates whose bones are found in Neolithic settlements were killed during crop raiding rather than through expeditions deeper into the forest.

Another possibility, raised by Boyle (2006) with regard to the Neolithic in western Europe, is that hunting was a prestige activity in which success conferred status. This motivation is even more difficult to test archaeologically, although some indication of the status of red deer may be the presence of mattocks made from antler beams in male graves, admittedly a tenuous link. Hunting may also have been a diversion during the winter when agriculture occupied less time.

The relative lack of interest in wild ungulates at most Kuyavian sites during the fifth millennium B.C. contrasts with the systematic exploitation of tortoise, fish, and waterfowl, discussed further below. Remains of multiple beavers at Brześć Kujawski and Pikutkowo show that when a wild animal was highly desired, the effort could be expended to hunt it. In the case of wild ungulates, it appears that they did not supply any particular resource that could not be obtained from the domestic livestock (even antlers could be gathered when shed rather than taken from hunted red deer) so apparently it was not worth the effort to pursue them in any broadly systematic way.

The Significance of ***Emys orbicularis***

The significant number of pond tortoise bones at Brześć Kujawski and Osłonki, as well as their presence at many of the other sites reported in this study, not only reflects the use of this species as a nutritional resource but also the environment around the settlements. First, the presence of thermo–sensitive reptiles such as *Emys orbicularis* can provide information on the ambient temperature in southeastern Kuyavia during the fifth millennium B.C., and second, the nesting habits of the pond tortoise can shed light on the prehistoric landscape in which anthropogenic changes may have improved conditions for their propagation. It must be kept in mind that the pond tortoise bones at these sites are not unusual or rare, but rather are an expected part of the faunal sample from any feature with a sizeable number of bones. As such, they reflect a species that was common in the surrounding habitat rather than one that was encountered once every few years. We can assume that the lakes and bogs of southeastern Kuyavia supported large populations of *Emys orbicularis,* although not so many that it was a dietary staple.

Although the recent range of the pond tortoise is largely in southern Europe, it continues to exist in some specific habitats in northern continental Europe, although it is considered endangered. Its Holocene range expansion into northern Europe was made possible by the higher temperatures during the Atlantic climatic period. A key determinant of the northern distribution of *Emys orbicularis* is the east–west climatic gradient from cooler summer temperatures in western Europe to warmer summer temperatures in eastern Europe (Lenk et al. 1999:1919). The latter favor the pond tortoise, and thus its abundance in southeastern Kuyavia during the fifth millennium B.C. testifies to warm summer temperatures, consistent with the prevailing model of mid–Holocene climate.

Observations of the nesting behavior of the pond tortoise can shed light on the prehistoric landscape surrounding the sites. Najbar and Szuszkiewicz (2007) report that female pond tortoises in western Poland laid eggs in sunny forest clearings at the end of May and early June. These nesting grounds were an average of 77 meters from the channel of the nearest main stream, although some small tributaries may have permitted them to cover some of this distance in water rather than completely over land. The female tortoises returned to the same nesting areas repeatedly. Overshadowing of the nesting areas by vegetation regeneration caused the tortoises to abandon them, however.

Bogucki (1981) first suggested that the sharp increase in pond tortoise remains during the final occupation phase at Brześć Kujawski may reflect anthropogenic landscape changes, specifically the opening and maintenance of cleared fields. Support for forest clearance and anthropogenic vegetation changes during the Lengyel occupation of this region is supported by the palaeobotanical analyses of Dorota Nalepka (2005). Now that the high presence of *Emys orbicularis* has been demonstrated at Osłonki as well as at Brześć Kujawski, and in light of their documented preference for open, sunny clearings, it is now possible to postulate again that the increase in quantity of pond tortoise bones on these sites is a corroborating proxy indicator of anthropogenic landscape modification.

Birds and Fish: Additional Economic Diversification

The role of fish and birds in the economy of the Neolithic settlements of southeastern Kuyavia is difficult to assess. Clearly effort was expended to catch fish and hunt birds, and the traces of this activity are clearly visible, particularly at larger sites like Brześć Kujawski and Osłonki. Yet it is not possible to say that these were mainstays of the economy. More probably, their abundance in the local habitat meant that it would have been foolish not to take advantage of them. Thus the significance of their exploitation lies somewhere between opportunistic and critical.

The extent of fishing seen at the Neolithic sites of southeastern Kuyavia is not paralleled elsewhere in Neolithic central Europe during the fifth millennium B.C., although this is probably more an effect of the lack of preservation and recovery than of economic behavior. Only the anomalous site of Hüde am Dümmer, clearly not from the same cultural tradition, shows a comparable level of fish exploitation (Hüster 1983), as do the very early Funnel Beaker sites such as Bistoft LA11 (Johansson 1979, 1981).

In the case of birds, their seasonal abundance, particularly on harvested fields and lakeshores, would have been impossible to miss. The abundance of waterfowl would have presented an opportunity too good to miss. In contrast to the concentration on ducks and geese at Brześć Kujawski, a sample of 74 bones from Paraneolithic contexts dated to the Atlantia/Subboreal transition at Dudka in the Mazurian Lakeland about 200 km NW of Brześć Kujawski revealed a more diverse pattern. (Gumiński 2005). Although most bones were from ducks and geese, a broader spectrum of aquatic, terrestrial, and woodland species was exploited.

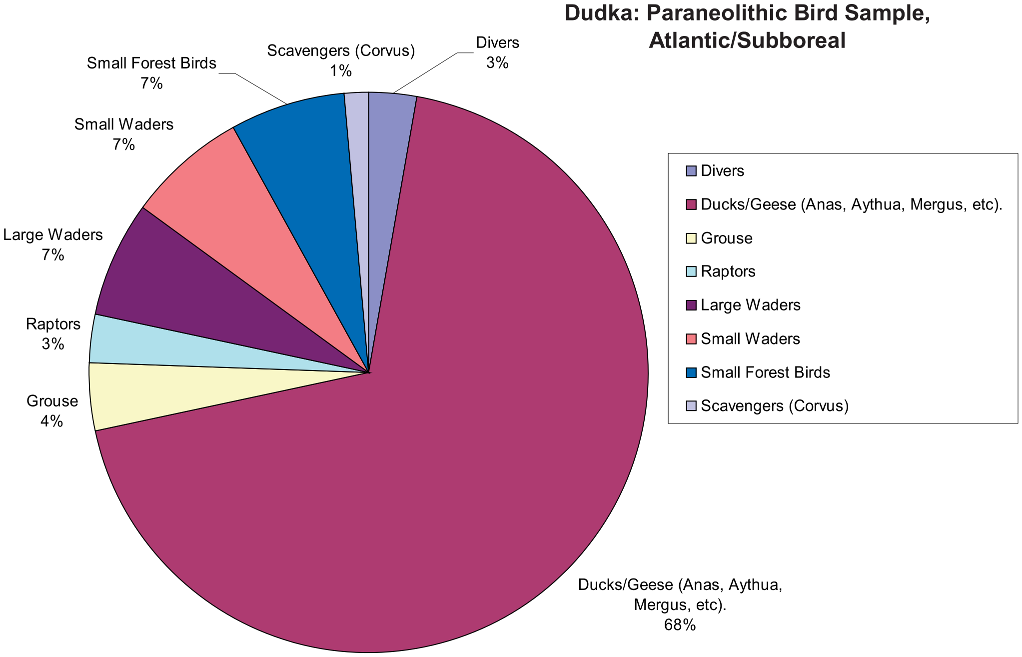


Fig. 1367. Diversity of birds exploited by Paraneolithic inhabitants of Dudka at the Atlantic/Subboreal transition.

Ryc. 1367. Rozmaitość ptaków eksploatowanych przez paraneolitycznych mieszkańców Dudki na przełomie od okresu atlantyckiego do subborealniego.

The significance of the finds of large numbers of bird bones at Brześć Kujawski and Osłonki is highlighted by the fact that bird bones are so scarce at Neolithic sites in interior Europe. At the circular enclosure at Ölkam in Austria, where a very large sample of animal bone was recovered, only 16 bird bones were found, of which 10 could be identified (Schmitzberger 1999). They were largely from birds of the deciduous upland forests and fields, including capercaillie, lesser spotted eagle, corn crake, and carrion crow. From the large fourth millennium B.C. settlement at Bronocice in upland southern Poland, 20 bird bones were recovered, of which 17 were identified to three species: black grouse, capercaillie, and common crane (Bocheński 1982).

Thus, the regional sample of several hundred Neolithic bird bones from southeastern Kuyavia reflects the heightened exploitation of birds where they were abundant, especially of waterfowl. A similar predation pattern is seen in Brittany (Tresset 2005), the Netherlands (Zeiler 2006) the Funnel Beaker sites of northern Germany (Ewersen 2003), and the Masurian Lake region in NE Poland (Gumiński 2005), where locally abundant waterfowl and terrestrial birds were hunted extensively. The interesting development in southeastern Kuyavia is that here at the edge of the Danubian world we see farmers taking advantage of the abundant wild resources that had been the mainstays of the Mesolithic foraging economy for several millennia.

Summary: the Mature Animal Economy in Neolithic Kuyavia

In contrast to the cattle–heavy animal economy of the Linear Pottery culture of the sixth millennium B.C., the animal economy of the Neolithic societies of Kuyavia during the fifth millennium B.C. was diversified among several major livestock species and several species of wild ungulates, supplemented by fish, turtles, and waterfowl. The relative consistency among assemblages, or at least the lack of dramatic imbalances between wild and domestic species or among the major domestic taxa would suggest that it is possible to characterize the animal economy of the Brześć Kujawski Group as "mature". Moreover, there appears to be no clear specialization on any one species, suggesting that the use of the major animal taxa was integrated into a stable economic strategy. This strategy also would have included the domestic and wild plant species used by the inhabitants of these sites (Bieniek 2002) and the other economic relationships among the households in the community and the world beyond.

In the mature Neolithic animal economy of the fifth millennium B.C., each major category of livestock played a particular role. Pigs satisfied the "base demand" for meat and other primary products like hides, fats, tallow, and other animal by–products. They are cheap animals to keep, meaning that it is not necessary to feed them very long before they reach their maximum meat weight. In general, they are able to find their own food, in and around the settlement and in the fields and forests. They can be tended by children and the elderly, so they enable otherwise non–productive members of society to contribute to the household economy. Pigs also reproduce abundantly, so it is not necessary to keep a large dedicated breeding population.

Sheep and goats, which had been part of the Neolithic economy in central Europe since the sixth millennium B.C., played a somewhat more complex role. They are more expensive to keep than pigs, for they need to be kept somewhat longer and have only one or two kids or lambs at a time. It is thus necessary to maintain a larger breeding stock. It is generally necessary to keep a fairly large flock, so it one or two are lost to a predator it is not a crippling loss. In addition to providing meat and possibly secondary products like milk, sheep and goats probably played an important role in barter, bridewealth, and the other sorts of petty economic transactions that occurred among households in the Neolithic hamlet.

Cattle would have been the jumbo jets of the Neolithic economy. They are large and heavy, so they need space, both outdoors and indoors. Cattle grow slowly and reproduce relatively slowly, usually singly, so they need to be kept longer than sheep and goats. They also carry a higher degree of risk. If a cow or ox dies before its time, or if one is stolen or turns feral, a large investment is lost. The returns from cattle, however, are substantial. First, they yield a tremendous amount of meat, which can be eaten right away, preserved for future use by smoking or drying, and exchanged in transactions between households. They also provide large hides.

Then, there are secondary cattle products such as milk and possibly animal traction. The evidence from the Neolithic faunal assemblages in southeastern Kuyavia for their use in the fifth millennium B.C. is equivocal at best, although there are hints. Logically, however, it seems clear that the widespread use of secondary products, for which clear evidence begins to appear in the fourth millennium B.C., did not spring forth fully formed. There must have been antecedents and experiments, once the major elements of the meat–producing Neolithic economy became established and stable.

6.8.3

BROADER PICTURE IN TIME AND SPACE

The search for comparative faunal data from the fifth millennium B.C. across central Europe resulted in the astonishing realization that there continue to be very few regional collections of Danubian faunal assemblages comparable to those found in the Polish lowlands. While samples from southern Scandinavia and extreme northern Germany, as well as from lakeside settlements in the western Alps, have been published with regularity, very little work has been done on faunal samples from Neolithic settlements in the Danubian world. A major part of this is the result of poor bone preservation on loess. Yet it seems that even allowing for this factor, the number of archaeozoological analyses of Danubian settlements is nowhere near what might have been predicted from the interest 30 years ago in animal bones and the information they contain on human behavior.

Parallels with the Villeneuve–Saint–Germain Group and Cerny Culture of the Paris Basin

The major exception to the generalization above is the cluster of Neolithic sites in the Paris Basin, specifically the Late Linear Pottery (*Rubané Recent*) of the late sixth millennium B.C. and its successors, the Villeneuve–Saint–Germain and Cerny Groups of the fifth millennium B.C.. The Paris Basin sites are either on redeposited loess or gravel terraces, and thus the bone preservation is far better than in the decalcified loess uplands of central Europe. Thus the Neolithic sites of the Paris Basin during the sixth and fifth millennia B.C. provide excellent contemporaneous archaeozoological comparanda for the assemblages from the Polish lowlands.

A Neolithic regional group that is very close culturally, ecologically, and chronologically to the Brześć Kujawski Group in Kuyavia is the Villeneuve–Saint–Germain (VSG) Group of the Paris Basin. The VSG Group is a late Danubian cultural group of the fifth millennium B.C. that shows many continuities from earlier Linear Pottery farming communities but also has distinct features. Many VSG settlements have yielded large samples of animal bones which have the potential to provide important comparanda for the faunal samples of the Polish lowlands, although unfortunately much of this information is not yet widely published in journals and monographs.

As with many Brześć Kujawski Group animal bone samples, VSG faunal assemblages are usually dominated by domestic cattle (usually about 60–80% of NISP) but with greater numbers of sheep/goat (between 5 and 20%) and pigs (between 10 and 30%) than in the earlier Linear Pottery faunal assemblages in this area (see Arbogast 1995: Figure 6). There are notable exceptions to this generalization, such as Longueil–Sainte–Marie LBR II and LBR III, where the faunal samples have significant numbers of pigs (67% and 38% respectively), fewer cattle, and very few sheep/goat (Arbogast 1995). Although somewhat different in character from the faunal samples of the Brześć Kujawski Group, the VSG fauna display a similar heterogeneity that contrasts that the extreme predominance of domestic cattle at Linear Pottery sites.

Bedault and Hachem propose that it is possible to observe changes in the VSG economy over time (Bedault 2006, Bedault and Hachem 2008). In the early VSG, the economy is focused primarily on cattle and secondarily on sheep and goat, while in "classic" VSG, pig replaces sheep and goat as the livestock species of importance second only to cattle. Arbogast (1995: 327) suggests that the rise in pig use in VSG presages the animal economies of the Middle Neolithic. My own interpretation is that the VSG faunal assemblages provide another example of the emergence of mature animal economies during the fifth millennium B.C. in contrast to the earlier cattle–dominated animal economies of the sixth millennium.

The development of a mature animal economy in the Paris Basin continued in the Cerny Culture of the second half of the fifth millennium B.C. (Tresset 1997), which appears to succeed VSG in this area but with novel cultural features such as earthen long barrows, enclosures, and new patterns of land use. Cerny faunal assemblages are dominated by cattle, with pigs now consistently in second position. Mortality profiles of Cerny cattle suggest that secondary products such as milk and traction now figured more significantly in the animal management strategy (Tresset 1997: 303–309).

Eventually, a more detailed comparison between the Neolithic faunal assemblages of the Paris Basin and those of southeastern Kuyavia will be very fruitful. In both region, Linear Pottery communities also settled off the loess and were succeeded by local groups that not only continued the earlier traditions of settlement and architecture but also engaged with non–Danubian communities beyond the Neolithic frontier. These in turn were succeeded by *in situ* cultural formations as the Neolithic frontier moved on. In light of the similarities noted by Midgley (2005) between the post–Danubian Funnel Beaker Culture of the Polish Lowlands and the Cerny Culture of the Paris Basin during the late fifth millennium and fourth millennium B.C., parallel developments in regional animal economies during the previous centuries would not be unexpected.

The Animal Economy at Vésztő–Bikeri in Hungary

Another region in central Europe that provides rich evidence for regional animal economies during the fifth millennium B.C. is the Carpathian Basin. Over the last 50 years, many Hungarian Late Neolithic/Copper Age faunal assemblages have been identified, in many cases by the late Sándor Bökönyi (e.g. Bökönyi 1971). The Hungarian data are too numerous and varied both regionally and chronologically to summarize here, but they offer the potential for broad comparisons with other regional animal economies in central Europe during the fifth millennium B.C.

Without trying to draw more than is warranted from such a comparison, it is worth considering here a recently–reported faunal assemblage from the Tiszapolgár settlement of Vésztő–Bikeri located in the valley of the Körös river (Parkinson, Yerkes, and Gyucha 2002; Nicodemus 2003)[5]. Nicodemus analyzed a faunal assemblage of 2838 identified specimens, of which 83% belonged to domestic mammals, with most of the remainder coming from wild ungulates, fish, birds, and tortoises. The resource diversity is thus very similar to that seen at the sites of the Brześć Kujawski Group, despite their distant separation.

Charting the NISP of the major economic mammal species at Vésztő–Bikeri produces Figure 1368 which bears a striking similarity to the overall proportions of taxa found, for example, at Osłonki. While it may be possible to dismiss this similarity as coincidental, nonetheless it may provide another example of a mature diversified animal economy of the fifth millennium B.C. Pig comprise a quarter of the NISP, while sheep and goat make up another 32%. The hunting of wild ungulates is low but noticeable. Moreover, mortality data for the Vésztő–Bikeri livestock indicates that meat production was still the major goal, consistent with the evidence from the Kuyavian samples.

The purpose in mentioning the fauna from Vésztő–Bikeri here is not to suggest that there are any cultural connections between the Hungarian Plain and the Polish Lowlands but rather to indicate that during the fifth millennium B.C. mature diversified animal economies were emerging in many parts of central Europe. These regions had already been settled by agriculturalists for a millennium or more, but earlier animal economies had a more pioneer or experimental character. It took over a millennium for the early farmers of central Europe to find proportions of livestock that worked for particular regions and for the other aspects of the subsistence and settlement system to be harmonized with the needs of the different species. These animal economies in turn formed the foundation for the next transformation in the relationship between people and their animals, the Secondary Products Revolution of the fourth millennium B.C.

Red Deer Hunting in Austria

So as not to suggest that all animal economies during the fifth millennium B.C. were so heavily weighted toward domestic livestock, a contrasting picture is presented by a faunal sam-

---

[5] The author is grateful to Amy Nicodemus of the University of Michigan for permission to cite her 2003 Master's thesis submitted to the Department of Anthropology at Florida State University.

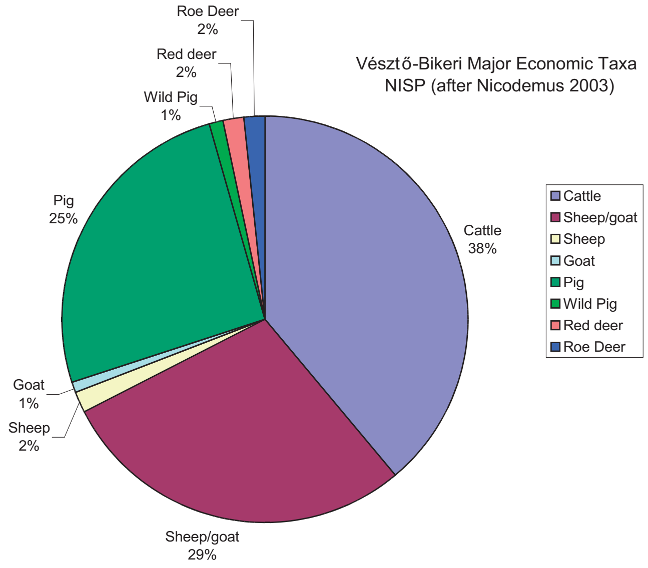


Fig. 1368. NISP of major economic taxa from Vésztő–Bikeri (after Nicodemus 2003).

Ryc. 1368. GLS głównych gatunków zwierząt gospodarczych z Veszto–Bikeri (wg Nicodemusa 2003).

ple from a Lengyel settlement pit at Melk–Winden in Austria (Pucher 2004). A total of 2207 NISP came from five domestic and fourteen wild mammal taxa, along with three types of birds and the pond tortoise. The principal economic taxa (NISP= 2064) were dominated by red deer, roe deer, and wild pig, while a quarter of the NISP came from domestic cattle (Figure 1369). Very few sheep and goat, and no definitive sheep bones, were found.

An even more extreme case of red deer exploitation is shown by the faunal remains from the circular ditched enclosure (*Kreisgrabenanlage*) at Ölkam, also in Austria (Schmitzberger 2001). At Ölkam, almost 90% of the 3462 mammal NISP came from wild ungulates, especially

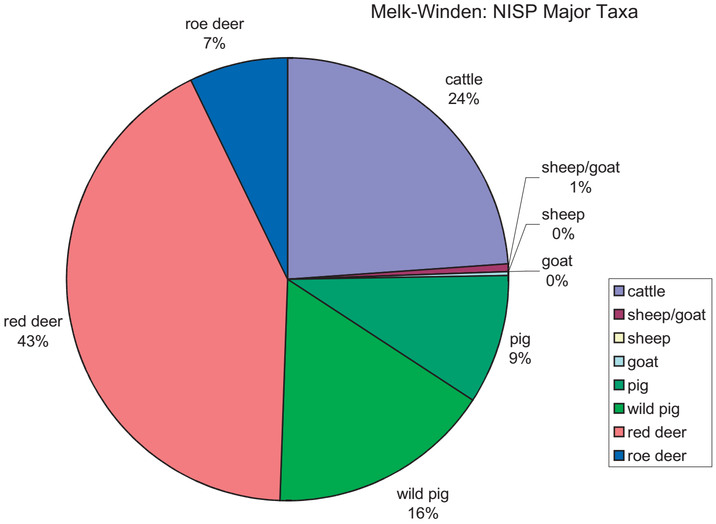


Fig. 1369. NISP of principal economic taxa from Melk–Winden, Austria (based on data in Pucher 2004).

Ryc. 1369. GLS głównych gatunków zwierząt gospodarczych z Melk–Winden w Austrii (w oparciu o dane zamieszczone u Puchera 2004).

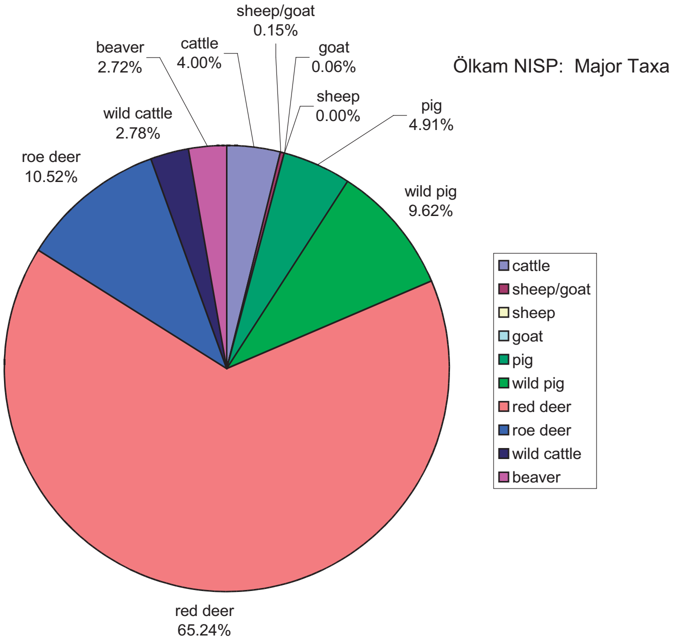


Fig. 1370. NISP of principal economic taxa from Ölkam, Austria (based on data in Schmitzberger 2001).

Ryc. 1370. GLS głównych gatunków zwierząt gospodarczych z Olkam w Austrii (w oparciu o dane zamieszczone u Schmitzbergera 2001).

red deer but also including significant components of wild pig and roe deer along with some wild cattle (Figure 1370 below). Again, very few sheep and goat, with no definitive sheep bones, were found, along with a relatively small number of cattle and domestic pig bones.

Clearly certain biotopes in central Europe were well suited to high populations of cervids. It might be suggested that a similar local concentration of red deer and roe deer might account for the relatively high proportions of these species observed at Brześć Kujawski in comparison with the other Lengyel sites of southeastern Kuyavia. The presence of anomalous local faunal assemblages should be expected, and only the study of many contemporaneous samples can give an accurate picture of the regional animal economy.

The Brześć Kujawski Group and the Early Cattle of the Baltic Basin

It is increasingly apparent that the first element of the Neolithic economy to reach the foragers of the Baltic basin at the end of the fifth millennium B.C. was domestic cattle (Noe–Nygaard and Hede 2006) The initial agricultural expansion of the Linear Pottery culture during the sixth millennium B.C. had brought domestic cattle to the North European Plain, along the lower Oder and Vistula rivers. Yet there is no evidence yet of domestic cattle in the south Baltic area contemporaneous with the Linear Pottery culture, despite its proximity. It was only during the second half of the fifth millennium B.C. that the leakage of cattle through the farming frontier and through the borderland between the world of the Danubian farming communities and the world of the Baltic foragers took place.

The closest Neolithic agricultural population with substantial populations of domestic cattle during the fifth millennium B.C. on the North European Plan was the Brześć Kujawski Group of the Lengyel Culture. There is simply no other candidate for a thriving animal economy with significant farming populations keeping substantial livestock populations along the farming frontier at this time. It thus seems likely that the starting point for at least some of the cattle that found their way north to the Baltic basin toward the end of the fifth millennium B.C. was the Kuyavian plateau.

What mechanisms are possible for the transfer of cattle from farmers to foragers? Forager–farmer exchange is clearly a possibility, and Klassen (2000) and Zvelebil (2006) note the movement of many types of items between the Baltic zone and interior Europe. Theft of cattle by foragers is also a possibility. The simplest mechanism for the northward movement of cattle during the fifth millennium B.C. is the escape of livestock from human control.

Bogucki (1995) speculates about the potential for feral cattle to penetrate the farming frontier in northern Europe. He points out that in colonial North America feral livestock were a major concern, and animals routinely escaped their human owners and went into the wilderness. Large herds of feral cattle could be found in the Carolinas, for example. In northern Europe, this process may have been facilitated by the creation of artificial glade habitats through burning by foragers. Feral cattle would have found these to be congenial spots in the forest to feed and eventually to multiply.

Ultimately, the source of the earliest cattle in the Baltic zone will have to be addressed through DNA analysis. The accumulating number of early cattle bones dated very close to 4000 B.C. should provide some useful archaeogenetic material. When this research is undertaken, it will be necessary to sample the cattle bones from sites of the Brześć Kujawski Group to see whether the speculation here can be substantiated.

6.8.4

SUMMARY: MATURE ANIMAL ECONOMIES OF CENTRAL EUROPE DURING THE FIFTH MILLENNIUM B.C.

The fifth millennium B.C. saw the establishment of what can be termed “mature animal economies” throughout central Europe, and the faunal remains from sites of the Brześć Kujawski Group of the Lengyel Culture reflect this development. These economies were different from the pioneer animal economies of the sixth millennium B.C. that characterize the early farming communities. In central Europe, such pioneer economies are weighted heavily toward domestic cattle, just as in southeastern Europe the pioneer Neolithic animal economies were dominated by ovicaprids. In a mature animal economy, one finds a greater diversity of livestock species, each playing a specific role not just in their contribution to diet but also in their utilization in the household economy.

These were still primarily meat–production economies, however, although it is likely that dairy products were exploited in a secondary role. Exostoses on cattle lower limbs provide hints of possible early attempts at animal traction, as a precursor to the definitive evidence for its use during the fourth millennium B.C. Although the restructuring of animal economies around greater use of secondary products did not take place until the fourth millennium B.C., such mature animal economies during the preceding millennium set the stage for the Secondary Products Revolution and its implications for wealth creation and differences in status and power.

At the same time, wild resources played a low but consistent role in the animal economy of the Brześć Kujawski Group. Wild artiodactyls, such as wild cattle, wild pig, red deer, and roe deer were hunted, perhaps more opportunistically rather than systematically. The scarcer wild species, such as wild horse and bear, themselves generally solitary by nature, were certainly only hunted when the opportunity arose, probably when they were unfortunate enough to have wandered too close to the settlements, their fields, or their connecting trails. Fur–bearing mammals, such as otter and especially beaver, on the other hand, were specific targets of human predation, as shown by the beaver butchery and skinning activity that occurred at Brześć Kujawski and Pikutkowo.

Exploitation of tortoises, fish, and waterfowl complemented the mammal economy. The intensity of this use of aquatic resources only becomes apparent when the sites of the Brześć Kujawski Group are compared with contemporaneous sites elsewhere in central Europe, where the recovery of isolated traces of tortoise, fish, and birds is considered to be unusual, whereas in southeastern Kuyavia such finds are ubiquitous. Each of these taxa may have had its position in the annual cycle. Waterfowl in particular may have been winter and spring quarry, while turtles probably were caught during the warmer months.

This study highlights the importance of studying faunal exploitation on a regional scale rather than relying on a single site to determine the overall pattern. While it is rarely possible to find so many Neolithic sites with substantial collections of animal bones within a single region in central Europe, the desirability of regional analysis is apparent. Only when sufficient faunal samples in many different regions are fully studied will it be possible to understand the variability in Neolithic animal exploitation.

6.9

Wykorzystanie zwierząt przez grupę brzesko–kujawską kultury lendzielskiej: streszczenie

Od momentu wznowienia prac wykopaliskowych w Brześciu Kujawskim w 1976 roku, pozyskanie, oraz analiza kości zwierzęcych stały się głównym celem programu badawczego omawianego w tym tomie. Zawiera on sprawozdanie z analizy dziesięciu próbek kości zwierzęcych, pochodzących z dziewięciu stanowisk, między innymi z Brześcia Kujawskiego, Osłonek, Falborza, Miechowic 4 i 4a, Pikutkowa, Konar, Smólska i Zagajewic. Próbki, pochodzące z trzech pierwszych stanowisk przebadał P. I. Bogucki, natomiast analizy pozostałych sześciu stanowisk dokonał Daniel Makowiecki, który również przebadał materiał z jednej niewielkiej, uzupełniającej próbki z Osłonek. P. I. Bogucki, który jest autorem sprawozdania zamieszczonego w tym tomie, chciałby wyrazić wdzięczność dr Makowieckiemu za udostępnienie danych, pochodzących z w /w próbek kości. Za ewentualne błędy rzeczowe, lub interpretacyjne odpowiada P. I. Bogucki. Niniejsze sprawozdanie przedstawia kości zwierząt poddane tradycyjnej archeozoologicznej analizie, ze zwróceniem szczególnej uwagi na działalność gospodarczą grupy brzesko–kujawskiej. Podane tu informacje mogą być w przyszłości wykorzystywane w różnych schematach analitycznych przez badaczy o zróżnicowanych podejściach naukowych.

Omówienie zamieszczone w tym tomie dotyczy gospodarki zwierzęcej grupy brzesko–kujawskiej w południowo–wschodniej części Kujaw w piątym tysiącleciu BC. Należy je traktować, jako uzupełnienie analizy, zamieszczonej w tomie I, a dotyczącej gospodarki zwierzęcej w okresie kultury ceramiki wstęgowej rytej. W okresie szóstego tysiąclecia BC. gospodarka zwierzęca kultury ceramiki wstęgowej rytej dotyczyła głównie bydła domowego, przy niewielkim wykorzystaniu owcy i kozy, oraz praktycznie całkowitym braku świni domowej. Zasada ta obowiązuje na wszystkich stanowiskach kultury ceramiki wstęgowej rytej w południowo-wschodniej części Kujaw i odzwierciedla bardziej ogólną tendencję na terenie całej Europy. Taka szczególna uwaga poświęcona hodowli bydła tj. opieka nad nim do okresu dorosłości, oraz zabezpieczenie przed chorobą, kradzieżą, lub zaginięciem jest cechą charakterystyczną kultury ceramiki wstęgowej rytej. Jest to cecha nieco zaskakująca, wziąwszy pod uwagę pionierski charakter tej kultury na terenie południowo–wschodnich Kujaw.

Stanowiska kultury ceramiki wstęgowej rytej charakteryzują się stosunkowo niewielką liczebnością kości dzikich ssaków, gadów, ryb i ptaków. Na przestrzeni ostatnich 30 lat przebadano wystarczającą ilość stanowisk w południowo–wschodniej części Kujaw, ze zwróceniem szczególnej uwagi na szczątki zwierzęce, aby stwierdzić, że jest to wyraźnie rezultat celowej działalności człowieka, związanej z określoną kulturą, a nie wynik procesów tafonomicznych, bądź technik wykopaliskowych. Stosunkowo niewielka liczba kości dzikich zwierząt kopytnych takich jak: jeleń, sarna, dzikie bydło i dzika świnia jest jeszcze bardziej zaskakująca, wziąwszy pod uwagę fakt, że w /w gatunki najprawdopodobniej licznie występowały w lasach polskich nizin w szóstym tysiącleciu BC.

Podczas tej części piątego tysiąclecia BC, kiedy rozkwitała grupa brzesko–kujawska, sposób wykorzystania zwierząt na terenie południowo–wschodnich Kujaw w sposób zasadniczy różnił się od tego, jakiego używano w okresie kultury ceramiki wstęgowej rytej. Niniejsza praca, w kilku aspektach, zajmuje się dokumentacją sposobu wykorzystania zwierząt. Po pierwsze, ilość szczątków zwierzęcych została ustalona za pomocą różnych pomiarów tj. liczby wszystkich zidentyfikowanych okazów (na wszystkich stanowiskach) oraz liczby stref diagnostycznych (sposób zastosowany w Brześciu Kujawskim i Osłonkach). Zostały ustalone ilości względne sześciu najliczniej występujących, a wiec zapewne posiadających największe znaczenie gospodarcze, gatunków tj.: bydła domowego, owcy, kozy, świni, jelenia i sarny. Wielkości te zostały następnie przebadane i porównane w odniesieniu do wszystkich dziesięciu próbek kości zwierząt. Po drugie, przebadano procesy zrośnięcia nasady kości z trzonem, oraz wyrzynania się zębów trzonowych żuchwy w celu ustalenia profilu uboju najważniejszych zwierząt hodowlanych takich jak: bydło, owce/kozy i świnie. Po trzecie wykorzystano dane metryczne w celu ustalenia, jaką rolę odgrywały dzikie odpowiedniki zwierząt domowych (bydła i świni) w zespołach szczątków zwierzęcych. Dokonano również analizy pomiarów kości w celu odróżnienia w próbkach osobników męskich i żeńskich. Wreszcie zaprezentowano dowody na występowanie rozdrobnienia kości, uboju, oraz zmian patologicznych.

Kości zwierząt świetnie zachowują się w gliniastym podłożu południowo–wschodnich Kujaw. Ze względu na naruszony charakter strefy ornej i warstwy kulturowej, szczątki zwierzęce poddane analizie pochodzą głównie z obiektów archeologicznych, takich jak: jamy odpadkowe, duże glinianki, oraz rowy fundamentowe długich domów. Pomimo iż wyłączenie kości z warstwy kulturowej spowodowało usunięcie pewnej ilości okazów z danej próbki, nie zmienia to w sposób istotny wyników badań, szczególnie jeśli chodzi o proporcje zidentyfikowanych gatunków w próbce. Stosunkowo niewiele kości było zwietrzałych, czy też naruszonych przez gryzonie, co wskazuje na to, że wkrótce po wyrzuceniu zostały zakopane.

Od początku badań w Brześciu Kujawskim autor posługiwał się komputerową bazą danych w celu zapisu i zestawienia danych, dotyczących kości zwierząt. Dla próbki z Brześcia Kujawskiego zastosowano program BONECODE (R. H. Meadow 1987b), a w Osłonkach użyto najpierw programu ANIMALS (D. V. Campana and P. J. Crabtree 1987), a następnie the York Faunal Analysis System (J. Harland et al.2003), dostępnego w Microsoft Access. Próbka z Brześcia Kujawskiego będzie musiała w przyszłości zostać przeniesiona do nowoczesnej bazy danych. Kopie archiwalne danych bazy z Osłonek na nośniku CD–ROM będą przechowywane w bibliotekach instytucji uczestniczących w projekcie.

WZGLĘDNA LICZEBNOŚĆ GATUNKÓW

Główną metodą ustalenia względnej liczebności gatunków było policzenie globalnej liczby szczątków, zwanej w skrócie GLS[1]. Pomimo pewnych wad, jest to skuteczny sposób na dokonywanie tego typu ustaleń. Dla próbek z Brześcia Kujawskiego i Osłonek ustalenie ilości zostało dokonane poprzez policzenie poszczególnych okazów, oraz policzenie stref diagnostycznych. Podobne wyniki wskazują na to, że liczba poszczególnych okazów jest ważnym narzędziem w ustaleniach ilościowych zespołów neolitycznych szczątków zwierząt. Najniższe dane liczbowe nie zostały wzięte pod uwagę ze względu na różne warunki na poszczególnych stanowiskach, oraz problemy nieodłącznie związane z tego typu pomiarem. Autor w swojej analizie próbki z Osłonek nie brał pod uwagę kości żeber oraz kręgów, za wyjątkiem kręgu szczytowego i kręgu obrotowego, podczas gdy dr Makowiecki uwzględniał je w swoich analizach próbek. Aby uzyskać dobrą analizę porównawczą poszczególnych stanowisk, przy obliczaniu udziału procentowego w niniejszym sprawozdaniu odjęto kości żeber i kręgów (za wyjątkiem kręgu szczytowego i obrotowego) od ogólnej liczby kości. Są one wyszczególnione w tabelach CLXXXVI – CXCVIII.

Próbki szczątków zwierzęcych z południowo–wschodnich Kujaw zawierają ogromną liczbę zwierząt domowych. Największa ich próbka pochodzi z Osłonek, gdzie 94.5% kości ssaków zostało zidentyfikowanych jako zwierzęta domowe, pomimo że liczba ta mogłaby zostać nieznacznie pomniejszona na skutek analizy metrycznej kości świń. Próbka z Brześcia Kujawskiego zawiera najwyższy udział procentowy kości zwierząt dzikich (37.34%). Liczba ta jest nieco podwyższona o kości bobrów uzyskane z jednego obiektu. We wszystkich innych próbkach całkowita liczba kości dzikich zwierząt była bardzo niska, chociaż zauważa się większe zróżnicowanie gatunków w stosunku do stanowisk kultury ceramiki wstęgowej rytej.

Gdy analiza próbek ogranicza się do głównych ssaków użytkowych takich jak: bydło, owce, kozy, świnie, jelenie i sarny, przeważają tu kości zwierząt hodowlanych. Jedynie w Brześciu Kujawskim i Falborzu kości jelenia i sarny stanowią ponad 5% ogólnej liczby zidentyfikowanych okazów, przy czym w Brześciu Kujawskim ich udział procentowy zostaje pomniejszony przy zastosowaniu analizy strefy diagnostycznej. Ważnym problemem, którym zajmiemy się

---

[1] W anglojęzycznej literaturze stosuje się skrót NISP (przypis tłumaczy).

poniżej jest również proporcja względna świni udomowionej i dzikiej.

ZWIERZĘTA HODOWLANE

Główne gatunki zwierząt, takie jak bydło, owce, kozy i świnie stanowią większą cześć dziesięciu analizowanych tutaj próbek kości (ryc. 1317). Stosunkowo mało między sobą zróżnicowane stanowiska zawierają materiał wykazujący ogólną zgodność charakteru zespołów, jeśli chodzi o trzy główne rodzaje zwierząt hodowlanych. Ogólnie rzecz biorąc, we wszystkich próbkach bydło stanowi od 30% do 60% udziału procentowego, owca i koza pomiędzy 20% i 40%, a świnia od 10% do 30% (zazwyczaj pomiędzy 20% a 30%). Pomimo, iż każdy gatunek z osobna wydaje się mieć duży udział procentowy, przy ujęciu ogólnym wyraźnie widać, że żaden z gatunków nie dominuje nad innym, w przeciwieństwie do kultury ceramiki wstęgowej rytej, gdzie wyraźnie przeważało bydło. W Brześciu Kujawskim i Osłonkach ustaleń ilościowych poszczególnych próbek dokonano na podstawie liczby poszczególnych okazów, jak też liczby stref diagnostycznych. Podobne wyniki wskazują na to, że liczba poszczególnych okazów jest ważnym narzędziem w ustaleniach ilościowych zespołów fauny neolitycznej.

Ciekawa różnica pomiędzy próbkami analizowanymi przez autora (w Brześciu Kujawskim, większości stanowisk w Osłonkach i Falborzu) i D. Makowieckiego pojawia się na ryc. 1317, gdzie w pierwszym przypadku występuje niższy udział procentowy bydła, a większy świni, natomiast w drugim większy bydła a mniejszy świni. Nie można ustalić czemu należy przypisać te rozbieżności: czy różnicy w zastosowanej technice analitycznej, wielkości danej próbki, czy też temu, że zespoły analizowane przez autora pochodzą z dużych, centralnie położonych osad, podczas gdy inne zespoły z mniejszych stanowisk.

Dzięki dużym ilościowo próbkom, można było ustalić, że kozy stanowią zazwyczaj większą grupę niż owce wśród podrodziny kóz (*Caprinae*). W innym przypadku zwierzęta te można byłoby przyporządkować któremukolwiek z gatunków podrodziny *Caprinae*. Uwaga ta ma istotne znaczenie dla kształtowania wpływu gospodarki grupy brzesko–kujawskiej na środowisko przyrodnicze.

Bydło jest nadal głównym składnikiem prawie wszystkich próbek szczątków zwierzęcych, związanych z grupą brzesko–kujawską, chociaż zauważa się przejście do większej liczby małych zwierząt hodowlanych. Duże znaczenie ma tutaj pojawienie się świni, która stanowi około ¼ większości wszystkich próbek.

Obecność psów została udokumentowana w zespołach szczątków zwierzęcych z sześciu stanowisk, możemy więc założyć, że znajdowały się one na wszystkich stanowiskach. Psy odgrywały dużą rolę w niszczeniu kości w miejscach jam odpadkowych, tak więc musimy założyć, że tylko część możliwej liczby kości została zachowana do pozyskania w celach archeologicznych.

Duża ilość materiału z Osłonek, pochodząca z 322 osobnych układów kulturowych, pozwoliła na porównanie wpływu, jaki miał typ obiektu, lub wielkość próbki na globalną liczbę szczątków. Około 60% całkowitej liczby szczątków pochodzi z jam–glinianek, podczas gdy około 36% z mniejszych jam odpadkowych. Niektóre jamy charakteryzują się dużą koncentracją materiału kostnego zwierząt (np. jamy o numerach 53, 116, 137, 204 i 208). Porównując udział procentowy poszczególnych gatunków zwierząt użytkowych w różnych obiektach, okazuje się, że w gliniankach liczba kości bydła jest wyższa (39%), a liczba kości owcy/kozy niższa (32%). W mniejszych jamach odpadkowych natomiast liczby te są odwrotne (29% kości bydła i 42% kości owcy/kozy).Liczba kości świni pozostaje niezmienna, ok. 24–25%. Na podstawie próbek z obiektów o GLS większej niż 100, z pięciu glinianek i sześciu mniejszych jam, które razem stanowią ponad 72% GLS, w Osłonkach można było ustalić następujące proporcje: 36% kości bydła, 33% kości owcy/kozy i 23% kości świni. W analizie tego typu danych liczbowych będą występowały różnice ze względu na rozmiar próbki i układ kulturowy, tak więc niewielkim różnicom nie należy przypisywać zbyt wielkiego znaczenia.

SSAKI DZIKIE

Wśród kości dzikich zwierząt znajdujemy dzikie zwierzęta kopytne, gatunki leśnych i rzecznych ssaków, żółwie, ryby i ptaki. Każdy z tych gatunków z osobna stanowi jedynie niewielki procent udziału w danej próbce. Jednak wszystkie razem stanowią szeroki zakres bogactwa fauny. Wśród dzikich zwierząt kopytnych najczęściej spotykane są jeleń i sarna, podczas gdy kości tura nie występują w znaczących ilościach pośród kości bydła. Dzika świnia ma niewielki, ale znaczący udział w próbce kości świni. Dziki koń zaznacza swoją obecność niewielką liczbą kości na każdym prawie stanowisku.

Warto wspomnieć dwa gatunki, nienależące do zwierząt kopytnych, a mianowicie bobra (*Castor fiber*) i niedźwiedzia (*Ursus arctos*). Kości bobra występują na pięciu stanowiskach. W Brześciu Kujawskim znaleziono pięć prawie kompletnych egzemplarzy w jamie 820, co wskazuje na skórowanie bobrów, po ich upolowaniu nad jeziorem Smętowo, gdzie zapewne znajdowały się żeremia. W dużym obiekcie w Pikutkowie odkryto trzy kolejne bobry o fragmentarycznie zachowanych szkieletach. Niewielka liczba kości europejskiego niedźwiedzia brunatnego została odkryta w Brześciu Kujawskim i Osłonkach. Większość kości niedźwiedzia pochodziła od jednego osobnika, szczególnie z jego prawej, tylnej łapy. Odkryto również pojedyncze okazy wydry rzecznej, zająca, żbika i łasicy.

ŻÓŁWIE, RYBY I PTAKI

Fragmenty tarczy górnej (*karapaks*) i dolnej (*plastron*) pancerza europejskiego żółwia błotnego (*Emys orbicularis*)znajdują się niemal na wszystkich stanowiskach. Najbardziej liczne są jednak w Brześciu Kujawskim i Osłonkach, gdzie poza pojedynczymi fragmentami, można było również spotkać *in situ* kompletnie, lub częściowo zachowane tarcze górne i dolne pancerza, bądź je zrekonstruować. Na stanowiskach grupy brzesko–kujawskiej znajduje się największa liczba szczątków neolitycznego żółwia błotnego w całej Europie środkowej. Znaczenie obecności dużej ilości fragmentów żółwia dla odtworzenia klimatu schyłku piątego tysiąclecia BC zostanie omówione później.

Analiza zespołów ryb z Brześcia Kujawskiego i Osłonek dokonana przez D. Makowieckiego pokazuje przewagę ryb karpiowatych (*Cyprinidae*), określonych zarówno na poziomie rodziny jak i gatunku. W ich skład wchodzą: *Carassius carassius, Abramis brama, Tinca tinca, Aspius aspius, Leuciscus idus i Rutilus rutilus*. W Brześciu Kujawskim 85,3 % ryb należało do tego gatunku, a w Osłonkach 81,7%. Z innych gatunków najbardziej liczny na obu stanowiskach był szczupak (*Esox lucius*) ; niewielką ilość całkowitej liczby szczątków w Brześciu Kujawskim stanowi okoń (*Perca fluviatilis*), nieliczny na stanowisku w Osłonkach.

Do tej pory została przebadana jedynie próbka kości ptaków z Brześcia Kujawskiego (ponad 25 lat temu, przez P. I. Boguckiego). Próbka z Osłonek zawiera więcej materiału i po przebadaniu na pewno będzie cennym źródłem informacji. Większość kości w Brześciu Kujawskim należy do ptactwa wodnego, takiego jak kaczka krzyżówka (*Anas platyrynchos*), kaczka (*Aythya cf. Fuligula*), gęś (*Anser cf.anser/cf.fabalis*), oraz niewielka ilość ptactwa lądowego. Pobieżna analiza próbki z Osłonek wskazuje na podobną dominację ptactwa wodnego. Odkryto również niewielkie próbki kości ptaków na pozostałych stanowiskach.

PROFILE ŚMIERTELNOŚCI ZWIERZĄT HODOWLANYCH.

Procesy zrośnięcia nasady kości z trzonem oraz wyrzynania się i ścierania zębów trzonowych żuchwy, które posłużyły do ustalenia struktury śmiertelności głównych gatunków zwierząt hodowlanych, mają na celu zrozumienie sposobu eksploatacji zwierząt przez człowieka.

PROFILE ZROŚNIĘCIA NASADY KOŚCI Z TRZONEM

Zrośnięcie nasady kości z trzonem zostało przebadane w Brześciu Kujawskim i Osłonkach w odniesieniu do wszystkich kości kończyn (łącznie z kością łopatki i miednicy) w oparciu o następujące etapy: etap przed zrośnięciem nasady kości, moment zrośnięcia (linia zrośnięcia nasady z trzonem) oraz etap po zrośnięciu nasady kości. W swojej analizie próbki z Brześcia Kujawskiego z 1981 roku, autor zastosował metodę Wilsona (1978), który pogrupował kości ze względu na kolejność zrastania nasady z trzonem, obliczył udział procentowy każdej grupy kości, której zrośnięcie dokonało się w tym samym czasie, a następnie przedstawił dane w sposób graficzny, ustalając wiek każdej z grup. W niniejszym sprawozdaniu dane zostały nieco przegrupowane w oparciu o model Crabtree (1989), oraz przykład O'Connora (2000), co pozwoliło ustalić sekwencję pokazaną na ryc. 33. Pokazuje ona, że większość bydła osiągała 30–ty miesiąc życia, po czym część z nich została zabijana. Tylko około 60% bydła żyło dłużej niż 48 miesięcy. Około połowa kóz i owiec była zabijana przed upływem 36–go miesiąca życia. Około 30% świń nie dożywało 12–go miesiąca życia i tylko 16% osiągało wiek dłuższy niż 42 miesiące (najprawdopodobniej zwierzęta zarodowe, bądź stare sztuki dzikie i półdzikie).

Dane z Osłonek, dotyczące zrośnięcia nasady kości z trzonem, zostały poddane takiej samej analizie, a jej wyniki są widoczne na ryc. 1324. Wykazują one podobne tendencje, jak w Brześciu Kujawskim. W Osłonkach zaobserwowano większą liczbę uboju młodego bydła i pomimo większej gradacji w uboju owcy i kozy, krzywa śmiertelności kończy się tu w tym samym miejscu, co w Brześciu Kujawskim. Profile śmiertelności świni są identyczne na obu stanowiskach.

Jako że świnię hodowano wyłącznie dla mięsa, gwałtowny spadek krzywej śmiertelności nie jest tu dużym zaskoczeniem. Profile bydła oraz owcy/kozy są trudniejsze w interpretacji, jednakże dane zrośnięcia nasady kości z trzonem sugerują, że gatunki te nie były hodowane wyłącznie dla mięsa. W przypadku bydła, najbardziej wartościowym produktem pochodnym było mleko; mogło tak również być w przypadku kozy i owcy. Omawiane stanowiska wyprzedzają pierwsze użycie wełny o około 2000 lat, tak więc hodowla owcy w celu jej uzyskania jest nieprawdopodobna. Możemy założyć, że owcę trzymano dłużej w innym celu niż uzyskanie mięsa i mleka, np. aby powiększyć stado, bądź w celu, wymiany między domostwami.

WYRZYNANIE SIĘ I ŚCIERANIE ZĘBÓW TRZONOWYCH ŻUCHWY

Procesy wyrzynania się i ścierania zębów u podstawowych zwierząt hodowlanych w Brześciu Kujawskim i Osłonkach zostały opracowane w oparciu o etapy wyróżnione przez Granta (1975, 1982). Interpretacja uzyskanych wyników została utrudniona przez brak nienaruszonych kości żuchwy z zachowanym szeregiem zębów trzonowych. Sposób analizy danych z Osłonek polega na zestawieniu etapów ścierania zębów określonych jako M1 i M2 (u bydła M2 i M3), w przypadku gdy zęby te pochodzą z tej samej żuchwy.

Analiza wyrzynania się zębów u bydła na stanowisku w Osłonkach sugeruje, że główny ubój dorosłych egzemplarzy odbywał się wkrótce po osiągnięciu przez nie 48 miesiący życia, tak więc niewiele zwierząt dożywało do zaawansowanych etapów ścierania zębów trzonowych M3 (ryc. 1326 i 1327). Dane dotyczące świń potwierdzają analizę zrośnięcia nasady kości z trzonem, a ich ciągła dystrybucja wskazuje na brak uboju sezonowego (ryc. 1328). Dane, dotyczące owcy i kozy są stosunkowo trudne do interpretacji i układają się one w pewne charakterystyczne grupy (ryc. 1329). Do 42 miesiąca życia, dane te są zbieżne z wynikami analizy zrośnięcia nasady kości z trzonem, przy czym najciekawsze są wyniki badań ścierania zębów dla egzemplarzy starszych. Dane te sugerują istnienie grupy zwierząt 5–6 letnich, oraz niewielkiej grupy zwierząt, liczącej ponad 6 lat. Dowodzi to, że owce i kozy były trzymane długo po osiągnięciu wieku, w którym uzyskiwały maksymalną wagę żywca, co sugeruje, że ich wartość nie polegała wyłącznie na wartości mięsa.

D. Makowiecki przyjął inną metodę badania wyrzynania się i ścierania zębów trzonowych żuchwy, a mianowicie zebrał dane dla wszystkich badanych przez siebie próbek i podzielił je według wieku. Dane te uzupełniają te, które zostały uzyskane ze stanowiska w Osłonkach, ponieważ pokazują stałą redukcję zwierząt od momentu urodzenia do 42 miesiąca życia, oraz szczyt uboju, który mieści się między 42 i 60 miesiącem życia, z niewielką ilością zwierząt dożywających szóstego roku życia, lub dłużej. Możemy zatem wnioskować, że w momencie zrośnięcia nasady kości z trzonem w wieku 48 miesięcy, stado bydła redukowano o dorosłe egzemplarze. Tak więc, pomimo iż mięso nie było jedynym celem hodowli bydła, było jednak znacznie ważniejsze niż jakikolwiek inny produkt.

Zebrane dane, dotyczące etapów wyrzynania się i ścierania zębów u kozy i owcy są porównywalne z wynikami badań w Osłonkach, wskazując na intensywny ubój pomiędzy 36 i 48 miesiącem życia zwierząt, z niewielką ilością starszych egzemplarzy. Podobnie jak poprzednio, pomimo iż mięso nie było jedynym wykorzystywanym przez człowieka produktem, wydaje się, że było ważniejsze niż inne. Zebrane dane, dotyczące etapów wyrzynania się i ścierania zębów u świni wskazują, jak należy się spodziewać, duży liczebnie ubój wśród młodych egzemplarzy, którego szczyt przypada pomiędzy 12 a 24 miesiącem życia zwierząt.

Jest zatem rzeczą niezwykłej wagi, aby połączyć ze sobą wyniki badań, dotyczące zrośnięcia nasady kości z trzonem oraz wyrzynania się i ścierania zębów żuchwy w celu uzyskania pełniejszego obrazu profilów śmiertelności i populacji zwierząt hodowlanych. Znajduje to swoje zastosowanie szczególnie w odniesieniu do bydła, owcy i kozy. Podczas gdy dane, dotyczące zrośnięcia nasady kości z trzonem pozwalają sądzić, że duża część tych zwierząt przeżywała dłużej. Badania nad ścieraniem zębów żuchwy jasno wskazują na moment śmierci, który musiał nastąpić wkrótce po momencie zrośnięcia nasady. Niewiele egzemplarzy bydła przeżyło swój piąty rok życia, a mała ilość kóz i owiec przeżyła więcej niż cztery. Wprawdzie nie można wykluczyć drugorzędnych celów hodowli zwierząt, jednak stada w południowowschodniej części Kujaw były głównie skierowane na produkcję mięsa.

ANALIZY METRYCZNE

Kości zwierząt ze stanowisk kultury lendzielskiej w południowowschodniej części Kujaw zostały zmierzone przy wykorzystaniu standardowych metod opublikowanych przez A. von den Drieschа (1976) i stanowią jeden z większych zbiorów pomiarów neolitycznych zwierząt kopytnych, pochodzących z okresu ponad 4000 lat BC. w Europie klimatu umiarkowanego. Pełne wykorzystanie całego materiału z tej próbki będzie wymagało całych lat badań, jednak nawet teraz na podstawie wstępnych obserwacji możemy ustalić pewne kluczowe kwestie, dotyczące udomowiania zwierząt, głównie w oparciu o próbkę kości bydła i świni ze stanowiska w Osłonkach.

Różnice osteologiczne pomiędzy dzikim i domowym bydłem od dawna są wyzwaniem dla archeozoologów. Od końca lat 70–tych starano się wypracować możliwie najlepsze metody odróżnienia bydła domowego od dzikiego w danej próbce. W tym celu posługiwano się „osobnikiem wzorcowym", zwykle dzikim, wiadomego pochodzenia. Następnie pomiary archeologicznych okazów normalizowano w sposób algebraiczny i logarytmiczny oraz ustalano stopień znormalizowanego odchylenia pomiaru danego elementu od odpowiadającego mu pomiaru elementu osobnika wzorcowego.

W swojej analizie szczątków zwierzęcych ze stanowiska w Brześciu Kujawskim P. I. Bogucki zastosował algebraiczną metodę rozwiniętą przez H. P. Uerpmanna (1979) i użył pomiarów opracowanych przez M. Degerbola (1970), a dotyczących niewielkiego okazu polodowcowego tura z Danii, oraz krowy typu Ullerslev, jako osobników wzorcowych. Rezultaty tej analizy wykazują, że praktycznie wszystkie kości bydła ze stanowiska w Brześciu Kujawskim mają mniejsze rozmiary, niż kości krowy typu Ullerslev, tak więc można zakładać, że są to kości zwierząt domowych.

W celu przeprowadzenia takiej samej analizy kości bydła ze stanowiska w Osłonkach, P.I. Bogucki zastosował metodę logarytmiczną rozwiniętą przez R. H. Meadowa (1999). Tak jak poprzednio krowa typu Ullerslev posłużyła jako osobnik wzorcowy, tym razem jednak użyto pomiarów sporządzonych przez K. Steppana(2001), zgodnie z konwencją A. von den Driescha. Rezultat analizy był bardzo podobny do wyniku pomiarów na stanowisku w Brześciu Kujawskim ponad 25 lat temu. Pokazywał on, że praktycznie wszystkie kości bydła w Osłonkach należały do zwierząt domowych, być może za wyjątkiem kilku dużych okazów, mniej niż dwudziestu, które mogły należeć do niewielkich rozmiarów dzikiego bydła.

Podobne podejście zastosowano w przypadku próbki kości świni ze stanowiska w Osłonkach, używając logarytmicznej metody R. H. Meadowa oraz osobnika wzorcowego w postaci świni z terenu Węgier, opisanej przez N. Russella (1993). Wyniki (ryc. 1338) wskazują na większy udział osobników dzikich, niż miało to miejsce w przypadku bydła. Pozwala to wnioskować, że próbka kości świni na stanowisku w Osłonkach zawiera bardziej znaczącą ilość kości dzikich zwierząt, niż można by przypuszczać po analizie wyłącznie oglądowej. Badania poszczególnych pomiarów, takich jak szerokość końca bliższego kości promieniowej, najmniejsza długość szyjki łopatki i największa długość boczna kości skokowej wskazują, że kości do tej pory oddzielone od pozostałych prawie z całą pewnością należą do okazów zwierząt dzikich.

ZMIANY PATOLOGICZNE, UBÓJ I SPALANIE

Zespoły szczątków zwierzęcych znajdowane obecnie na neolitycznych stanowiskach w południowowschodniej części Kujaw są efektem końcowym długotrwałego procesu rozbierania tuszy, sortowania, dystrybucji, gotowania, rozdrobnienia kości w celu wydobycia szpiku, selekcji kości w celu produkcji narzędzi, usuwania kości, niszczenia ich przez zwierzęta mięsożerne oraz mechanicznego rozdrobnienie *in situ*. Tak więc badanie na ich podstawie technik uboju nie jest zadaniem łatwym. Największe kości długie: kość udowa, kość ramienna i kość piszczelowa, były najbardziej rozdrobnionymi elementami kości szkieletu pozaczaszkowego.

Na kościach znajduje się stosunkowo niewiele nacięć, chociaż tam gdzie występują, są one bardzo wyraźne. Wśród kości bydła nacięcia najczęściej znajdują się na kości skokowej. Na szczególną uwagę zasługują nacięcia na kościach psa, wszystkie pochodzące z jednego obiektu i od jednego osobnika, co wskazuje na wystąpienie przynajmniej jednego przypadku zabicia psa w celu jego konsumpcji przez mieszkańców Osłonek.

Szczególnie dramatyczny przypadek uboju widzimy na przykładzie mocno skostniałej czaszki kozy, pochodzącej ze stanowiska w Osłonkach, na której widnieje dziura o średnicy 43 mm powstała na skutek uderzenia w prawą część ciemieniową krótko przed, lub po śmierci zwierzęcia. Autor sugeruje, że zwierzę mogło być uderzone T–kształtnym toporem rogowym. Takie topory licznie występują na stanowiskach grupy brzesko–kujawskiej.

Pośród innych ciekawych zmian patologicznych znajdujemy kilka kości śródstopia/ śródręcza (*metapodial*) i członu palcowego, o cechach przerostu kości u podstawy bliższej powierzchni stawowej. Chociaż trudno wyciągnąć daleko idące wnioski, odkształcenie kości może wskazywać na urazy natury biomechanicznej, spowodowane eksploatacją zwierząt w celach pociągowych. Dobrze znane nam przypadki wykorzystania zwierząt pociągowych w środkowej Europie pochodzą z okresu czwartego tysiąclecia BC, tak więc odkształcone kości mogą wskazywać na wcześniejszą tego rodzaju działalność, pochodzącą jeszcze z poprzedniego tysiąclecia.

REGIONALNA GOSPODARKA ZWIERZĘCA

Na poziomie najbardziej ogólnym, dziesięć omawianych tu próbek szczątków zwierzęcych wykazuje wiele podobieństw. W skład ich wchodzą te same gatunki zwierząt użytkowych: bydła domowego, owcy, kozy, świni, jelenia i sarny. Proporcje gatunków dzikich i domowych zwierząt wykazują tendencje stałe. Jedynie w Brześciu Kujawskim i Falborzu liczba zwierząt jeleniowatych przekracza 10%. Pomimo, że dane metryczne sugerują większą eksploatację dzikiej świni, niż wynikałoby to z identyfikacji danych egzemplarzy, można wyciągnąć wniosek, że gospodarka zwierzęca grupy brzesko–kujawskiej odbywała się w oparciu o zwierzęta udomowione.

Na poziomie bardziej szczegółowym występują różnice pomiędzy próbkami szczątków zwierzęcych, dotyczące udziału procentowego głównych gatunków zwierząt użytkowych. Jednak, jak wspomniano wcześniej, takie różnice mogą również występować w obrębie jednego zespołu, kiedy porównuje się próbki z różnego typu obiektów. Różnice, które tu obserwujemy, mają prawdopodobnie znaczenie lokalne i dotyczyły uboju w stadzie, a w Brześciu Kujawskim i Falborzu przypadkowej działalności myśliwskiej w różnych domostwach i różnie realizowanej.

Problemem, który nie został do tej pory szczegółowo omówiony, jest gospodarcze wykorzystanie bobrów, które, jak wykazują badania z Brześcia Kujawskiego i Pikutkowa, miały większe znaczenie dla człowieka, niż tylko cel utrzymania się przy życiu. W jamie 820 na stanowisku w Brześciu Kujawskim odkryto rozdzielone tusze pięciu bobrów, których główne części nadal zalegały w porządku anatomicznym. Znalezisko to jest interpretowane, jako przykład skórowania zwierząt. Na stanowisku w Pikutkowie, w jednej z dużych jam odpadkowych odkryto fragmentarycznie zachowane szkielety trzech bobrów. Pomimo, iż nie zachowały się one w układzie anatomicznym, co miało miejsce w Brześciu Kujawskim, to jednak koncentracja kości bobrów prawdopodobnie również wskazuje na ich skórowanie. Na szczególną uwagę zasługują nacięcia na dalszych kościach piszczelowych. Duże i płytkie jezioro Smętowo było prawdopodobnie miejscem, sprzyjającym rozwojowi kolonii bobrów.

Nietypowym gatunkiem odkrytym na tych stanowiskach, był europejski niedźwiedź brunatny. Kilka kości śródręcza/śródstopia wystąpiło w takim samym układzie kulturowym w Osłonkach; prawdopodobnie jest to pozostałość po skórowaniu niedźwiedzia.

Przez długi czas uważano, że zespoły szczątków zwierzęcych z Falborza mają wyjątkowy charakter, szczególnie jeśli chodzi o występowanie części ciała różnych gatunków zwierząt. Aby ustalić, czy było to miejsce pierwotnego uboju zwierząt, zastosowano prostą technikę badawczą, której M. R. Rosenberg et al. (1998) użyli na stanowisku Hallan Cemi w Turcji. Kości bydła i sarny zgadzają się z oczekiwanymi wynikami, jeśli chodzi o udział kości bogatych i ubogich w mięso w przypadku uboju pierwotnego. Jednak kości owcy/kozy, sarny i świni wykazują odwrotne tendencje, co sugeruje, że zwierzęta te były zabite w innym miejscu i tylko kości „mięsne" (bogate w mięso) zostały dostarczone do Falborza, w celu konsumpcji.

SKŁAD REGIONALNEJ GOSPODARKI ZWIERZĘCEJ

Głównymi gatunkami, które składają się na mikroregionalną gospodarkę zwierzęcą południowo–wschodnich Kujaw w piątym tysiącleciu BC, są domowe zwierzęta kopytne, dzikie zwierzęta kopytne, żółwie błotne, ryby i ptaki. Inne gatunki, chociaż nie bez znaczenia (jak w przypadku bobra), odgrywają mniejszą rolę w ogólnym obrazie tamtejszej gospodarki.

DOMOWE ZWIERZĘTA KOPYTNE

Neolityczna gospodarka zwierzęca południowo–wschodnich Kujaw była zdominowana przez zwierzęta domowe, stanowiące ponad 90% zespołów szczątków zwierzęcych. Obserwacja ta przeczy poprzednim wnioskom na temat zespołów szczątków zwierzęcych w Brześciu Kujawskim, zgodnie z którymi na stanowiskach kujawskich miała znajdować się większa proporcjonalnie liczba zwierząt dzikich (P. I. Bogucki 1989, 1996). Obecnie można jednak uznać, że na stanowiskach grupy brzesko-kujawskiej znajdują się zespoły szczątków zwierzęcych, należących prawie zupełnie do głównych zwierząt domowych tj.: bydła, owcy, kozy i świni. Ilość zwierząt hodowlanych była w stanie zaspokoić zapotrzebowanie na mięso mieszkańców południowo–wschodnich Kujaw w piątym tysiącleciu BC bez większej konieczności myślistwa. Biorąc pod uwagę krzywe śmiertelności ze stanowisk w Osłonkach i Brześciu Kujawskim oraz dane wyrzynania się zębów z innych stanowisk można stwierdzić, że wszystkie gatunki zwierząt hodowlanych wykorzystywane były w celu produkcji mięsa, a inne cele miały znaczenie drugorzędne.

Użycie czterech różnych gatunków zwierząt hodowlanych wskazuje na fakt, że gospodarka zwierzęca była zorganizowana i wewnętrznie zróżnicowana. Innymi słowy, każdy z tych gatunków miał inne wymagania, jeśli chodzi o wyżywienie i opiekę oraz łączyła je inna relacja z hodowcą. Odgrywały też inną rolę w gospodarce rolniczej. Bydło i owca zajmowały podobne nisze, jako że oba gatunki były wypasane i mogły korzystać z nieużytków oraz innych terenów trawiastych takich jak terasy zalewowe małych strumieni. W oparciu o bogatą literaturę, dotyczącą współczesnego leśnego wypasu bydła (np. S. Adams 1975), P. I. Bogucki (1982) zasugerował możliwość wypasu niewielkiej ilości bydła neolitycznego w okolicznych lasach. Również w lasach można wypasać owce. Według ostatnich sugestii F. W. M. Very (2000) dzika populacja zwierząt roślinożernych w Europie pre–neolitycznej żyła raczej w lesie parkowym, niż w gęstej puszczy, jak to było zwykle rekonstruowane. Hipoteza F. W. M. Very została skrytykowana przez Mitchella (2005), ale zapoczątkowała ona dyskusję na temat naturalnego charakteru lasu, w którym zamieszkiwali neolityczni rolnicy (np. A. Kreuz 2008). Jako że społeczności, zajmujące się hodowlą bydła i owiec, były obecne na terenie południowo–wschodnich Kujaw kilkaset lat przed pojawieniem się omawianych tu osad, istnieje możliwość, że tereny otwarte do wypasu współwystępowały z lasami o niskim poszyciu, które mogły sprzyjać niewielkiemu wypasowi zwierząt. Układ ten mógł zostać wzmocniony przez następne kilka stuleci użytkowania terenów przez grupę brzesko–kujawską.

Kozy, jako liściożerne, nie konkurują o pożywienie z owcami i bydłem, ale raczej spożywają inny zestaw roślin, włączając do niego krzewy i podrosty, które mogły stanowić część odradzającej się pokrywy roślinnej pól uprawnych i innych terenów odkrytych, a co za tym idzie, obecność znacznej liczby kóz może być przytaczana jako jedna z przyczyn długoterminowych zmian roślinności, zaobserwowanych w danych pyłkowych z rejonu Osłonek przez D. Nalepkę (2005). O ile wpływ owiec i bydła mógł być osłabiony przez leśny wypas w siedliskach, których roślinność była uprzednio zaadaptowana do takiej działalności przez dzikie zwierzęta roślinożerne (zgodnie z hipotezą F. W. M. Very), kozy mogły spożywać inny rodzaj roślin, które w związku z tym były tylko umiarkowanie dotknięte przez inwentarz żywy.

W omawianych zespołach w tym opracowaniu kozy przewyższają liczebnie owce na wielu stanowiskach. Przykładowo, więcej kóz niż owiec jest w Brześciu Kujawskim, Osłonkach, Konarach i Pikutkowie, z relacją owca: koza między 1:1,6 a 1:2. W Falborzu ta relacja to 1:1, podczas gdy w Miechowicach 4a wynosi ona 1,3:1 owcy: kozy. Miechowice mają 4,17:1 owcy: kozy, Smólsk 2,5:1, a Zagajewice 1,9:1. R. W. Redding (1985, 1991) rozważył znaczenie relacji owca: koza i bydło: w relacji do owcy/kozy w odniesieniu do Bliskiego Wschodu i Egiptu. Zdaniem R. W. Reddinga, mieszana populacja *caprinae*, w której głównym celem jest pozyskanie energii i białka, powinna mieć relację owca: koza między 5:1 a 1:0, w zależności od warunków środowiskowych. Z drugiej strony, jeśli celem jest bezpieczeństwo stada, definiowane jako minimalizacja fluktuacji rozmiarów stada, relacja owca: koza powinna mieścić się w przedziale 1,7:1 a 1:3, z kozami dorównującymi ilościowo owcom, lub nawet je przewyższającymi. Próbki z Brześcia Kujawskiego, Osłonek, Konar, Pikutkowa, Falborza i Miechowic 4a pasują do modelu zabezpieczonego stada (wg R. W. Reddinga), podczas gdy trzy inne zbliżają się do funkcji pozyskania energii, lub białka. Dysponując stosunkowo niewielką próbką z Miechowic 4, Smólska i Zagajewic, zgodność materiału z tego regionu wskazuje raczej na opiekę nad stadami owiec i kóz, której celem jest maksymalne, długoterminowe bezpieczeństwo lub zrównoważona wydajność (używając określenia R. W. Reddinga 1984, s. 239).

Jest jeszcze wiele kwestii, których należy się dowiedzieć o neolitycznej hodowli świń. P. I. Bogucki (1989) zaproponował system hodowli, w którym świniom zasadniczo pozwalano poruszać się w okolicach osady przy ograniczonym do minimum doglądaniu przez ludzi, co mogło doprowadzić do zetknięcia z rodzimymi dzikimi świniami i wywoływało krzyżowanie się. Nowe świadectwa znacznego wzrostu udziału genów dzikich świń w populacji udomowionych gatunków około 4000 BC. (G. Larson et al 2007) pozwala zakładać, że jest to model wiarygodny. C. Grigson (1982: 305) wskazał na to, że wydajna hodowla świni polega na umiejętności pozostawienia przez człowieka części populacji świń (szczególnie prośnych macior) w niewoli na rozród, zapewniając udomowionej świni schronienie zimą i dokarmiając ją zebranym ziarnem i odpadkami.

R. W. Redding i M. R. Rosenberg (1998) zaproponowali model neolitycznej hodowli świń, w którym wszystkie hodowane świnie są efektem parzenia się dzikich odyńców i udomowionych macior. Model ten nazwali „modelem hodowlanym opartym na samicach". Zatem otaczane opieką świnie składają się z samic i ich młodych. Hodowcy nie muszą troszczyć się o wielkie, głodne i zapewne agresywne samce, a jedynie zapewniają na zimę schronienie prośnym samicom i ich młodym. R. W. Redding i M. R. Rosenberg (1998, s. 68) budują swój oparty na samicach model hodowlany, biorąc pod uwagę bardzo wczesne stanowiska neolityczne na Bliskim Wschodzie i wskazują, że wraz z pojawieniem się uprawy zbóż, należałoby oczekiwać porzucenia tego modelu ze względu na trudności utrzymania świń z dala od upraw. Jednakże poświadczona obecność wielkich dzikich świń wśród próbek kości świń na takich stanowiskach jak Osłonki, współwystępowanie świń i ziarna na tych stanowiskach oraz dowody Larsona et al (2007) dotyczące znacznego wzrostu udziału genów dzikich świń w tym okresie czasu sugeruje, że taki oparty na samicach model hodowli mógł być stosowany w południowo–wschodniej części Kujaw w piątym tysiącleciu BC.

DZIKIE ZWIERZĘTA KOPYTNE

Tylko w Brześciu Kujawskim i w mniejszym stopniu w Falborzu jeleń i sarna faktycznie wystąpiły jako znaczące składniki zespołów szczątków zwierzęcych. Na innych stanowiskach są one obecne w niewielkich ilościach. Jeśli weźmiemy pod uwagę ilość zrzucanego poroża, reprezentacja upolowanego jelenia kurczy się jeszcze bardziej. Dzikie bydło i świnie są faktycznie obecne na wszystkich stanowiskach i nie można ich nie brać pod uwagę, ale wygląda na to, że nie miał miejsca żaden systematyczny wysiłek, mający na celu pozyskanie tych gatunków. Stosunkowo słabo rozwinięte łowiectwo nie stoi w sprzeczności z faktem, że lasy i pola otaczające osady neolityczne na Kujawach południowo–wschodnich były istotnym naturalnym źródłem pozyskiwania dzikich zwierząt kopytnych. Z tej lub też innej przyczyny, mieszkańcy tych stanowisk nie korzystali z nich w większym zakresie, niż to zostało opisane.

Zatem dlaczego mieszkańcy tych stanowisk w ogóle podejmowali działalność łowiecką? Jedną z możliwości, rozważanych przez P. I. Boguckiego (1981,1982) w jego analizie fauny z Brześcia Kujawskiego, jest polowanie na dzikie zwierzęta roślinożerne w celu ochrony zbiorów przed zniszczeniem. H. P. Uerpmann (1977) był pierwszym, który podniósł kwestię neolitycznego łowiectwa mającego na celu ochronę zbiorów, oraz to, że w innych częściach świata takie „ogrodowe łowiectwo” miało zasadnicze znaczenie dla ludów prahistorycznych (np. Linares 1976). W świetle poglądu uznającego rolnictwo neolityczne za intensywną i skoncentrowaną działalność (A. Bogaard 2004) ochrona zbiorów przed dzikimi roślinożercami byłaby bardzo ważna. Inną możliwością, rozważaną przez K. V. Boyle (2006) w odniesieniu do neolitu Europy zachodniej jest fakt, że łowiectwo było działalnością prestiżową i sukces w niej odniesiony dodawał ważności. Ta motywacja jest jednak jeszcze trudniejsza do sprawdzenia na gruncie archeologii, chociaż pewną przesłanką dotyczącą ważności jelenia może być obecność w grobach męskich, toporów wykonanych z tyki poroża, choć jest to, co prawda, wątłe ogniwo. Łowiectwo mogło także stanowić urozmaicenie podczas zimy, kiedy prace polowe zabierały mniej czasu.

ZNACZENIE *EMYS ORBICULARIS*

Kości żółwia błotnego w Brześciu Kujawskim i Osłonkach, jak również fakt ich obecności na wielu innych stanowiskach, wymienionych w tym sprawozdaniu wskazują nie tylko na wykorzystanie tego gatunku, jako źródła wartości odżywczych, ale również dają obraz środowiska naturalnego wokół osad. Po pierwsze, obecność zmienno–cieplnych gadów, takich jak *Emys orbicularis* może dostarczyć informacji na temat temperatury na terenie południowo–wschodnich Kujaw w piątym tysiącleciu BC. Po drugie, zwyczaje, związane z gniazdowaniem żółwia błotnego, mogą rzucać światło na krajobraz pradziejowy, w którym zmiany antropogeniczne mogły poprawić warunki, sprzyjające ich rozmnażaniu. Możemy założyć, że mokradła południowo–wschodnich Kujaw sprzyjały rozwojowi dużych populacji *Emys orbicularis,* choć nie na tyle dużych, aby stanowiły one podstawę wyżywienia okolicznych mieszkańców.

Pomimo, iż obecnie żółw błotny zamieszkuje głównie tereny południowej Europy, nadal występuje w pewnych szczególnych siedliskach w północnej części kontynentu europejskiego. Jego ekspansja do północnej Europy w okresie holocenu, została umożliwiona przez wyższą temperaturę spowodowaną atlantyckim okresem klimatycznym. Czynnikiem warunkującym północne rozprzestrzenienie *Emys orbicularis* jest położenie klimatycznego gradientu, oddzielającego obszary z chłodnymi porami letnimi w Europie zachodniej, od obszarów z ciepłymi porami letnimi w Europie wschodniej (Lenk et al. 1999: 1919). Właśnie te cieplejsze warunki sprzyjają rozwojowi żółwia błotnego, stąd też ich obfita liczba na terenie południowo–wschodnich Kujaw w piątym tysiącleciu BC. Świadczy to o wysokiej temperaturze letniej na tym terenie, co jest zgodne z przyjętym modelem klimatu w środkowym holocenie.

Obserwacja zwyczajów, związanych z gniazdowaniem żółwia błotnego może rzucać światło na to jak wyglądał krajobraz pradziejowy na terenie omawianych stanowisk. B. Najbar i E. Szuszewicz (2007) piszą, że samice żółwia błotnego w zachodniej Polsce składały jaja na nasłonecznionych polanach leśnych w końcowym okresie maja i na początku czerwca. Miejsca występowania gniazd były oddalone od koryta najbliższego, dużego strumienia o 77 metrów, choć niewielkie dopływy mogły pozwolić samicom na pokonanie tej odległości częściowo drogą wodną. Samice żółwia wybierały te same miejsca do budowy gniazd. Jeśli miejsca te stawały się zacienione na skutek bujnego rozwoju roślinności, wtedy żółwie porzucały je. P. I. Bogucki (1981) zasugerował, że duży wzrost liczby szczątków żółwia błotnego w ostatniej fazie działalności grupy brzesko–kujawskiej może wskazywać na antropogeniczne zmiany krajobrazu, a w szczególności powstawanie i utrzymywanie się przestrzeni niezalesionych. Dowody na powstawanie przecinek leśnych, oraz antropogeniczne zmiany wegetacji podczas panowania kultury lendzielskiej na tych terenach, są poparte przez analizy paleobotaniczne Doroty Nalepki (2005).

PTAKI I RYBY: DODATKOWE UROZMAICENIE GOSPODARKI

Trudno ustalić jaką rolę odgrywały ryby i ptaki w gospodarce osad neolitycznych południowo–wschodnich Kujaw. Oczywiście istnieją ślady działalności człowieka takie jak rybołówstwo, czy też polowanie na ptactwo, szczególnie na stanowiskach większych: w Brześciu Kujawskim, lub Osłonkach. Nie można jednak stwierdzić, czy stanowiły one podstawę gospodarki człowieka tamtego okresu. Wydaje się raczej, że zwierzęta te występowały w tak dużej liczbie, że byłoby dziwne, gdyby człowiek z nich nie korzystał. Tak więc ich eksploatacja wynikała zarówno z konieczności, jak też z faktu ich dużej dostępności w środowisku naturalnym. Duża liczba ptactwa, występującego sezonowo, szczególnie na polach w okresie żniw, lub na brzegach jezior, nie mogła pozostać niezauważona.

PODSUMOWANIE: DOJRZAŁY CHARAKTER GOSPODARKI ZWIERZĘCEJ W OKRESIE NEOLITU NA TERENIE KUJAW

W przeciwieństwie do gospodarki kultury ceramiki wstęgowej rytej z szóstego tysiąclecia BC, która opierała się głównie o eksploatację bydła, gospodarka zwierzęca społeczności neolitycznych z terenu Kujaw, w piątym tysiącleciu p.n.e., była bardziej zróżnicowana i polegała na wykorzystaniu kilku głównych gatunków zwierząt hodowlanych, jak również dzikich ssaków, ryb, żółwi i ptactwa wodnego. Stosunkowo spójny charakter zespołów, a w każdym razie brak dużych dysproporcji pomiędzy gatunkami zwierząt domowych i dzikich oraz między głównymi gatunkami zwierząt domowych, wskazuje na to, że gospodarka grupy brzesko-kujawskiej nosiła cechy dojrzałej. Brak specjalizacji w hodowli jednego z gatunków sugeruje, że wykorzystanie głównych zwierząt użytkowych było częścią stabilnej strategii gospodarczej tamtego okresu. Znajdowała ona również swoje odzwierciedlenie w sposobie wykorzystania roślin dzikich i domowych przez mieszkańców omawianych stanowisk (A. Bieniek 2002) oraz innych relacjach natury gospodarczej pomiędzy poszczególnymi domostwami w ramach wspólnoty, jak również poza nią.

W gospodarce zwierzęcej pełnego neolitu w piątym tysiącleciu BC. każda większa kategoria inwentarza żywego odgrywała pewną specjalną rolę. Świnie zaspokajały zapotrzebowanie na „towary pierwszej potrzeby"', takie jak mięso i inne podstawowe produkty, a wśród nich skóry, tłuszcze, łój i inne zwierzęce półprodukty. Są to zwierzęta tanie w hodowli, co oznacza, że nie potrzeba karmić ich zbyt długo do momentu osiągnięcia maksymalnej wagi mięsnej i że są w stanie samodzielnie znaleźć pokarm dla siebie na terenie osady oraz w jej okolicach, a także na polach i w lasach. Mogą być doglądane przez dzieci i starców, a zatem pozwalają nieproduktywnym członkom społeczności brać aktywny udział w gospodarstwie domowym. Świnie to także zwierzęta szybko mnożące się, zatem nie ma potrzeby utrzymywać ich dużego stada zarodowego.

Owce i kozy odgrywały nieco bardziej złożoną rolę. Są trudniejsze w hodowli niż świnie, gdyż muszą być hodowane nieco dłużej i mają za każdym razem tylko jedno lub dwa młode. Konieczne jest zatem pozostawianie większego stada zarodowego. Zazwyczaj należy utrzymywać dość duże stado, tak aby utrata jednej czy dwóch sztuk z powodu drapieżników nie była stratą niepowetowaną.

Bydło w gospodarce neolitycznej można by uznać za siłę napędową o szczególnie wielkim potencjale. Jest ono wielkie i ciężkie, a zatem potrzebuje przestrzeni, zarówno na zewnątrz, jak i wewnątrz. Bydło rośnie wolno i rozmnaża się stosunkowo wolno, zwykle dając jedno młode w miocie, a zatem musi być hodowane dłużej niż owce i kozy. Ponadto niesie ze sobą wyższy stopień ryzyka. Jednakże zyski przynoszone przez bydło są pokaźne. Po pierwsze, dostarcza ono ogromnych ilości mięsa, które może być zjedzone natychmiast lub zabezpieczone do przyszłego użytku przez wędzenie względnie suszenie oraz wymienione w transakcjach między gospodarstwami domowymi. Dostarcza ponadto wielkich skór, zaś jeśli chodzi o wykorzystanie pochodnych produktów takich jak mleko oraz zwierzęcego sprzężaju, dowody pochodzące z południowo–wschodnich Kujaw z piątego tysiąclecia BC są niejednoznaczne. Logicznie rzecz biorąc, wydaje się jasne, że szeroko rozpowszechnione użycie produktów pochodnych, które w sposób pewny i udokumentowany występują w czwartym tysiącleciu BC nie pojawiły się nagle, w pełni ukształtowane. Musiało być ono poprzedzone działalnością ludzi oraz ich eksperymentami w okresie, kiedy główne elementy neolitycznej gospodarki mięsnej zostały ustalone i ustabilizowane.

GOSPODARKA ZWIERZĘCA GRUPY BRZESKO–KUJAWSKIEJ KULTURY LENDZIELSKIEJ W PERSPEKTYWIE ŚRODKOWOEUROPEJSKIEJ

Poszukiwanie porównawczych danych, dotyczących szczątków zwierzęcych z piątego tysiąclecia BC w centralnej części Europy prowadzi do zaskakującego wniosku, że ciągle jest bardzo niewiele naddunajskich zespołów kości zwierzęcych w porównaniu z tymi, które odkryto na Niżu Polskim. O ile próby z południowej Skandynawii i najbardziej na północ wysuniętej części Niemiec, a także z położonych nad jeziorami osad z północnych Alp są regularnie publikowane, to włożono bardzo niewiele pracy w analizę szczątków zwierzęcych, pochodzących z osad neolitycznych ze świata naddunajskiego. Jest to w zasadniczej części wynikiem złego zachowania kości w środowisku lessowym. Jednak wydaje się, biorąc nawet pod uwagę ten czynnik, że ilość analiz archeozoologicznych osad naddunajskich jest daleka od tego, czego można było spodziewać się po zainteresowaniu kośćmi zwierzęcymi 30 lat temu oraz informacjami jakich one dostarczają na temat zachowania człowieka z tamtego okresu.

Zasadniczym wyjątkiem od powyższego uogólnienia jest skupisko stanowisk neolitycznych w Basenie Paryskim, a w szczególności późnej ceramiki wstęgowej rytej (*Rubané Recent*) ze schyłku szóstego tysiąclecia BC i jej następców, czyli grup Villeneuve–Saint–Germain (VSG) i Cerny z piątego tysiąclecia BC. Tak jak w wielu próbkach szczątków zwierzęcych grupy brzesko–kujawskiej kultury lendzielskiej, zespoły zwierzęce VSG są zwykle zdominowane przez udomowione bydło (zazwyczaj około 60–80% GLS). Natomiast ilość owcy/kozy (między 5 a 20%) i świni (między 10 a 30%) jest większa niż we wcześniejszych zespołach szczątków zwierzęcych kultury ceramiki wstęgowej rytej, pochodzących z tego samego obszaru (patrz R. Arbogast 1995, wykres 6). Są znaczne wyjątki od tego uogólnienia, takie jak Longueil–Saint–Marie LBR II i LBR III, gdzie próbki szczątków zwierzęcych zawierają znaczną liczbę świń (odpowiednio 67% i 38%), mniej bydła i bardzo mało owcy/kozy (R. Arbogast 1995). Pomimo pewnej odmienności w charakterze od próbek kości zwierzęcych grupy brzesko–kujawskiej kultury lendzielskiej, fauna VSG wykazuje podobną do niej heterogeniczność, w przeciwieństwie do skrajnej przewagi udomowionego bydła na stanowiskach kultury ceramiki wstęgowej rytej.

Bedault i Hachem (L. Bedault 2006, L. Bedault i L. Hachem 2008) proponują aby uznać, że we wczesnej VSG gospodarka była głównie nakierowana na bydło, a dodatkowo na owce i kozy jako gatunki inwentarza żywego o ważności mniejszej tylko od bydła. R. Arbogast (1995, s. 327) proponuje, aby uznać, że wzrost użycia świni w VSG zapowiada środkowo neolityczne gospodarki zwierzęce. Zespoły szczątków zwierzęcych w jasny sposób dostarczają kolejnego przykładu pojawiania się dojrzałej gospodarki zwierzęcej podczas piątego tysiąclecia p.n.e., w odróżnieniu od wcześniejszych, zdominowanych przez bydło gospodarek zwierzęcych z szóstego tysiąclecia BC.

Rozwój dojrzałej gospodarki zwierzęcej w Basenie Paryskim w drugiej połowie piątego tysiąclecia BC kontynuuje kultura Cerny, która pojawia się aby zastąpić w tym rejonie VSG. Pojawia się ona wraz z nowymi cechami kulturowymi, takimi jak długie kurhany z nasypami ziemnymi, zagrody i nowe formy użytkowania ziemi. Zespoły szczątków zwierzęcych kultury Cerny są zdominowane przez bydło, ze świniami teraz stale obecnymi na drugim miejscu. Profile śmiertelności bydła w kulturze Cerny sugerują, że produkty pochodne, takie jak mleko i sprzężaj występują teraz w bardziej znaczący sposób w strategii postępowania ze zwierzętami (A. Tresset 1997, s. 303–309).

Innym rejonem Europy środkowej, który dostarcza bogatego świadectwa dla regionalnych gospodarek zwierzęcych w piątym tysiącleciu BC jest Kotlina Karpacka. Warto tu rozpatrzyć ostatnio przedstawione sprawozdanie dotyczące zespołu szczątków zwierzęcych z osady kultury tiszapolgarskiej w Vésztö–Bikeri położonej w dolinie rzeki Körös (W. A. Parkinson, R. W. Yerkes i A. Gyucha 2002; A. Nikodemus 2003)[2]. Nikodemus przeanalizowała zespół szczątków zwierzęcych liczący 2838 zidentyfikowanych osobników, z których 83% należało do udomowionych ssaków, przy czym większość pozostałych pochodziła od dzikich zwierząt kopytnych, ryb, ptaków i żółwi. GLS głównych gospodarczych gatunków ssaków w Vésztö–Bikeri (ryc. 1368) wykazuje uderzające podobieństwo do ogólnej proporcji jednostek taksonomicznych odkrytych np. w Osłonkach. Świnia stanowi ¼ GSL, zaś owca i koza dalsze 32%. Łowiectwo dzikich zwierząt kopytnych jest niskie, lecz zauważalne. Ponadto, dane śmiertelności dla inwentarza żywego z Veszto–Bikeri świadczą, że produkcja mięsa była ciągle głównym celem, co zgadza się z danymi uzyskanymi z próbek Kujawskich.

Odmienny obraz prezentuje próbka szczątków zwierzęcych pochodzących z lendzielskiej jamy osadowej z Melk–Winden w Austrii (E. Pucher 2004). Ogólna liczba 2207 GLS pochodzi od pięciu udomowionych i czternastu dzikich jednostek gatunkowych ssaków, wraz z trzema typami ptaków i żółwiem błotnym. Zasadnicza gospodarczo jednostka (GSL =2064) była zdominowana przez jelenia, sarnę i dziką świnię, podczas gdy ¼ GSL pochodzi od udomowionego bydła (ryc. 1369). Odkryto bardzo mało kości owcy i kozy, brak jest również jakichkolwiek pewnych kości owcy. Bardziej skrajny przypadek wykorzystywania jelenia jest ukazany przez zwierzęce szczątki kostne pochodzące z osady typu Kreisgrabenanlagen z Ölkam, także w Austrii (M. Schmitzberger 2001). W Olkam prawie 90% z 3462 należących do ssaków GLS pochodzi od dzikich zwierząt kopytnych, w szczególności od jelenia, ale zawiera również znaczące domieszki dzikiej świni i sarny, wraz z pewną ilością dzikiego bydła (ryc. 1370 u dołu). Tutaj także odkryto bardzo mało kości owcy i kozy, przy braku wyraźnych kości owcy, wraz ze stosunkowa małą ilością bydła i kości udomowionej świni.

PODSUMOWANIE: DOJRZAŁA GOSPODARKA ZWIERZĘCA W EUROPIE ŚRODKOWEJ W PIĄTYM TYSIĄCLECIU BC

Piąte tysiąclecie BC przyniosło, co może być nazwane „dojrzałą gospodarką zwierzęcą” w całej Europie środkowej, zaś zwierzęce szczątki kostne ze stanowisk grupy brzesko–kujawskiej kultury lendzielskiej w rejonie Brześcia Kujawskiego i Osłonek odzwierciedlają ten rozwój. Gospodarka ta była inna, niż pionierska gospodarka zwierzęca szóstego tysiąclecia BC, która charakteryzowała wczesne społeczności rol-

---

[2] Autor jest wdzięczny Amy Nicodemus z Uniwersytetu Michigan (*University of Michigan*) za pozwolenie cytowania jej pracy magisterskiej z 2003 roku, przedstawionej na Wydziale Antropologii Stanowego Uniwersytetu Florydy (*Florida State University*).

nicze. W Europie środkowej pionierskie wzorce gospodarowania, są przeważnie mocno skierowane ku udomowionemu bydłu. W dojrzałej gospodarce zwierzęcej, można znaleźć większe zróżnicowanie gatunków inwentarza żywego, z których każdy odgrywa szczególną rolę, nie tylko przez swój udział w sposobie odżywiania człowieka, lecz także w użyteczności ekonomicznej w gospodarstwie domowym.

Pomimo, że były to ciągle gospodarki nastawione na produkcję mięsa, to jednak istnieje możliwość, że mleczarskie produkty były wykorzystywane w sposób uboczny. Nakostniaki (*Exostoses*) na dolnych partiach kończyn bydła dostarczają przesłanek, że mogły to być wczesne próby zwierzęcego sprzężaju, którego potwierdzone zastosowanie pochodzi z czwartego tysiąclecia BC. Chociaż restrukturyzacja gospodarki zwierzęcej w celu większego użytkowania produktów pochodnych nie miała miejsca aż do czwartego tysiąclecia BC, to taka dojrzała gospodarka zwierzęca w poprzednim tysiącleciu stanowiła etap w kierunku Rewolucji Produktów Pochodnych, wraz z jej konsekwencjami, tj. tworzeniem się bogactwa oraz zróżnicowaniem w pozycji społecznej i władzy.

W tym samym czasie dzikie bogactwa naturalne odgrywały niską, lecz stałą rolę w gospodarce zwierzęcej grupy brzesko–kujawskiej. Na dzikie zwierzęta parzystokopytne, takie jak dzikie bydło, dzika świnia, jeleń i sarna polowano zapewne raczej przy nadarzającej się okazji aniżeli w sposób systematyczny. Rzadsze, dzikie gatunki, takie jak dziki koń czy niedźwiedź, były na pewno tylko wtedy przedmiotem łowów, kiedy nadarzała się okazja, a więc zapewne wówczas, gdy zawędrowały zbyt blisko osad, związanych z nimi pól lub łączących je szlaków. Z drugiej strony, zwierzęta futerkowe, takie jak wydra, a szczególnie bóbr były szczególnym celem zabiegów człowieka, co pokazuje czynność oprawiania i skórowania bobra, która wystąpiła w Brześciu Kujawskim i Pikutkowie.

Wykorzystanie żółwi, ryb i ptactwa wodnego uzupełniało gospodarkę opartą o eksploatację ssaków. Intensywność wykorzystywania wodnych bogactw naturalnych dopiero wtedy staje się widoczna, kiedy stanowiska z grupy brzesko–kujawskiej są porównywane ze współczesnymi sobie stanowiskami na innych terenach Europy środkowej, gdzie uzyskanie odosobnionych śladów żółwia, ryb i ptaków jest uznawane za niezwykłe, podczas gdy na południo–wowschodnich Kujawach takie znaleziska są wszechobecne. Każda z tych systematycznych jednostek zwierzęcych mogła mieć swoją pozycję w cyklu rocznym. Ptactwo wodne w szczególności mogło być zdobyczą zimową i wiosenną, podczas gdy żółwie były zapewne łapane podczas cieplejszych miesięcy.

Praca ta naświetla ważność badań nad eksploatacją zwierząt w skali regionu, w przeciwieństwie do budowania ogólnego wzorca zachowań w oparciu o jedno odosobnione stanowisko. Pomimo, że odkrycie tak wielu stanowisk neolitycznych z pokaźnym zbiorem kości zwierzęcych w ramach pojedynczego regionu w Europie środkowej jest rzadkością, atrakcyjność analizy regionalnej jest oczywista. Dopiero kiedy wystarczające próbki szczątków zwierzęcych z wielu różnych regionów zostaną w pełni przebadane, faktycznie będzie możliwe zrozumienie zróżnicowanego sposobu wykorzystania zwierząt w neolicie.

Z języka angielskiego tłumaczyli
Agata i Bogusław Maryniak

References

Aaris-Sørensen, K.
1980 Depauperation of the mammalian fauna of the island of Zealand during the Atlantic period. *Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening* 142: 131-138.

Adams, S.
1975 Sheep and cattle grazing in forests: a review. *Journal of Applied Ecology* 12(1): 143-152.

Andersen, R., P. Duncan and J. D. C. Linnell (editors)
1998 *The European Roe Deer: the Biology of Success*. Scandinavian University Press, Oslo/Boston.

Anthony, D. and D. Brown
2000 Eneolithic horse exploitation in the Eurasian steppes: diet, ritual, and riding. *Antiquity* 74: 75-86.

Arbogast, R., A. Petrequin and P. Petrequin
1995 Le fonctionnement de la cellule domestique d'après l'étude des restes osseux d'animaux: le cas d'un village néolithique du lac de Chalain (Jura, France). *Anthropozoologica* (21): 131-146.

Bakels, C.
1978 *Four Linearbandkeramik Settlements and their Environment: a Paleoecological Study of Sittard, Stein, Elsloo and Hienheim*. Leiden University Press, Leiden.

Balasse, M., H. Bocherens, A. Tresset, A. MariottiI and J. Vigne
1997 Émergence de la production laitière au Néolithique? Contribution de l'analyse isotopique d'ossements de bovins archéologiques. *Comptes Rendus de l'Académie des Sciences. Série 2. Sciences de la Terre et des Planètes* 325(12): 1005-1010.

Bartosiewicz, L., V. Boroneant, C. Bonsall and S. Stallibrass
2006 Size ranges of prehistoric cattle and pig at Schela Cladovei (Iron Gates Region, Romania). *Analele Banatului* 14(1):23-42.

Bartosiewicz, L., W. van Neer and A. Lentacker
1997 *Draught Cattle: Their Osteological Identification and History*. Musée Royal de l'Afrique Centrale, Tervuren, Belgium.

Bedault, L.
2006 The exploitation of animals in Villeneuve-Saint-Germain society at the end of the early Neolithic in the Paris basin. Paper presented at the 12th Annual Conference of the European Association of Archaeologists, Kraków, Poland.

Bedault, L. and L. Hachem
2008 Recherches sur les sociétés danubiennes à partir du Bassin parisien: une approche structurelle des données archéozoologiques. In *Fin des Traditions Danubiennes dans le Néolithique du Bassin Parisien et de la Belgique (5100-4700 BC)*, edited by Burnez-Lanotte L., Ilett M. and A. P., pp. in press. Société Préhistorique Française, Paris.

Bednorz, J.
1976 *Ptaki Wodne i Błotne Zagospodarowanych Łąk Zalewowych w Dolinie Warty koło Poznania*. Adam Mickiewicz University Zoological Series 5, Poznań.

Benecke, N.
1994 *Archäozoologische Studien zur Entwicklung der Haustierhaltung in Mitteleuropa und Südskandinavien von den Anfängen bis zum ausgehenden Mittelalter*. Akademie Verlag, Berlin.

Bennett, D. and R. Hoffmann
1999 *Equus caballus*. *Mammalian Species* (628): 1-14.

Bieniek, A.
2002 Archaeobotanical analysis of some early Neolithic settlements in the Kujawy region, central Poland, with potential plant gathering activities emphasised. *Vegetation History and Archaeobotany* 11(1-2): 33-40.

Bochenski, L.
1982 Szczątki ptaków z neolitycznej osady w Bronocicach. *Acta Zoologica Cracoviensia* 26(5): 159-166.

Boessneck, J.
1969 Osteological differences between sheep (*Ovis aries* Linne) and goat (*Capra hircus* Linne). In *Science in Archaeology*, edited by D. Brothwell, and Eric Higgs, pp. 331–358. Praeger Publishers, New York.

1977 Die Tierknochen aus der Siedlung der Rössener Kultur von Schöningen, Kreis Helmstedt, Eichendorfstrasse, und die Probleme ihrer Ausdeutung. *Neue Ausgrabunden und Forschungen in Niedersachsen* 11: 153-156.

1978 Die Vogelknochen aus der Moorsiedlung Hüde I am Dümmer, Kreis Grafschaft Diepholz. *Neue Ausgrabungen und Forschungen in Niedersachsen* 12: 155-169.

Boessneck, J., J. Jequier and H. Stampfli
1963 *Seeberg Burgäschisee-Süd. Die Tierreste*. Acta Bernensia 2. Verlag Stampfli, Bern.

Bogaard, A.
2004 *Neolithic Farming in Central Europe: an Archaeobotanical Study of Crop Husbandry Practices*. Routledge, London, New York.

Bogucki, P.
1979 Tactical and strategic settlements in the early Neolithic of lowland Poland. *Journal of Anthropological Research* 35(2): 238-246.

1980 Neolithic bird remains from Brześć Kujawski, Poland. *OSSA: International Journal of Skeletal Research* 7: 33-40.

1981 *Early Neolithic Economy and Settlement in the Polish Lowlands.* Ph.D., Harvard University.

1982 *Early Neolithic Subsistence and Settlement in the Polish Lowlands*. BAR International Series 150. British Archaeological Reports, Oxford, England.

1984 Patterns of animal exploitation in the Early Neolithic of the Polish lowlands. In *Animals and Archaeology: 4. Husbandry in Europe*, edited by J. Clutton-Brock and C. Grigson, pp. 35-44. BAR International Series 227. British Archaeological Reports, Oxford.

1984 Ceramic sieves of the Linear Pottery Culture and their economic implications. *Oxford Journal of Archaeology* 3(1): 15–30.

1986 The antiquity of dairying in temperate Europe. *Expedition* 28(2): 51-58.

1988 *Forest Farmers and Stockherders: Early Agriculture and its Consequences in North-Central Europe*. Cambridge University Press, Cambridge.

1989 Exploitation of domestic animals in Neolithic Central Europe. In *Early Animal Domestication and its Cultural Context*, edited by P. J. Crabtree, D. Campana and K. Ryan, pp. 118-134. MASCA Research Papers in Science and Archaeology. Museum Applied Science Center for Archaeology, Philadelphia.

1993 Animal traction and household economies in Neolithic Europe. *Antiquity* 67(256): 492-503.

1995 Prelude to agriculture in north-central Europe. In *Before Farming: the Role of Plants and Animals in Early Societies*, edited by D. V. Campana, pp. 105-116. Research Papers in Science and Archaeology. vol. 12 Supplement. University Museum, MASCA, Philadelphia.

2003 Neolithic dispersals in riverine interior central Europe. In *The Widening Harvest. The Neolithic Transition in Europe: Looking Back, Looking Forward*, edited by A. Ammerman and P. Biagi, pp. 249-272. Archaeological Institute of America, Boston.

Bökönyi, S.
1971 The development and history of domestic animals in Hungary: the Neolithic through the Middle Ages. *American Anthropologist* 73(3): 640-674.

Bollongino, R., C. Edwards, K. Alt, J. Burger and D. Bradley
2006 Early history of European domestic cattle as revealed by ancient DNA. *Biology Letters* 2(1): 155-159.

Boyle, K. V.
2006 Neolithic wild game animals in Western Europe: the question of hunting. In *Animals in the Neolithic of Britain and Europe. [Neolithic Studies Group Seminar Papers 7.]*, edited by D. Sarjeantson and D. Field, pp. 10-23. Oxbow Books, Oxford.

Brown, D. and D. Anthony
2000 Eneolithic horse exploitation in the Eurasian steppes: diet, ritual and riding. *Antiquity* 74: 75-86.

Brown, T.
1997 Clearances and clearings: deforestation in Mesolithic/Neolithic Britain. *Oxford Journal of Archaeology* 16(2): 133-146.

Campana, D. V. and P. J. Crabtree
1987 ANIMALS - a C language computer program for the analysis of faunal remains and its use in the study of early Iron Age fauna from Dun Ailinne. *Archaeozoologia* 1(1): 57-68.

Childe, V. G.
1942 The antiquity and function of antler axes and adzes. *Antiquity* 16(63): 258-264.

Clark, K. M.
2006 Dogs and wolves in the Neolithic of Britain. In *Animals in the Neolithic of Britain and Europe. [Neolithic Studies Group Seminar Papers 7.]*, edited by D. Sarjeantson and D. Field, pp. 32-41. Oxbow Books, Oxford.

Clutton-Brock, J.
1995 Origins of the dog: domestication and early history. In *The Domestic Dog: Its Evolution, Behaviour and Interactions with People*, edited by J. Serpell, pp. 8–20. Cambridge University Press, Cambridge.

Coles, J. and B. Orme
1983 Homo sapiens or *Castor fiber*. *Antiquity* 57: 95-102.

Constantin, C., D. Mordant and D. Simonin (eds.)
1997 *La Culture de Cerny: Nouvelle économie, Nouvelle Société au Néolithique. Actes du Colloque International de Nemours, 9-10-11 Mai 1994*. Mémoires du Musée de préhistoire d'Ile-de-France, no 6. A.P.R.A.I.F., Nemours.

Copley, M., R. Berstan, S. Dudd, S. Aillaud, A. Mukherjee, V. Straker, S. Payne and R. Evershed
2005 Processing of milk products in pottery vessels through British prehistory. *Antiquity* 79(306): 895-908.

Coppinger, R. and R. Schmeider
1995 Evolution of working dogs. In *The Domestic Dog: Its Evolution, Behavior, and Interactions with People*, edited by J. Serpell, pp. 21-47. Cambridge University Press, Cambridge.

Crabtree, P. J.
1989 *West Stow, Suffolk: Early Anglo-Saxon Animal Husbandry*. East Anglian Archaeology 47. Suffolk County Planning Department, Ipswich.

Craig, O.
2002 The development of dairying in Europe: potential evidence from food residues on ceramics. *Documenta Prehistorica* 29: 97-107.

Craig, O., J. Chapman, C. Heron, L. Willis, L. Bartosiewicz, G. Taylor, A. Whittle and M. Collins
2005 Did the first farmers of central and eastern Europe produce dairy foods? *Antiquity* 79(306): 882-894.

Cupere, B. de., A. Lentacker, W. van Neer, M. Waelkens and L. Verslype
2000 Osteological evidence for the draught exploitation of cattle: first applications of a new methodology. *International Journal of Osteoarchaeology* 10(4): 254-267.

Degerbøl, M. and B. Fredskild
1970 The Urus (*Bos primigenius* Bojanus) and neolithic domesticated cattle (*Bos taurus domesticus* Linne) in Denmark. *Det Kongelige Danske Videnskabernes Selskab Biologiske Skrifter* 17(1): 1-177.

Degerbøl, M. and H. Krog
1951 Den europæiske sumpskildpadde (*Emys orbicularis* L.) i Danmark. *Danmarks Geologiske Undersøgelse* 2(78): 1-130.

Dickson, J., K. Oeggl and L. Handley
2003 The Iceman reconsidered. *Scientific American* 288(5): 70-79.

Dobney, K., A. Ervynck, U. Albarella and P. Rowley-Conwy
2004 The chronology and frequency of a stress marker (linear enamel hypoplasia) in recent and archaeological populations of *Sus scrofa* in north-west Europe, and the effects of early domestication. *Journal of Zoology* 264(02): 197-208.

Dobney, K. and G. Larson
2006 Genetics and animal domestication: new windows on an elusive process. *Journal of Zoology* 269(2): 261-271.

Döhle, H.-J.
1993 Haustierhaltung und Jagd in der Linienbandkeramik - ein Überblick. *Zeitschrift für Archäologie* 27(1): 105-124.

1997 Zum Stand der Untersuchungen an neolithischen Tierknochen aus Mitteldeutschland. *Jahresschrift für mitteldeutsche Vorgeschichte* 79: 111-147.

Driesch, A. von den
1976 *A Guide to the Measurement of Animal Bones from Archaeological Sites*. Peabody Museum of Archaeology and Ethnology, Harvard University, Cambridge, Mass.

Edwards, C., R. Bollongino, A. Scheu, A. Chamberlain, A. Tresset, J. Vigne, J. Baird, G. Larson, S. Ho, T. Heupink, B. Shapiro, A. Freeman, M. Thomas, R. Arbogast, B. Arndt, L. Bartosiewicz, N. Benecke, M. Budja, L. Chaix, A. Choyke, E. Coqueugniot, H. Döhle, H. Göldner, S. Hartz, D. Helmer, B. Herzig, H. Hongo, M. Mashkour, M. Özdogan, E. Pucher, G. Roth, S. Schade-Lindig, U. Schmölcke, R. Schulting, E. Stephan, H. Uerpmann, I. Vörös, B. Voytek, D. Bradley and J. Burger
2007 Mitochondrial DNA analysis shows a Near Eastern Neolithic origin for domestic cattle and no indication of domestication of European aurochs. *Proceedings of the Royal Society B: Biological Sciences* 274(1616): 1377-1385.

Ervynck, A., K. Dobney, H. Hongo and R. Meadow
2002 Born free: new evidence for the status of pigs from Çayönü Tepesi, Eastern Anatolia. *Paléorient* 27: 47-73.

Ewersen, J.
2003 Heidmoor: Beispiel Spurensuche. *Beitraege zur Archaeozoologie und Praehistorischen Anthropologie* 4: 51-56.

Gabałówna, L.
1963 Ślady osadnictwa kultur z cyklu wstęgowych w Radziejowie Kujawskim. *Prace i Materiały Muzeum Archeologicznego i Etnograficznego. Seria Archeologiczna* 9: 25-91.

Gautier, A.
1984 How do I count you? Let me count the ways. Problems in archaeozoological quantification. In *Animals and Archaeology 4: Husbandry in Europe*, edited by C. Grigson and J. Clutton-Brock, pp. 237-251. BAR International Series 227. British Archaeological Reports, Oxford.

Gebert, C. and H. Verheyden-Tixier
2001 Variations of diet composition of red deer (*Cervus elaphus* L.) in Europe *Mammal Review* 31(3-4): 189-201.

Gentry, A., J. Clutton-Brock and C. Groves
2004 The naming of wild animal species and their domestic derivatives. *Journal of Archaeological Sciencei* 31: 645–651.

Gilbert, A. and B. Singer
1982 Reassessing zooarchaeological quantification. *World Archaeology* 14(1): 21-40.

Götherström, A., C. Anderung, L. Hellborg, R. Elburg, C. Smith, D. Bradley and H. Ellegren
2005 Cattle domestication in the Near East was followed by hybridization with aurochs bulls in Europe. *Proceedings: Biological Sciences* 272(1579): 2345-2350.

Grant, A.
1975 The animal bones. In *Excavations at Portchester Castle I. Roman*, edited by B. W. Cunliffe, pp. 378-408, 437-450. Society of Antiquaries, London.

1982 "The use of tooth wear as a guide to the age of domestic ungulates," in *Ageing and Sexing Animal bones from Archaeological Sites,* edited by B. Wilson, C. Grigson, and S. Payne, pp. 91-108. BAR British Series 109. British Archaeological Reports, Oxford.

Grayson, D.
1973 On the methodology of faunal analysis. *American Antiquity* 38(4): 432-439.

Grigson, C.
1982 Porridge and pannage: pig husbandry in Neolithic Europe. In *Archaeological Aspects of Woodland Ecology*, edited by S. Limbrey and M. Bell, pp. 297–314. BAR International Series 146. British Archaeological Reports, Oxford.

1969 The uses and limitations of differences in absolute size in the distinction between the bones of aurochs (*Bos primigenius*) and domestic cattle (*Bos taurus*)," in *Domestication and Exploitation of Plants and Animals*, edited by P. J. Ucko and G. W. Dimbleby, pp. 277-294. Duckworth, London.

Grygiel, R.
1986 Household cluster as a fundamental social unit of the Brześć Kujawski group of the Lengyel culture in the Polish lowlands. *Prace i Materiały Muzeum Archeologicznego i Etnograficznego: Seria Archeologiczna* 31: 43-334.

2004 *Neolit i Początki Epoki Brązu w Rejonie Brześcia Kujawskiego i Osłonek (The Neolithic and Early Bronze Age in the Brześć Kujawski and Osłonki Region)* 1. Konrad Jażdżewski Foundation for Archaeological Research, Museum of Archaeology and Ethnography, Łódź.

Grygiel, R. and P. Bogucki
1990 Neolithic manufacture of antler axes at Brześć Kujawski, Poland. *Archeomaterials* 4(1): 69-76.

Guilday, J.
1971 *Biological and Archeological Analysis of Bones from a 17th Century Indian Village (46 PU 31), Putnam County, West Virginia*. Report of Archeological Investigations 4. West Virginia Geological and Economic Survey, Morgantown.

Gumiński, W.
2005 Bird for dinner: Stone age hunters of Dudka and Szczepanki, Masurian Lakeland, NE-Poland. *Acta Archaeologica* 76: 111-148.

Harland, J., J. Barrett, J. Carrott, K. Dobney and D. Jaques
2003 The York System: An integrated zooarchaeological database for research and teaching. *Internet Archaeology* 13: http://intarch.ac.uk/journal/issue13/harland_index.html.

Hofmann, R.
1989 Evolutionary steps of ecophysiological adaptation and diversification of ruminants: a comparative view of their digestive system. *Oecologia* 78(4): 443-457.

Hüster, H.
1983 Die Fischknochen der neolithischen Moorsiedlung Hüde I am Dümmer, Kreis Grafschaft Diepholz. *Neue Ausgrabungen und Forschungen in Niedersachen* 16: 401-480.

Jędrzejewska, B. and W. Jędrzejewski
1998 *Predation in Vertebrate Communities : the Białowieża Primeval Forest as a Case Study*. Springer, Berlin/New York.

Jażdżewski, K.
1938 Cmentarzyska kultury ceramiki wstęgowej i związane z nimi ślady osadnictwa w Brześciu Kujawskim. *Wiadomości Archeologiczne* 15: 1-105.

Jenkins, S. and P. Busher
1979 *Castor canadensis*. *Mammalian Species* (120): 1-8.

Jensen, G.
1996 Effektive okser af kronhjortens tak. In *Arkaeologiske Eksperimenter i Lejre*, edited by M. Meldgaard and M. Rasmussen, pp. 40-48. Naturens Verden/Historisk-Archæogisk Forsøgcenter, Lejre.

Johannsen, N. N.
2006 Draught cattle and the South Scandinavian economies of the 4th millennium BC. *Environmental Archaeology* 11(1): 35-48.

Johansson, L.
1981 Bistoft LA 11. Siedlungs-und Wirtschaftsformen im frühen Neolithikum Norddeutschlands und Südskandinaviens in Festschrift für Karl Wilhelm Struve zum 65. Geburtstag. *Offa. Berichte und Mitteilungen zur Urgeschichte, Frühgeschichte und Mittelalterarchäologie Neumünster* 38: 91-129.

Johansson, L. and F. Johansson
1979 *Socio-ekonomiska strukturer i tidigt neolitikum och deras förutsättningar: studier över Bistoft LA 11, ett boplatsfynd från Schleswig-Holstein*. Göteborgs universitet, Institutionen för arkeologi.

Kalis, A., J. Merkt and J. Wunderlich
2003 Environmental changes during the Holocene climatic optimum in central Europe-human impact and natural causes. *Quaternary Science Reviews* 22(1): 33-79.

Kalis, A. and J. Meurers-Balke
1997 Landnutzung im Neolithikum. *Neolithikum. Geschichtlicher Atlas der Rheinlande 2.1* 2: 25–55.

Klassen, L.
2004 *Frühes Kupfer im Norden: Untersuchungen zu Chronologie, Herkunft und Bedeutung der Kupferfunde der Nordgruppe der Trichterbecherkultur*. Jysk Arkæologisk Selskab, Aarhus.

Kreuz, A.
2008 Closed forest or open woodland as natural vegetation in the surroundings of Linearbandkeramik settlements? *Vegetation History and Archaeobotany* 17(1): 51-64

Larson, G., U. Albarella, K. Dobney, P. Rowley-Conwy, J. Schibler, A. Tresset, J.-D. Vigne, C. J. Edwards, A. Schlumbaum, A. Dinu, A. Balacsescu, G. Dolman, A. Tagliacozzo, N. Manaseryan, P. Miracle, L. Van Wijngaarden-Bakker, M. Masseti, D. G. Bradley and A. Cooper
2007 Ancient DNA, pig domestication, and the spread of the Neolithic into Europe. *Proceedings of the National Academy of Sciences* 104(39): 15276-15281.

Larson, G., K. Dobney, U. Albarella, M. Fang, E. Matisoo-Smith, J. Robins, S. Lowden, H. Finlayson, T. Brand, E. Willerslev, P. Rowley-Conwy, L. Andersson and A. Cooper
2005 Worldwide phylogeography of wild boar reveals multiple centers of pig domestication. *Science* 307(5715): 1618-1621.

Lasota-Moskalewska, A. and H. Kobryń
1990 The size of aurochs skeletons from Europe and Asia in the period from the Neolithic to the Middle Ages. *Acta Theriologica* 35(1-2): 89-109.

Lasota-Moskalewska, A., H. Kobryń and K. Świeżyński
1987 Changes in the size of the domestic and wild pig in the territory of Poland from the Neolithic to the Middle Ages. *Acta Theriologica* 32(1-10): 51-81.

Lenk, P., U. Fritz, U. Joger and M. Wink
1999 Mitochondrial phylogeography of the European pond turtle, *Emys orbicularis* (Linnaeus 1758). *Molecular Ecology* 8(11): 1911-1922.

Louwe Kooijmans, L. P.
1993 Mesolithic/Neolithic transformation in the lower Rhine basin. In *Case Studies in European Prehistory*, edited by P. Bogucki, pp. 95-145. CRC Press, Boca Raton.

Magnell, O.
2004 The body size of wild boar during the Mesolithic in southern Scandinavia. *Acta Theriologica* 49(1): 113-130.

Makowiecki, D.
2003 *Historia Ryb i Rybołowstwa w Holocenie na Niżu Polskim w Świetle Badań Archeoichtiologicznych*. Instytut Archeologii i Etnologii Polskiej Akademii Nauk, Poznań.

Marciniak, A.
1999 Faunal Materials and Interpretive Archaeology—Epistemology Reconsidered. *Journal of Archaeological Method and Theory* 6(4): 293-320.

2005 *Placing Animals in the Neolithic: Social Zooarchaeology of Prehistoric Farming Communities*. UCL Press, London.

Marshall, F. and T. Pilgram
1993 NISP vs. MNI in Quantification of Body-Part Representation. *American Antiquity* 58(2): 261-269.

McQuade, M. and L. O'Donnell
2007 Late Mesolithic fish traps from the Liffey estuary, Dublin, Ireland. *Antiquity* 81(313): 569-584.

Meadow, R. and M. Zeder (editors)
1978 *Approaches to Faunal Analysis in the Middle East*. Peabody Museum of Archaeology and Ethnology, Harvard University.

Meadow, R. H.
1978a Effects of context on the interpretation of faunal remains: a case study. In *Approaches to Faunal Analysis in the Middle East.*, edited by R. Meadow and M. Zeder, pp. 15-21. Peabody Museum of Archaeology and Ethnology, Cambridge, Mass.

1978b "Bonecode" -- a system of numerical coding for faunal data from Middle Eastern sites. In *Approaches to Faunal Analysis in the Middle East.,*, edited by R. H. Meadow and M. A. Zeder, pp. 169-186. Peabody Museum of Archaeology and Ethnology, Cambridge, Mass.

1981 Early Animal Domestication in South Asia: A First Report of the Faunal Remains from Mehrgarh, Pakistan. *South Asian Archaeology*: 143–179.

1983 Notes on the faunal remains from Mehrgarh, with a focus on cattle (Bos). *South Asian Archaeology*: 34–40.

1999 The use of size index scaling techniques for research on archaeozoological collections from the Middle East. In *Historia Animalium Ex Ossibus. Beiträge zur Paläoanatomie, Archäologie, Ägyptologie, Ethnologie, und Geschichte der Tiermedizin*, edited by C. Becker, H. Manhart, J. Peters and J. Schibler, pp. 285-300. Verlag Marie Leidorf, Rahden/Westf.

Midgley, M. S.
1985 Review of *Bogucki, Early Neolithic Subsistence and Settlement in the Polish Lowlands*. *Bulletin of the Institute of Archaeology, London* 21/22: 176-177.

2005 *The Monumental Cemeteries of Prehistoric Europe*. Tempus, Stroud.

Milisauskas, S.
1999 The earliest evidence of wheeled vehicles in Europe and the Near East. *Antiquity* 73: 778-90.

Mitchell, F. J. G.
2005 How open were European primeval forests? Hypothesis testing using palaeoecological data. *Journal of Ecology* 93(1): 168-177.

Mitrus, S. and M. Zemanek
2003 European pond tortoise, *Emys orbicularis*, neonates overwintering in the nest. *Herpetological journal* 13(4): 195-198.

2004 Body size and survivorship of the European pond turtle *Emys orbicularis* in Central Poland. *Biologia, Bratislava* 59(14): 103-107.

Modderman, P.
1988 The Linear Pottery Culture: diversity in uniformity. *Berichten van de Rijksdienst voor het Oudheidkundig Bodemonderzoek* 38: 63-139.

Moran, N. and T. O'Connor
1994 Age attribution in domestic sheep by skeletal and dental maturation: a pilot study of available sources. *International Journal of Osteoarchaeology* 4: 267–285.

Najbar, B. and E. Szuszkiewicz
2007 Nest-site fidelity of the European pond turtle *Emys orbicularis* (Linnaeus, 1758) (Testudines: Emydidae) in western Poland. *Acta Zoologica Cracoviensia* 50A(1-2): 1-8.

Nalepka, D.
2005 *Late Glacial and Holocene Palaeoecological Conditions and Changes of Vegetation Cover Under Early Farming Activity in the South Kujawy Region (Central Poland)*. Acta Palaeobotanica Supplementum No. 6. W. Szafer Institute of Botany, Polish Academy of Sciences, Kraków.

Nicodemus, A.
2003 *Animal Economy and Social Change During the Neolithic-Copper Age Transition on the Great Hungarian Plain.* Master of Science thesis, Florida State University.

Nobis, G.
1975 Zur Fauna des ellerbekzeitlichen Wohnplatzes Rosenhof in Ostholstein. In *Archaeozoological studies*, pp. 160-163. Amsterdam: North-Holland Pub. Co., 1975.

1978 Problems of the early husbandry of domestic animals in northern Germany and Denmark. *Archaeo-Physika* 10: 378-379.

Noe-Nygaard, N. and M. U. Hede
2006 The first appearance of cattle in Denmark occurred 6000 years ago: an effect of cultural or climate and environmental changes. *Geografiska Annaler, Series A: Physical Geography* 88(2): 87-95.

Noe-Nygaard, N., T. D. Price and S. U. Hede
2005 Diet of aurochs and early cattle in southern Scandinavia: evidence from 15N and 13C stable isotopes. *Journal of Archaeological Science* 32(6): 855-871.

O'Connor, T.
2000 *The Archaeology of Animal Bones*. Sutton, Stroud.

2003 *The Analysis of Urban Animal Bone Assemblages: A Handbook for Archaeologists*. York Archaeological Trust/Council for British Archaeology, York.

Parkinson, W. A., R. W. Yerkes and A. Gyucha
2002 The transition from the Neolithic to the Copper Age: excavations at Vésztö-Bikeri, Hungary, 2000-2002. *Journal of Field Archaeology* 29(1): 101-121.

Pasitschniak-Arts, M.
1993 *Ursus arctos*. *Mammalian Species* (439): 1-10.

Payne, S. and G. Bull
1988 Components of variation in measurements of pig bones and teeth, and the use of measurements to distinguish wild from domestic pig remains. *Archaeozoologia II/1* 2: 27-66.

Plug, C. and I. Plug
1990 MNI counts as estimates of species abundance. *South African Archaeological Bulletin* 45: 53-57.

Pucher, E.
2004 Der mittelneolithische Tierknochenkomplex von Melk-Winden (Niederösterreich). *Annalen des Naturhistorischen Museums in Wien A Mineralogie Petrologie Geologie Palaeontologie Archaeozoologie Anthropologie Praehistorie* 105A: 363-403.

Redding, R. W.
1984 Theoretical determinants of a herder's decisions: modeling variation in the sheep/goat ratio. In *Animals and Archaeology: 3. Early Herders and their Flocks*, edited by J. Clutton-Brock and C. Grigson, pp. 161-170. BAR International Series 202. British Archaeological Reports, Oxford.

1991 The role of the pig in the subsistence system of ancient Egypt: a parable on the potential of faunal data. In *Animal Use and Culture Change*, edited by P. J. Crabtree and K. Ryan, pp. 20-30. MASCA Research Papers in Science and Archaeology. Supplement to Volume 8. MASCA, the University Museum of Archaeology and Anthropology, University of Pennsylvania, Philadelphia.

Riedel, K., K. Pohlmeyer and D. von Rautenfeld
2004 An examination of Stone Age/Bronze Age adzes and axes of red deer (*Cervus elaphus* L.) antler from the Leine Valley, near Hannover. *European Journal of Wildlife Research* 50(4): 197-206.

Rolett, B. V. and M. Chiu
1994 Age estimation of prehistoric pigs ("*Sus scrofa*") by molar eruption and attrition. *Journal of Archaeological Science* 21(3): 377-86.

Rollefson, G. and I. Köhler-Rollefson
1992 Early neolithic exploitation patterns in the Levant: Cultural impact on the environment. *Population & Environment* 13(4): 243-254.

Rosell, F., O. Bozser, P. Collen and H. Parker
2005 Ecological impact of beavers *Castor fiber* and *Castor canadensis* and their ability to modify ecosystems. *Mammal Review* 35(3-4): 248-276.

Rosenberg, M., R. Nesbitt, R. W. Redding and B. L. Peasnall
1998 Hallan Çemi, pig husbandry, and post-Pleistocene adaptations along the Taurus-Zagros arc (Turkey). *Paléorient* 24(1): 25-41.

Rowley-Conwy, P.
1995 Wild or domestic? On the evidence for the earliest domestic cattle and pigs in south Scandinavia and Iberia. *International Journal of Osteoarchaeology* 5: 115-126.

Russell, N.
1993 *Hunting, Herding and Feasting: Human Use of Animals in Neolithic Southeast Europe.* Ph.D. dissertation, University of California, Berkeley.

1999 Symbolic dimensions of animals and meat at Opovo, Yugoslavia. In *Material Symbols: Culture and Economy in Prehistory*, pp. 153-172. Center for Archaeological Investigations, Southern Illinois University, Carbondale.

2004 Livestock of the early farmers. In *Ancient Europe 8000 B.C.–A.D. 1000: Encyclopedia of the Barbarian World*, edited by P. Bogucki and P. J. Crabtree, pp. 211-217. Scribners/Gale Group, Farmington Hills, Michigan.

Schley, L. and T. J. Roper
2003 Diet of wild boar *Sus scrofa* in Western Europe, with particular reference to consumption of agricultural crops.. *Mammal Review* 33(1): 43-56.

Schmid, E.
1972 *Atlas of Animal Bones: for Prehistorians, Archaeologists and Quaternary Geologists*. Elsevier, London.

Schmitzberger, M.
1999 Jungsteinzeitliche Wildvogelfunde aus Ölkam/OÖ. *Jahrbuch des Oberösterreichischen Musealvereines Gesellschaft für Landeskunde* 144: 431-437.

2001 Die Tierknochen aus der mittelneolithischen Kreisgrabenanlage Ölkam (Oberösterreich). *Jahrbuch des Oberösterreichischen Musealvereines Gesellschaft für Landeskunde* 146(1): 43-86.

Schmitzberger, M. and E. Pucher
2003 Holozäne Biberfunde (*Castor fiber* L.) aus Österreich. *Denisia* 9: 13-19.

Semperé, A., V. Sokolov and A. Danilkin
1996 *Capreolus capreolus*. *Mammalian Species* (538): 1-9.

Slater, J.
2007 Prehistoric find located beneath the waves. swissinfo.ch, http://www.swissinfo.org/eng/feature/detail/Prehistoric_find_located_beneath_the_waves.html, accessed September 10, 2007.

Sobociński, M.
1985 Szczątki kostne z osad ludności kultury ceramiki wstęgowej na Kujawach (ze studiów nad rozwojem kultur wstęgowych na Kujawach). *Roczniki Akademii Rolniczej w Poznańiu* 164: 87-127.

Sommer, R. and N. Benecke
2005 The recolonization of Europe by brown bears *Ursus arctos* Linnaeus, 1758 after the Last Glacial Maximum. *Mammal Review* 35(2): 156-164.

2006 Late Pleistocene and Holocene development of the felid fauna (Felidae) of Europe: a review. *Journal of Zoology* 269(1): 7-19.

Steppan, K.
2001 Ur oder Hausrind? Die Variabilität der Wildtieranteile in linearbandkeramischen Tierknochenkomplexen. In *Rôle et Statut de la Chasse dans le Néolithique Ancien Danubien (5500 - 4900 av. J.-C.).* edited by R.-M. Arbogast, C. Jeunesse and J. Schibler, pp. 171-186. Verlag Marie Leidorf, Rahden/Westf.

Suttie, J. M. and P. F. Fennessy
1992 Recent advances in the physiological control of velvet antler growth. In *The Biology of Deer*, edited by R. Brown, pp. 471-486. Springer, New York.

Teichert, M.
1999 Ur- und frühgeschichtliche Knochenreste des Bibers, *Castor fiber* L., aus den östlichen Bundesländern Deutschlands. *Hercynia* 32(1): 99-109.

Tresset, A.
1997 L'approvisionnement carné Cerny dans le contexte néolithique du Bassin parisien. *Mémoires du Musée de Préhistoire d'Ile-de-France* (6): 299-314.

2005 L'avifaune des sites mesolithiques et neolithiques de Bretagne (5500 a 2500 av. J-C.): implications ethnologiques et biogeographiques. *Revue de Paleobiologie Volume Special* 10: 83-94.

Uerpmann, H.-P.
1977 Betrachtungen zur Wirtschaftsform neolithischer Gruppen in Südwestdeutschland. *Fundberichte aus Baden-Württemberg* 3: 144-161.

1979 *Probleme der Neolithisierung des Mittelmeerraums*. Beihefte zum Tübinger Atlas des Vorderen Orients, Reihe B 28. Reichert-Verlag, Wiesbaden.

Ultsch, G.
2006 The ecology of overwintering among turtles: where turtles overwinter and its consequences. *Biological Reviews* 81(03) : 339-367.

Vera, F. W. M.
2000 *Grazing Ecology and Forest History*. CABI Publishing, Wallingford (UK).

Watson, J. P. N.
1979 The estimation of the relative frequencies of mammalian species: Khirokitia 1972. *Journal of Archaeological Science* 6(2): 127-37.

Wilson, B., J. Hamilton, D. Bromwell, and P. Armitage.
1978. "The animal bones," in *The Excavation of an Iron Age Settlement, Bronze Age Ring Ditches, and Roman Features at Ashebille Trading Estate, Abingdon (Oxfordshire), 1974-1976*, edited by M. Parrington, pp. 110-139. London: Council for British Archaeology (Research Report 28).

Wright, J., C. Jones and A. Flecker
2002 An ecosystem engineer, the beaver, increases species richness at the landscape scale. *Oecologia* 132(1): 96-101.

Zeder, M. A. and B. Hesse
2000 The initial domestication of goats (*Capra hircus*) in the Zagros Mountains 10,000 years ago. *Science* 287(5461): 2254-2257.

Zeiler, J.
2006 Birds. In *Schipluiden. A Neolithic Settlement on the Dutch North Sea Coast c3500 cal BC*, edited by L. P. Louwe Kooijmans and P. F. B. Jongste, pp. 421-442. Analecta Praehistorica Leidensia. vol. 37/38. Leiden University Faculty of Archaeology, Leiden.

Zvelebil, M.
2006 Mobility, contact, and exchange in the Baltic Sea basin 6000-2000 BC. *Journal of Anthropological Archaeology* 25(2): 178-192.