THE EVOLUTION OF THE SUBSISTENCE ECONOMY AND ARCHAEOBOTANICAL RESEARCH IN LITHUANIA

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1. INTRODUCTION

Systematic research of the evolution of early prehistoric economy in Lithuanian territory is to date based largely on animal bone analyses and the evolution of animal husbandry. Our knowledge of the early evolution of plant use and agriculture in Lithuanian territory is based on only a few settlements and find sites. This data is for the most part inferential: accidentally found seeds, nutshells or grain imprints on pottery, palynological data, and the existence of farming tools. These types of finds may provide us with a general picture of economy and its evolution, however, the specific chronological and geographical nature of the evolution remains fuzzy. Archaeobotanical research that includes macroremains (preserved seeds and fruits) has the potential to fill this void. Systematic macrobotanical research in Lithuania had so far not been undertaken; the project described herein represents its first, pioneering efforts.

The majority of archaeobotanical research in Lithuania up to now has concentrated on palynology. The data often is not site specific, only locationally approximate. This is a problem, since pollen rain is subject to considerable variation. Sediment catchment must be measured against the pollen catchment; pollens from several local microenvironments will be mixed (Butzer 1982:178-9). Also, the palynological samples taken thus far have not been 'fine resolution', further allowing only gross calculations in regard to chronology and evolution. There has not been any systematic collection or incorporation of macrobotanical data in the assessment of the subsistence economy, which, especially when used as a supplement to palynological data, has definite advantages over palynological data alone. Plant macrofossils are frequently determinable to species level, are usually not transported very far from their point of origin, and identifiable remains are often preserved of plants which either produce very low amounts of pollen, or which produce fragile pollen which is not fossilized. It should be noted that there are limits to macrobotanical data as well; however, when used in conjunction with palynological data, macrofossils and pollen are largely complementary (Birks and Birks 1980:66–7)

Macrobotanical methods and analysis have the potential to more thoroughly answer questions dealing not only with specific environmental and ecological contexts and places, but also to make wider inferences concerning the differential chronological and regional development of the economy. This, in turn, adds to the research of wider problems concerning social structure, gender roles, political economy and ideology (Hastorf 1991,1993; Gumerman 1997; Earle et al 1998; Kelertas 1997).

2. AIMS OF RESEARCH

The environment itself is a vital part of a people's economic life- it provides the basis from which humans make choices about how to manipulate and extend the resources they have available. We see the environment not as determining the subsistence economy, but rather as a backdrop which gives several choices. The environment influences people, as people influence it.

Paleoethnobotanical research can give much information on environmental reconstruction (Behre and Jacomet 1991; Jacomet et.al.1989; Jones 1988; Koerber-Grohne 1967). However, archaeobotany deals with more than just this aspect of human life. On a broader scale, paleoethnobotany can elucidate with the people-plant ecosystem. Plants provide food, wood for construction and fuel, fibers for clothing, tools and other crafts, as well as ingredients and components for medicine and socioreligious symbols (Ford 1979; Butzer 1982; Dimbley 1978). It is important to incorporate all of these aspects in a holistic reconstruction of the economy.

Analysis of all types of plant remains, including wood, charcoal and fibers, is work for the future. Here we describe the collection and identification of macrobotanical finds of seeds, nuts and fruits from archaeological sites of Neolithic and Bronze ages from two microregions, the Kretuonas site series in northeastern Lithuania (see Girininkas 1994, 1997; Гирининкас 1990) and the site of Turlojiškė (see Merkevičius 1997, 2000) in southwestern Lithuania. We hope to contribute more precisely to interpretations of the role of plants in human subsistence systems as they evolved in the East Baltic.

The work is part of what we plan as a larger research goal directed toward investigating food systems and their development in the East Baltic. Food systems are the set of conditions under which food is produced and distributed, prepared and consumed, and finally, discarded (La Bianca 1991). Especially in complex societies, there can be elaborate food systems (Gumerman 1997). Often there are differences in production and consumption between different groups in society. The intensification of production is especially important since it may be related not to population growth or the degradation of land, but to more direct social and political changes (Hastorf 1993, Kelertas 1997). Different patterns of consumption between sites can show variation in economy between sites, for example evidence of specialization in certain crops, or differences in access to special foods. Food can mark or reaffirm status, and thus can be differentially distributed in a society by gender, age or status (Goody 1982; Welch and Scarry 1995). Our long term goal is to research patterns of subsistence production and consumption, and the social and political uses of food.

3. PROBLEMS AND LIMITATIONS

Systematically collecting archaeobotanical data that concerns not only environmental reconstruction, but also the multi-varied socio-cultural dimension of prehistoric peoples (for example, gender studies and political economy) and its evolution is a collaborative task. Although palynological investigations have been included in the excavation works of some Lithuanian archaeologists working with stone and bronze age materials, these investigations have been limited to only a few sites. Furthermore, the research has typically been carried out in a restricive manner, where the archaeologist provides the samples and the palynologist merely identifies the pollen grains, nothing more. This sort of approach is rather limited at best.

Just as important, the macrobotanical aspect of archaeobotanical work has thus far not been seriously engaged in any systematic manner. The macrobotanical research presented here began as a part of a joint project on the evolution of economy with Algirdas Girininkas, Linas Daugnora and Gediminas Motuza[1]. Because of its pioneering nature, the research of the last 3 years has been wrought with difficulties, including lack of local specialists, limited time and insufficient funds. Also the results thus far are not enough for conclusive interpretations concerning economy, be it subsistence, gender, or political economy. In order to investigate specifics about the evolution of plant use, a substantial data base is necessary. This work must be viewed as only a beginning of the potentials of archaeobotanical research in Lithuania.

Moreover, recent concerns with Stone and Bronze Age periodization as well as major chronological (including stratigraphical) discrepancies illustrated by recent radiocarbon datings of this time period's archaeological sites (Antanaitis 1999; commentary by Antanaitis and Jacobs in Ramsey et. al. 2000) further confuse a proper understanding of the evolutionary sequence of prehistoric processes, including the evolution of economy.

4. BRIEF OVERVIEW OF PREVIOUS WORK ON THE EVOLUTION OF ECONOMY IN THE STONE AND BRONZE AGES

Lithuanian archaeologists, like all East Baltic archaeologists, consider the defining signature of the Neolithic as the appearance not of domestication, but of ceramics, roughly beginning in the mid-seventh millenium b.p. (uncalibrated radiocarbon years)[2]. The subsistence economy at the start of the East Baltic Neolithic appears to have been a continuation of a previous Mesolithic tradition that relied on hunting, fishing, and gathering. This is suggested by tool in-

[1] The project was funded by Lithuania's Science and Studies Fund (Lietuvos valstybinis mokslo ir studijų fondas).

[2] The most often cited date for Lithuania is one that marks the beginning of the Neolithic in neighboring Latvian territory, at the site of Zvidze: 6535±60 B.P. (TA-862), or 5620 (5480) 5370 cal. B.C. All calibrated dates in this text were calibrated using Stuiver and Reimer 1998 (see References), at the two sigma level.

ventories, animal bone data, finds of nutshells and a few other wild plants. The intensive management of certain resources such as hazelnuts and water chestnuts, could have been precursive to farming. A case could be made for plant husbandry by at least as early as the Late Mesolithic in the East Baltic (see, for example, Zvelebil 1994; Lang 1998). The existing data show that throughout the East Baltic Neolithic the transition to a dominating farming economy was a very slow process that did not generally intensify until the Bronze Age or even later (Паавер 1965; Zvelebil and Rowley-Conwy 1986; Zvelebil 1986, 1994, 1995a, 1995b, 1998; Dolukhanov 1978, 1986, 1993; Daugnora and Girininkas 1996; Girininkas 1998; Lang 1999).

Two Lithuanian microregions have been used for generalizing about the evolution of economy in Lithuania, located in northeastern and in northwestern Lithuania. These are categorized as Western and Eastern. The western series of sites are those of Šventoji, Nida, Duonkalnis, Daktariškė and Šarnelė; the eastern are principally the series of sites at Kretuonas, the Narkūnai hillfort (bottom layer) and a few other hillforts.

The study of early prehistoric economy is relatively new in Lithuania itself. L.Daugnora and A.Girininkas have done the most extensive work concerning the evolution of Stone Age economy to date (1998, 1996, 1995), and their work concerns mostly animal husbandry. Other archaeologists such as Rimantienė (1979, 1980, 1989, 1996a, 1996b,1998a, 1998b, 1999), Butrimas (1996) and Grigalavičienė (1995) provide additional data on the development of farming, especially plant cultivation. R. Rimantienė's research and publications concerning early evidence for agriculture far outweighs that of any other Lithuanian archaeologist to date.

Macrobotanical finds of the Mesolithic period are relatively few, but remains of hazelnuts *Corylus avellana* (hazelnuts) and *Trapa natans* (waterchestnuts) are the most numerous. The Mesolithic Maksimonys 4 campsite hearth contained a carbonized fern root, in addition to a waterchestnut shell. Finds from hearth 15 of the Mesolithic Netiesai 1 site included a fragment of a pit similar to a cherry or bird cherry, while the hearths of many Lampėdžiai campsites contained hazelnut shells as well as waterchestnut remains and a wild plum pit. From archival records of archaeological excavations, we know that the Mesolithic Galubalis and Kamšai peatbog sites had waterchestnuts and hazelnuts.

We have no solid paleobotanical data relating to agriculture from sites of the earliest part of the Neolithic. *Corylus avellana* and *Trapa natans* are the only early botanical finds in both west and east Lithuania from this time period. Fragments of hoes have been found at Šventoji 1B and 2B and Kretuonas 1B[3]. Neither seeds nor pollen of cultured plants have been found in East Lithuania's earliest Neolithic sites.

Hoes and grinding equipment were found in both eastern and western Lithuanian sites. The first domestic plant in (western) Lithuania, and the one found in most amounts was hemp. Hemp seeds were found in most of the Šventoji Middle to Late Neolithic sites[4]. One theory is that hemp was introduced as a substitute for lime at this time, as pollen diagrams show that the amount of linden decreased and thus made raw material used for fiber and making nets more difficult to acquire (Rimantienė). Other researchers have different interpretations concerning the decrease of lime (e.g. Lang 1994, Rösch 1996). Mallets, small shovels and fragments of hoes are also related to gathering activities that may or may not have been associated with cultivation or the deliberate management of plant resources.

During the Late Neolithic, in western Baltic Haff culture sites, not only carbonized *Quercus* and *Malus* fruits (acorns and apples) have been found, but also pollen and seed analysis show that cultivated plants were *Triticum dicoccon* (emmer wheat), *Hordeum* (barley), *Panicum* and *Setaria italica* (millet, Italian millet), and *Cannabis* (hemp).

Between the first and second phases of the Subboreal climatic period, the pollen of narrow leaf plantain, sorrel, Chenopodiaceous and Umbelliferous plants found in the cultural layers in West Lithuania sites are considered to be indicator species primarily related to the spread of pastures and the development of farming (Daugnora and Girininkas 1996:180; Kabailienė 1990:100–1). It must be noted, however, that viewing such vegetational changes as anthropo-

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[3] Šventoji 2B (LJ-2523): 4730±50 BP or 3640 (3618, 3608, 3521) 3370 cal. B.C.; Šventoji 1B (LJ-2528): 4640±60 BP or 3630 (3490, 3471, 3372) 3140 cal. B.C. The settlement site of Kretuonas 1B has no radiocarbon dates, but has been considered Middle Neolithic and contemporaneous with the Kretuonas 1B graves. The site has been the token Middle Neolithic East Lithuanian site in evolution of economy assessments. A new radiocarbon date of Kretuonas grave 3 (OxA-5926), 5580±65 BP or 4540 (4446, 4421, 4398, 4381, 4367) 4260 cal.B.C., turns out to fall into the date range of what has been called Early Neolithic.

[4] These sites date to c. 4400–3850 uncal. radiocarbon years B.P., or c. 3300–2000 cal. B.C.

genic can be problematic; these indicators cannot be viewed as absolute. Factors other than human agency can be responsible for disturbance phases, including natural fires, wind-throws, paludification, and geological changes (Zvelebil 1994:49; Edwards 1982:17). Meadows can be and could have been natural. The *Ulmus* (elm) decline in the mid-Holocene has also been interpreted as the probable result of human activity, i.e., the use of elm boughs for animal fodder (e.g. Seibutis and Savukynienė 1998:54). However, the reason for the decline of *Ulmus* in this time period has been long debated and is not agreed upon.

A few push ards and a model of an ox yoke as well as a marked increase of stone hoes, grinding stones and sickles are also indicative of agricultural development. The presence of longhouses in East Lithuania (Žemaitiškė 2[5]), interpreted as used not only for human residence, but also as stabling farm animals and storage of food, is additionally suggestive of increased farming activities (Daugnora and Girininkas 1995:46), as are the strorage places in the houses of Nida sites. All possible reaping (including knives, sickles, containers) and processing tools (including chopping, grating, and grinding tools) at relevant sites have not yet been analyzed.

At the end of the Early Bronze age, the analysis of pollen in West Lithuania shows Cerealea were common and the quantity of plants that tend to spread in cleared areas (heather, willow-herb) had increased, while analyses from cultural layers in East Lithuania 'do not witness any signs of cultural plants related to agricultural development' up to the beginning of the Iron Age (Daugnora and Girininkas 1998:231; Kabailienė 1990:96–102). Cerealea pollen became more abundant in Lithuanian territory in general in the second half of the Subboreal (Seibutis and Savukynienė 1998). Still other Lithuanian researchers (see Kondratienė 1998) postulate that agriculture in Lithuanian territory became significant only at the turn of the 8th and 9th centuries A.D.

5. MACROBOTANICAL METHODS

For best cultural information, samples must be collected from the archaeological site during excavation (Pearsall 1989). The preservation of plant materials depends on many factors, among which are not only site formation processes that include sediment type, depth of the deposit, moisture regime, and the presence of oxygen for uncarbonized remains, but also on the specific plants' physical properties such as density, surface charactersitics and size, the frequency and method of use and disposal by those who inhabited the site, and even the archaeobotanist's sample processing methods (Miksicek 1987; Hastorf and Popper 1988). Different sediment types, for example, require different collection and processing strategies (Körber-Grohne 1991). Sandy sediments typically do not preserve organic materials very well, therefore the volume of a single macrobotanical sample from a site with a sandy matrix will be considerably larger (i.e., about 30 liters) than from a matrix which preserves organic material well. Large samples require more effort in retrieving botanical remains, however with the mechanical aid of a flotation machine (see below), the processing is relatively fast and effortless, but less effective for uncarbonized remains. Peaty sediments often preserve plant material very well, so significantly smaller sample sizes (i.e., 1–5 liters) could be sufficient (Kenward et. al. 1980).

Adequate number of remains collected from the processed samples depends on the data analysis planned by the researcher. Every archaeobotanical school uses its own set of methods from subsampling to the data analysis (see Jacomet et. al. 1989 versus diverse publications of Jones and van der Veen). Most researchers should probably agree that more is better, but the recommended number of remains per sample varies anywhere from at least 512 remains per sample (Van der Veen and Fieller 1982) to 50 remains per sample (Van der Veen 1992), while 500 seed counts is the statistically better suited number. The samples discussed here varied in number of remains per sample from 0 to 310, with arithmetic means for Turlojiškė 1997 at 92 seeds per liter of sediment, and Turlojiškė 1999 at 29 seeds per liter of sediment.

A highly recommended strategy for collecting samples is the "blanket sampling" strategy, where samples are taken from every level in each unit and from all features (Pearsall 1989). This is an easy method to incorporate into routine excavations. It is important that discrete contexts be sampled separately; features like hearths, postholes and pits - separately from middens and housefloors, for example. Some contexts, however, such as disturbed areas like plow zones or rodent burrows do not need to be sampled. In ongoing excavations, usually one season's analyses will reveal which contexts have the most useful information (Pearsall 1989:95–8; Antanaitytė 1998).

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[5] This mostly Late Neolithic site is in the Kretuonas series of sites and has one radiocarbon date (Vs-311) of 3570±120 BP or 2280 (1916, 1895, 1895) 1620 cal. BC (an Early Bronze Age date).

Our sampling and processing methodology evolved through time and was revised to reflect the need for more stratigraphically discrete samples. Thus, the methods used in the 1997/1998 and 1999 seasons were not altogether identical and are described separately below.

5A. 1997 / 1998 methods:

1. Collection of sediment samples. In 1997 and 1998, samples were collected from Kretuonas 1, 1A, 1B, 1C, 1D (Švenčionys district) and Turlojiškė (Marijampolė district), from Neolithic and Early Bronze age sites[6]. 166 samples were collected. Using the blanket sample strategy, column samples were taken systematically every 1–2 meters throughout the entire excavation plot by cultural layer in 1997 at the sites of Turlojiškė and Kretuonas 1. Kretuonas 1A, 1B,1C, 1D site samples taken in 1998 were along the margins of previously excavated settlements. We took bulk (one mass) samples from the settlements being researched. One goal in 1998 was to establish the baseline densities of macrobotanical remains for determining the most appropriate volume for sediment samples and most productive contexts for future sampling.

2. Processing the samples. In order to separate botanical remains and other artifacts from the soil matrix, we built a SMAP variant of a flotation machine (Watson 1976). This machine allows large volumes of sediment to be processed relatively quickly. The main principle is to separate the botanical remains from the rest of the mineralogical, artifactual and osteological contents within the samples. A soil sample is poured into an inner bucket with 0.5 mm screen attached to the bottom. This inner bucket rests inside a 55 gallon drum, which is filled with water pumped from a stream near the flotation site. The botanical material is lighter than water and flows out a sluiceway into a collection bag. This is called the light fraction. Heavier material sinks to the bottom of the inner bucket and is captured in the screen; this matrix is called the heavy fraction, and includes larger artifacts like pottery and stone tools, as well as small artifacts often missed in excavation, like fish bones, teeth and microflakes.

3. Analysis. For this preliminary report, subsampling was a necessity. From the 120 samples that were taken at Kretuonas, three Late Neolithic (Narva culture) samples (68, 77, 81) were fully analysed. From 46 samples taken at the Early Bronze Age Turlojiškė site, six were fully analysed (121, 122, 139, 149, 154b, 158b) (see Table 1). The remaining samples were scanned for their main species only.

The samples completly analysed were fine fractions (< 1 mm) and had volumes between 500 and 1000 ml. They were subsampled with a riffle type sample splitter, which is a subsampling method resulting in representative data of a subsampled population (van der Veen and Fieller 1982; van der Veen 1984). In order to better compare the samples, the counts were calculated for one litre of sediment. All the seeds of the wild plants were uncarbonised, but the only crop that was found in the samples (*Panicum miliaceum*) was charred. Preservation was relatively poor. After sorting, the seeds were identified with a comparative collection (VegLab – palaeoenvironmental research) and identification manuals (Berggren 1969; Berggren 1981; Anderberg 1994; Beijerinck 1947; Schoch, et al. 1988; Dombrovskaja 1959). Also especially helpful was Jensen (1998).

Categories of sample types (moist conditions; ruderal conditions; open vegetation on sandy soils) were created using the different taxa within the samples. These categories were utilized to classify the remaining scanned samples. At Kretuonas only 30 of the remaining samples contained seeds, whereas at Turlojiškė almost all the samples had seeds.

5B. Methods of 1999 season

Considering the pioneering nature of systematic macrobotanical research in Lithuania, a fundamental research goal of the 1997-98 season was to establish the most effective strategy for taking samples. With the limitations of the project in mind – shortage of time, funds, local specialists – the plans for the 1999 season were ammended to collect samples mostly from sites with good preservation (i.e., mostly from sites with peaty and gyttja soils) and to direct most systematic research attention geared toward the full potential of macrobotany on one token site, the site of Turlojiškė.

1. Collection of samples. Turlojiškė's 1999 1st area, 1st plot is 10x4 m and mostly in peaty and gyttja soil, overlain by peaty topsoil and a layer of uneven clay (possibly former marl?) that was deposited on top of the subsequent, "purer" peaty soil. The "clay" was deposited there from the construction of an irrigation ditch not far from the excavation plot. This relatively recent topsoil layer and disturbed clayey layer were

[6] The site of Turlojiškė appears to be mostly Early Bronze Age and is thusly referred to throughout this paper. It appears, however, that the site also contains some Late Bronze Age material; some Late Neolithic material is also suspected. Only future radiocarbon dating will clarify this site's chronologial range.

Table 1a. **Botanical macroremains from Turlojiškė (1999 and 1997) and Kretuonas.**

	Turlojiškė 99																						
Sample numbers	**1**	**17**	**4**	**8**	**24**	**3**	**2**	**7**	**25**	**13**	**36**	**42**	**31**	**29**	**10**	**34**	**22**	**11**	**19**	**28**	**18**	**27**	**26**
Ecological group / Taxa																							
Crops																							
Panicum miliaceum L.	·	·	·	·	·	·	·	·	·	·	·	·	·	274	·	1	·	·	·	·	·	·	·
Ruderal plants																							
Anagallis sp.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Chenopodium album L.	44	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	1	·	·	·	·	·	·
Chenopodium cf. *glaucum* L.	·	·	1	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Chenopodium sp.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Mentha cf. *arvensis* L.	·	3	·	·	1	·	·	·	7	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Polygonum aviculare L.	·	·	·	3	11	·	·	·	·	·	1	·	·	1	·	·	·	·	·	·	·	·	3
Polygonum minus Huds.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Polygonum persicaria L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Potentilla cf. *anserina* L.	1	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Ranunculus aconitifolius type	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Scirpus sylvaticus L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Silene alba type	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Stellaria cf. *media* (L.) Vill.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	5	·
Urtica dioica L.	·	2	1	·	·	·	·	·	7	1	·	·	2	9	2	1	1	·	·	·	4	·	·
Trees and forest plants																							
Alnus glutinosa (L.) Gaertn.	·	·	·	·	·	·	·	·	·	·	·	3	·	·	·	·	·	·	·	·	·	·	·
Alnus sp., fruit scale	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Alnus sp., seed	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Betula sect. *Albae*	·	·	·	1	1	·	·	1	·	·	1	·	·	1	·	·	·	1	·	·	·	·	·
Cornus cf. *sanguinea* L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Fragaria vesca L.	·	·	·	·	·	·	2	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Hypericum cf. *perforatum* L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Picea / Pinus, needle	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Rubus idaeus L.	·	·	·	·	·	·	·	·	1	·	·	·	·	·	·	·	1	·	·	1	1	·	·
Silene dioica type	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Plants of wetlands and coasts																							
Alisma plantago-aquatica L.	·	2	·	·	1	·	·	·	3	·	·	·	1	·	1	1	1	1	1	·	·	4	2
Calla palustris L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Carex remota / praecox	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Carex spp. (bicarpellate)	·	·	1	·	12	2	·	2	·	·	4	2	·	1	3	·	·	·	·	·	·	·	11
Carex spp. (tricarpellate)	7	2	2	·	9	1	·	·	8	3	11	17	8	13	6	2	·	·	1	1	·	1	6
Carex vesicaria type	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Cirsium palustre (L.) Scop	1	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Eleocharis palustris (L.) R.Br.	·	·	·	·	·	·	·	·	·	1	·	·	·	·	·	·	·	·	·	·	·	·	·
Lycopus europaeus L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Mentha aquatica L.	·	·	·	·	2	·	·	·	·	·	·	·	·	·	·	·	·	1	·	·	·	·	·
Menyanthes trifoliata L.	·	2	·	·	1	1	·	1	2	3	3	·	7	3	3	1	2	6	7	·	3	·	3
Ranunculus cf. *lingua* L.	·	·	·	·	·	·	·	1	1	3	1	·	·	1	2	·	·	1	·	2	1	·	2
Ranunculus sceleratus L.	·	4	·	·	1	·	·	·	2	1	·	·	·	3	5	2	·	6	1	1	·	·	3
Rhynchospora alba (L.) Vahl	·	·	·	·	·	·	·	·	·	·	·	·	1	·	·	·	·	·	·	·	·	·	·
Schoenoplectus lacustris (L.) Palla	·	1	·	·	·	3	·	·	1	·	·	1	·	·	2	1	3	2	2	1	1	2	·
Solanum dulcamara L.	·	·	·	·	·	·	·	·	·	·	·	·	1	·	·	·	·	·	·	·	·	·	·
Stellaria palustris Retz.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Typha latifolia L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Typha sp.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·

Turlojiškė 99																			Turlojiškė 97							Kretuonas 97		
15	23	40	14	33	32	43	44	50	39	49	35	41	48	30	51	47	46	52	122	139	149	154b	158b	121	Σ	68	77?	81
·	·	1	·	·	·	·	·	·	·	1	·	·	·	·	·	·	·	·	·	·	4	·	·	·	281	·	·	·
·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	1	1	·	2	·	·	·
·	·	·	·	·	1	·	·	·	1	·	·	·	·	·	·	·	·	·	2	·	·	·	1	7	57	215	133	22
·	·	·	·	·	·	·	·	1	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	2	·	·	·
·	·	·	·	·	·	·	·	·	·	·	1	·	1	·	·	·	·	·	2	·	·	·	·	·	4	·	·	·
·	·	·	·	·	·	·	·	·	·	4	·	·	·	·	·	·	·	·	·	·	·	·	·	·	15	·	·	·
·	·	·	1	·	·	·	·	1	·	·	·	·	·	1	·	·	·	·	·	·	·	·	·	·	22	·	·	·
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·	·	1	·	·	·	1	2	3	·	·	·	·	·	·	·	·	2	·	·	·	·	·	·	·	12	·	·	·
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·	·	1	·	·	·	·	1	·	·	·	·	2	·	·	·	·	·	·	·	·	·	·	·	·	10	·	·	·
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1	·	1	·	·	3	·	1	·	1	3	·	·	3	1	·	1	·	·	9	1	6	12	16	1	78	·	·	·
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5	3	10	·	·	5	22	9	8	9	19	10	8	18	9	12	3	5	·	1	8	6	23	53	4	349	1	5	1
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1	1	4	·	2	1	2	1	1	2	8	·	4	2	·	·	·	·	·	3	2	4	5	1	1	92	·	·	·
1	·	·	·	2	·	·	·	3	·	·	·	·	·	4	·	·	·	·	·	·	·	·	·	·	25	·	·	·
7	1	1	·	1	4	·	1	1	·	5	·	2	2	·	·	·	1	·	1	1	10	6	4	1	78	·	·	·
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18	·	·	·	·	·	·	1	1	18	5	1	·	7	·	·	1	15	3	11	·	4	3	1	·	109	·	·	·
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·	·	·	·	·	·	1	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	1	·	·	·

Aquatic plants																							
cf. *Lemna* sp.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Chara sp.	2	·	·	·	·	·	2	·	·	·	·	·	·	·	·	·	1	·	·	·	·	·	·
Groenlandia densa (L.) Fourr.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Lemna minor L.	·	·	·	·	1	·	·	·	·	·	·	·	·	·	·	·	1	·	·	·	·	·	1
Lemna trisulca L.	·	·	·	·	·	·	·	·	·	·	·	1	·	2	·	·	1	·	·	·	·	·	·
Najas marina L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Nuphar lutea (L.) Sm.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Nymphaea alba L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Potamogeton perfoliatus L.	·	·	·	·	·	1	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Potamogeton sp.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Ranunculus sect. *Batrachium*	·	·	·	·	·	·	·	·	1	1	·	·	1	·	·	·	·	·	·	·	·	·	1
Salvinia natans (L.) All.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	7	·	·	·	·	·	·	·	·
Other																							
Apiaceae	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Arenaria serpyllifolia L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Asteraceae	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Brassicaceae	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Caryophyllaceae	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Centaurea / Cirsium	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Chenopodiaceae	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Cyperaceae	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Juncus sp.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Mentha sp.	·	·	·	·	·	·	·	·	·	·	·	1	3	1	·	·	·	·	·	·	·	·	·
Moehringia sp.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Plantago sp.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Polygonaceae	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Polygonum sp.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	2	·	·	·	1	·	·	·	·
Potentilla sp.	·	·	·	·	·	·	·	·	·	1	·	·	·	1	·	2	·	2	1	·	·	·	·
Ranunculus sp.	·	1	·	·	·	·	·	·	1	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Rumex sp.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Stachys sp.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Stellaria spp.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Indeterminate	3	·	·	1	·	·	·	·	·	·	·	1	6	·	·	·	1	2	·	·	·	·	·
Σ	**58**	**17**	**5**	**5**	**40**	**8**	**4**	**5**	**34**	**14**	**21**	**26**	**30**	**310**	**33**	**11**	**13**	**22**	**14**	**6**	**10**	**12**	**32**

Other remains

Corylus avellana L.
Malus / Pyrus
Nuphar sp.
Nymphaea cf. *candida*
Rubus sp.

.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	12	1	3	2	**22**	.	.	.
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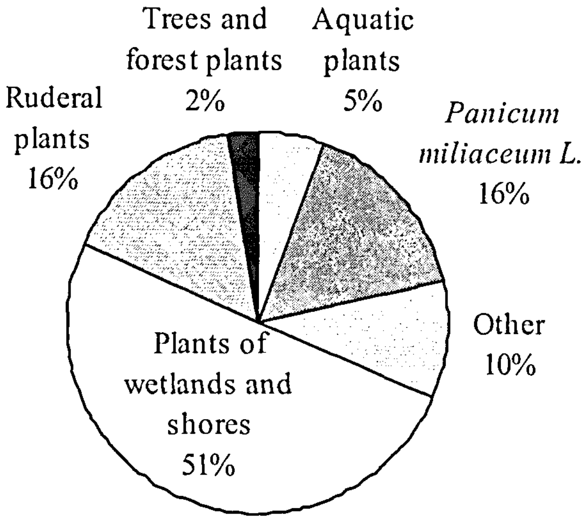
34	**6**	**29**	**5**	**15**	**23**	**44**	**29**	**32**	**35**	**54**	**12**	**25**	**44**	**18**	**18**	**7**	**38**	**4**	**77**	**37**	**134**	**107**	**126**	**71**	**1753**	**217**	**141**	**25**

Table 1b. Summary of Early Bronze Age Turlojiškė macroremains by ecological groups



excluded from the macrobotanical sample collection. The samples were taken at semi-random locations throughout the majority of the cultural layer underneath the disturbed layer, at various depths, but mostly in places where ceramics were found or where there appeared to be a possible feature. Due to good preservation of organic materials in such soil (as well as time constraints), the samples were limited to volumes of one liter per sample. The exact depths were recorded.

The plot was stratified into 8 layers: Layer 1 – peaty topsoil and "clay" from the irrigation ditch (excluded); Layer 2a – the first or upper part of the peaty layer; Layer 2b – the second part of the peaty layer; Layer 2c – the very bottom of the peaty layer, directly above the gyttja; Layer 3a – the very top of the gyttja layer; Layer 3b – the first part of the gyttja layer; Layer 3c – the bottom half of the gyttja layer; Layer 4a – marl. Excavation proceeded only to the marl layer, which was significantly deeper in the plot's westernmost portion (up to 200 cm) than its easternmost (up to approximately 115 cm). It must be noted that these layers are oversimplified, as the stratigraphy is considerably more complex. Altogether, 52 stratified samples were taken (and 43 of these were analyzed), to a depth of 126 cm.

2. Processing the samples. All macrobotanical samples of the 1999 season were water sieved with hand screens, a method better suited for these types of deposits (see Badham and Jones 1985). We used 0.5 and 0.25 mm screens. Washing out peaty and gyttja sediments by hand in this manner is a very time-consuming process; for most of the one liter samples, the washing process took about 2.5 hours on average.

3. Analysis. Samples from the 1999 season were also identified with a bisecting microscope; they were identified by geobotanist Dalia Kisielienė of the Geology Institute in Vilnius. The seeds were identified with the comparative collections (private collections of A. Grigas and D. Kisielienė; collection of macrofossils [Institute of Geology, Lithuania]) and identification manuals (Grigas 1986; Snarskis 1954; Lietuvos TSR flora 1961; Кац 1965; Доброхотов 1961). The goal of a finer resolution interpretation of this area's sequence of change was reached by finer stratigraphy as well as better integration of the archaeological and zooarchaeological data with the archaeobotanical finds. No subsampling was necessary due to the smaller volume of these samples.

6. DATA INTERPRETATIONS

6A. 1997–1998 Kretuonas and Turlojiškė macrobotanical data interpretation (see Table 1a and 1b)

Almost all the represented species in the samples from 1997 are wild plants. Only one sample from Turlojiškė (149) contained carbonised millet grains (*Panicum miliaceum*) (Figure 1). Besides this, no other crops were found at these sites. Broomcorn millet appears rather early in southeastern Europe (7th millennium b.p., uncalibrated; Zohary and Hopf 1993) and is also known from Late Neolithic sites in West Lithuania. Other food plants were raspberry (*Rubus*

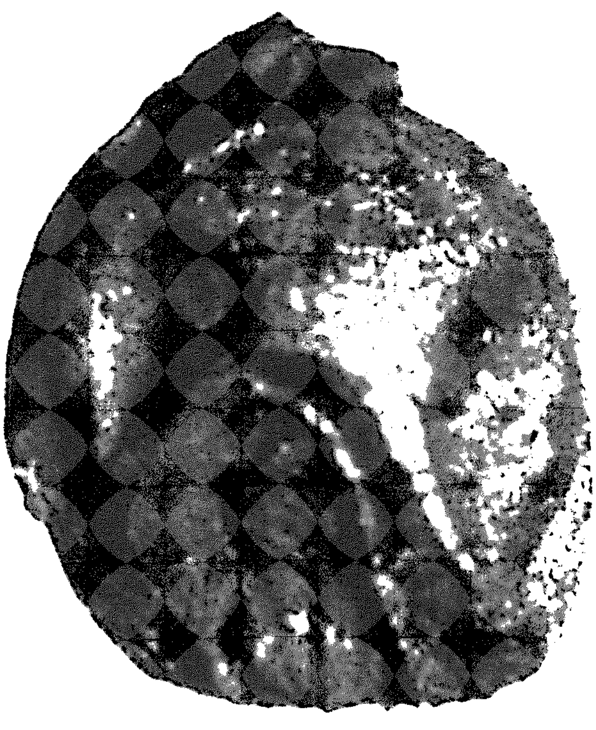


Fig. 1. *Panicum miliaceum* from Turlojiškė (sample 149) (Photo by Simone Riehl).

idaeus), probable apple tree (*Malus sylvestris*) and hazelnut (*Corylus avellana*).

Of the wild species that can be assigned to ecogroups, the wetland plants are most numerous at Turlojiškė. Considering the absolute counts of the seeds, wetland plants as well as ruderals are most abundant. The species spectrum at Turlojiškė was also broad. At Turlojiškė there were at least 5 different types of samples representing 3 different ecological categories: one category indicating moist conditions with a very high proportion of sedges and other wetland and waterplants (*Alisma plantago-aquatica*, *Typha latifolia*, *Chara* sp., *Schoenoplectus lacustris*; Turloj 154b, 158b and 122), one indicating moist but more ruderal conditions, with *Urtica dioica* as the dominant species within the samples (Turloj 139 and 149), and one with the main species (*Arenaria serpyllifolia*, *Chenopodium album*) adapted to open vegetation on sandy soils (Turloj 121).

The scanned samples also reflect a similar spectrum of ecological categories as already described for the fully analysed samples. Most of the subsamples were dominated by species from wetland habitats, followed by those from ruderal habitats. Hazelnut remains were common in several samples as well.

The picture is much different at Kretuonas. Ruderals, namely *Chenopodium album* type, are the main ecological category at this site. *Chenopodium album* could well be a modern contaminant of the samples, due to its abundance and the fact that it was uncharred. From the 30 samples scanned, 83% were dominated by this species. Only 3 samples were dominated by seeds from gathered fruits (*Rubus idaeus*) and hazelnut (*Corylus avellana*). In addition to these species, the tricarpellate *Carex* spp. was recovered, which was also abundant at Turlojiškė. Coniferae trees are indicated by the finds of some needle fragments of *Picea*/*Pinus*.

With the few counts of other species from Kretuonas (*Rumex* sp., *Galium* sp., *Polygonum lapathifolium*/*persicum*, *Ranunculus* sp., *Taraxacum* sp.) the species spectrum can be described as small and probably contaminated by modern *Chenopodium album*. The sandy character of the sediment at this site may have been also reason for the taphonomy of the botanical remains.

Because the number of samples taken in 1997/98 was relatively small and the samples were not taken stratigraphically to reflect change through time, it is difficult to reach final conclusions on changing economy and ecology based on these results. A more detailed examination of the samples in relation to their specific archaeological contexts was set to be undertaken the next season. However, it seems clear that the late introduction of crop husbandry in eastern and western Lithuania is validated by these remains. The recovery of *Panicum mileaceum* in southwestern Lithuania is a first; until now there were no macrofossils of this species recovered from the Early Bronze Age or earlier in this area.

6B. 1999 Turlojiškė's Area 1, Plot 1 macrobotanical data interpretation (see Tables 1 and 2, Figure 2)

The macrobotanical samples were taken from Area 1, Plot 1. The excavated plot was divided into 1 meter quadrants and 8 separate layers.

The deepest layer from which a sample was taken for macrobotanical analysis was layer 4a (125–126 cm deep). The sample was comprised of a light whitish grey material, reminiscent of clay or freshwater limestone. In this sample, *Rubus idaeus* and *Schoenoplectus lacustris* seeds were found. Right next to this sample was a mano. Also close by a bone artifact made from the metarsus of *Alces alces* (elk) was recovered.

The next major layer was comprised of gyttja. It was divided into three sublayers from bottom to top – 3c, 3b and 3a. One sample was taken from the 3c layer. Here the remains of 9 species of plants were found. Out of these, 4 species were water plants. These were Potamogenaceae family representatives (*Groenlandia densa, Potamogeton perfoliatus, Potamogeton* sp.) and *Najas marina*. The other fruits belonged to wetland and shore plants – *Carex* spp., *Ranunculus sceleratus*, *Schoenoplectus lacustris*. Single fruits of *Alnus glutinosa* and *Urtica dioica* were also recovered from this layer. These species are frequent on shorelines, especially if the soil is rich in nitrogen.

Other finds in the 3c sublayer include some rocks, a pottery sherd[7] and charcoal in close association in the plot's southeast corner which was possibly a destroyed hearth; a piece of wood similar to a plank fragment and some scattered rocks on the west end; a mano; a *Bos taurus* (cattle) bone, and a bone that may be *Sus suis* or *Sus scrofa* (pig or wild boar).

From sublayer 3b, one pottery sherd, charcoal, a cattle rib and duck bone on the west end, a pig bone on the east end and a few scattered fishscales were recoverd. No botanical samples were taken from this layer.

From layer 3a, three samples were taken. Their species composition differs little from the previous nitric one. Among the water plants there are no more Potamogetonaceae, however, the aquatic plants *Nymphaea alba, Ranunculus* sect. *Batrachium* and

[7] Unfortunately, most of the ceramics at this site were poorly preserved and unidentifiable.

Table 2. **Summary of Turlojiškė 1999 sample macroremains by layer.**

Turlojiškė 1999; Area 1, Plot 1

Early Bronze age

							totals
sample volume (l)	3,8	17,6	17	3,3	1,3	2	**45**
layer	2a	2b	2c	3a	3c	4a	
Trees and forest plants							
Alnus glutinosa (L.) Gaertn.	0	3	7	0	2	0	**12**
Betula sect. *Albae*	1	5	4	0	0	0	**10**
Cornus cf. *sanguinea* L.	0	0	1	0	0	0	**1**
Rubus idaeus L.	0	4	0	0	0	1	**5**
Fragaria vesca L.	0	2	0	0	0	0	**2**
Total absolute count	**1**	**14**	**12**	**0**	**2**	**1**	**30**
Density per liter	**0,26**	**0,8**	**0,7**	**0**	**1,5**	**0,5**	
Plants of wetlands and coasts							
Alisma plantago-aquatica L.	2	14	15	2	0	0	**33**
Calla palustris L.	0	0	1	0	0	0	**1**
Carex spp. (tricarpellate)	11	62	132	24	5	0	**234**
Carex spp. (bicarpellate)	1	26	45	2	0	0	**74**
Cirsium palustre (L.) Scop	1	0	0	0	0	0	**1**
Eleocharis palustris (L.) R.Br.	0	1	3	0	0	0	**4**
Lycopus europaeus L.	0	0	7	0	0	0	**7**
Mentha aquatica L.	0	3	0	0	0	0	**3**
Menyanthes trifoliata L.	2	43	32	0	0	0	**77**
Ranunculus cf. *lingua* L.	0	13	8	4	0	0	**25**
Ranunculus sceleratus L.	4	22	28	0	1	0	**55**
Rhynchospora alba (L.) Vahl	0	1	0	0	0	0	**1**
Solanum dulcamara L.	0	1	2	0	0	0	**3**
Schoenoplectus lacustris (L.) Palla	1	19	51	1	15	6	**93**
Stellaria palustris Retz.	0	0	1	0	0	0	**1**
Typha sp.	0	0	1	0	0	0	**1**
Total absolute count	**22**	**205**	**326**	**33**	**21**	**6**	**613**
Density per liter	**5**	**12,4**	**20,9**	**10**	**1**	**3**	
Aquatic plants							
Chara sp.	2	3	0	0	0	0	**5**
Groenlandia densa (L.) Fourr.	0	0	0	0	3	0	**3**
Lemna minor L.	0	2	3	0	0	0	**5**
Lemna trisulca L.	0	4	7	0	0	0	**11**
Najas marina L.	0	0	2	5	2	0	**9**
Nuphar lutea (L.) Sm.	0	0	3	0	0	0	**3**
Nymphaea alba L.	0	0	0	1	0	0	**1**
Potamogeton perfoliatus L.	0	1	0	0	1	0	**2**
Potamogeton sp.	0	0	1	0	2	0	**3**
Ranunculus sect. *Batrachium*	0	3	5	1	0	0	**9**
Salvinia natans (L.) All.	0	7	0	0	0	0	**7**
Total absolute count	**2**	**20**	**21**	**7**	**8**	**0**	**58**
Density per liter	**0,5**	**1,1**	**1,2**	**2,1**	**2,7**	**0**	

Ruderal plants							
Chenopodium album L.	44	1	2	0	0	0	47
Chenopodium cf. *glaucum* L.	1	0	1	0	0	0	2
Chenopodium sp.	0	0	2	0	0	0	2
Mentha cf. *arvensis* L.	3	8	4	0	0	0	15
Polygonum aviculare L.	3	13	5	1	0	0	22
Polygonum persicaria L.	0	0	1	0	0	0	1
Potentilla cf. *anserina* L.	1	0	1	0	0	0	2
Stellaria cf. *media* (L.) Vill.	0	5	0	0	0	0	5
Urtica dioica L.	3	27	24	1	1	0	56
Total absolute count	**55**	**54**	**40**	**2**	**1**	**0**	**152**
Density per liter	**14,5**	**3,1**	**2,4**	**0,6**	**0,8**	**0**	
Cultivated plants							
Panicum miliaceum L.	0	275	2	0	0	0	277
Total absolute count	**0**	**275**	**2**	**0**	**0**	**0**	**277**
Density per liter	**0**	**15,5**	**0,1**	**0**	**0**	**0**	
Other							
Mentha sp.	0	5	2	0	3	0	10
Polygonum sp.	0	3	2	0	0	0	5
Potentilla sp.	0	7	2	0	0	0	9
Ranunculus sp.	1	1	4	0	2	0	8
Asteraceae	0	0	0	1	0	0	1
Apiaceae	0	0	1	0	0	0	1
Indeterminate	4	10	5	0	1	0	20
Total absolute count	**5**	**26**	**16**	**1**	**6**	**0**	**54**
Density per liter	**1,3**	**1,5**	**0,9**	**0,3**	**4,6**	**0**	

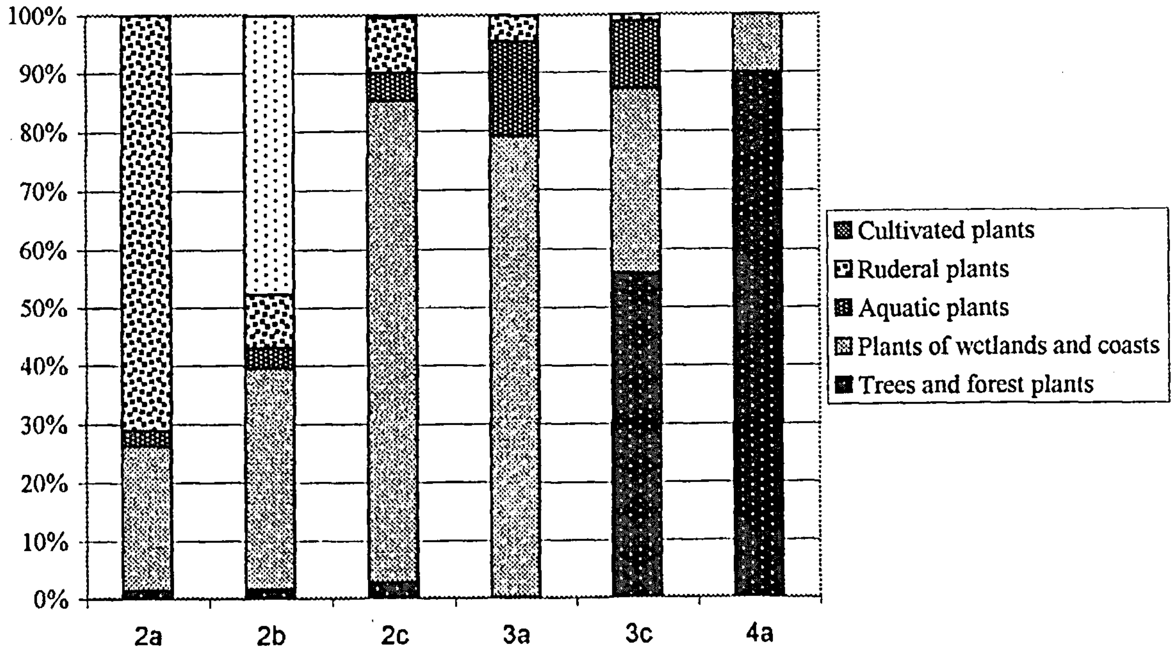


Fig. 2. Relative percentages of ecotypes at Turlojiškė by layer.

Nuphar lutea are present. Wetland plants also become more numerous including the fruits of *Alisma plantago-aquatica* and *Ranunculus* cf. *lingua*. No macroremains of trees were found in the 3a layer. Archaeological remains include pottery in the southwest corner, long poles on the northwest side, and fish bones.

Above this gyttja layer was a peaty layer. It was also divided into thinner sublayers (2a, 2b, 2c). The 2c sublayer is near the contact with gyttja and 15 botanical samples were taken from this layer. The number of species found in this layer is significantly larger than the previous ones. Not only does the number of species of various ecological groups grow, but the carpological remains are also more abundant. Identified in this layer were *Alnus glutinosa, Betula* sect. *Albae* and *Cornus* cf. *sanguinea* remains. In addition, *Coryllus avellana* nutshells were found, separate from the samples.

If the alder is a typical shore plant, then the others would have to be considered forest representatives. However, in order to judge the nature of the woods in this place better, the macroremain data should be compared with palynological data.

One of the most abundant groups in this layer is the group of wetland and shore plants. Aside from the plants mentioned for the 3a layer, new species appear here – *Menyanthes trifoliata, Ranunculus sceleratus, Stellaria palustris, Typha, Calla palustris, Eleocharis palustris, Solanum dulcamara* and *Lycopus europaeus*. The first two, together with *Alisma plantago-aquatica*, *Carex* spp., *Schoenoplectus lacustris* are almost evenly distributed throughout the excavation plot. The other mentioned species were found only in single instances of seeds in separate samples. Only *Lycopus europaeus* should be singled out, which, although not abundant, was found in four samples, localized in rows 1–4 of the plot. In the other layers the remains of this species were not recovered.

Although wetland and shore plants become more abundant in the 2c layer, the number of water plant species does not grow fewer compared with the layer below it. The same water plant species remain as in the 3a–3c layers, and new plants also appear including *Lemna minor* and *Lemna trisulca*. If the increase of tree and wetland plants could be associated with a lowering of the water level and the retreat of the shoreline, then the fact that the water plants do not decrease is difficult to explain. Most likely it is associated with past fluctuations in the water level.

Several ruderal plants were also found in the 2c layer. They are represented by a few *Chenopodium* (*Ch.album, Ch.glaucum*) and *Polygonum* (*P.aviculare, P.persicaria*) genus species as well as *Mentha* cf. *arvensis* and *Potentilla* cf. *anserina*. The remains of these plants are not abundant and were found in separate samples scattered throughout the plot. Only *Urtica dioica* fruits were found in many of the samples from this layer. Burnt finds of *Panicum miliaceum* seeds in quadrants B2 and B8 point to their cultivation in the area of the excavated settlement site.

Other finds in this layer included an almost complete pottery vessel (with a smooth surface) on the east side (one of the *Panicum* seeds was found in it); one Salmon family fishbone on the east side and some scattered poles on the west side. No domestic animal bones were identified, but on the west side of the plot *Arvicola terrestris* and *Lutra lutra* bones were recovered.

The floral composition of layer 2b is very similar to the 2c layer with 59% of the identified species found in both layers. The biggest differences are seen in the water plant group. In the 2b layer *Najas marina* and *Nymphea alba* are no longer present. Here a few *Chara* sp. oospores were found.

A find of 7 megaspores of *Salvinia natans* in quadrant B5 was surprising. This plant does not grow anymore in Lithuanian territory and is considered an indicator of somewhat warmer conditions.

Among the ruderal plants in this layer, *Mentha arvensis, Polygonum aviculare* and *Urtica dioica* remain dominant. A large amount of *Panicum miliaceum* seeds was found in quadrant A5. In all 274 millet seeds were counted. All of them were charred and rather large (width 1.4–2.1 (average 1.73) mm; length 1.9–2.8 (average 2.23) mm[8]). This confirms the assumption about the cultivation of millet that was put forth based on the remains from the 1997 field season.

The 2b layer has the heaviest concentration and most variety of archaeological finds; but no identified domestic animal bones – 74% of the fauna were fish, with some bird bones, one of the chicken family, a few other bird bones and a few *Arvicola terrestris*.

From the upper part of the peaty layer (2a layer) four samples were taken. Plants of wetlands and shores as well as ruderals dominate the remains from this layer. There are no more water plants except for two *Chara* sp. oospores found in the sample from the lower portion of quadrant C10. Also found here were *Cirsium palustre*, *Carex* spp., *Potentilla* cf. *anserina* and a large number of *Chenopodium album* seeds.

In the samples from quadrants C7 and C5, from the plot's central portion, altogether different species

[8] 172 examples were measured; the others were not due to their fragmentary or deformed nature.

were found than previously mentioned, although they are ascribed to the same ecological groups. Moreover, a third of the species are common to both samples. In the fourth sample, single finds of *Betula* sect. *Albae* and *Polygonum aviculare* fruits were found. Here there are no more wetland plants. This shows that the growing conditions in quadrant B3 zone's 2a layer's time of formation were somewhat drier, most likely due to the higher elevation compared to the other edge of the plot. Neither pottery nor domestic animal bones save possibly a dog were recovered from this layer. More terrestrial animals were recovered than fish, and one bird was recovered.

In summarizing the results of the plant macro-remains from the 1999 field season, the examined sediments should be ascribed to the Subboreal. It appears that during the formation of the bottom portion of the peaty layer, a shallow body of water existed in the excavated area. To judge its origin is problematic. However, many of the identified water plants show that the water was either standing still or slowly running. It seems that there was a lowering of the floodplain which was either filled in with water or a shallow river's backwater. The occurrence of water, wetland and ruderal plant remains in the same layers shows past fluctuations in the water level.

It is difficult to judge the spread of forest in this territory, since not many macroremains of trees or shrubs were recovered. Only a few forest species were identified, which could successfully survive as much in woodland communities as in a more open landscape.

The number of species ascribed to the ruderal plant group is not large. Among these are plants that could have grown alongside paths or people's dwellings, as well as in plots of land that is being worked. We must keep in mind that many of these plants cannot be taken only as indicators of the environment of people, because they are also encountered in natural plant communities unrelated to the activites of people, especially when their remains are not numerous. Thus, based also on the archaeological and osteological data of other researchers, we can assume that there may have likely been wet natural meadows where animals were herded in the excavated territory. We cannot disregard the possibility that there were also small plots of worked land in the area, since *Panicum miliaceum* seeds show that these plants were most likely cultivated. Moreover, the environmental conditions were favorable for such cultivation.

7. CONCLUSIONS

In summary, the botanical remains from Kretuonas and Turlojiškė represent the natural environment surrounding the site, with the highest proportion of species those of aquatic and wetland plants. Anthropogenically influenced habitats must have also existed, and many of the ruderal plants might have grown as weeds amongst millet (e.g. *Polygonum* spp., *Stellaria media*, etc.), although some of the wetland plants may have been weeds on what were most likely poorly drained soils, e.g. *Carex* sp. Millet seems to be the only crop that was cultivated by the inhabitants of Turlojiškė, but plant food was gathered as well, for example hazelnut, raspberry and apple. The main subsistence strategies were livestock keeping, hunting, fishing and gathering.

The more detailed results from the field season in 1999 confirm those of 1997. The find of a concentration of carbonized millet grains emphasizes the cultivation of this cereal.

Considering the results from 1997 and 1999 together, the ecological habitats containing the most taxa are in decreasing order: wetland plants (20), ruderals (15), aquatic plants (12) and woodland plants (10). A certain degree of anthropogenic influence is indicated.

The species with more than 50 seeds in the whole data set are also primarily wetland plants, amongst those *Alisma plantago-aquatica*, *Carex* species, *Menyanthes trifoliata*, *Ranunculus sceleratus*, *Schoenoplectus lacustris* and *Typha latifolia*. Most of these species, but especially the latter is assumed to be part of disturbed, eutrophic habitats. The second group with high counts are the ruderals, mainly the species *Chenopodium album*, *Scirpus sylvaticus and Urtica dioica*, which might partially also have grown as weeds. Amongst the aquatic plants, *Lemna* sp. and *Chara* sp. were especially common.

These results are confirmed by comparing the ubiquity of different taxa. Plants with more than 30% ubiquity in the whole data set are again the ruderal (*Urtica dioica*) and the species from wetland habitats, confirming in all the strong presence of this kind of environment. Highest ubiquities were found with *Carex* spp., *Menyanthes trifoliata*, *Ranunculus sceleratus*, *Schoenoplectus lacustris* and *Alisma plantago-aquatica*.

It is interesting to note that there are several changes through time seen in the stratigraphic layers from the Turlojiškė site concerning animal and plant husbandry. All of the domesticated animals are found in the gyttja layer (3b and c) and no cultivated plants were present in these layers. In the higher peaty layers

(2b and c), however, millet is present and no domesticated animal bones were recovered. In the top layer 2a, there are neither millet nor domesticated animal bones found. This pattern is difficult to explain, but it may have to do with the water levels, so that when the area became drier and it was more suitable for growing crops, the animals were kept elsewhere. Whatever the reason, a variation of economic patterns within the Early Bronze age in this plot is keenly illustrated.

8. FUTURE RESEARCH

There are several questions that have been answered through this relatively small scale study of the plant remains from the sites of Turlojiškė and the Kretuonas series in Lithuania. We have demonstrated that paleoethnobotany has potential to elucidate some of the general chronological questions regarding the beginnings of plant cultivation in the East Baltic. It also has potential to answer questions about the types of vegetation surrounding sites. From this study, we have seen that the traditional time frame of plant domestication as relatively late and small scale seems to be upheld by the botanical remains. The vegetation around the sites reflects their low lying and wet character. Probably small fields were also relatively wet as they were undrained at this time, and some wetland species could have been weed seeds in these fields as well (Jones 1988).

These preliminary results need to be strengthened by continuing systematic sampling of these and other sites. Future research should focus on recovereing samples from both eastern and western Lithuania, in order to compare the trajectory of plant cultivation in these two areas. Only with detailed remains from many sites will the goals of elucidating the subsistence economy and the nature of food systems be possible. Also the incorporation of analyses of other plant remains, such as charcoal and pollen data will add to the picture.

There are several avenues of future research that in our mind would be usefully employed in expanding on the research presented here. Interpretations in paleoethnobotany often focus strictly on ecological and economic interpretation of subsistence change, to the exclusion of social and political factors. Variation in the subsistence economy is often tracked at broad spatial and temporal scales. If we want to understand changes in food use between various groups in society, variations in inter and intra household relations are key (Gumerman 1994; Hastorf 1993; Kelertas 1997).

Many factors must be taken into account when people decide the patterns that food preparation and presentation will take, and both large and small scale economic and social factors are important. As Sharman et. al. (1991) point out, often large scale political and economic organization differentially defines people's options and affects their social relationships, daily lives and dietary practices. But small-scale variations in environment and circumstances and a range of informal activites (often carried out by women and children) may have far reaching effects on people's diet and nutritional status (Sharman, et. al 1991). It must also be kept in mind that when studying consumption, distribution and production of food it can be that households are part of a larger residential unit or tied into larger family grouping and are frequently open and flexible (Sharman et. al. 1991; Wilk and Rathje 1982).

Slowly more studies are being undertaken by European archaeobotanists which look at variation in food systems between groups, but often these focus on later, historic time periods (e.g. De Hingh and Bakels 1995). Part of the problem is that archaeobotanists often work in isolation from archaeologists. Integration in fieldwork and analysis between specialists is essential in order to gain a more complete picture of prehistoric life. This includes not only consultation in field work and sampling strategies, but also integration of different analysis techniques. For example, pottery analysis can contribute to analysis of food preparation and consumption patterns. Variation in ceramics can indicate differences in food use and feasting between different groups in society, such as between elites and commoners (Johannessen 1993; Le Count 1996). Such studies usually focus on on sylistic, contextual differences in ceramics. One area of research that is currently underutilized is examining sherds or whole pots for their content through lipid or other chemical analysis (Rottlaender 1985).

Skeletal and zooarchaeological analyses can also add to the picture of diet and food use in prehistory. Chemical analysis of skeletal remains give information on variation in diet, nutrition, health and disease. Many studies of skeletal remains have focused on variation between and amongst groups, stressing such factors as differences in gender (Buikstra et. al 1989; Hastorf 1991) and status (Schoeninger 1979). Animals, as well as plants are part of the food system, and links between plant and animal use should be studied as well. Animals use may be structured by or reflect social aspects of life for example, butchery practices may define ethnicity or be regulated by state institutions (Lyman 1987; Zeder 1991). Specialists from many areas must work together to give a complete picture of past food preparation, distribution and consumption. Paleoethnobotany is one of these areas that is crucial, as only it can bring to light the direct remains of past plant use.

Acknowledgements

Indrė Antanaitis wishes to express her sincere gratitude to Allan Hall (Environmental Archaeology Unit of the Department of Biology, University of York,) and Glynis Jones (Dept.of Prehistory and Archaeology, University of Sheffiled) for much appreciated advice and consultations. Many thanks as well to Algimantas Merkevičius (Archaeology Dept., Vilnius Univeristy), Algirdas Girininkas (Archaeology Dept., Lithuania's History Institute) and Linas Daugnora (Dept. of Anatomy and Histology, Lithuania's Academy of Veterinary Science) for their collaboration and sharing of yet unpublished data.

REFERENCES

Anderberg A.-L., 1994 – Atlas of seeds and small fruits of Northwest-European plant species with morphological descriptions. Resedaceae – Umbelliferae 4. Stockholm, 1994.

Antanaitytė I., 1998 – Paleomakrobotanikos darbų ataskaita, projektui „Baltų ūkio raida priešistorijoje". Lietuvos Mokslo ir studijų fondui.(Palaeomacrobotanical work report, for project "The evolution of economy of the Balts in prehistory". Lithuania's Science and Studies Foundation.) Manuscript.

Antanaitis I., 1999 – Concerning the transition to farming in the East Baltic // Documenta Praehistorica. Ljubljana University, 1999. Vol. XXVI, p. 89–100.

Badham K., and **Jones G.**, 1985 – An experiment in manual processing of soil samples for plant remains // Circaea . 1985. Vol. 3(1), p. 15–26.

Behre K. and Jacomet S., 1991 – The Ecological Interpretation of Archaeobotanical Data // Progress in Old World Paleoethnobotany, edited by W. van Zeist, K. Wasilokowa, K. Behre. Rotterdam: Balkema, 1991, p. 81–108.

Beijerinck W., 1947 – Zadenatlas der Nederlandsche Flora. Wageningen, 1947.

Berggren G., 1969 – Atlas of seeds and small fruits of Northwest-European plant species with morphological descriptions. Cyperaceae 2. Stockholm, 1969.

Berggren G., 1981 – Atlas of seeds and small fruits of Northwest-European plant species with morphological descriptions. Salicaceae–Cruciferae 3. Arlöw, 1981 .

Birks H.J.B. and **Birks H.H.**, 1980. – Quaternary Paleoecology. London: Edward Arnold, 1980.

Botanikos vardų žodynas, 1998 – Vilnius: Botanikos instituto leidykla, 1998.

Buikstra J.E., Frankenberg S., Lambert J.B. and **Xue L.**, 1989 – Multiple expectations // The Chemistry of Prehistoric Human Bone / edited by T.D. Price. Cambridge: Cambridge University Press, 1989, p. 155–210.

Butrimas A., 1996 – Šarnelės neolito gyvenvietė // Lietuvos archeologija: Vilnius: Diemedžio leidykla, 1996. T. 14, p. 174–191.

Butzer K., 1982 – Archaeobotany: vegetation and plant utilization // Archaeology as Human Ecology: Method and Theory for a Contextual Approach. Cambridge: Cambridge University Press, 1982, p. 171–190.

Daugnora L. and **Girininkas A.**, 1998 – Stock Breeding in the Baltic Culture Area // Archaeologia Baltica / ed. by V. Kazakevičius, A.B. Olsen and D.N. Simpson. Vilnius: Žara, 1998. Vol. 3.

Daugnora L. and **Girininkas A.**, 1996 – Osteoarcheologija Lietuvoje. Vidurinysis ir vėlyvasis Holocenas. Vilnius: Kultūros paveldo centras, 1996.

De Hingh A. and **Bakels C.**, 1996 – Paleoethnobotanical evidence for social difference: The example of early medieval domain of Serris–Les Ruelles, France // Early Farming in the Old World: Recent Advances in Archaeobotanical Research / edited by K.–E. Behre and K. Oeggl. Berlin: Springer Verlag, 1996, p. 117–120.

Dimbley G., 1978 – Plants and Archaeology. New Jersey: Humanities Press, Inc., 1978.

Dolukhanov P., 1978 – Ecology and Economy in Neolithic Eastern Europe. New York: St. Martin's Press, 1978.

Dolukhanov P., 1986 – The Late Mesolithic and the Transition to Food Production in Eastern Europe // Hunters in Transition / edited by M. Zvelebil. 1986, p. 109–119.

Dolukhanov P., 1993 – Foraging and farming groups in North-eastern and North-western Europe: Identity and interaction // Cultural Transformations and Interactions in Eastern Europe. Avebury: Aldershot, 1993, p. 122–145.

Dombrovskaja A., et. al. 1959 – Atlas der im Torf vorkommenden Pflanzenreste. Moskau, 1959.

Earle T., Bech J.H., Kristiansen K., Aperlo P., Kelertas K. and **Steinberg J.**, 1998 – The political economy of Late Neolithic and Early Bronze age society: the Thy Archaeological Project // Norwegian Archaeological Review. 1998.

Edwards K., 1982 – Man, space and the woodland edge – speculation on the detection and interpretation of human impact in pollen profiles // Archaeological Aspects of Woodland Ecology / ed. by B.M. Bell and S. Limbrey. Oxford: British Archaeological Report S146, 1982, p. 5–22.

Ford R., 1979 – Paleoethnobotany in American archaeology // Advances in Archaeological Method and Theory / edited by M.B. Schiffer. New York: Academic Press 1979. Vol. 2, p. 286–336.

Girininkas A., 1994 – Baltų kultūros ištakos. Vilnius: Savastis, 1994.

Girininkas A., 1997 – Kretuono 1-osios gyvenvietės tyrinėjimai // Archeologiniai tyrinėjimai Lietuvoje 1996 ir 1997 m. Vilnius: Lietuvos Istorijos Institutas, 1997, p. 7–11.

Girininkas A., 1998 – The Influence of the Natural Environment on the Inhabitants of the Shores around Lake Kretuonas during the Holocene // Environmental History and Quaternary Stratigraphy of Lithuania / ed. by M. Kabailienė, D. Moe, U. Miller and T. Hackens. PACT 54. Belgium: Rixensart, 1998, S. 171–181.

Goody J.R., 1982 – Cooking, Cuisine and Class: A Study in Comparative Sociology. Cambridge: Cambridge University Press, 1982.

Grigalavičienė E., 1995 – Žalvario ir ankstyvasis geležies amžius Lietuvoje. Vilnius: Mokslo ir enciklopedijų leidykla, 1995.

Grigas A., 1986 – Lietuvos augalų vaisiai ir sėklos. Vilnius: Mokslas, 1986.

Gumerman G., 1994 – Feeding specialists: The effect of specialization on subsistence variation // Paleonutrition: The Diet and Helalth of Prehistoric Americans / ed. by K.D. Sobolik (Center for Archaeological Investigations Occasional Paper No. 22). Southern Illinois University, Carbondale, 1994, p. 80–97.

Gumerman G., 1997 – Food and complex societies // Journal of Archaeological Method and Theory. 1997. Vol. 4, Nr. 2, p. 105–139.

Hastorf C., 1991 – Gender, Space and Food in Prehistory // Engendering Archaeology: Women and Prehistory / ed. by J. Gero ir M. Conkey. Oxford: Blackwell, 1991, p. 132–159.

Hastorf C., 1993 – Agriculture and the Onset of Political Inequality. Cambridge: Cambridge University Press, 1993.

Hastorf C., and **Popper V.**, 1988 – Current Paleoethnobotany: Analytical methods and cultural interpretation of archaeological plant remains. Chicago: University of Chicago Press, 1988.

Jacomet S., **Brombacher C.** and **Dick M.**, 1989 – Archäobotanik am Zürichsee. Ackerbau, Sammelwirtschaft und Umwelt von neolithischen und bronzezeitlichen Seeufersiedlungen im Raum Zürich. Berichte der Zürcher Denkmalpflege, Monographien 7. Zürich: Orell Füssli, 1989.

Johannessen S., 1993 – Food, dishes and society in the Mississippi Valley // Foraging and Farming in the Eastern Woodlands / ed. by S.M. Scarry. Gainesville: University of Florida Press, 1993, p. 182–205.

Jones G.E.M., 1984 – Interpretation of archeological plant remains: Ethnographic models from Greece // Plants and Ancient Man / ed. by W. Van Zeist and W.A. Caspaire. Rotterdam: Balkema, 1984, p. 43–61.

Jones M., 1985 – Archaeobotany beyond subsistence reconstruction // Beyond Domestication in Prehistoric Europe / ed. by Barker and Gamble. 1983, p. 107–128.

Jones M., 1988 – The phytosociology of early arable weed communities with special reference to southern England // Der praehistorishe Mensch und seine Umwelt / ed by H. J. Kuester, (Forschungen und Berichte zur Vor und Fruehgeschichte un Baden–Wuerttemberg, Band 31). Stuttgart: Konrad Theiss Verlag, 1988, p. 43–52.

Kabailienė M., 1990 – Lietuvos Holocenas (Tyrimo metodai, stratigrafija ir paleogeografija). Vilnius: Mokslas, 1990.

Kabailienė M., 1998 – Vegetational History and Climate Changes in Lithuania during the Late Glacial and Holocene, according to Pollen and Diatom Data // Environmental History and Quaternary Stratigraphy of Lithuania / ed. by M. Kabailienė, D. Moe, U. Miller and T. Hackens. PACT 54. Belgijum, Rixensart, 1998, p. 13–30.

Kelertas K., 1997 – Agricultural food systems and social inequality: the archaeobotany of Late Neolithic and Early Bronze age Thy, Denmark. Ph.D. dissertation in archaeology. University of California at Los Angeles, 1997.

Kenward H.K., **Hall A.R.** and **Jones A.K.G.**, 1980 – A tested set of techniques for the extraction of plant and animal macrofossils from waterlogged archaeological deposits // Science and Archaeology. 1980. No. 22, p. 3–15.

Kondratienė O., 1998 – Palynologische Angaben über die Entwicklung des Ackerbaus in Litauen // Environmental History and Quaternary Stratigraphy of Lithuania / ed. by M. Kabailienė, D. Moe, U. Miller and T. Hackens. PACT 54. Belgium: Rixensart, 1998, p. 61–67.

Koerber-Grohne U., 1967 – Geobotanische Untersuchengen auf der Fedderseen Wierde. Wiesbaden: Steiner, 1967.

Körber-Grohne U., 1991 – Identification methods. Progress in Old World Palaeoethnobotany / ed. by W. Van Zeist and Behre. Rotterdam: Balkema, 1991, p. 3–24.

La Bianca O.S., 1991 – Food systems research – An overview and case study from Madaba Plains, Jordan // Food and Foodways. 1991. Nr. 4. p. 221–235.

Lang G., 1994 – Quartäre Vegetationsgeschichte Europas. Methoden und Ergebnisse. Jena: Gustav Fischer Verlag, 1994.

Lang V., 1999 – Pre-Christian History of Farming in the Eastern Baltic Region and Finland: A Synthesis // Environmental and Cultural History of the Eastern Baltic Region / ed. by U. Miller, T. Hackens, V. Lang, A. Raukas, Sh. Hicks. PACT 57. Belgium: Rixensart, 1999, p. 359–372.

Le Count L.J., 1996 – Pottery and Power: Feasting, Gifting and Displaying Wealth amongst the Late and Terminal Classic Lowland Maya. Ph.D. Dissertation, Department of Anthropology, University of California Los Angeles, 1996.

Lietuvos, 1961 – Lietuvos TSR flora. Vilnius, 1961. T. 3.

Lyman R.L., 1982 – Archaeofaunas and subsistence studies. Advances in Archaeological Method and Theory / ed by M. B. Schiffer. New York: Academic Press, 1982, vol. 5, p. 331–393.

Martin A., and **Barkely W.D.**, 1961 – Seed Identification Manual. Berkely: University of California Press, 1961.

Merkevičius A., 1997 – Turlojiškės archeologinių objektų tyrinėjimai 1996 ir 1997 m. // Archeologiniai tyrinėjimai Lietuvoje 1996 ir 1997 metais. Vilnius: Lietuvos Istorijos Institutas, 1998, p. 26–29.

Merkevičius A., 2000 – Turlojiškės archeologinio komplekso tyrinėjimai // Archeologiniai tyrinėjimai Lietuvoje 1998 ir 1999 metais. Vilnius: Diemedžio leidykla, 2000, p. 44–46.

Miksicek C.H., 1987 – Formation processes of the archaeobotanical record // Advances in Archaeological Method and Theory / ed. by M. B. Schiffer. New York: Academic Press, 1987. Vol 10, p. 211–247.

Pearsall D., 1989 – Paleoethnobotany: a Handbook of Procedures. San Diego: Academic Press, 1989.

Ramsey C.B., Pettitt P.B., Hedges R.E.M., Hodgins G.W.L. and **Owen D.C.**, 2000 – Radiocarbon dates from the Oxford AMS System: Archaeometry datelist 29. Commentary on Lithuanian graves by I. Antanaitis and K. Jacobs // Archaeometry. 2000. Vol. 42(1), p. 243–254.

Rimantienė R., 1979 – Šventoji I: Narvos kultūros gyvenvietės. Vilnius: Mokslas, 1979.

Rimantienė R., 1980 – Šventoji II: Pamarių kultūros gyvenvietės. Vilnius: Moklsas, 1980.

Rimantienė R., 1989 – Nida: senųjų baltų gyvenvietė. Vilnius 1989.

Rimantienė R., 1996a. – Akmens amžius Lietuvoje. Vilnius: Žiburio leidykla, 1996.

Rimantienė R., 1996b. – Šventosios 4-oji radimvietė. Šventosios 6-oji radimvietė // Lietuvos archeologija. Vilnius: Diemedžio leidykla, 1996. T. 14, p. 5–173.

Rimantienė R., 1998a. – The First Narva Culture Farmers in Lithuania // Harvesting the Sea, Farming the Forest / ed. by Marek Zvelebil, L. Domanska and R. Dennell. Sheffield Academic Press, 1998.

Rimantienė R., 1998b. – The Relationship between Stone Age People and their Environment in Lithuania // Environmental History and Quaternary Stratigraphy of Lithuania / ed. by M. Kabailienė, D. Moe, U. Miller ir T. Hackens. PACT 54. Belgium: Rixensart, 1998, p. 143–156.

Rimantienė R., 1999 – Traces of Agricultural Activity in the Stone Age Settlements of Lithuania // Environmental and Cultural History of the Eastern Baltic Region / ed. by U. Miller, T. Hackens, V. Lang, A. Raukas, Sh. Hicks. PACT 57. Belgium: Rixensart, 1999, p. 275–290.

Roesch M., 1996 – New approaches to prehistoric land-use reconstruction in south western Germany. In Early Farming in the Old World: Recent Advances in Archaeobotanical Research // Vegetation History and Archaeobotany / edited by K.E. Behre and K. Oeggl. Berlin: Springer Verlag, 1996, p. 65–80.

Rottlaender R., 1983 – Einfuehrung in die naturwissenschaftliche Methoden in der Archeaologie // Archaeologia Venatoria. Tuebingen, 1983. Vol. 6.

Schoch W. H., Pawlik B. and **Schweingruber F.**, 1988 – Botanische Makroreste – Atlas zur Bestimmung häufig gefundener und ökologisch wichtiger Pflanzensamen. Bern, 1988.

Schoeninger J. M., 1979 – Diet and status at Chalcatzingo: Some empirical and technical aspects of strontium analysis // American Journal of Physical Anthropology. 1979. Vol. 51, p. 295–310.

Seibutis A. and **Savukynienė N.**, 1998 – A Review of Major Turning Points in the Agricultural History of the Area Inhabited by the Baltic Peoples, Based on Palynological, Historical and Linguistic Data // Environmental History and Quaternary Stratigraphy of Lithuania / ed. by M. Kabailienė, D. Moe, U. Miller ir T. Hackens. PACT 54. Belgium: Rixensart, 1998, p. 51–59.

Sharman A., Theophano J., Curtis and **Messer E.**, 1991 – Diet and Domestic Life in Society. Philadelphia: Temple University Press, 1991.

Snarskis P., 1954 – Vadovas Lietuvos TSR augalams pažinti. Vilnius, 1954.

Stuiver M. and **Reimer P. J.**, 1993 – Extended 14C data base and revised CALIB radiocarbon calibration program // Radiocarbon. 1993. Vol. 35 (1), p. 215–230.

Stuiver M., Reimer P.J., Bard E., Beck J.W., Burr G.S., Hughen K.A., Kromer B, McCormac F.G., v.d., Plicht J. and **Spurk M.**, 1998 – INTCAL98 Radiocarbon age calibration 24,000 – 0 cal BP. // Radiocarbon. 1998. Vol. 40, p. 1041–1083.

van der Veen M. and **Fieller N.**, 1982 – Sampling for seeds // Journal of Archaeological Science. 1982. Vol. 9, p. 287–298.

van der Veen M., 1984 – Sampling for seeds. Plants and Ancient Man / ed. by W. van Zeist and W.A. Casparie. Boston: Balkema, 1984, p. 193–200.

van der Veen M., 1992 – Crop husbandry regimes: an archaeobotanical study of farming in Northern England 1000 bc – AD 500 (Sheffield Archaeological Monographs 3). Sheffield: J.R. Collis, 1992.

Watson P., 1976 – In pursuit of prehistoric subsistence // The Midcontinental Journal of Archaeology. 1976. Vol. 1, p. 77–100.

Welch P.D. and **Scarry C.M.**, 1995 – Status–Related variation in foodways in the Moundville Chiefdom // American Antiquity. 1995. Vol. 60 (3), p. 397–420.

Wilk R. and **Rathje W.**, 1982 – Household Archaeology // American Behavioral Scientist. 1982. Vol. 25, p. 617–639.

Zeder M. A., 1988 – Understanding urban process through the study of specialized subsistence economy in the Near East // Journal of Anthropological Archaeology, 1988. Vol. 7, p. 1–55.

Zohary D. and **Hopf M.**, 1993 – Domestication of plants in the old world. The origin and spread of cultivated plants in West Asia, Europe, and the Nile Valley. 2nd ed. Oxford: Clarendon Press, 1993.

Zvelebil M., 1986 – Mesolithic prelude and neolithic revolution // Hunters in Transition / ed. by M. Zvelebil. Cambridge University Press: Cambridge, 1986, p. 5–15.

Zvelebil M., 1994 – Plant Use in the Mesolithic and its Role in the Transition to Farming // Proceedings of the Prehistoric Society. 1994, p. 35–74.

Zvelebil M., 1995a. – Hunting, gathering or husbandry? Management of food resources by the Late Mesolithic communities of temperate Europe // MASCA Research Papers in Science and Archaeology. 1995. Vol. 12. Supplement, p. 79–104.

Zvelebil M., 1995b. – Neolithization in Eastern Europe. Documenta Praehistorica / ed. by M.Budja. Ljubljana, 1995.

Zvelebil M., 1998 – Agricultural Frontiers, Neolithic Origins, and the Transition to Farming in the Baltic Basin // Harvesting the Sea, Farming the Forest. Sheffield Academic Press / ed. by Marek Zvelebil, L. Domanska and R. Dennell, 1998, p. 9–27.

Zvelebil M., Rowley-Conwy P., 1986 – Foragers and Farmers in Atlantic Europe // Hunters in Transition / ed. by M. Zvelebil. Cambridge University Press: Cambridge, 1986, p. 67–93.

Вульф Е.В., Малеева О.Ф., 1969 – Мировые ресурсы полезных растений. Ленинград, 1969.

Гиршинкас А., 1990 – Крятуонас: – средний и поздний неолит. // Lietuvos archeologija. Vilnius, 1990. T. 7.

Доброхотов В.Н., 1961 – Семена сорных растений. Москва: из-во Сельскохозяйственной литературы, 1961.

Кац Н.Я., Кац С.В., Кипиани М.Г., 1965 – Атлас и определитель плодов и семян, встречающихся в четвертичных отложениях СССР. 1965.

Паавер К., 1965 – Формирование териофауны и изменчивость млекопитающих Прибалтики в голоцене. Тарту: АН Эстонской ССР, 1965.

ŽEMĖS ŪKIO RAIDA IR ARCHEOBOTANINIAI TYRINĖJIMAI LIETUVOJE

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Santrauka

Ankstyvosios priešistorijos žemės ūkio raidos tyrinėjimai Lietuvoje iki šiol daugiausia rėmėsi tiktai palinologiniais bei netiesioginiais (atsitiktinai pastebėtos sėklos, žemdirbystės įrankių egzistavimas) duomenimis. Šiame straipsnyje aprašyta sistemingų archeomakrobotaninių tyrinėjimų nauda ir galimybės bei pirmųjų sistemingų tyrimų, atliktų neolito-ankstyvojo bronzos amžiaus Kretuono gyvenviečių serijoje Šiaurės Rytų Lietuvoje bei ankstyvojo bronzos amžiaus Turlojiškės gyvenvietėje Pietvakarių Lietuvoje, metodai ir rezultatai (žr. lenteles 1a ir 1b, pav. 1). Aukštos rezoliucijos stratigrafinė makrobotaninių liekanų analizė kontekste su archeologiniais ir zooarcheologiniais radiniais Turlojiškės gyvenvietėje (žr. lentelę 2 ir pav. 2) iliustruoja gyvulių domestikacijos ir augalų kultivacijos eigą ankstyvajame bronzos amžiuje šiame paminkle.

LENTELIŲ SĄRAŠAS

Lentelė 1a. Augalų makroliekanos Turlojiškės (1999 ir 1997 m.) ir Kretuono gyvenvietėse.

Lentelė 1b. Augalų makroliekanų pasiskirstymas pagal ekologines grupes ankstyvojo bronzos amžiaus Turlojiškės gyvenvietėje.

Lentelė 2. Augalų makroliekanų pasiskirstymas pagal sluoksnius Turlojiškės gyvenvietėje 1999 m.

ILIUSTRACIJŲ SĄRAŠAS

1 pav. *Panicum miliaceum* iš Turlojiškės gyvenvietės (radinys iš 149 pav.; nuotrauka Simone Riehl).

2 pav. Ekotipų procentinis santykis Turlojiškės gyvenvietės atskiruose sluoksniuose.

РАЗВИТИЕ ЗЕМЛЕДЕЛИЯ В ЛИТВЕ И АРХЕОБОТАНИЧЕСКИЕ ИССЛЕДОВАНИЯ

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Резюме

Исследование развития раннего земледелия в доисторическое время в Литве до сих пор основывалось лишь на палинологических и других (обнаружение орудий земледелия и семян) данных. В этой статье приводятся данные о археo-макроботанических системных исследованиях на поселениях неолита и ранней бронзы озера Крятуонас (Восточная Литва) и Турлоишкес (Юго-Западная Литва). Приводится методика и результаты макроботанических исследовании (таб. 1а и 1б рис. 1). Высокая резолюция макроботанических остатков в контексте с археологическими и зооархеологическими находками иллюстрирует развитие доместикации животных и культивацию растений на поселении Турлоишкес в раннем бронзовом веке (таб. 2 и рис. 2).

СПИСОК ТАБЛИЦ

Таблица 1а. макроостатки растений в поселениях Турлоишкес (1999 и 1997 гг.) и Кретионас.

Таблица 1б. Распределение макроостатков растений по экономическим группам в поселении Турлоишкес раннего бронзового века.

Таблица 2. Распределение макроостатков растений по слоям в поселении Турлоишкес, 1999 г.

СПИСОК ИЛЛЮСТРАЦИЙ

Рис. 1. *Panicum miliaceus* из поселения Турлоишкес (находка с рис 149; фото Симон Риль).

Рис. 2. Процентное соотношение экотипов в отдельных слоях поселения Турлоишкес.

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