

# A Reconstruction of the Flora and Vegetation in the Central Area of Early Medieval Kiev, Ukraine, Based on the Results of Palynological Investigations\*

Lyudmila G. Bezusko, Timur V. Bezusko, and Sergei L. Mosyakin

M.G. Kholodny Institute of Botany, National Academy of Sciences of Ukraine, 2  
Tereshchenkivska Street, Kyiv (Kiev), 01601 Ukraine; flora@ln.ua.

## Abstract

This paper provides a partial reconstruction of the main features of the flora and vegetation of the central area of the city of Kiev (Kyiv in the Ukrainian-based transliteration), Ukraine, in early medieval times. The reconstruction is based on fossil spore and pollen samples. Samples for the spore-pollen analysis were selected in 1998 and 1999 during archaeological investigations on the grounds of St. Michael's Gold-Domed Cathedral and in three adjacent areas in the hilly central part of Kiev. According to archaeological data, the samples were dated to between the 10th and 12th centuries A.D. Analysis of the fossil palynoflora yielded a general list of 102 taxa of different ranks (identified by species, genus, family, or order), 72 of which were herbaceous (62.9% to 82.1% for the four sites). Analysis of the herbaceous pollen on the species level turned up a significant number of weedy flora. The data was used to supplement prior lists of weedy and cultivated plants. A comparison of our species list with diagnostic species of modern syntaxa of ruderal vegetation gives evidence that some

synanthropic plant species achieved their community-forming role only during the last millennium. The data collected and analyzed in his paper provide only a fragmentary view of the natural (nonsynanthropic) vegetation that surrounded the ancient city of Kiev. However, it includes new details and paleobotanical information on the anthropic factors influencing the formation of the urban flora and vegetation of ancient Kiev.

## Introduction

Understanding the interactions between humans and the natural world is best solved using methods from both the natural sciences and historiography. The reliability of paleobotanical (or archeobotanical) reconstruction is very much enhanced by combining the tools of palynology (especially paleopalynology) and paleoethnobotany, in short, by studying microfossils alongside macrofossils. Use of spore-pollen analysis to study the cultural layers of archeological sites, especially in urbanized areas, provides insight into the anthropic, or human-influenced, components of past vegetation. This is

---

\* Published online November 18, 2003

especially true when the pollen belongs to plants that are considered indicators of economic activity—namely, crop plants and weedy species associated with human presence, and especially human economic activity, in the natural or man-altered environment.

In paleobotanical terms, the ancient city of Kiev (Kyiv in the Ukrainian-based transliteration), Ukraine's capital and the so-called "Mother of Russian Cities," is a fascinating model for study. Situated along an important historical trade route, it played a leading role in the urban development of eastern Europe, until its devastation in A.D. 1240 by the Mongol and Tatar hordes of Batu Khan (a grandson of Genghis Khan). Between the 10th and 12th centuries, Kiev was among the largest and most densely populated urban areas in Europe. It is safe to assume, then, that Kiev's flora and vegetation were considerably altered by humans during these two centuries.

## Material and Methods

In our study, samples for spore-pollen analysis were selected in 1998 and 1999 during archaeological investigations on the grounds of St. Michael's Gold-Domed Cathedral and in adjacent areas in the hilly central part of Kiev. In this article, we present the results of our palynological analysis of the first series of data. The samples were dated to between the 10th and 12th centuries A.D. They came from the following early medieval sites: (1) a 10th-century Slavonic burial site at modern-day Sofia Square; (2) a 10th-century Slavonic burial site on the grounds of the present-day reconstructed St. Michael Gold-Domed Cathedral (trench No. 6); (3) a 10th-century Scandinavian burial site on the grounds of St. Michael's Gold-Domed Cathedral (chamber No. 2,

the northern corner at the western side of the cathedral's gate); (4) construction fill from a building dating from the end of the 11th century through the 12th century A.D. on the grounds of St. Michael's Gold-Domed Cathedral (trench No. 15, building No. 2).

The three selected burial sites are from roughly the same era. They can be traced to the formative years of feudal ancient Rus, which included nearly all of present-day Ukraine, Belarus, and parts of northwestern Russia. This powerful medieval Slavonic state is usually called Kievan Rus in the history books, as its capital city was Kiev. In the 10th century and the first half of the 11th century, there were no permanent buildings in the immediate vicinity of the studied burial sites. The last burials to take place there were probably in the first half of the 11th century, and urban development of the area began around this time. This historical part of ancient Kiev is known as Izyaslav City or Izyaslav–Svyatopolk City. Prince Izyaslav (Isiaslav), the son of the Kievan Grand Prince Yaroslav (Iaroslav) the Wise, built St. Dmitry Monastery here in the 1060s. St. Peter's Church was built at the monastery between 1085 and 1087 by orders of Yaropolk, the elder son of Izyaslav. St. Michael's Gold-Domed Cathedral was founded in 1108 by Svyatopolk, who was then the Grand Prince of Kiev (Tolochko, 1976; Dehtiarov & Reutov, 1999; Ivakin, 2001).

In our palynological study, pollen preparation and processing followed the standard procedure proposed by V.P. Grichuk (Pokrovskaya, 1966). The samples were treated with heavy liquids (KI + CdI<sub>2</sub>) with the specific gravity of 2.0, 2.1, and 2.2 g/cm<sup>3</sup>. For pollen identification, we used the reference pollen collections of the Department of Vascular Plants at the M.G. Kholodny Institute of Botany and of the

Department of Biology at the National University “Kyiv-Mohyla Academy.” We also referred to pollen-identification manuals and special palynomorphological articles on pollen analysis (Erdtman, 1943, 1957, 1965; Kupriyanova, 1965; Kupriyanova & Aleshina, 1972, 1978; Boros & Jarai-Komlodi, 1975; Bobrov, Kupriyanova & Tarasevich, 1983; Grichuk & Monoszon, 1971; Monoszon, 1950, 1973, 1976, 1985; Kazartseva, 1982; Askerova, 1987; Romanova & Bezusko, 1987; Savitsky, Bezusko, Savitska & Bezusko, 1998, and others). The scientific plant names follow the recent nomenclatural checklist of vascular plants of Ukraine (Mosyakin & Fedoronchuk, 1999). For interpreting the results of our paleopalynological analysis of the medieval spore-pollen (SP) samples, we used methodological principles and data based on previous actuopalynological studies (i.e., studies of modern pollen, as opposed to studies of fossil pollen, or paleopalynology). In particular, these studies demonstrated a dependence between SP spectra in recent and subrecent surface-soil samples and the present-day vegetation patterns in the forest and forest-steppe zones of Ukraine (Arap, 1972, 1974, 1976; Bezusko, Bezusko & Yesilevsky, 1998). The similarities revealed in these studies allow us, with a reasonable degree of probability, to extrapolate fossil SP data and thereby reconstruct basic vegetation patterns in this area of medieval Kiev.

Our analysis of the fossil palynoflora yielded a general list of 102 taxa of different levels (identified by species, genus, family, or order): See Table 1. The analysis also allowed us to establish ratios between the arboreal pollen (AP, pollen of trees and shrubs) and nonarboreal pollen (NAP, pollen of mostly herbaceous plants) content of the fossil spore-pollen spectra. As shown in Figure 1, all SP spectra are

characterized by some domination of pollen from herbaceous plants (62.9% to 82.1%). Of course, the ratio of pollen from nonarboreal plants to pollen from arboreal plants in the fossil SP spectra provides only generalized information indicating the presence and very approximate shares of corresponding plants. In modern (recent) SP spectra, ratios vary greatly seasonally and annually depending on climatic and atmospheric conditions, phenological rhythms of flowering periods of various plants, and other factors. However, in steppe and forest-steppe zones, the corresponding ratios in recent and subrecent samples are usually lower.

## Trees and Shrubs of Ancient Kiev

The list of arboreal pollen includes 30 taxa (12 identified genera and 18 identified species). The pollen of *Betula pendula*, *Pinus sylvestris*, and *Tilia cordata* was present in all four SP spectra. The forests surrounding the early medieval city of Kiev from the north were represented mainly by *Pinus sylvestris*, *Alnus glutinosa*, *Betula pendula*, *Betula pubescens*, *Corylus avellana*, *Salix* species, as well as other species of trees and shrubs. These species are still typical of modern-day forests of the forest zone, which lies north of Kiev. However, the data also show that the dendroflora of the ancient town was also composed of *Acer platanoides*, *Quercus robur*, *Tilia cordata*, *Carpinus betulus*, *Fraxinus excelsior*, *Ulmus* species, *Viburnum* species, *Rosa canina*, *Sambucus nigra*, and some other plants. These species are mostly typical of the more open plant communities of the forest-steppe zone to the south and are also abundant today, mostly in the southern parts of Kiev. Since Kiev is situated at the border of the forest and forest-steppe zones, it is not surprising to find these trees and shrubs represented.

The linden, or lime, tree, *Tilia cordata*, played an important economic role in ancient Kiev. It was harvested for its timber, bast, and tar, and its blossoms made into tea. It was also considered a medicinal and even sacred plant, and the practice of preserving linden trees endures to this day: The oldest linden tree in Kiev dates back 500 years and grows near the ruins of the Tithe (Desyatynna) Church (Voinstvensky, 1986).

Pollen of the walnut tree, *Juglans regia*, a source of nuts and high-quality wood, was identified in the SP spectra. Historical records indicate that walnut trees were first planted in the Kiev area in the gardens of the Mezhygorsky and Vydebetsky monasteries near ancient Kiev (now within modern-day Kiev). But the date of these introductions was defined rather widely, as probably sometime between the 10th and 12th centuries A.D. (Strela, 1990). Our palynological data is the first paleobotanical confirmation of the presence of this valuable cultivated species in the Kiev dendroflora of the second half of the 10th century to the 12th century A.D.

In the SP spectrum from deposits of the end of the 11th century through the 12th century A.D., pollen grains of apple trees, *Malus* species, were also identified. Historical sources tell of an abundance of apple gardens in the territory of early medieval Kiev. For example, chronicles of the 11th century mention the famous apple garden of the Kyivo-Pechersky Monastery (Kiev Cave Monastery) and also the gardens near the St. Sofia Cathedral (also known as the Cathedral of the Holy Wisdom) and the St. Cyril (Kirilovsky) Monastery (Uspenskaya, Klimenko, Kuznetsov & Davydenko, 1991; Kokhno & Kurdyuk, 1994). As a rule, gardens of ancient Kievan Rus were cultivated near monasteries, convents, estates of

princes and boyars (members of Rus nobility, ranking immediately below the princes), as well as near houses of other town inhabitants (Uspenskaya, Klimenko, Kuznetsov & Davydenko, 1991).

## Herbaceous Plants

The general list of plants identified in the SP spectra includes 72 herbaceous taxa (26 families, 7 genera, and 39 species). Analysis of the herbaceous components on the species level turned up a significant number of weedy plants, almost half of the total number.

We have compared our palynological data with paleoethnobotanical data for Kiev from the same era obtained by G.A. Pashkevich (1991, 1998): See Table 2. Notably, we have added *Beta vulgaris* and *Malus* (probably *M. domestica*) to Pashkevich's list of 11th- to 12th-century cultivated plants. According to A.I. Barbarych (1962), who based his work on the available historical chronicles and records, *Beta vulgaris* had been known in Kievan Rus since the 10th and 11th centuries A.D. It later spread to neighboring Lithuania and Poland.

It is noteworthy that A.I. Barbarych also mentions *Ribes* and *Rubus* among the plants cultivated in Kievan Rus times. We found microfossils for these genera in the 11th- to 12th-century deposits (see Table 1). These deposits (but not those from the 10th-century sites) also contained pollen grains of *Sorbus* species, *Rosa canina* s.l., *Sambucus nigra*, *Viburnum* species, *Valeriana* species, *Convallaria majalis*, *Thalictrum aquilegifolium*, and other species, some of which were probably cultivated, or at least favored and preserved, in urban areas. Of the variety of weeds that appeared during the 11th and 12th centuries, *Chenopodium foliosum* is a species that was widely cultivated as a leaf vegetable in early medieval times.

Of course, in addition to the “standard” set of crops, many weedy species were occasionally used, in Kievan Rus and elsewhere in medieval Europe, as “famine food” or as complementary additions to the standard diet of medieval population.

We have made additions to Pashkevich’s list (1991, 1998) of weedy flora of ancient Kiev (Table 2 [link here]). Among these species, newly listed archaeophytes (nonnative taxa introduced before the end of the 15th century) are represented by *Centaurea cyanus*, *Scleranthus annuus*, *Spergula arvensis*, *Atriplex sagitata*, *Chenopodium foliosum*, *Cichorium intybus*, *Sonchus arvensis*, *Fallopia convolvulus*, *Echinochloa crusgalli*, *Setaria glauca*, *Setaria viridis*. Newly listed apophytes (native taxa) are represented by *Artemisia absintium*, *Tussilago farfara*, *Cerastium arvense*, *Atriplex tatarica*, *Chenopodium botrys*, *Chenopodium glaucum*, *Chenopodium rubrum*, *Polycnemum arvense*, and *Plantago lanceolata*. New additions to the list of euapophytes (typical apophytes) are *Arctium tomentosum*, *Artemisia scoparia*, *Artemisia vulgaris*, *Cirsium arvense*, *Echium vulgare*, *Stellaria media*, *Chenopodium album* s.l., *Taraxacum officinale* s.l., *Chelidonium majus*, *Plantago major*, *Plantago media*, *Polygonum aviculare* s.l., *Rumex crispus*, *Rumex confertus*, *Galium aparine*, and *Equisetum arvense*.

From these data, we can confirm the immigration and naturalization status of many of the weedy species of present-day Kiev, as reported by V. V. Protopopova (1991). The most essential changes we’ve made are to the group known as the kenophytes (species that immigrated during the period from the 16th century to the present). Several weedy species should now be recognized as archaeophytes rather than kenophytes. Along with those mentioned above and others, *Cannabis sativa*

(and its weedy races, usually known collectively as *Cannabis ruderalis* Janisch.) should now be considered an archaeophyte in Kiev.

The data provided here not only summarize the content of the crop and weed floras of ancient Kiev but also clearly demonstrate the prospects of further success in using paleoethnobotanical methods alongside palynological ones. The paleoethnobotanical method, for instance, considerably deepens our knowledge about grain crop species. This is because the palynological method can usually only identify the pollen of these grains to the level of “cereals” within the group collectively known in paleoethnobotanical studies as Cerealina. However, palynological materials are more informative when determining the species content of weedy flora. Undoubtedly, the most “trustworthy” taxa are those whose presence is confirmed by the two paleobotanical methods. In our study, these are the weedy species *Chenopodium album* s.l. and *Fallopia convolvulus*.

## Modern-Day Descendants

We compared the species composition of the fossil weed flora (Table 2) with the diagnostic table of syntaxa of Ukraine’s synanthropic vegetation compiled using the Braun-Blanquet method (Solomakha, Kostylev & Shelyag-Sosonko, 1992). The results of our analysis show that among the 36 species of weeds we reported as macrofossils and pollen remnants, 16 taxa are diagnostic species on the levels of taxonomic classes and orders of the modern syntaxa of ruderal and segetal vegetation of Ukraine. These syntaxa and their diagnostic species are listed below.

Class *Artemisietea vulgaris* Lohm., Prsg. et R. Tx. in R. Tx. 1950:

Diagnostic species: *Chelidonium majus*, *Atriplex sagitata*.

Order *Artemisietalia vulgaris* Lohm. in R. Tx. 1947:

Diagnostic species: *Tussilago farfara*.

Order *Galio-Alliarietalia* Oberd. ex Gors et Th. Mull. 1969:

Diagnostic species: *Galium aparine*.

Class *Chenopodietea* Br.-Bl. 1951; emend. Lohm., J. et R. Tx. 1961:

Diagnostic species: *Chenopodium album*, *Sonchus arvensis*, *Fallopia convolvulus*.

Order *Polygono-Chenopodietalia* J. Tx. et Matuszk. 1962:

Diagnostic species: *Echinochloa crusgalli*, *Setaria viridis*.

Class *Galio-Urticatea* Pass. 1962:

Diagnostic species: *Galium aparine*, *Chelidonium majus*.

Order *Calystegietalia sepium* Tx. 1950:

Diagnostic species: *Galium aparine*.

Class *Meliloto-Artemisietea absinthii* Elias 1980:

Diagnostic species: *Artemisia absinthium*.

Order *Meliloto-Artemisietalia absinthii* Elias 1979:

Diagnostic species: *Echium vulgare*.

Class *Plantaginetalia majoris* R. Tx. et Prsg. in R. Tx. 1950:

Diagnostic species: *Plantago major*, *Polygonum aviculare*.

Class *Polygono-Chenopodietea* (Lohm., J. et R. Tx. 1961) Elias 1984:

Diagnostic species: *Chenopodium album*, *Polygonum aviculare*, *Setaria glauca*, *Spergula arvensis*.

Class *Sisymbrio-Onopordetea* (Br.-Bl. 1964) Gors 1966:

Diagnostic species: *Atriplex tatarica*, *Chenopodium glaucum*.

Our data show that 7 of the 12 syntaxa listed are represented by several different species. The simultaneous presence (in our SP spectra) of several diagnostic species for each syntaxon is indirect evidence of the existence of these or similar syntaxa in the past. Thus, we can assume that in ancient Kiev, several paleosyntaxa of ruderal vegetation were already well developed by the 10th, 11th, and 12th centuries, and these paleosyntaxa were similar in their ecological and phytosociological characteristics to the listed syntaxa of the present-day ruderal vegetation of Ukraine.

Syntaxa of the class *Artemisietea vulgaris* are widespread on moderately humid sandy, chernozem and clayey substrata. They very seldom occur on rubbly substrata. Communities of mesophytic perennials, which are mostly represented in the order *Artemisietalia vulgaris*, occur at present mostly within the forest and forest-steppe zones of Ukraine. The class *Chenopodietea* includes communities dominated by annual ruderal species growing mostly on mechanically disturbed substrata (Solomakha, Kostylev & Shelyag-Sosonko, 1992). Communities of nitrophilous mesophytes growing mostly on dry or slightly humid soils are united within the class *Galio-Urticatea*. The class *Plantaginetalia majoris* contains ruderal plant communities of open habitats, especially pastures and livestock grazing fields with condensed (trampled) and nitrified soils. The class *Polygono-Chenopodietea* unites segetal and ruderal communities on light sandy soils, and the class *Sisymbrio-Onopordetea* contains ruderal communities of annuals and biennials growing on loose substrata in well-illuminated localities, often

quite close to human dwellings (Solomakha, Kostylev & Shelyag-Sosonko, 1992).

Undoubtedly, these seven paleosyntaxa differed somewhat from their modern analogues in Ukraine's synanthropic vegetation (for example, they did not include some recent immigrants). However, it is important to note that the modern analogues of most of these paleosyntaxa occur within the studied area at present.

Our data also provide evidence that some synanthropic plant species (in particular, many archaeophytes and all kenophytes) achieved their community-forming role in ruderal and segetal vegetation only during the last millennium, as suggested earlier (Kostylev, Bezusko, Gotun & Pashkevich, 1997). Before that, they were mostly plants of marginal and naturally disturbed habitats, and their role in well-defined plant communities was nearly negligible.

## Conclusion

In conclusion, we should point out that the data collected and analyzed here provide only a fragmentary view of the natural (nonsynanthropic) vegetation that surrounded the ancient city of Kiev from the 10th to the 12th century A.D. However, this set of data includes new and valuable paleobotanical information about the anthropic factors influencing the formation of the urban flora and vegetation of early medieval Kiev. For some synanthropic plant species traditionally regarded as kenophytes (recent migrants) in the Kiev area, there is now direct paleobotanical evidence of their archaeophytic status. Botanists have often underestimated the archaeophytic content of the flora and the degree to which humans have transformed the flora. There are numerous actualistic methods (i.e., those based on the

concept of actualism or uniformitarianism, and thus on modern characteristics of plants, their communities, and present ranges) for assessing the status of archaeophytes in floras (see review in Zajac, 1983–1988), but paleobotanical evidence has the last word in establishing the native-versus-introduced status and the time of immigration of synanthropic plant species.

## Acknowledgments

The authors are grateful to Steven E. Clemants and Janet Marinelli (Brooklyn Botanic Garden) for their kind help and advice on the manuscript. We are also grateful to anonymous reviewers for their valuable comments.

## Literature Cited

- Arap, R.Y. (1972). Palynological investigations of soil surface layers in the forest-steppe zone of the Ukrainian SSR. *Ukrayinski Botanichni Zhurnal* 29(4), 506–513 (in Ukrainian).
- Arap, R.Y. (1974). Ratios of recent spore and pollen spectra and the plant cover composition in Volhynian Polissya. *Ukrayinski Botanichni Zhurnal* 31(1), 493–498 (in Ukrainian).
- Arap, R.Y. (1976). Palynological investigations of soil surface layers in Ukrainian Polesie. In I.V. Teslenko (Ed.), *Palynological investigations of sedimentary layers of Ukraine and adjacent regions* (pp. 11–16). Kiev: Naukova Dumka (in Russian).
- Askerova, R.K. (1987). *Palynology of Compositae: Cichoriaceae*. Baku: Elm (in Russian).
- Barbarych, A.I. (1962). *Our cultivated plants*. Kyiv: Radyanska Shkola (in Ukrainian).
- Bezusko, L.G., Bezusko, A.G. & Yesilevsky, S.O. (1998). Actupalynological aspects of the Holocene paleoecology (on the example of the steppe zone of Ukraine). *Naukovi Zapysky NaUKMA. Pryrodnychi Nauky* [Proceedings of National University "Kyiv-Mohyla Academy," Natural Sciences Series] 5, 51–57 (in Ukrainian).

- Bobrov, A.E., Kupriyanova, L.A. & Tarasevich, V.F. (1983). *Spores of ferns and fern allies, and pollen of gymnosperms and monocots of the flora of the European part of the USSR*. Leningrad: Nauka (in Russian).
- Boros A. & Jarai-Komlodi, M. (1975). *An atlas of recent European moss spores*. Budapest: Akademiai Kiado.
- Dehtiarov, M.G. & Reutov, A.V. (1999). *Mykhailivskiy Zolotoverkhiy monastyr [The St. Michael Gold-Domed Monastery]* (2nd ed.). Kiev: Tekhnika (in Ukrainian).
- Erdtman, G. (1943). *An introduction to pollen analysis*. Waltham, MA: Chronica Botanica Co.
- Erdtman, G. (1957). *Pollen and spore morphology: plant taxonomy. Gymnospermae, Pterydophyta, Bryophyta [illustrations] (An introduction to palynology [Vol. II])*. Stockholm & Uppsala: Almquist and Wiksell.
- Erdtman, G. (1965). *Pollen and spore morphology: plant taxonomy. Gymnospermae, Bryophyta [Text]. (An introduction to palynology [Vol. II])*. Stockholm & Uppsala: Almquist and Wiksell.
- Grichuk, V.P. & Monoszon, M.K. (1971). *The manual of uniseriate spores of ferns of the family Polypodiaceae R. Br. occurring in the territory of the USSR*. Moscow: Nauka. (in Russian).
- Ivakin, G.Y. (2001). New facts from the history of the “Izyaslav city” in Kiev. *Magisterium of the National University “Kyiv-Mohyla Academy.” Archaeological Studies*. 6, 19–25 (in Ukrainian).
- Kazartseva, T. I. (1982). Fossil and modern pollen of three species of the genus *Tilia* (Tiliaceae). *Botanicheskij Zhurnal* 67, 805–811 (in Russian).
- Kokhno, N.A. & Kurdyuk, A.M. (1994). *Theoretical principles and experience of introduction of woody plants in Ukraine*. Kiev: Naukova Dumka (in Russian).
- Kostylev, O.V., Bezusko, T.V., Gotun, I.A. & Pashkevich, G.O. (1997). Phytocenologic reconstructions of palaeobotanical data at the base of the information about Avtunichy (Chernigivska region). *Ukrainskyi fitotsenolohichniy zbirnyk (Kiev); Series A, 1(6)*, 40–44 (in Ukrainian).
- Kupriyanova, L.A. (1965). *Palynology of Amentiferae*. Moscow & Leningrad: Nauka (in Russian).
- Kupriyanova, L.A. & Aleshina, L.A. (1972). *Pollen and spores of plants in the flora of the European part of the USSR* (Vol. 1). Leningrad: Nauka (in Russian).
- Kupriyanova, L.A. & Aleshina, L.A. (1978). *Pollen and spores of plants in the flora of the European part of the USSR. Lamiaceae–Zygophyllaceae*. Leningrad: Nauka (in Russian).
- Monoszon, M.K. (1950). Description of pollen of *Artemisia* species growing in the territory of the USSR. *Trudy Geologicheskij Institut [Proceedings of Institute of Geography]* 46, 271–360 (in Russian).
- Monoszon, M.K. (1973). *Pollen identification manual of species of the family Chenopodiaceae*. Moscow: Nauka (in Russian).
- Monoszon, M.K. (1976). Diagnostics of pollen of species of the genus *Thalictrum* L. In *Palynology in the USSR* (pp. 24–27). Moscow: Nauka (in Russian).
- Monoszon, M.K. (1985). Pollen morphology of species of the genus *Plantago* L. (a manual for spore and pollen analysis). In V.S. Volkova & A.F. Khlonova (Eds.), *Palynostratigraphy of the Mesozoic and Cenozoic of Siberia* (pp. 65–73). Novosibirsk: Nauka (in Russian).
- Mosyakin, S. L. & Fedoronchuk, M.M. (1999). *Vascular plants of Ukraine. A nomenclatural checklist*. Kiev: National Academy of Sciences of Ukraine.
- Pashkevich, G.A. (1991). *Paleoethnobotanical finds in the territory of Ukraine: Ancient Rus’, a catalog*. Kiev: Institute of Archaeology, National Academy of Sciences of Ukraine (in Russian).
- Pashkevich, G.A. (1998). Paleoethnobotanical studies of materials from excavations of St. Michael’s Gold-Domed Cathedral in Kiev. *Arkheologichni Doslidzhennya [Archaeological Studies]* (1998), 61–62 (in Ukrainian).
- Pokrovskaya, I.M. (Ed.) (1966). *Paleopalynology* (Vol. 1). Leningrad: Nauka (in Russian).
- Protopopova, V.V. (1991). *The synanthropic flora of Ukraine and ways of its development*. Kiev: Naukova Dumka (in Russian).
- Romanova, L.S. & Bezusko, L.G. (1987). Pollen of some weedy plants of the family Caryophyllaceae Juss. as an indicator of anthropic activity in the past. *Ukrayinski Botanichniy Zhurnal* 43(1), 42–46 (in Ukrainian).



- Savitsky V.D., Bezusko, L.G., Savitska, O.V. & Bezusko, T.V. (1998). Pollen of weedy species of Papaveraceae Juss. as an indicator of anthropic activity in the past. *Ukrayinski Botanichnyi Zhurnal* 55(3), 301–306 (in Ukrainian).
- Solomakha, V.A., Kostylev, O.V. & Shelyag-Sosonko, Y.R. (1992). *Synanthropic vegetation of Ukraine*. Kiev: Naukova Dumka (in Ukrainian).
- Strela, T.E. (1990). *Walnut*. Kiev: Naukova Dumka (in Russian).
- Tolochko, P.P. (1976). *Ancient Kiev*. Kiev: Naukova Dumka (in Russian).
- Uspenskaya, N.D., Klimenko, Y.A., Kuznetsov, S.I. & Davydenko, I.A. (1991). *Formation of stands of cultivated plants at monuments of ancient Rus'*. Kiev: Naukova Dumka (in Russian).
- Voinstvenskiy, M.L. (Ed.) (1986). *Nature conservation fund of the Ukrainian SSR*. Kiev: Urozhay (in Ukrainian).
- Zajac, A. (1983–1988). Studies on the origin of archaeophytes in Poland. *Zeszyty Naukowe Uniwersytetu Jagiellonskiego. Prace botaniczne* 11 (1983), 87–107; 15 (1987), 7–50, 93–129; 17 (1988), 23–51.

## Glossary

**Actualistic:** Based on the concept of actualism or uniformitarianism, and thus on modern characteristics of plants, their communities, and present ranges.

**Dendroflora:** Trees and other woody species.

**Mesophytic:** A land plant that grows in an environment that has a moderate amount of moisture.

**Paleobotany:** A branch of botany concerned with fossil plants.

**Paleoethnobotany:** A branch of botany concerned with how people used plants in the past.

**Paleosyntaxa:** A fossil plant community or association.

**Palynological:** Related to the study of spores and pollen.

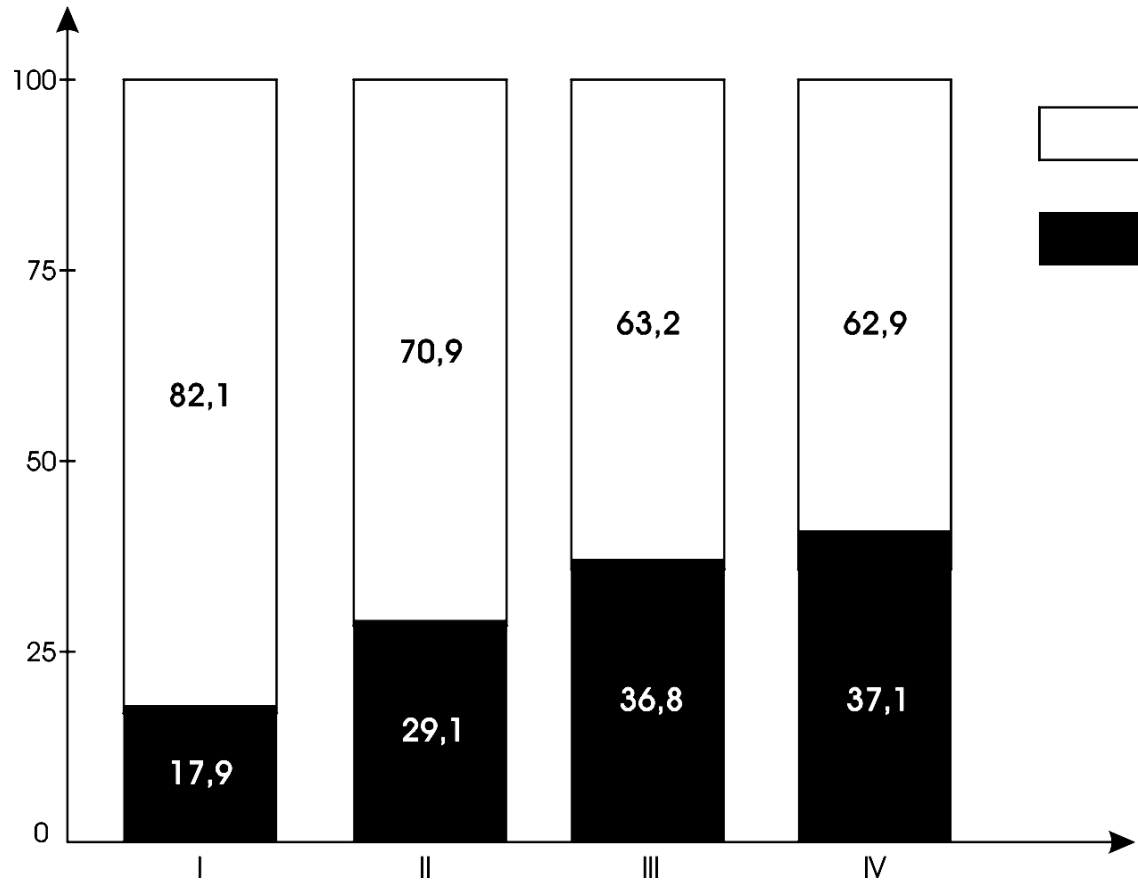
**Ruderal:** Characteristic of lands that are highly disturbed but rich in water, nutrients, and other resources.

**Segetal:** Growing in fields of grain.

**Synanthropic:** Living in close association with humans.

**Syntaxa:** A plant community or association.

**Figure 1: Ratios of pollen grains of arboreal and herbaceous plants in spore-pollen spectra from early medieval deposits of Kiev (10th–12th centuries A.D.)**



white – percentage of nonarboreal pollen (NAP, or pollen of herbaceous plants)

black – percentage of arboreal pollen (AP, or pollen of trees and shrubs)

I. Slavonic burial site, 10th century A.D. (modern St. Sophia Square)

II. Slavonic burial site, 10th century A.D. (modern St. Michael's Gold-Domed Cathedral, trench No. 6)

III. Scandinavian burial site, 10th century A.D. (modern St. Michael's Gold-Domed Cathedral, chamber No. 2 at the northern corner of the western side of cathedral gate)

IV. Construction fill from a building dating from the end of 11th to the 12th century A.D. (St. Michael's Gold-Domed Cathedral; trench No. 15, building No. 2)

**Table 1. A list of microfossil taxa identified in four early medieval deposits from the territory of the St. Michael's Gold-Domed Cathedral and adjacent territories (arranged into two groups: arboreal and herbaceous plants)**

	Taxon	X century AD		XI–XII century AD	
		I	II	III	IV
	<b>Pollen grains of trees and shrubs</b>				
	Aceraceae				
1.	<i>Acer</i> sp.			X	X
2.	<i>Acer platanoides</i> L.				X
	Betulaceae				
3.	<i>Alnus</i> sp.	X		X	X
4.	<i>Alnus glutinosa</i> (L.) Gaertn.	X		X	
5.	<i>Alnus</i> cf. <i>incana</i> (L.) Moench	X			
6.	<i>Betula</i> sp.	X	X	X	
7.	<i>Betula pendula</i> Roth	X	X	X	X
8.	<i>Betula pubescens</i> Ehrh.	X		X	X
	Caprifoliaceae				
9.	<i>Sambucus nigra</i> L.				X
10.	<i>Viburnum</i> sp.				X
	Corylaceae				
11.	<i>Carpinus betulus</i> L.	X			X
12.	<i>Corylus avellana</i> L.		X		X
	Ericaceae				
13.	<i>Calluna vulgaris</i> (L.) Hull	X			X
	Fagaceae				
14.	<i>Fagus sylvatica</i> L.				X
15.	<i>Quercus</i> sp.				X
16.	<i>Quercus robur</i> L.	X		X	X
	Juglandaceae				
17.	<i>Juglans regia</i> L.		X	X	X
	Grossulariaceae				
18.	<i>Ribes</i> sp.				X
	Oleaceae				
19.	<i>Fraxinus excelsior</i> L.		X	X	X
	Pinaceae				
20.	<i>Picea</i> sp.	X			
21.	<i>Picea abies</i> (L.) H. Karst.				X
22.	<i>Pinus sylvestris</i> L.	X	X	X	X
	Rosaceae				
23.	<i>Malus</i> sp.				X
24.	<i>Malus domestica</i> Borkh.				X
25.	<i>Rosa canina</i> L.				X
26.	<i>Rubus</i> sp.				X
27.	<i>Sorbus</i> sp.				X
	Salicaceae				

28.	<i>Salix</i> sp.	X		X	X
	Tiliaceae				
29.	<i>Tilia cordata</i> Mill.	X	X	X	X
	Ulmaceae				
30.	<i>Ulmus</i> sp.	X			X
	<b>Pollen grains of herbaceous plants</b>				
	Alismataceae				
31.	Alismataceae [gen. non ident.]	X			X
	Alliaceae				
32.	Alliaceae [gen. non ident.]				X
	Apiaceae				
33.	Apiaceae [gen. non ident.]	X		X	X
	Asteraceae				
34.	Asteraceae [gen. non ident.]	X	X	X	X
35.	<i>Arctium tomentosum</i> Mill.	X			X
36.	<i>Artemisia</i> sp.	X	X	X	X
37.	<i>Artemisia absinthium</i> L.	X		X	
38.	<i>Artemisia scoparia</i> Waldst. et Kit.	X			
39.	<i>Artemisia vulgaris</i> L.	X	X	X	
40.	<i>Centaurea cyanus</i> L.				X
41.	<i>Cichorium inthybus</i> L.	X	X	X	
42.	<i>Cirsium arvense</i> (L.) Scop.				X
43.	<i>Cirsium oleraceum</i> (L.) Scop.				X
44.	<i>Sonchus arvensis</i> L.				X
45.	<i>Taraxacum officinale</i> Wigg. aggr.	X			X
46.	<i>Tussilago farfara</i> L.	X		X	
	Balsamimaceae				
47.	<i>Impatiens noli-tangere</i> L.			X	
	Boraginaceae				
48.	Boraginaceae [gen. non ident.]			X	
49.	<i>Echium vulgare</i> L.	X			
	Brassicaceae				
50.	Brassicaceae [gen. non ident.]	X		X	X
	Cannabaceae				
51.	Cannabaceae [gen. non ident.]		X		
52.	<i>Cannabis</i> sp.	X	X		X
53.	<i>Cannabis sativa</i> L.		X		
	Caryophyllaceae				
54.	Caryophyllaceae [gen. non ident.]	X			X
55.	<i>Cerastium arvense</i> L.	X			
56.	<i>Scleranthus annuus</i> L.				X
57.	<i>Spergula arvensis</i> L.				X
58.	<i>Stellaria media</i> (L.) Vill.	X			
	Chenopodiaceae				
59.	Chenopodiaceae [gen. non ident.]	X	X	X	X
60.	<i>Atriplex sagittata</i> Borkh.	X			
61.	<i>Atriplex tatarica</i> L.	X	X		
62.	<i>Beta vulgaris</i> L.				X

63.	<i>Chenopodium album</i> L.s.l.	X	X		X
64.	<i>Chenopodium botrys</i> L.	X	X	X	X
65.	<i>Chenopodium foliosum</i> Asch.				X
66.	<i>Chenopodium glaucum</i> L.				X
67.	<i>Chenopodium rubrum</i> L.				X
68.	<i>Polycnemum arvense</i> L.				X
	Convallariaceae				
69.	<i>Convallaria majalis</i> L.				X
	Cyperaceae				
70.	Cyperaceae [gen. non ident.]	X			X
	Euphorbiaceae				
71.	Euphorbiaceae [gen. non ident.]	X			
	Fabaceae				
72.	Fabaceae [gen. non ident.]	X	X	X	X
	Lamiaceae				
73.	Lamiaceae [gen.non ident.]	X	X	X	X
74.	<i>Mentha</i> sp.	X			
75.	<i>Origanum vulgare</i> L.	X		X	X
76.	<i>Salvia</i> sp.	X		X	
	Lemnaceae				
77.	Lemnaceae [gen. non ident.]				X
	Liliaceae				
78.	Liliaceae [gen. non ident.]	X	X		X
	Papaveraceae				
79.	Papaveraceae [gen.non ident.]	X			X
80.	<i>Chelidonium majus</i> L.	X			
	Plantaginaceae				
81.	Plantaginaceae [gen. non ident.]	X	X	X	
82.	<i>Plantago lanceolata</i> L.	X		X	
83.	<i>Plantago major</i> L.	X			X
84.	<i>Plantago media</i> L.				X
	Poaceae				
85.	Poaceae [gen. non ident.]	X	X	X	X
	Polygonaceae				
86.	Polygonaceae [gen. non ident.]	X		X	X
87.	<i>Bistorta officinalis</i> Delarbre ( <i>B. major</i> Gray)				X
88.	<i>Fallopia convolvulus</i> (L.) A. L?ve	X		X	X
89.	<i>Polygonum aviculare</i> L. s.l.	X		X	
90.	<i>Rumex confertus</i> Wild.			X	
91.	<i>Rumex crispus</i> L.	X		X	
	Potamogetonaceae				
92.	Potamogetonaceae [gen. non ident.]	X			X
	Primulaceae				
93.	Primulaceae [gen.non ident.]	X		X	X
	Ranunculaceae				
94.	Ranunculaceae [gen. non ident.]	X		X	X
95.	<i>Thalictrum aquilegifolium</i> L.				X
	Rosaceae				

96.	<i>Rosaceae</i> [gen.non ident.]	X		X	X
	Rubiaceae				
97.	<i>Rubiaceae</i> [gen. non ident.]	X			X
	Solanaceae				
98.	<i>Solanaceae</i> [gen.non ident.]	X			
	Typhaceae				
99.	<i>Typha</i> sp.	X			X
	Urticaceae				
100.	<i>Urtica</i> sp.	X		X	X
	Valerianaceae				
101.	<i>Valeriana</i> sp.				X
	Violaceae				
102.	<i>Violaceae</i> [gen.non ident.]				X
	<b>Spores</b>				
	Bryales				
103.	<i>Bryales</i> [gen.non ident.]	X	X	X	X
	Equisetales				
104.	<i>Equisetum arvense</i> L.			X	
	Lycopodiales				
105.	<i>Huperzia</i> ?	X			
106.	<i>Lycopodium</i> sp.		X	X	X
107.	<i>Lycopodium clavatum</i> L.	X	X		
108.	<i>Lycopodiella inundata</i> (L.) Holub		X		
	Polypodiales				
109.	<i>Polypodiales</i> [gen. non ident.]	X	X	X	X
110.	<i>Athyrium filix-femina</i> (L.) Roth			X	
111.	<i>Dryopteris filix-mas</i> (L.) Schott			X	
112.	<i>Sphagnum</i> sp.	X	X		

**Table 2. A list of macrofossil and microfossil taxa identified in the early medieval deposits from Kiev (arranged into two groups: cultivated plants and weeds)**

	Taxon	Xth century AD		XI-XII century AD	
		Macrofossils (Pashkevich 1991, 1998)	Microfossils	Macrofossils (Pashkevich 1991, 1998)	Microfossils
<b>Cultivated plants</b> (1 to 7 are pollen grains of Cerealia)					
1.	<i>Avena sativa</i> L.	X		X	
2.	<i>Hordeum vulgare</i> L.	X		X	
3.	<i>Panicum miliaceum</i> L.	X		X	
4.	<i>Secale cereale</i> L.	X		X	
5.	<i>Triticum aestivum</i> L.	X		X	
6.	<i>Triticum durum</i> Desf.	X		X	
7.	<i>Triticum monococcum</i> L.	X		X	
8.	<i>Beta vulgaris</i> L.				X
9.	<i>Cannabis sativa</i> L. s.l.		X		

10.	<i>Juglans regia</i> L.		X		X
11.	<i>Malus domestica</i> Borkh.				X
<b>Weeds</b>					
12.	<i>Arctium tomentosum</i> L.		X		X
13.	<i>Artemisia absintium</i> L.		X		X
14.	<i>Artemisia scoparia</i> Waldst. et Kit.		X		
15.	<i>Artemisia vulgaris</i> L.		X		X
16.	<i>Atriplex sagittata</i> Borkh.		X		
17.	<i>Atriplex tatarica</i> L.		X		
18.	<i>Centaurea cyanus</i> L.				X
19.	<i>Cerastium arvense</i> L.		X		
20.	<i>Chelidonium majus</i> L.		X		
21.	<i>Chenopodium album</i> L. aggr.	X	X	X	X
22.	<i>Chenopodium botrys</i> L.		X		X
23.	<i>Chenopodium foliosum</i> Asch.				X
24.	<i>Chenopodium glaucum</i> L.				X
25.	<i>Chenopodium rubrum</i> L.		X		X
26.	<i>Cichorium intybus</i> L.		X		X
27.	<i>Cirsium arvense</i> (L.) Scop.				X
28.	<i>Echinochloa crusgalli</i> (L.) P. Beauv.	X			
29.	<i>Echium vulgare</i> L.		X		
30.	<i>Equisetum arvense</i> L.		X		
31.	<i>Fallopia convolvulus</i> (L.) A.L?ve	X	X		X
32.	<i>Galium aparine</i> L.	X			
33.	<i>Plantago lanceolata</i> L.		X		
34.	<i>Plantago major</i> L.		X		
35.	<i>Plantago media</i> L.				X
36.	<i>Polycnemum arvense</i> L.		X		
37.	<i>Polygonum aviculare</i> L.		X		
38.	<i>Rumex confertus</i> Willd.		X		
39.	<i>Rumex crispus</i> L.		X		
40.	<i>Scleranthus annuus</i> L.				X
41.	<i>Setaria glauca</i> (L.) P. Beauv.	X			
42.	<i>Setaria viridis</i> (L.) P. Beauv.	X			
43.	<i>Spergula arvensis</i> L.				X
44.	<i>Stellaria media</i> (L.) Vill.		X		
45.	<i>Sonchus arvensis</i> L.				X
46.	<i>Tarxacum officinale</i> Wigg. aggr.		X		X
47.	<i>Tussilago farfara</i> L.		X		