LATE GLACIAL ENVIRONMENTAL HISTORY IN LITHUANIA

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Abstract

A detailed description of the Late Glacial environment was attempted through an interpretation of pollen data and lithological records in the sequences with ^{14}C chronologies. Pollen data suggests that during the pre-Alleröd time (>11.9^{14}C kyr. BP) tree-less vegetation flourished in the area where sedimentation in freshwater bodies with a high water level was dominant. The formation of *Betula* and *Pinus* predominating forest (11.9–11.8^{14}C kyr. BP) coincides with the increasing representation of the organic constituent in investigated sequences. Palaeobotanical records show some improvement of the climatic conditions since the middle of the Younger Dryas cold event (10.5–10.4^{14}C kyr. BP). Sedimentation in oligo-mesotrophic nutrient-rich lakes with a rather high water level was typical for the end of the Late Glacial.

Key words: pollen data, vegetation development, environmental changes, Late Glacial, Lithuania.

Introduction

This paper presents a synthesis of Late Glacial environmental data derived from pollen records examined in Lithuania. The application of palaeobotanical data and ^{14}C investigations suggest a valuable background for the reconstruction of vegetation dynamics as one of the main constituents of the palaeoenvironment.

The Late Glacial pollen survey is well established in Lithuania. Late Glacial vegetation history, biostratigraphy and chronostratigraphy have been discussed by Kabailienė (1990: 175; 1993: 208–222; 1998: 13–30), Kabailienė and Raukas (1987: 125–131), Seibutis (1963–1964: 347–371), Šulija (1971: 1459–1465) and others. During recent years abundant new data discussing environmental changes both on a local and a regional scale has been collected (Stančikaitė et al 1998:77–88; Blažauskas et al 1998: 20–30; Baltrūnas et al 2001: 260; Stančikaitė et al 2002: 391–409; Bitinas et al 2002: 375–389; Stančikaitė et al 2003: 47–60; Stančikaitė et al 2004: 17–33). An interdisciplinary approach has been applied to the investigation of lake and bog sequences that has provided new data for the reconstruction of detailed vegetation patterns and their response to climatic fluctuations, and ecological alternations of the lakes related to climatic shifts.

In Lithuania (53º54´–56º27´N and 20º56´–26º51´E), the formation of the landscape was directly influenced by the Middle and Late Pleistocene glaciations (Basalykas 1958: 504; Kudaba 1983: 186). The marginal area of the Late Weichselian glaciation (Fig. 1) crosses the southeastern part of the country, forming the prominent relief of the Baltija Upland. Eastwards from this marginal ridge stretches the gently undulating landscape of the Middle Pleistocene age.

The investigated sites represent different physical-geographical and geological-geomorphological regions (Fig. 1, Table 1). Analyses of the former geological and lithostratigraphical data, together with interpretations of black and white stereoscopic aerial photographs (scale 1:17000), served as a background for the selection of the coring places with the most representative layers of biogenic or limnic origin.

Methods

Coring and sampling

Using a Russian sampler with a tube one millimetre in length and five centimetres in diameter, sediment cores from lakes Kašučiai and Lieporiai, as well as from Juodonys Bog, were taken, and later sub-sampled every two to seven centimetres for pollen and ^{14}C investigations. Sediment samples covering a two to five-centimetre interval were taken directly from the walls of Kriokšlys, Rudnia, Zervynos and Pamerkiai outcrops.

Pollen investigations

The pollen preparation followed the standard procedure described by Grichiuk (1940) and Erdtman (1936: 154–164), with the improvements suggested by Stockmarr (1971: 615–621). More than 1,000 terrestrial pollen grains were counted for each level and AP+NAP sum based the percentage calculation of the spectra. The presented pollen diagrams display the main tree and herb pollen taxa used for the stratigraphical sub-

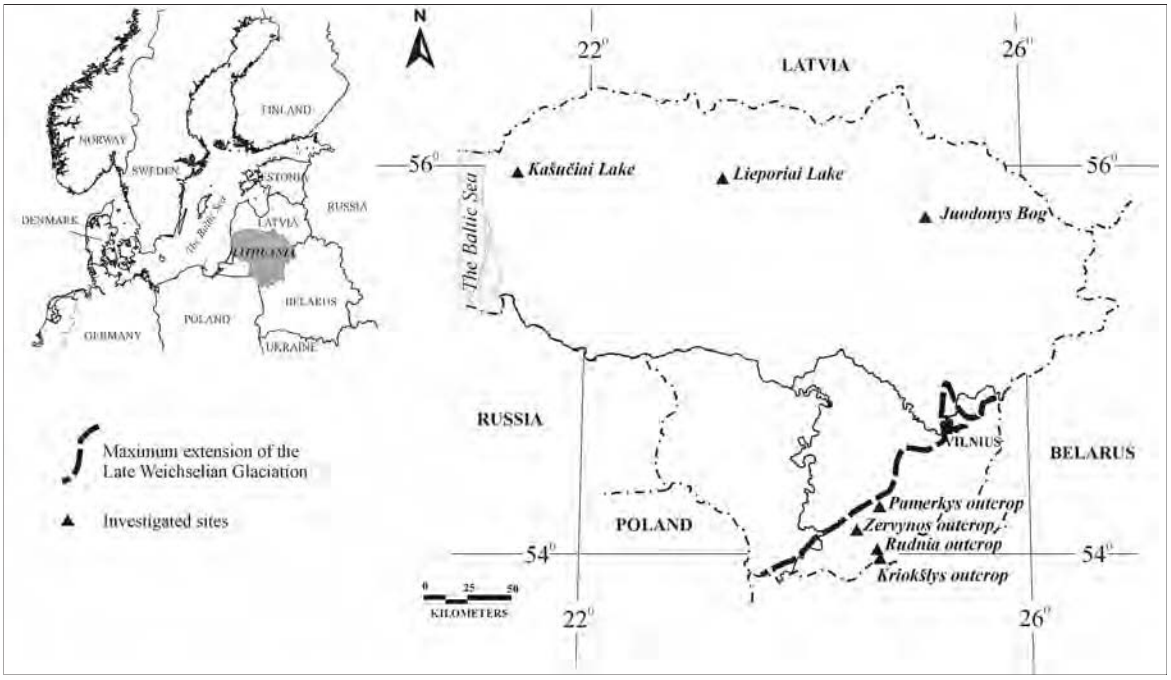

Fig. 1. The locations of the sites investigated

Table 1. Short description of the investigated sites

Site	Coring places	Altitude, m a.s.l.	Description of the sites studied
Kriokšlys Outcrop	54°02'10"N 24°37'23"E	124.66	Outcrop situated within Kriokšlys village on the left bank of the River Ūla, surrounded by fields. A thermophilous *Pinus* forest grows at a distance of a few hundred metres.
Rudnia Outcrop	55°04'11"N 24°39'41"E	120.15	Outcrop on the bank of the River Ūla which crosses a sand predominating glaciofluvial plain with pine forest growing over.
Zervynos Outcrop	54°06'26"N 24°29'45"E	107	Outcrop on the right bank of the River Ūla situated within Zervynos village surrounded by pine predominating forest.
Pamerkys Outcrop	54°18'45"N 24°43'52"E	114.50	Outcrop discovered on the right bank of the River Pamerkys, in the territory of an extended thermophilous pine forest and vast meadows growing on river terraces.
Juodonys Bog	55°44'22"N 25°26'15"E	93	Drained peat bog covered by bushy vegetation and fields on the till plain of the Late Weichselian age.
Lieporiai Lake	55°54'04"N 23°14'19"E	120	Drained lake situated between hills in a gently undulating relief of the Late Weichselian age.
Kašučiai Lake	55°59'28"N 21°18'26"E	36	Small shallow lake situated between morainic hills of the Late Weichselian age and surrounded by fields.

division of the sequences and following environmental reconstructions. The identifications of the pollen and spores followed Fægri and Iversen (1989: 328), Moore, Webb, Collinson (1991: 216) and Moe (1974: 132–142), in conjunction with the reference collection of the Department of Geology and Mineralogy at Vilnius University. The pollen spreadsheets, as well as percentage diagrams, were plotted using TILIA (version 2) and TILIA–GRAPH (version 2.0 b.4) (Grimm 1991). The CONISS program was applied for the determination of the local pollen assemblage zones.

Determination of the loss-on-ignition and $CaCO_3$ content

The determination of the loss-on-ignition and $CaCO_3$ content was started according to the conventional method as described by Bengtsson and Enell (1986: 423–433). Ignition residue is expressed as a percentage of dry weight, and results were plotted in diagrams. Ignition residue calculations were solved from the same samples that were used for the pollen analysis. The investigations were carried out in the Zervynos, Kriokšlys, Pamerkiai and Lieporiai sections.

Results

Chronology

Nine ^{14}C dates based the chronological subdivision of the presented cores (Table 2). The conventional ^{14}C dates from the bulk samples were determinated at the Radioisotope Laboratory of the Institute of Geology and Geography (Lithuania), Kiev Radiocarbon Laboratory (Ukraine) and the Laboratory of Isotope Geology of the Swedish Museum of Natural History (Sweden). Uncalibrated ^{14}C years before present (BP) are used in discussing the sediments' stratigraphy, environmental changes, vegetation composition and climatic variations. Chronostratigraphic units proposed by Mangerud et al (1974: 109–128), with some specifications suggested by Kabailienė (1990: 82–83) for Lithuanian territory, are followed.

Pollen stratigraphy and the main patterns of vegetation development

The chronostratigraphical comparison of the determinated local pollen assemblage zones (Table 3) led to the definition of the regional pollen assemblage zones (RPAZ), revealing the main peculiarities of Late Glacial vegetation.

RPAZ I (>12.3^{14}C kyr. BP) Bölling. The vegetation of RPAZ I is characterised by the expansion of *Betula* and the high amount of NAP pollen. The presence of *Pinus* pollen grains suggests the growing of taxa in the region or occurring in local stands. The appearance of broad-leaved tree pollen may be related to the long transport origin. The continuous high representation of Cyperaceae suggests the predominance of wet habitats suitable for sedges in the surroundings of the investigated lakes. The appearance of *Artemisia*, Poaceae and *Juniperus* indicates that areas with open vegetation predominated, and herbs as well as light-demanding taxa flourished.

RPAZ II (12.3–11.9^{14}C kyr. BP) Older Dryas. The formation of open herb predominating vegetation cover was typical for RPAZ II. At the beginning of the zone the share of *Betula* increased and the number of *Pinus* decreased. At the same time, an increasing representation of NAP was noticed, and Cyperaceae, together with *Artemisia*, predominated. The vegetation composition most likely had a rather sparse structure, and light-demanding, cold-tolerant plants were common.

RPAZ III a, b (11.9–10.9^{14}C kyr. BP) Alleröd. The pollen spectra discovered in Juodonys, Pamerkys and Kriokšlys sections (Fig. 3), and correlated with the first half of the Alleröd (RPAZ Ia), shows the forestation of the area by *Pinus* and *Betula*. Open pine-birch woods, with the increasing input of some herb species, appeared all over Lithuania. The representation of heliophytic shrubs suggests the existence of open areas, as well as the flourishing of Cyperaceae that prefers open wet habitats. During the second half of the regional pollen zone (RPAZ Ib), *Pinus* became the predominating species in the forest successions, which is especially obvious in eastern Lithuania. The increase in the total pollen concentration registered at the end of the pollen zone indicates the forest growing in the proximity of the investigated sites. Meanwhile, open ground indicators show that the forest was not yet dense. Forest-free areas were favoured by *Populus*, *Salix* and *Juniperus*.

Table 2. Uncalibrated ^{14}C (BP) dates from investigated cores

Site	No	Depth, cm	^{14}C age, BP	Lab. code	Dated material
Kriokšlys Outcrop	1	133–138	8350±225	Vs–1091	Gyttja
Rudnia Outcrop	1	100–110	11560±380	Vs–1094	Peat
Zervynos Outcrop	1	349–352	12130±2780	Vs–1092	Plant remains
Pamerkys Outcrop	1	515–525	11880±150	Vs–952	Wood
	2	520	11690±150	ST–13807	Wood
Juodonys Bog	1	265–270	9410±310	Vs–1433	Plant remains
	2	322–326	12170±180	Ki–10952	Peat
Kašučiai Lake	1	190–195	10160±200	Ki–10913	Gyttja
	2	290–295	14150±650	Ki–10914a	Gyttja

Table 3. Time-space correlation of the local and regional pollen assemblage zones, with a short description of the pollen spectra

Local pollen assemblage zones							Regional PAZ	The main patterns of the pollen spectra	Chrono zones
Kriokšlys Outcrop	Rudnia Outcrop	Pamerkys Outcrop	Juodonys Bog	Zervynos Outcrop	Lieporiai Lake	Kašučiai Lake			
*Artemisia-Betula-Juniperus-*Poaceae-Cyperaceae	*Betula-Artemisia-Juniperus*	*Betula-*Cyperaceae-*Juniperus-Artemisia*	*Betula-Juniperus-Artemisia-*Cyperaceae	*Betula-Juniperus-Artemisia-*Poaceae	Cyperaceae *Betula-Artemisia-Juniperus*	*Pinus-*Cyperaceae *Betula-Artemisia-*Chenopod.	IV	Increasing number of NAP (up to 30%) coincides with the rise of *Juniperus* curve (up to 6-7%) and *Betula* spread. *Artemisia* (up to 10-15%), Chenopodiaceae and Brassicaceae have a significance occurrence. Approaching the end of the zone some rise in *Pinus* representation registered.	10.0 DR 2
Pinus	*Pinus-*Poaceae	*Pinus-Betula*	*Pinus*	*Pinus*	*Pinus*	*Pinus*	IIIb	*Betula* and *Pinus* codominant in spectra showing up to 40% (birch) and 90% (pine) during the first half of the zone. Afterwards *Pine* increased in representation. NAP spectra is represented by *Artemisia*, Cyperaceae reaching 40%. Chenopodiaceae, Apiaceae and Rosaceae mainly.	10.9 AL
*Betula-*Cyperaceae		*Betula-Pinus*	*Betula-*Cyperaceae *Pinus-Betula-*Cyperaceae				IIIa		
				*Betula-*Cyperaceae *Juniperus-Salix*	*Betula-*Cyperaceae-*Artemisia-Urtica*	*Betula-Artemisia-*Cyperaceae	II	Increase in percentages of *Betula* is marked in RPAZ where taxa shows 28%. Number of the *Pinus* pollen decreased simultaneously and other trees are represented sporadically. NAP rises in compare with the previous zone and *Artemisia* reaches 7.7%. Simultaneous rise is registered in Chenopodiaceae (2.1%) and Cyperaceae (18.2%) curves.	11.9 DR 1
					*Pinus-Betula-*Cyperaceae	*Pinus-Artemisia-Betula-*Cyperaceae	I	The pollen assemblage is characterized by predominance of *Pinus* together with *Betula* in spectra. Maximum values of *Betula* rise to greater than 24% and *Pinus* has a peak of 60%. NAP varies around 15% and Cyperaceae (18.3%) together with *Artemisia* (5.2%) are the best represented. Pre-Quaternary taxa occurred sporadically.	12.3 BO

RPAZ IV (10.9–10^{14}C kyr. BP) Younger Dryas. Forest degradation and the flourishing of light-demanding taxa, especially herbs, shrubs and grasses, was noticed in the RPAZ IV. The share of NAP is much higher compared with the previous zone. On sandy areas, *Pinus* has been replaced by *Juniperus* and *Betula*, together with *Salix* established on newly opened morainic grounds. The rising amount of *Artemisia*, *Selaginella selaginoides*, Chenopodiaceae, Poaceae, Ranunculaceae, Caryophyllaceae and Cyperaceae suggests an expansion of herb and grass dominating patches. The rising number of *Pinus* pollen registered close to the upper limit of the RPAZ IV could be related to the gradual reestablishing of this tree into the forest successions.

Loss-on-ignition and $CaCO_3$ content

A simplified chronostratigraphical correlation of the loss-on-ignition diagrams is presented in Fig. 2. The investigated layers comprise sand, silty gyttja, silty sand and gyttja. Discussing the main features of the presented data sets, the predominance of terrigenous matter in the Late Glacial (>10^{14}C kyr. BP) layers should be stressed. This is especially obvious in the sediments dating back to the Younger Dryas. Terrigenous material reaches up to 90% to 95% in the separated intervals. Modern analogues suggest that particles of the sand and silt may originate from unconsolidated material that is influenced by erosion and aeolian processes. A high amount of the mentioned material was transported to the basins by the water streams, slope processes and wind. Thus, conclusions confirming an intensive inflow during the whole Late Glacial and Younger Dryas especially could be drawn. The formation of peat and gyttja during Alleröd could be explained as a fact confirming an increase of organogenic production. Most probably, the clastic input into the sedimentary basins decreased due to the formation of dense vegetation cover that prevented erosion activity. The lithological transition to Younger Dryas is sharp in small sedimentary basins, and more gradual in bigger ones. In the Zervynos section, the appearance of pre-Alleröd layers consisting of organogenic material was related to the existence of dense grass cover later covered by sediments due to termokarst processes. The amount of $CaCO_3$ was evaluated in the Kriokšlys sediment sequence. Some rise of the calcium carbonate content is registered in the Late Alleröd–Early Younger Dryas interval (Fig. 2), while in the rest of the section the representation of this material is minor.

Discussion

The accumulation of organogenic matter attends a non-glacial sedimentation, which in the area of the Weichselian ice sheet had started just after the retreat of the ice. Very few data sets investigated in Lithuania include the periods preceding Alleröd Interstadial. The biostratigraphic subdivision of the pollen diagrams constrained for lakes Bebrukas, Žuvintas and Ilgis, in southeast Lithuania (Kabailienė 1965: 302–335), suggest the existence of sediments dating back to Bölling warming, although an absolute chronology of these layers is absent. The sediment cores discovered in lakes Kašučiai and Lieporiai represent important new palaeobotanical data covering the period since Bölling warming. A good correlation between bio- and chronostratigraphical signals increased the importance of

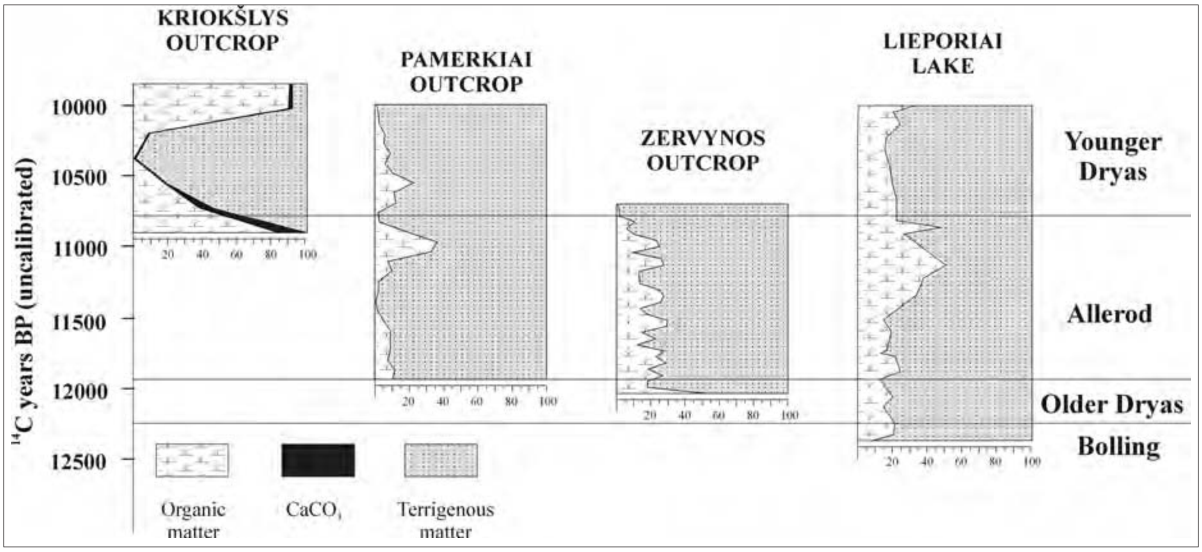

Fig. 2. Chronostratigraphical correlation of the loss-on-ignition diagrams

the Kašučiai core, where the oldest palaeobotanical spectra were formed 14150±650^{14}C BP. Layers of the Bölling age investigated in lakes Kašučiai and Lieporiai (Figs. 3, 4) are characterised by the predominance of terrigenous matter and the large amount of *Artemisia*, Chenopodiaceae, Cyperaceae and Poaceae together with *Betula*, mostly *Betula nana*, and *Pinus* pollen. A thin layer of plant remains containing a large amount of *Pinus*, *Betula*, *Juniperus*, *Salix* and *Artemisia* pollen was discovered in the Zervynos outcrop, southeast Lithuania, and dated to 12130±2780^{14}C kyr. BP (Vs–1092) (Blažauskas et al 1998: 25) that roughly coincides with the Bölling/Older Dryas. An increasing representation of heliophytic shrubs and birch pollen was noticed in the layers attributed to the Older Dryas chronozone (Figs. 3, 4). It is evident that an open, tree-less landscape predominated in this area. Despite the abundant occurrence of *Pinus* in pollen spectra (up to 60% to 70%), no additional evidence of this local origin can be presented. Most probably, open patches favoured the long-distance transport of these pollen grains, although an occurrence of scattered *Pinus* individuals cannot be excluded. The high representation of terrigenous matter in the sediments was also determinated by the paucity of the vegetation cover. Simultaneously, intensive surface erosion due to the high activity of the thermokarst, the formation of the river valleys and the changes in the water level in most lakes was noticed after the former investigations (Dvareckas 1998: 99–110). At the end of the Older Dryas, about 12000^{14}C years BP, the first transgression occurred in the Baltic Ice Lake **(**Björck 1995: 19–40**)** which existed within the area of the present Baltic Sea. The increasing level of the erosion basin may have influenced variations of the water level in the lakes and rivers.

The beginning of the Alleröd points to the remarkable environmental changes marked in bio- and lithostratigraphical records registered all over northern Europe (Lowe et al 1994: 185–198; Birks 1994: 107–119; Berglund et al 1994: 127–132; Coope et al 1998: 419–433; Leroy et al 2000: 52–71). The increasing representation of the organic constituent and the appearance of peat beds enriched by numerous plant macro remains points towards rising biological productivity and the formation of the entire vegetation cover. *Pinus* stands from the Pamerkiai outcrop were dated back to the Early Alleröd, 11880±150^{14}C yr BP (Stančikaitė et al 1998: 77–88). The appearance of *Betula* sect. *Albae* and *Pinus sylvestris* macro remains, together with high pollen percentages, show the formation of birch predominating forest at the beginning of the period and the flourishing of pine approaching the second half of the chronozone. The culmination of the pine was especially obvious in areas where dry soils prevailed, eg southeast Lithuania. The simultaneous appearance of *Juniperus communis* on dry sandy habitats was registered from plant macro remains and pollen records. Before birch and pine became predominant, the flourishing of *Populus*, as well as an increasing amount of *Salix* pollen, suggest open patches existed around. Later, these habitats were covered by forest, which ousted most of the shrubs and herbs except *Artemisia*, Poaceae, Cyperaceae and Chenopodiaceae. Due to the broad ecological range, representatives of the mentioned genus and families survived on eroded plots, slopes and terraces.

The increasing number of *Betula nana* and *Selaginella selaginoides* macro remains noticed later than 11.4–11.3^{14}C kyr. BP in the Rudnia and Pamerkiai sections could be interpreted as the result of some climatic cooling, and correlated with climatic oscilla-

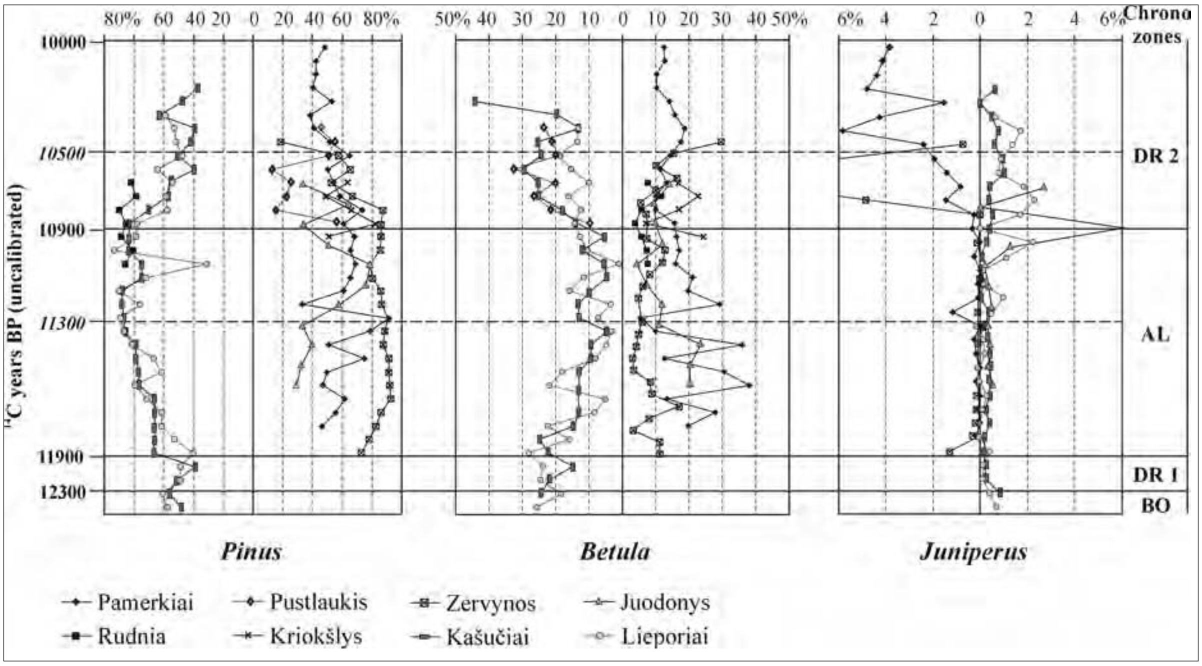

Fig. 3. Tree pollen spectra in the Late Glacial sediment sequences

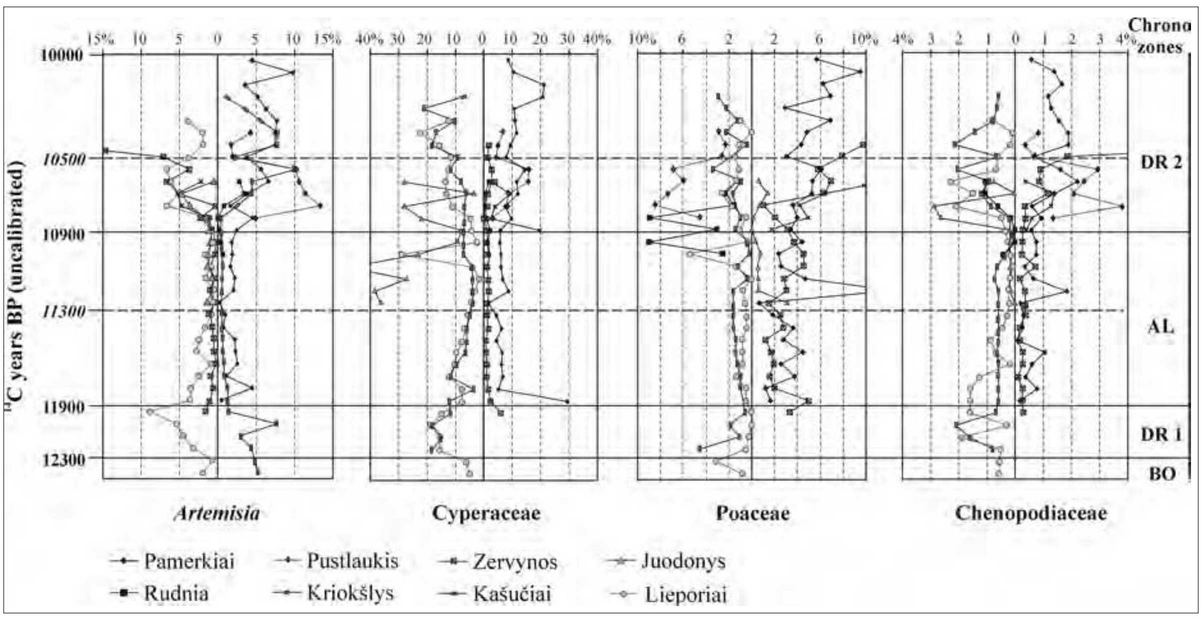

Fig. 4. The distribution of herb pollen in the Late Glacial sediment sequences

tions registered in surrounding countries (Paus 1988: 113–139; Lotter et al 1992: 187–204; Andrieu et al 1993: 681–706). The simultaneous *Pinus* expansion may indicate an increase in continentality and the subsequent drying of the climatic conditions (Walker 1995: 63–76). The decreasing number of planktonic *Aulacoseira* diatoms and the high representation of *Fragilaria* species suggest some lowering of the water level, that may have been caused by the mentioned climatic fluctuations (Šeirienė *pers com*), or a regression registered in the Baltic Ice Lake (Björck 1979: 248; Gudelis 1979: 159–173; Björck 1995: 19–40). The harshening of the climatic conditions is also confirmed by the increasing erosion activity and the subsequent input of clastic material into sediments.

The beginning of the Younger Dryas (10.9^{14}C kyr. BP) is marked by the progressive opening of the landscape, the flourishing of cold-tolerant plants and the retreat of thermophylous species. The strongest alteration of environmental conditions occurred in the earliest, 300-year-long period of the Younger Dryas (Goslar et al 1999: 899–911). The thinning of the forest cover (Fig. 3) coincided with the spread of heliophylous herbs (*Artemisia, Thalictrum* and Chenopodiaceae). *Populus* and *Juniperus*, according to pollen data, spread

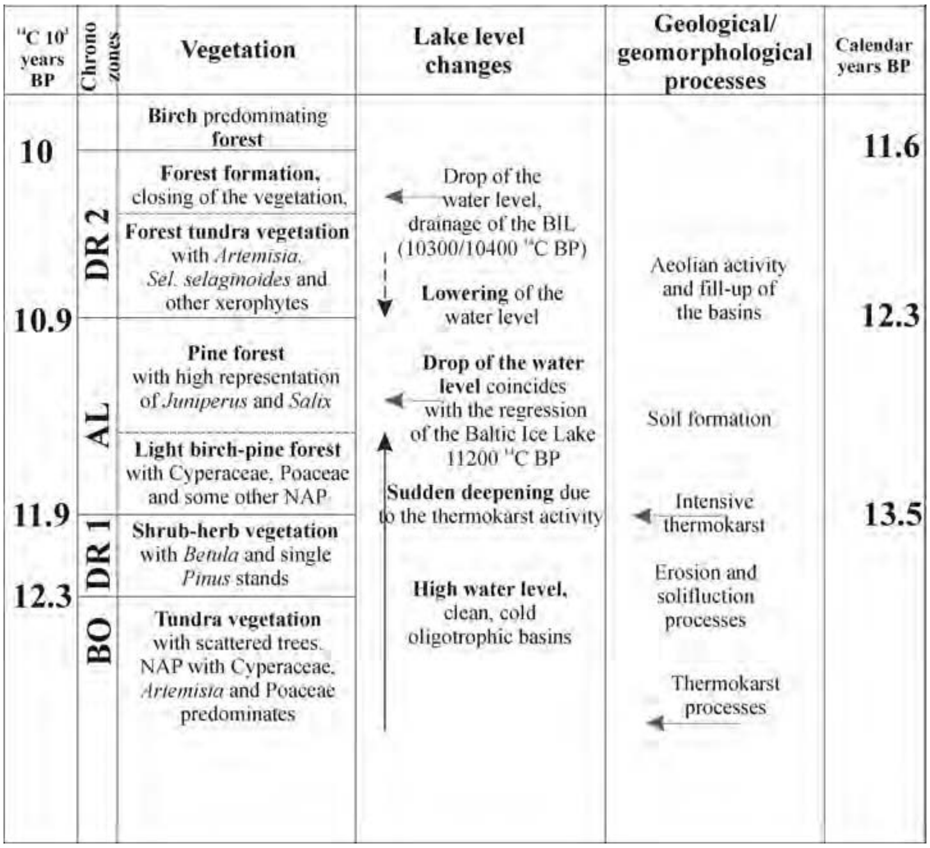

Fig. 5. Late Glacial environmental oscillations in Lithuania

out into newly opened areas before the culmination of birch. The prospering of birch in the local vegetation has been confirmed by the continuous representation of *Betula humilis* and *Betula* sect. *Albae* seeds in sediments (Blažauskas et al 1998: 20–30). Although the pollen of *Pinus* was reduced at the beginning of the period, its value (Fig. 3) and the sporadic occurrence of *Pinus sylvestris* macro remains show that this tree was represented locally. Pollen data suggests the formation of open shrubs and herbs dominating a landscape with light birch forest, juniper and possibly pine stands existing in the region.

The character of the composition of the vegetation, as well as the flourishing of cold-tolerant plants, such as *Selaginella selaginoides*, *Potamogeton alpinus* and *Potamogeton vaginatus*, indicate a drop in temperature and possibly changes in the humidity regime during the first half of the period. Younger Dryas climatic reconstructions show very low January temperatures, which had a strong impact on vegetation (Isarin et al 1998: 447–453; Isarin and Bohncke 1999: 158–173; Ammann et al 2000: 313–347; Renssen et al 2001: 41–57). Due to the declining vegetation and instability of the soils, especially in sandy areas, erosion processes were very active. Intensive soil nitrification was confirmed by the continuous representation of *Urtica dioica* macro remains (Blažauskas et al 1998: 20–30; Stančikaitė et al 2004: 17–33). Soil erosion was accompanied by aeolian processes and large massifs of continental dunes formed in southeast Lithuania and filled up numerous small lakes (Blažauskas et al 1998: 20–30; Stančikaitė et al 1998: 77–88). Diatom data points to the existence of oligo-mesotrophic, nutrient-rich palaeobasins with a high water level during the first half of the Younger Dryas cooling (Kabailienė 1990: 125).

Palaeobotanical records suggest some improving of the climatic conditions during the second half of the Younger Dryas that has also been reported from surrounding countries, and dated from 10.5–10.4^{14}C kyr BP onwards (Goslar et al 1993: 287–294; Birks et al 1994: 133–146; Berglund et al 1994: 127–132; Pokorny 2002: 101–122). For Lithuania, the expansion of the *Pinus* and the drop in heliophytic taxa can be interpreted as a response to climatic warming (Fig. 3, 4). The existence of wet bog conditions inferred from semi-aquatic plant, eg *Menyanthes trifoliata* and *Carex rostrata* macro remains, suggests the beginning of the bogging process, which means rather high humidity and the existence of quite a lot rich vegetation (Stančikaitė et al 1998: 77–88; Stančikaitė et al 2003: 47–60; Stančikaitė et al 2004: 17–33). The drainage of the Baltic Ice Lake around 10500–10300^{14}C years BP (Björck, Digerfeldt 1989: 209–219; Kabailienė 1999: 15–29) influenced the water balance in inland waters. Bogging processes, the lowering of the water level or the interruption of the sedimentation processes registered in the investigated lakes may be explained against this background.

The further development of the vegetation cover confirms progressive climate amelioration and increasing precipitation that coincides with the onset of the Holocene. The Late Glacial/Holocene transition is expressed as a rapid temperature rise registered in many sediment sequences in Europe.

Conclusions

The analysed data sets confirm the dominance of treeless vegetation during the pre-Alleröd time (>11.9^{14}C kyr BP) in Lithuania (Fig. 5). Only scattered *Pinus* and *Betula* stands may have grown in the region. Due to the poor vegetation cover, some of the terrigenous matter was transported into cold oligotrophic lakes with a high water level.

Coincident with the improvement of the climatic conditions at the beginning of the Alleröd, remarkable environmental changes occurred in the area. Open forest communities, with *Betula* and *Pinus* as dominating species, characterise the vegetation of the early Alleröd (11.9–11.4/11.3^{14}C kyr BP) (Fig. 5). The increase in biological productivity caused the higher representation of the organic constituent in the sedimentary sequences. The reexpansion of cold-tolerant plants (*Betula nana* and *Selaginella selaginoides*), accompanied by increasing erosion activity, may be interpreted as the result of some climatic instability occurring in the second half of the period (11.4/11.3–10.9^{14}C kyr. BP).

The prospering of a light birch predominating forest, together with heliophylous herbs and light-demanding shrubs, was typical for the first half of the Younger Dryas event (10.9–10.5/10.4^{14}C kyr BP). Due to the vegetation decline, intensive erosion and aeolian processes started. The successive expansion of *Pinus* and the drop in cold-tolerant plants suggests some improvement of the climatic conditions since 10.5/10.4^{14}C kyr. BP onwards. The rise in the mean temperature favoured the formation of *Pinus* and *Betula* predominating forest at the beginning of the Holocene.

Acknowledgement

The data presented here was collected while the author participated in scientific projects financed by the Lithuanian Science and Studies Foundation.

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Received: 2005

VĖLYVOJO LEDYNMEČIO GAMTINĖS APLINKOS RAIDA LIETUVOJE

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Santrauka

Vėlyvojo ledynmečio gamtinės aplinkos analizė buvo atlikta remiantis paleobotaninių, litostratigrafinių ir izotopinių (^{14}C) tyrimų rezultatais, gautais iš skirtingose Lietuvos teritorijos dalyse išanalizuotų limninių bei biogeninių nuosėdų storymių. Sporų-žiedadulkių tyrimų rezultatai leidžia teigti, jog ikialeriodiniu laikotarpiu (>11900^{14}C metų BP) tirtoje teritorijoje vyravo bemiškis kraštovaizdis, kuriame buvo gausu gėlų, aukšto vandens lygio sedimentacinių baseinų. Prieš 11900–11800^{14}C metų prasidėjęs miškų, kuriuose vyravo beržai ir pušys, formavimasis sutapo su organinės sudedamosios kiekio nuosėdose didėjimu. Sukaupta informacija leidžia teigti, jog vėlyvojo driaso antrojoje pusėje (nuo 10500–10400^{14}C metų BP) prasidėjo laipsniškas klimato sąlygų gerėjimas. Vėlyvojo ledynmečio pabaigoje nuosėdų kaupimasis vyko oligomezo-

trofiniuose, skaidriuose sedimentaciniuose baseinuose, kuriuose vyravo gana aukštas vandens lygis. Vandens lygio kritimas sutapo su Baltijos ledyninio ežero lygio kritimu, fiksuotu prieš 10400–10300 ^{14}C metų.