

Flora of kurgans in the forest steppe zone in Ukraine

BARBARA SUDNIK-WÓJCIKOWSKA
IVAN IVANOVYCH MOYSIYENKO

Судник-Войциковська Б., Мойсієнко І.І., 2010: **Флора курганів лісостепової зони України**. *Чорноморськ. бот. ж.*, Т. 6, № 2: 162-199.

Представлені результати вивчення флористичного різноманіття флори курганів лісостепової зони проведені на території Кіровоградської, Полтавської та Черкаської областей. Всього досліджено 25 курганів понад 3 м висотою на площі 12092,4 км². Досліджена флора курганів Лісостепу виявилась багатшою на види порівняно з 3 смугами степовою зони і налічує 460 видів судинних рослин. Кількість видів на одному кургані варіює від 85 до 159, а в середньому становить 107,5. Як і в Понтичному різнотравно- та багаторізнотравнозлаковому степу у флорі курганів лісостепу переважають гемікриптофіти (39,4%), тоді як в південніших степових смугах на курганах домінують терофіти. Також більш чисельними виявились фанерофіти (10,0%). Короткоживучі (одно-, дво- трирічні) види складають 33,1% флори курганів лісостепової зони. Більшість з них належить до синантропних видів, зокрема є бур'янами, що проникли з оточуючих полів. В цілому на курганах в лісостепу виявлено 112 антропофітів. Археофіти та кенофіти складають 13,7% та 7,6% флори курганів, відповідно.

Загалом на курганах представлені види, що мають оптимум трапляння у складі 20 синтаксонів вищого рангу. Види асоційовані з степовими синтаксонами (*Festuco-Brometea*, *Festucetea vaginatae*, *Polygono-Artemisietea* та *Galietales veri*) складають 49,3% дослідженої флори. Як і у флорі курганів справжніх та пустельних степів в лісостепу переважають види класів *Festuco-Brometea* та *Stellarietea mediae*, що вказує на напівнатуральний характер флори курганів. Також у флорі курганів лісостепу представлені види 5 класів дерев'янистої та чагарникової рослинності: *Quercu-Fagetea*, *Urtico-Sambucetea*, *Robinietea* та *Salicetea purpureae*.

Загалом на курганах у флорі лісостепової зони виявлено 47 раритетних видів. Дослідження проведені в лісостеповій зоні підтверджують, що вони є рефугіумом степової флори. Вони можуть відігравати значну роль у відновленні природного рослинного покриву. Тому, кургани повинні охоронятися і як пам'ятники археології, і як пам'ятки природи.

Ключові слова: кургани, рефугіум степової флори, флористичне різноманіття, лісостеп, охорона курганів, Полтавська, Черкаська та Кіровоградська області, Україна

SUDNIK-WÓJCIKOWSKA B. MOYSIYENKO I.I., 2010: **Flora of kurgans in the forest steppe zone in Ukraine**. *Chornomors'k. bot. z.*, Vol. 6, № 2: 162-199.

The results of study of floristic diversity of kurgans in the forest steppe zone in Poltava, Cherkasy and Kirovograd Regions, are presented. Twenty-five kurgans of more than 3 m high distributed over an area approx. 12092,4 km², were surveyed. Being estimated at 460 species, the investigated kurgan flora contains more species than the flora of the barrows in each of the 3 steppe zones. The number of species on a single kurgan varied from 85 to 159, with 107,5 in average. As in the Pontic herb(-rich) grass steppe zone, hemicryptophytes dominated in the flora of the kurgans (39,4%) in the forest steppe zone, whereas therophytes prevailed in the barrow flora in the steppe zones southwards. Phanerophytes were more numerous as well (10,0%). Short-living plants (one, two or three years old) constituted 33,1% of the kurgan flora in the forest steppe zone. Most of them are synanthropic species, e.g. weeds from the surrounding fields. The total number of alien species (anthropophytes) reached 112. Archaeophytes and kenophytes comprised 13,7% and 7,6% of the kurgan flora.

A total of 20 syntaxa of a higher rank were represented in all the kurgans studied. Species associated with steppe syntaxa such as: *Festuco-Brometea*, *Festucetea vaginatae*,

Polygono-Artemisietea and *Galietaia veri* comprised as much as 49,3% of the kurgan flora. As in the desert and grass steppes, species belonging to classes *Festuco-Brometea* and *Stellarietea mediae* were predominant in the forest steppe as well, which also confirmed the semi-natural character of the kurgan flora. A total of 5 classes of tree and shrub communities were represented on the kurgans in the forest steppe zone: *Quercu-Fagetea*, *Urtico-Sambucetea*, *Robinietea* and *Salicetea purpureae*.

The number of species of particularly high floristic value was estimated at 47. The investigations carried out in the forest steppe zone confirm that kurgans constitute refugia for the steppe flora. They could play an important role in the local restoration of the natural plant cover. Therefore, they should be put under protection both as archeological and nature monuments.

Key words: barrows, refugia of steppe flora, floristic diversity, forest steppe, protection of kurgans, Poltava, Cherkasy, Kirovograd Region, Ukraine

Судник-Войциковская Б., Мойсиенко И.И., 2010: **Флора курганов лесостепной зоны Украины**. *Черноморск. бот. ж.*, Т. 6, № 2: 162-199.

Представлены результаты изучения флористического разнообразия флоры курганов лесостепной зоны проведенные на территории Кировоградской, Полтавской и Черкасской областей. Всего исследовано 25 курганов более 3 м высотой на площади 12092,4 км². Исследованная флора курганов Лесостепи оказалась богаче видами, по сравнению с 3 полосами степной зоны и насчитывает 460 видов сосудистых растений. Количество видов на одном кургане варьирует от 85 до 159, а в среднем составляет 107,5. Как и в Понтической разнотравно- и богаторазнотравнозлаковой степи во флоре курганов лесостепи преобладают гемикриптофиты (39,4%), тогда как в более южных степных полосах на курганах доминируют терофиты. Также более многочисленными оказались фанерофиты (10,0%). Краткоживущие (одно-, дву-трехлетние) виды составляют 33,1% флоры курганов лесостепной зоны. Большинство из них принадлежит к синантропным видам, в частности сорнякам, которые проникли с окружающих полей. В целом на курганах в лесостепи выявлено 112 антропофитов. Археофиты и кенофиты составляют 13,7% и 7,6% флоры курганов, соответственно.

В целом на курганах представлены виды, имеющие оптимум встречаемости в составе 20 синтаксонов высокого ранга. Виды ассоциированные со степными синтаксонами (*Festuco-Brometea*, *Festucetea vaginatae*, *Polygono-Artemisietea* та *Galietaia veri*) составляют 49,3% исследованной флоры. Как и во флоре курганов настоящих и пустынных степей в лесостепи преобладают виды классов *Festuco-Brometea* и *Stellarietea mediae*, что указывает на полустепной характер флоры курганов. Также во флоре курганов лесостепи представлены виды 5 классов древесной и кустарниковой растительности: *Quercu-Fagetea*, *Urtico-Sambucetea*, *Robinietea* и *Salicetea purpureae*.

В целом на курганах во флоре лесостепной зоны выявлено 47 раритетных видов. Исследования проведенные в лесостепной зоне подтверждают, что они являются рефугиумом степной флоры. Они могут играть значительную роль при восстановлении природного растительного покрова. Поэтому, курганы должны охраняться и как памятники археологии, и как памятники природы.

Ключевые слова: курганы, рефугиум степной флоры, флористическое разнообразие, лесостепь, охрана курганов, Полтавская, Черкасская и Кировоградская области, Украина.

Introduction

The present work is the last one in the series of publications dealing with the biodiversity of kurgan flora in the steppe and forest steppe zones of Ukraine. Earlier papers concerned the flora of kurgans located southwards: desert steppe – *the west and central Pontic steppe zone* [MOYSIYENKO, SUDNIK-WÓJCIKOWSKA 2006], grass steppe zone – „poor forbs” – *the west Pontic grass steppe zone* [SUDNIK-WÓJCIKOWSKA, MOYSIYENKO 2006], and “rich forbs” – *the Pontic herb(-rich) grass steppe zone* [MOYSIYENKO, SUDNIK-WÓJCIKOWSKA 2009].

The aim of this study was to assess the richness and specific characters of the flora of kurgans within the forest steppe zone.

Study area

Kurgans investigated in the forest steppe zone are located in Poltava, Cherkasy (Cherkassy) and Kirovograd Regions. The forest steppe zone is an irregular strip that extends from the Balkan Peninsula to Changan Mountain [ЛЯВРЕНКО та ін., 1991]. In Ukraine, it is part of the East European forest steppe province and covers about 34% of the country's territory [МАРИНИЧ, ШИЩЕНКО, 2003]. The above mentioned zone runs approximately evenly with a parallel of latitude and occupies the whole central part of Ukraine. The forest steppe belt is about 1100 km long and 200-300 km wide. It covers the Volhynia-Podilia Upland, the Dnieper Upland, the Dnieper Lowland and the western part of the Central Russian Upland. The forest steppe zone is intersected by a number of rivers: Dniester, Dnieper, Pivdenny Bug and Seversky Donets. The density of river network decreases from west to east. Erosional landforms dominate in the landscape, so the river valleys have an asymmetric shape. The zone is dissected by a number of balkas, deeply notched valleys, erosion ravines. Flat watersheds often have suffusion soil falldowns [ГЕОБОТАНІЧНЕ РАЙОНУВАННЯ..., 1977, ДІДУХ, ШЕЛЯГ-СОСОНКО, 2003; МАРИНИЧ, ШИЩЕНКО, 2003].

The forest steppe zone is characterized by a temperate climate with a warm summer and a moderately cold winter. The climate becomes more continental towards the east. The average January temperatures range from 15 to -5°C , while the average July temperatures vary from 18 to 20°C . The mean annual precipitation is usually 550-750 mm in the west and 450 mm in the east, which slightly exceeds evaporation. Humidity is close to optimal. In summer the rain comes in downpours [ПРИРОДА..., 1984].

The main soils of the belt are deep black chernozems, leached black soils, degraded black soils or grey forest soils as well as parabrown soils. Sandy soils as well as solonetz-like black soils, meadow soils in combination with solonetz and solontschak soils are on river terraces, whereas mud and alluvial soils are found within river valleys [ПРИРОДА..., 1986].

The forest steppe zone is a macromosaic of forests, mainly on leached black soils, and meadow steppe on deep black soils. Among forest communities, deciduous forests dominate, especially oak forests with *Quercus robur*. Other tree species such as: *Fagus sylvatica* (in the west), *Carpinus betulus* (in the centre), *Acer* sp.div. *Tilia cordata* and *Fraxinus excelsior* are found alongside the oak. Alluvial forests occur in river valleys on sandy soils. Pine forests as well as *Betula* and *Populus tremula* kolka forests grow along river valleys [ГЕОБОТАНІЧНЕ РАЙОНУВАННЯ..., 1977]. According to the nomenclature proposed in publication *Map of the natural vegetation of Europe* [МАР..., 2000] the investigated kurgans are located in 4 subzones (Fig. 1): F41 – *East Polish-Ukrainian lime-pedunculate oak-hornbeam forests*; F44 – *Podolian-Moldavian thermophilous hornbeam-pedunculate oak forests*; L3 – *Moldavian-Ukrainian meadow steppes alternating with hornbeam-pedunculate oak forests in the south with Tatarian maple-pedunculate oak forests*; L4 – *South Sarmatian meadow steppes alternating with salt vegetation on solonetz soils and pedunculate oak forests*.

In these areas the steppe has been ploughed up, destroyed and is now largely under cultivation. The meadow steppe was originally rich in species. Nowadays, remnants of the steppe have been preserved within nature reserves and areas useless for agriculture, e.g. on slopes of river terraces, balkas, ravines, especially with rock outcrops.

The fine-grained deep black soils and leached black soils that formed under the steppe, which is rich in species, are characterized by a high humus content and are one of the most fertile soils in the world. At the same time the forest steppe has been intensively exploited by man for a long time. About 80% of the steppe is cultivated. The climate and soil conditions are most favourable for the cultivation of wheat, corn, buckwheat and sugar beet.

A total of 25 kurgans (F1-F25) were investigated (Fig. 1). Most of them (18) are located on the right bank of the Dnieper. GPS data – coordinates of barrows are presented in Table 1.

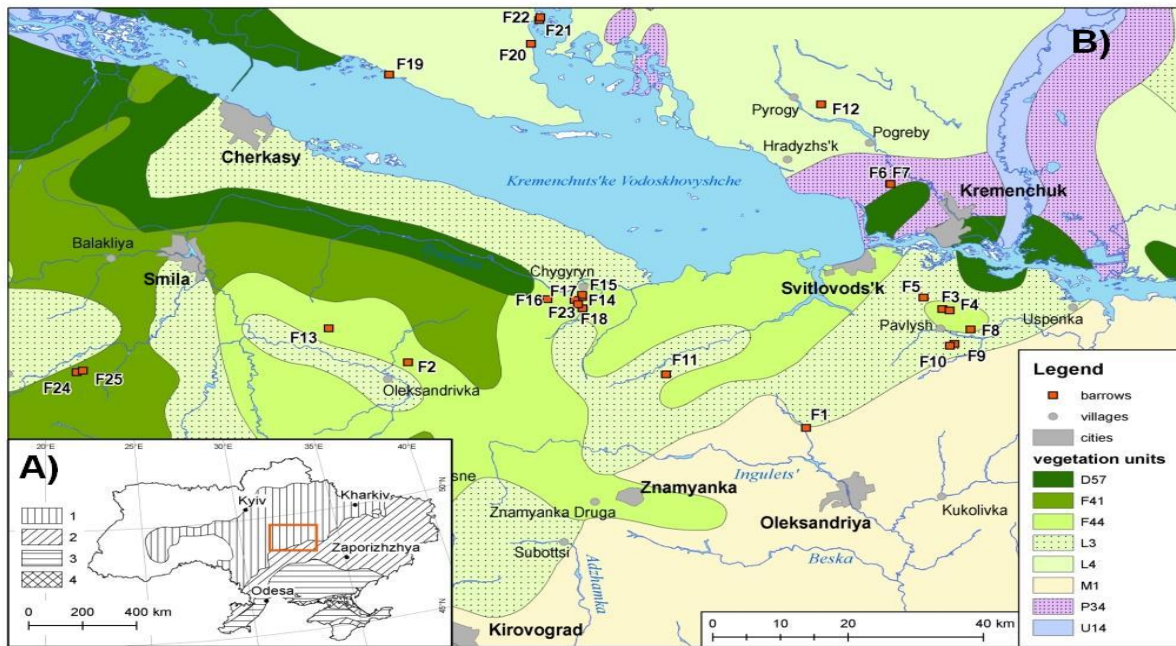


Fig. 1. A) The distribution of the investigated kurgans in the Poltava, Cherkasy and Kirovograd Regions; **B)** The location of the investigated area and the various types of steppes and forest steppe in Ukraine (according to *Map of the natural vegetation of Europe*, Bohn et al. 2000): D57 – South European xerophytic herb- and grass-rich pine and oak-pine forests on shallow carbonate soils with steppe plants; F41 – East Polish-Ukrainian lime-pedunculate oak-hornbeam forests; F44 – Podolian-Moldavian thermophilous hornbeam-pedunculate oak forests; L3 – Moldavian-Ukrainian meadow steppes alternating with hornbeam-pedunculate oak forests in the south with Tatarian maple-pedunculate oak forests; L4 – South Sarmatian meadow steppes alternating with salt vegetation on solonetz soils and pedunculate oak forests; M1 – west and central Pontic herb-rich grass steppe; P34 – West and East Pontic salt meadows in combination with halophytic communities on solonchak and halophytic steppe communities; U14 – Pontic hardwood alluvial forests in combination with poplar and willow alluvial forests, partly with alder carrs.

Рис. 1. А) Розташування курганів в Полтавській, Черкаській та Кіровоградській областях; **В)** Розміщення території дослідження відносно різних типів степів в Україні (*Map of the natural vegetation of Europe*, Bohn et al. 2000): D57 – Південноєвропейські ксерофітні різнотравні і багато злакові соснові та дубово-соснові ліси на неглибоких карбонатних ґрунтах зі степовими рослинами; F41 – Українські Східно-Подільські вапнові черешчатодубово – грабові ліси; F44 – Подільсько-Молдавські термофільні грабово-черешчатодубові ліси; L3 – Молдавсько-Українські лучні степи, що чергуються з грабово – черешчатодубовими лісами, а в південній частині з татарськокленово – черешчатодубовими лісами; L4 – Південносарматські лучні степи, що чергуються з галофітною рослинністю на засолених ґрунтах та черешчатодубовими лісами; M1 – Західно- та Центральнопонтичні багаторізнотравно злакові степи; P34 – Західно- та Центральнопонтичні залозені луки, що комбінуються з галофітними угрупованнями на солончаках і галофітизованими степовими угрупованнями; U14 – Понтичні алювіальні листяні ліси, що комбінуються з тополево-вербовими алювіальними лісами, з домішкою вільхових.



A)



B)

Fig. 8. Different kinds of kurgans: A) typical kurgan, **B)** “maidan”.

Рис. 8. Різні види курганів: А) типовий курган, **В)** “майдан”.

Table 1

Location and size of the investigated kurgans in the forest steppe zone in Poltava, Cherkasy and Kirovograd Regions

Таблиця 1

Локалізація та розміри досліджених курганів в лісостеповій зоні на території Полтавської, Черкаської та Кіровоградської областей

Code of the kurgan	Location (nearest village)	Longitude (E)	Latitude (N)	Height of kurgan (m)	Diameter of kurgan (m)
Kirovograd Region					
Aleksandriya District					
F1	Dibrova	33 ⁰ 03'02.3"	48 ⁰ 47'17.7"	6	70
F2	Nova Osota	32 ⁰ 17'10.6"	48 ⁰ 59'21.4"	4	70
Poltava Region					
Kremenchuk District					
F3	Pidgirne – Pavlysh	33 ⁰ 22'32.7"	48 ⁰ 57'18.1"	7	60
F4	Pidgirne – Pavlysh	33 ⁰ 23'21.7"	48 ⁰ 57'04.0"	3	45
F5	Bilets`kivka – Burty	33 ⁰ 20'34.3"	48 ⁰ 58'43.8"	3	40
F6	Yalyntsi, „3 Braty“	33 ⁰ 19'43.3"	49 ⁰ 10'37.7"	4	55
F7	Yalyntsi, „3 Braty“	33 ⁰ 19'47.4"	49 ⁰ 10'36.5"	3,5	50
Kirovograd Region					
Onufriivka District					
F8	Onufriivka – Pavlysh	33 ⁰ 25'19.6"	48 ⁰ 54'51.3"	6	60
F9	Pavlysh – Kamburliivka	33 ⁰ 23'00.0"	48 ⁰ 53'38.4"	4,5	50
F10	Pavlysh – Kamburliivka	33 ⁰ 22'25.2"	48 ⁰ 53'29.8"	7,5	65
Poltava Region					
Svitlovods`k District					
F11	Fedoruky	32 ⁰ 47'44.2"	48 ⁰ 54'38.8"	5	50
Poltava Region					
Globyne District					
F12	Ustymivka	33 ⁰ 13'38.7"	49 ⁰ 19'36.6"	6.5	60
Cherkasy Region					
Kamyanka District					
F13	Kamyanka – Grushkivka	32 ⁰ 08'30.7"	49 ⁰ 03'48.5"	4,5	80
Cherkasy Region					
Chyhyryn District					
F14	Chygyryn	32 ⁰ 39'44.7"	49 ⁰ 03'33.9"	4	55
F15	Chygyryn	32 ⁰ 39'48.6"	49 ⁰ 03'47.3"	4	40
F16	Chygyryn – Subotiv	32 ⁰ 35'32.8"	49 ⁰ 03'50.3"	3,5	38
F17	Chygyryn – Subotiv	32 ⁰ 38'44.9"	49 ⁰ 03'22.2"	4	45
F18	Cherneche	32 ⁰ 39'29.6"	49 ⁰ 02'26.7"	6	60
Cherkasy Region					
Chornobai District					
F19	Prydniprovs`ke, „Ostryuka”	32 ⁰ 22'16.8"	49 ⁰ 28'34.5"	7,5	65
F20	Lyashchivka	32 ⁰ 40'15.5"	49 ⁰ 29'44.9"	5	45
F21	Lyashchivka	32 ⁰ 41'54.2"	49 ⁰ 32'02.4"	3,5	40
F22	Lyashchivka	32 ⁰ 42'05.7"	49 ⁰ 32'18.2"	5	40
Cherkasy Region					
Smila District					
F23	Kutsivka	31 ⁰ 39'13.8"	49 ⁰ 02'54.0"	6	55
F24	Kutsivka	31 ⁰ 37'11.8"	49 ⁰ 02'37.6"	5,5	65
F25	Kutsivka	31 ⁰ 37'57.5"	49 ⁰ 02'42.1"	6	50

Material and methods

In the present work the same methods as those used in an earlier study [MOYSIENKO, SUDNIK-WÓJCIKOWSKA 2006, 2009, SUDNIK-WÓJCIKOWSKA, MOYSIENKO 2006] were applied. The following criteria were used to select the 25 kurgans:

- kurgans more than 3 m high were chosen;
- good state of preservation of kurgans;
- the state of preservation of the plant cover; it was assumed that the presence of typical steppe species, such tuft grasses as *Festuca valesiaca*, *Koeleria cristata* and *Stipa capillata* or *Bothriochloa ischaemum*, *Cleistogenes bulgarica* was indicative of a relatively good condition of plant cover.

The flora of 5 microhabitats within 25 kurgans was investigated. The data were compiled in Table A (Appendix 1) which contained the following additional information about each taxon: its occurrence and abundance (estimated according to a 3-point scale: 1 – sporadic, 2 – infrequent, 3 – common) in particular microhabitats within the kurgans investigated, species life form, its status in the historical-geographical classification, and origin in the case of alien species. Floristic analysis was conducted and the specific characters of the kurgan flora within forest steppe zone was determined. A five-grade scale was used to assess the frequency category of the species (see Fig. 3). The flora of 5 microhabitats within kurgans will be analysed in greater detail in another publication.

The species nomenclature follows S.L. MOSYAKIN, M.M. FEDORONCHUK [1999], Latin names of syntaxa are given according to B.A. СОЛОМАХА [1996], Б.М. МИРКИН, Л.Г. НАУМОВА [1998], and W. MATUSZKIEWICZ [2001].

Results

1. Biodiversity of the kurgan flora

A total of 460 species of vascular plants were reported from 25 kurgans in the forest steppe zone (Appendix 1). The one additional species at the bottom of Table A was found on the kurgan in this zone which was not investigated in the present study (coordinates of this kurgan: Cherkasy Region, Chygyryn District, v. Medvedivka (N 52°10'48.01", E 32°21'18.71"). The number of species on particular kurgans ranged from 85 to 159, 107,5 on average. The kurgan flora in the forest steppe was richer in species than the flora of the barrows in each of the earlier investigated steppe zones (the desert steppe zone – 305 species [MOYSIYENKO, SUDNIK-WÓJCIKOWSKA 2006], in the west Pontic grass steppe zone – 352 [SUDNIK-WÓJCIKOWSKA, MOYSIYENKO 2006], and in the Pontic herb(-rich) grass steppe zone – 439 species [MOYSIYENKO, SUDNIK-WÓJCIKOWSKA 2009]). The species belonged to 256 genera and 51 families. The following families were represented by the greatest number of taxa: *Asteraceae*, *Poaceae*, *Fabaceae*, *Lamiaceae*, *Caryophyllaceae*, *Rosaceae*, *Scrophulariaceae*, *Brassicaceae*, *Ranunculaceae*, *Apiaceae*, *Boraginaceae*, *Polygonaceae*, *Chenopodiaceae*, *Euphorbiaceae*, *Cyperaceae*, *Violaceae* (Fig. 2). Compared with the flora of kurgans located in the other zones the role of the *Caryophyllaceae* and *Ranunculaceae* families increased. Genera represented by the highest number of taxa were, as follows: *Veronica* (15), *Euphorbia* (8), *Carex* (7), *Potentilla* (7), *Salvia* (7), *Vicia* (7), *Viola* (7), *Artemisia* (6), *Trifolium* (6).

About 191 species (41,0% of the total kurgan flora) with the first (I) frequency class (Fig. 3) were considered sporadic or accidental (on 1-2 kurgans only). The group of common species recorded on 20-25 of the studied kurgans (frequency class V) made up about 4,8% of the flora: *Elytrigia repens* (25), *Koeleria cristata* (25), *Poa angustifolia* (25), *Convolvulus arvensis* (24), *Conyza canadensis* (24), *Chenopodium album* (24), *Artemisia absinthium* (23), *Euphorbia virgata* (23), *Linaria vulgaris* (23), *Bromopsis inermis* (22), *Falcaria vulgaris* (22), *Festuca valesiaca* (22), *Melandrium album* (22), *Salvia nemorosa* (22), *Setaria glauca* (22), *Sisymbrium polymorphum* (22), *Lactuca serriola* (21), *Medicago falcata* (21), *Achillea setacea* (20), *Agrimonia eupatoria* (20), *Gypsophila paniculata* (20), *Verbascum phoeniceum* (20).

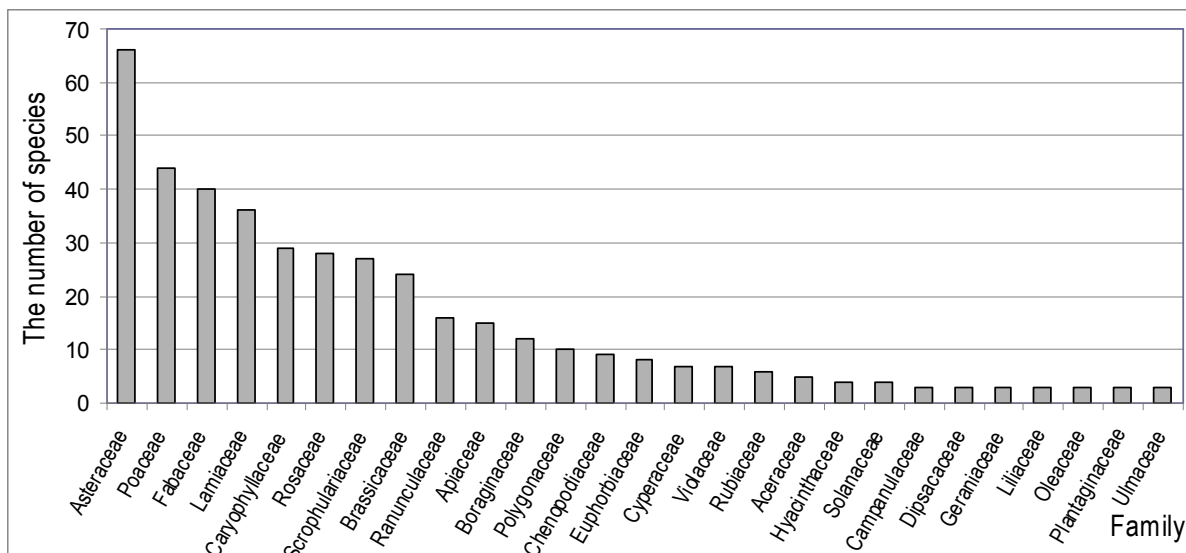


Fig. 2. The most important families (in terms of species number) in the total flora of kurgans in the forest steppe zone.

Рис. 2. Найбільш представлені (за кількістю видів) у флорі курганів лісостепової зони родини.

The total abundance of every species within the kurgans theoretically ranged from 0 up to 375 (a 3-grade scale was used to estimate the abundance of species, and 5 microhabitats within the 25 kurgans studied were taken into account: $3 \times 5 \times 25 = 375$). The abundance of only a few species exceeded 200, i.e.: *Poa angustifolia* (265) and *Elytrigia repens* (231). The abundance of 9 species ranged from 150 to 200: *Convolvulus arvensis* (198), *Koeleria cristata* (189), *Festuca valesiaca* (178), *Euphorbia virgata* (170), *Salvia nemorosa* (168), *Medicago falcata* (163), *Sisymbrium polymorphum* (156), *Bromopsis inermis* (151), *Stipa capillata* (150). At the same time, the above taxa were the most frequently encountered species.

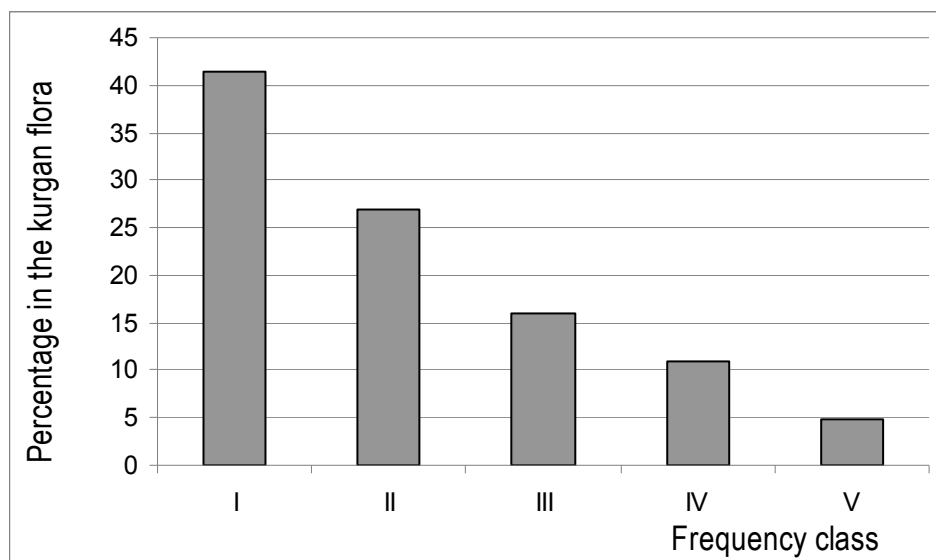


Fig. 3. Subdivision of the flora of kurgans in the forest steppe zone by class (the total number of species in each category is indicated at the top of the bar). Frequency classes: I – sporadic (1-2 kurgans), II – rare (3-6), III – relatively frequent (7-12), IV – frequent (13-19), common (20-25).

Рис. 3. Розподіл флори курганів лісостепової зони за класами частоти трапляння (на верхівці стовпчика вказана абсолютна кількість видів у кожній категорії). Класи частоти трапляння: I – спорадично (1-2 кургани), II – рідко (3-6), III – досить часто (7-12), IV – часто (13-19), звичайно (20-25).

2. Spectrum of life forms

The spectrum of life forms in the flora of kurgans in the forest steppe zone corresponded to that of the flora of the adjacent steppe zone. As well as in the *Pontic herb(-rich) grass steppe* zone, hemicryptophytes were the dominating group of species (39,4%). The second largest group were therophytes (33,1%), which usually dominated in the *west Pontic grass steppe* zone (43,2%), as well as in the desert steppe zone (46,5%). Most of the therophytes (81 from 152), are alien species e.g. many weeds from the surrounding fields.

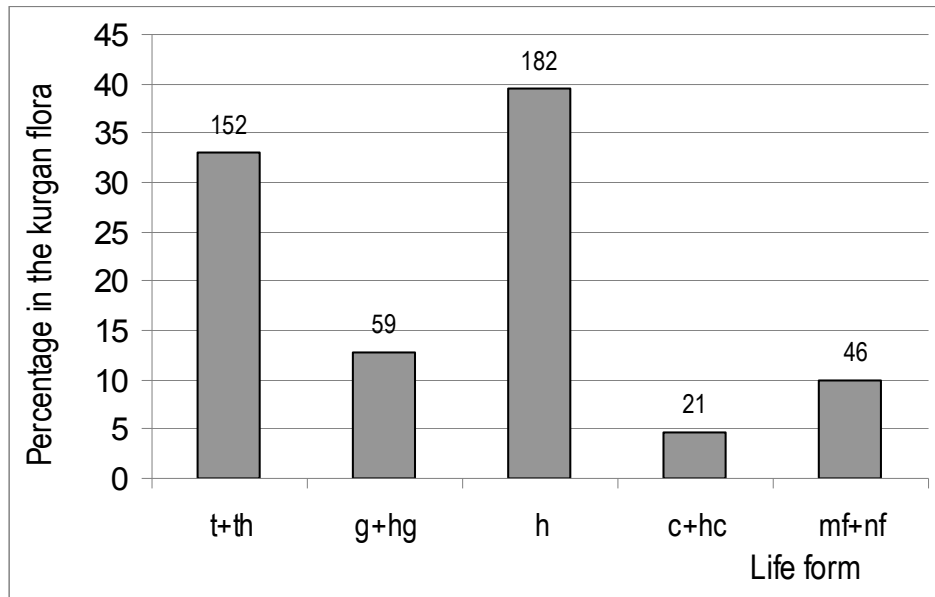


Fig. 4. Spectrum of life forms in the flora of kurgans in the forest steppe zone (for abbreviations see Appendix 1). The absolute number of species in each category is indicated at the top of the bar.

Рис. 4. Спектр життєвих форм флори курганів Лісостепу (прийняті скорочення дивись в Додатку 1). На верхівці стовпчика вказана абсолютна кількість видів у кожній категорії.

In the desert steppe zone phanerophytes comprised only 4% of the flora of kurgans, in the *west Pontic grass steppe* zone: 4,8%. Their role in the flora of the barrows increased towards the north: 8,7% in the *Pontic herb(-rich) grass steppe* zone and 10,0% in the forest steppe zone. The following species of native phanerophytes which were absent on the kurgans investigated in the zones further south were recorded: *Chamaecytisus ruthenicus*, *Ch. lindemannii*, *Sambucus racemosa*, *Spiraea hypericifolia*. In the case of the forest steppe zone “new” alien phanerophytes included: *Amelanchier ovalis*, *Caragana arborescens*, *Cotinus coggygria*, *Ptelea trifoliata*, *Syringa vulgaris*. Other life forms played a smaller role in the flora of the barrows: in the forest steppe zone geophytes comprised 12,9% of the kurgan flora, and chamaephytes – 4,6%.

3. Spectrum of socio-ecological groups

The flora of kurgans was distinguished by a wide sociological range. It included the representatives of at least 20 syntaxa of higher ranks (Fig. 5). As in kurgans of the 3 steppe zones, species representing communities of the *Festuco-Brometea* and *Stellarietea mediae* classes had the biggest share concerning complex groups of steppe grasslands and synanthropic communities, 57,3%, (i.e. 37,5%, and 19,8% respectively). Such domination reflects the semi-natural and anthropogenic character of the kurgan flora.

Species associated with various steppe syntaxa: *Festuco-Brometea*, *Festucetea vaginatae*, *Polygono-Artemisietea* and *Galietaia veri* comprised as much as 49,3% of the kurgan flora (37,5%; 4,4%; 1,5%; 5,9% respectively).

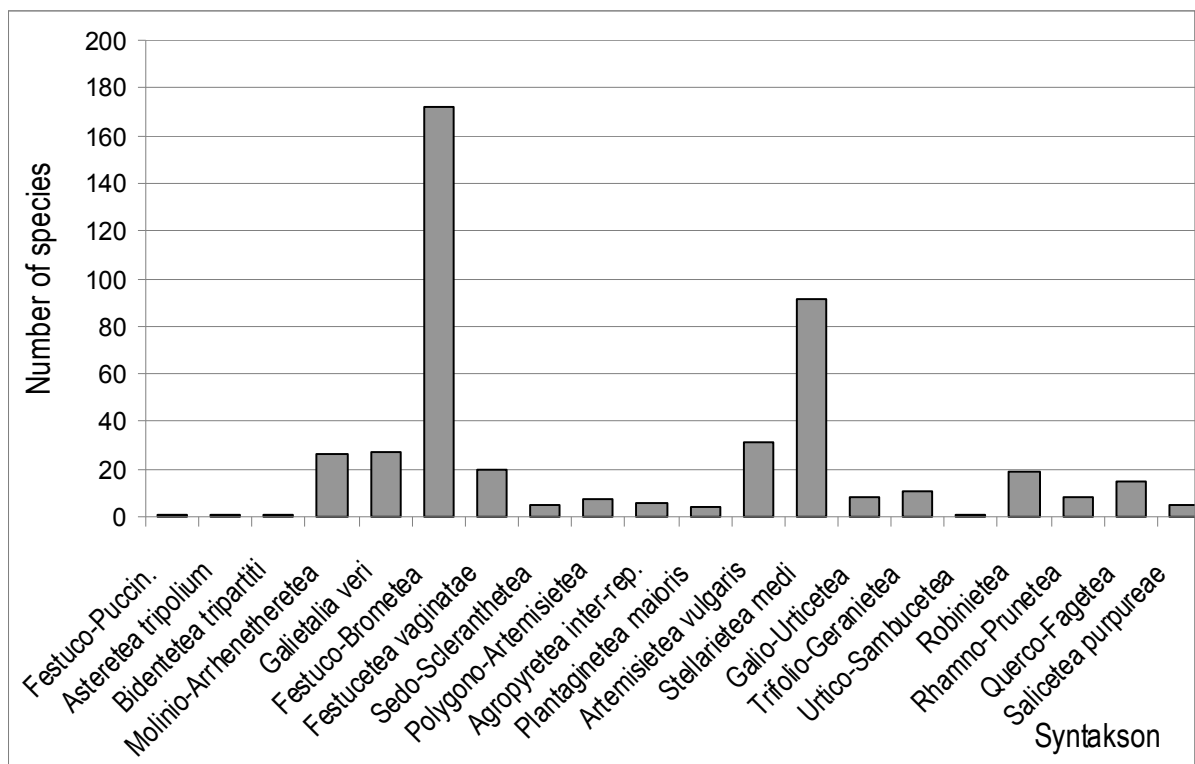


Fig. 5. The number of species from the syntaxa represented in the kurgan flora in the forest steppe zone (the order of syntaxa is not random – syntaxa given in a gradient from natural to synanthropic). For abbreviations see Appendix 1.

Рис. 5. Кількість видів в синтаксонах представлених на курганах в лісостеповій зоні (порядок синтаксонів не випадковий – в градієнті від натуральних до синантропних). Прийняті скорочення дивись в Додатку 1.

Species representing synanthropic syntaxa (with the exception of *Stellarietea mediae*), such as classes: *Artemisieteae vulgaris* and *Agropyreteae intermedio-repentis* as well as the *Plantagineetalia maioris* order (6,8%, 1,3%, 0,9% respectively) constituted 28,8 % of the kurgan flora.

Under more favourable soil moisture conditions, species belonging to the classes *Molinio-Arrhenatheretea* (except *Galietalia veri*) and *Bidentetea* were found growing at the foot of the kurgans, mostly on their northern side. However, their proportion in the flora of kurgans was estimated at 5,7 % and 0,2% respectively.

Species associated with forest and scrub communities were a slightly better represented in the flora of kurgans in the forest steppe zone than in the *Pontic herb(-rich) grass steppe* zone and much better than in the grass steppe and desert steppe zones. A higher number of syntaxa which were represented by a big number of species were recorded. A total of 5 classes of tree and shrub communities were represented on the kurgans in the forest steppe zone: *Quercu-Fagetea*, *Urtico-Sambucetea*, *Robinietea* and *Salicetea purpureae*. Species associated with the above syntaxa constituted 10,3% of the flora of kurgans. The plant communities from the above classes were usually found at the foot of the kurgans. Other syntaxa of higher ranks, including halophyte communities (*Asteretea tripolii*, *Festuco-Puccinellietea*) were poorly represented on the kurgans.

4. Spectrum of species groups in the historical-geographical classification of plants

The spectrum of synanthropic species groups in the flora of kurgans in the forest steppe zone (Tab. 2, Fig. 6) corresponded basically with the spectra for the earlier investigated 3 steppe zones.

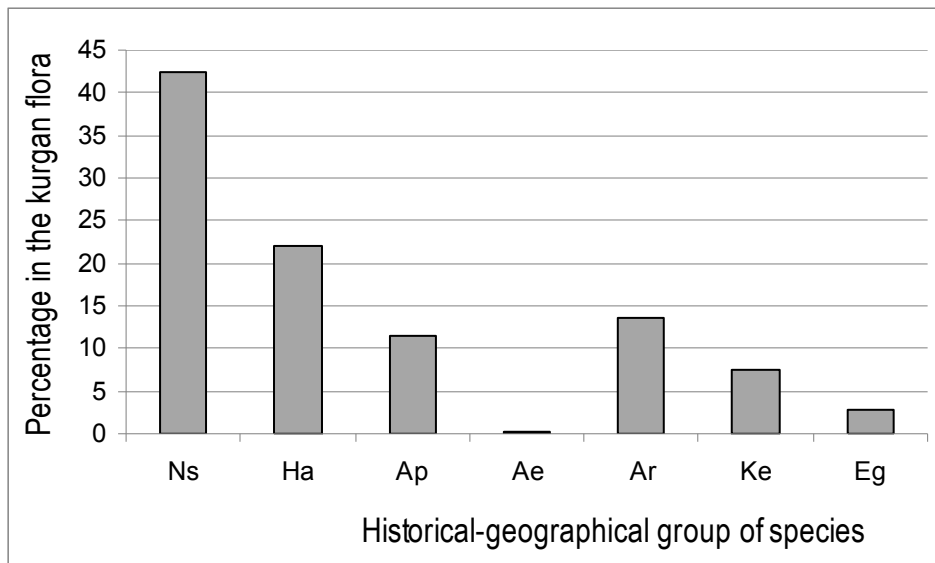


Fig. 6. Historical-geographical classification of the total flora of kurgans in the forest steppe zone. For abbreviations see Appendix 1 and Table 2.

Рис. 6. Географічно-історична класифікація флори курганів лісостепової зони. Прийняті скорочення дивись в Додатку 1 та Таблиці 2.

Native species accounted for 76,1% of the flora of kurgans in the investigated zone whereas non-synanthropic plants comprised 42,4% of the kurgan flora. The most frequently occurring species (frequency class V) were: *Agrimonia eupatoria*, *Festuca valesiaca*, *Gypsophila paniculata*, *Koeleria cristata*, *Salvia nemorosa*, *Sisymbrium polymorphum*, *Verbascum phoeniceum*. The percentage of native and non-synanthropic species in the flora of kurgans was similar as in the case of 2 steppe zones: in the Pontic herb(-rich) grass steppe zone 74,2% and 41,4%, in the desert steppe zone: 77,2% and 40,9% respectively. Differences were bigger in the case of the west Pontic grass steppe zone: 70,8% and 39,5%, respectively.

Depending on the level of transformation of the habitats into which they penetrate, apophytes can be subdivided into 3 groups: hemiapophytes (22,0% of the total flora) and euapophytes + apophytes-oekiophytes (11,7%) (Fig. 6). With respect to frequency, hemiapophytes distinctly predominated over euapophytes; 14 hemiapophytes belonged to frequency class V (*Achillea setacea*, *Bromopsis inermis*, *Euphorbia virgata*, *Falcaria vulgaris*, *Medicago falcata*, *Poa angustifolia*, but only 8 euapophytes represented the above frequency class (*Chenopodium album*, *Convolvulus arvensis*, *Elytrigia repens*, *Linaria vulgaris*, *Melandrium album*). The abundance of hemiapophytes is twice as high as that of euapophytes (3077 and 1391 respectively).

The total number of species of alien origin (anthropophytes) amounted to 110 (80 of them are therophytes). They comprised 23,9% of the flora of kurgans in the forest steppe zone and represented mainly families such as: *Asteraceae* (18 species), *Brassicaceae* (13), *Poaceae* (11), *Fabaceae* (7), *Rosaceae* (7) and *Lamiaceae* (7). Archaeophytes dominated among alien species (13,7% of the total flora of kurgans; the abundance of 63 species of archaeophytes was estimated at 1222). The most frequently occurring archaeophytes (frequency class V) were: *Artemisia absinthium*, *Lactuca seriola*, *Setaria glauca*; frequency class IV: *Ballota nigra*, *Capsella bursa-pastoris*, *Carduus nutans*, *Cichorium intybus*, *Descurainia sophia*, *Fallopia convolvulus*, *Lappula squarrosa*, *Lathyrus tuberosus*, *Setaria viridis*, *Sisymbrium loeselii*, *Viola arvensis*. Kenophytes were less numerous (34 species; 7,4%) and their total abundance was estimated to be 485. Only 1 species of kenophytes represented frequency class V (*Conyza canadensis*).

Table 2

The number and abundance of species in groups of historical-geographical classification of the flora of kurgans in the forest steppe zone

Таблиця 2

Кількість і рясність видів в групах географічно-історичної класифікації флори курганів лісостепової зони

	Species in historical-geographical group		Total abundance of species in historical-geographical group	
	Number	%	Number	%
Indigenous species:	350	76,1	8714	83,3
Non-synanthropes (Ns)	195	42,4	4219	40,3
Apophytes:	155	33,7	4495	43,0
- Hemiapophytes (Ha)	101	22,0	3077	29,4
- Euapophytes (Ap)	53	11,5	1391	13,3
- Oekiophytes (Ae)	1	0,2	27	0,3
Anthropophytes:	110	23,9	1750	16,7
Archaeophytes (Ar)	63	13,7	1222	11,7
Kenophytes (Ke)	34	7,4	485	4,6
Ergasiophygophytes (Eg)	13	2,8	43	0,4
Total flora	460	100	10464	100

The following species were included in frequency class IV: *Amaranthus retroflexus*, *Armeniaca vulgaris*. Ergasiophygophytes are a group of species which escaped from the cultivated fields surrounding the kurgans and became temporarily established on the barrows. They, however, made up only 2,8 % of the total flora of kurgans.

The synanthropization index of the kurgan flora estimated from the proportion of apophyte and anthropophyte species in the flora of kurgans was more or less the same in the three steppe zones studied: 57,6% (in the desert steppe zone: 59,1%, in the grass steppe zone: 60,5%, and in the *Pontic herb(-rich) grass steppe* zone: 59,0%). It is interesting to note that the percentage of the particular groups of synanthropic species was comparable in the three steppe zones.

However, some differences appeared when the geographical origin of the species was analyzed. It should be noted that the number of anthropophytes of various origins changed with the south-north direction: the share of Mediterranean-European species increased; in the desert steppe zone the contribution of Mediterranean-(Eur)asian species was much higher than that of Asian species. In the case of the grass steppe the differences in the proportion of the above two species groups were less pronounced, whereas in the *Pontic herb(-rich) grass steppe* as well as forest steppe zone Asian species played a more important role.

5. Floristic values of the kurgans and the protection of the plant cover

Similar problems exist concerning the conservation of the flora of kurgans in the case of the forest steppe zone and the steppe zones. The process of overgrowing of kurgans with trees and shrubs is much more strongly marked in the forest steppe than in the steppe zones. Shrubs and groups of trees occur more frequently and abundantly in this zone. They displace light-loving steppe species.

In the forest steppe zone we noted kurgans completely overgrown with forest, e.g. within a Scythian earthwork „Motroninskoye”, near Kholodnyi Yar and Melniki village (Chyhyryn District, Cherkasy Region). The steppe vegetation has been entirely destroyed on these kurgans. The forest has existed here for centuries. Partially overgrown kurgans are more often observed. Trees and shrubs are found growing at the foot and on the northern slopes of the kurgans. Steppe species are very rare in places densely overgrown with forests or shrubs

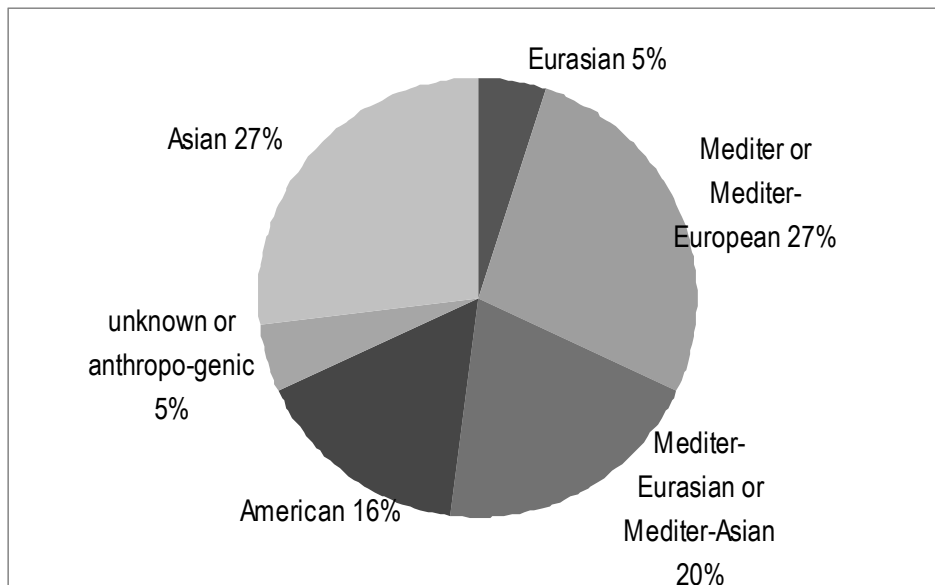


Fig. 7. Origin of the alien flora of kurgans in the forest steppe zone.

Рис. 7. Походження адвентивного елемента флори курганів лісостепової зони.

In the past the forest steppe zone was mainly inhabited by sedentary tribes (but penetrated by nomadic populations too) and the land was utilized agriculturally much earlier than the areas of southern Ukraine. These two factors had a significant effect on the flora of kurgans in the forest steppe. Special type of kurgans (ukr. “maidan”) occur locally here (Fig. 8). We did not find any of these structures in the desert steppe zone and in the proper steppe zone during the course of our investigations. In the Middle Ages these kurgans were dug up and the soil enriched with saltpetre was gained from the central part of “maidans”. Saltpetre was used by kozaks in production of gun-powder. Now, in these types of kurgans a characteristic deep “crater” may be observed. In the vicinity of these kurgans – piles of soil (ukr. “usy”) – the remains of used soil from the inside of “maidans” is deposited. Changes in the shape of these kurgans also had an influence on the species composition of these structures.

The other problems concerning the anthropogenic transformation of the flora of kurgans were similar in the case of the forest steppe and the steppe zones. These problems were discussed in more detail in our earlier publications [МОЙСІЄНКО, СУДНИК-ВОЙЦИКОВСЬКА, 2008, MOYSIYENKO, SUDNIK-WÓJCIKOWSKA, 2006, 2009; SUDNIK-WÓJCIKOWSKA, MOYSIYENKO, 2006]. The data presented below refer only to sozophytes recorded on the kurgans in the forest steppe.

Native species consist 76% of floristic list in the Appendix 1; among them 47 species are especially interesting (Fig. 9): *Astragalus dasyanthus*, *Eremogone rigida*, *Linaria biebersteinii* listed in “Plants of Ukraine in the 1997 IUCN – Red List of Threatened Plants” [МОСЯКІН, 1999], also *Astragalus dasyanthus* from the “Europeaen Red List” [Червона книга..., 1996], *Adonis vernalis*, *Pulsatilla pratensis*, *Stipa capillata*, and also *Astragalus dasyanthus* – the “Red Data Book of Ukraine” [ЧЕРВОНА КНИГА..., 2009], *Anthemis tinctoria* (as *Anthemis subtinctoria*), *Asyneuma canescens*, *Hyacinthella leucophaea*, *Iris pumila*, *Salvia austriaca*, *Salvia betonicaefolia*, *Vinca herbacea* – the “Red Data List of Poltava Region” [БАЙРАК, СТЕЦЮК, 2005]”, *Amygdalus nana*, *Anemone sylvestris*, *Carex stenophylla*, *Cerasus fruticosa*, *Ephedra distachya*, *Goniolimon tataricum*, *Limonium tomentellum* subsp. *alutaceum* (as *L. alutaceum*) *Muscari neglectum*, and also *Hyacinthella leucophaea* – the “Red Data List of Kirovograd Region” [ЗАПОВІДНІ..., 1999] and *Allium flavescens*, *A. guttatum*, *Anchusa pseudochoroleuca*, *Aster bessarabicus*, *Astragalus varius*,

Carex supina, Cephalaria uralensis, Cleistogenes bulgarica, Elisanthe viscosa, Eremogone micradenia, Euphorbia kaleniczenkoi, Euphorbia subtilis, Galatella villosa, Helictotrichon pubescens, Hesperis tristis, Hieracium virosum, Iris hungarica, Jurinea calcarea, J. salicifolia, Lathyrus pannonicus, Linum hirsutum, Peucedanum alsaticum, Phlomis pungens, Salvia nutans, Seseli tortuosum, Thymus dimorphus, and also Amygdalus nana, Anemone sylvestris, Cerasus fruticosa, Iris pumila, Muscari neglectum, Salvia austriaca, Vinca herbacea – the “Red Data List of Cherkasy Region” [ШЕВЧИК та ін., 2006].

It appears that a considerable number of steppe species belongs to the above mentioned group of species of high conservation value [МОЙСІЄНКО, СУДНИК-ВОЙЦИКОВСЬКА, 2008; МОЙСІЄНКО, СУДНИК-ВОЙЦИКОВСЬКА, 2006, 2009; СУДНИК-ВОЙЦИКОВСЬКА, МОЙСІЄНКО, 2006]. This may be due to many reasons. The investigated kurgans in the forest steppe zone occurred over a much larger geographic area, i.e. within three regions, whereas the kurgans in the desert steppe zone within one region only, and in the grass steppe (*Pontic herb-rich grass steppe* and *west Pontic grass steppe*) within two regions. As a result, three local red lists of species were used in the case of the forest steppe, and 1-2 lists in the case of the steppe zone. In addition, a considerable number of steppe species, among others species typical of southern steppe areas, are included in the local floristic lists of species in the forest steppe zone, although the conditions prevailing within this zone are not optimal for this group of species. The flora of kurgans in the forest steppe is characterized by a higher proportion of sozophytes: from 2 to 21 species, 6,8 on average. The most valuable kurgans in terms of rare species were: F1 (13 species), F2 (12), F13 (21), F19 (15). Among the kurgans investigated in all the zones, kurgan F13 situated near Kamienka supported the highest number of rare species. The data pertaining to rare, valuable and protected species of plants on the kurgans in the forest steppe provide an additional argument that the kurgans in this zone should be under protection not only as archaeological sites but also as nature monuments (as in the case of the steppe zone).

Acknowledgements:

The study was supported by the Ministry of Science and Higher Education in Poland: grant NN 304081835 (2008-2011).

References

- БАЙРАК О.М., СТЕЦЮК Н.О. Атлас рідкісних і зникаючих рослин Полтавщини // Полтава: Верстка, 2005. – 248 с.
- ГЕОБОТАНІЧНЕ РАЙОНУВАННЯ Української РСР / За ред. А.І. Барбарича // Київ: Наук. думка, 1977. – 305 с.
- ДІДУХ Я.П., ШЕЛЯГ-СОСОНКО Ю.Р. Геоботанічне районування України та суміжних територій // Укр. ботан. журн. – 2003. – Т. 60, № 1. – С. 6-17.
- ЗАПОВІДНІ КУТОЧКИ КІРОВОГРАДСЬКОЇ ЗЕМЛІ / Андрієнко Т.Л., Терещенко П.С., Клестов М.Л. та ін. (під заг. ред. д.б.н. Т.Л. Андрієнко). – Київ: Арктур-А, 1999. – 240 с.
- ЛАВРЕНКО Е.Н., КАРАМЫШЕВА З.В., НИКУЛИНА Р.И. Степи Евразии. – Л.: Из-во «Наука», 1991. – 146 с.
- МИРКИН Б.М., НАУМОВА Л.Г. Наука о растительности. – Уфа: Гилем, 1998. – 412 с.
- МАРИНИЧ О.М., ШИЩЕНКО П.Г. Фізична географія України. – Київ: Знання, 2003. – 479 с.
- МОСЯКІН С.Л. Рослини України у Світовому Червоному списку // Укр. ботан. журн. – 1999. – Т. 56, № 1. – С. 79-88.
- МОЙСІЄНКО І.І., СУДНИК-ВОЙЦИКОВСЬКА Б. Созофіти у флорі курганів – рефугіумів степової флори на півдні України // Заповідна справа в Україні. – Т.14, Вип. 1. – 2008. – С.16-24.
- ПРИРОДА Украинской ССР. Климат / Бабиченко В.Н., Барабаш М.Б., Логвинов К.Т. и др. (Отв. ред. Логинов К.Т., Щербань М.Г.) – К.: Наукова думка, 1984.-232 с.
- ПРИРОДА Украинской ССР. Почвы / Вернандер Н.Б., Гоголев И.Н., Ковалишин Д.И. и др. (Отв. ред. Н.Б.Вернандер, Д.А.Гютюнник). – К.: Наукова думка, 1986. – 214 с.
- СОЛОМАХА В.А. Синтаксономія рослинності України // Укр. фітоцен. зб. – 1996. – Сер. А, вип. 4 (5). – 120 с.
- ШЕВЧИК В.Л., КУЗЕМКО А.А., ЧОРНА Г.А. Список рідкісних видів судинних рослин, що підлягають охороні в межах Черкаської області // Заповідна справа в Україні. – 2006. – Т. 12, № 1. – С. 11-17.
- ЧЕРВОНА КНИГА України / Ю.Р.Шеляг-Сосонко (відп. ред.) та ін. – Київ: Вид-во Укр. енци., 1996. – 608 с.
- ЧЕРВОНА КНИГА України / Я.П.Дідух (ред.) та ін. – Київ: Вид-во «Глобалконсалтинг», 2009. – 912 с.

- MAP of the Natural vegetation of Europe, 1: 2 500 000 [KARTE der natürlichen Vegetation Europas, 1:2 500 000] / BOHN U., GOLLUB G., HETTWER C. et al. – Bonn: Bundesamt für Naturschutz, 2000. – Maps: 9 sheets. – Legend: 153 p.
- MATUSZKIEWICZ W. Przewodnik do oznaczania zbiorowisk roślinnych Polski. – Warszawa: Wydawnictwo Naukowe PWN, 2001. – 537 p.
- MOSYAKIN S. L., FEDORONCHUK M. M. Vascular plants of Ukraine. A nomenclatural checklist. – Kiev: M. G. Kholodny Institute of Botany, National Academy of Sciences of Ukraine, 1999. – 346 pp.
- МОЙСИЙЕНКО І.І., СУДНИК-ВÓЈЦИКОВСКА Б., 2009: The flora of kurgans in the Pontic herb(-rich) grass steppe zone in Ukraine // Chornomors'k. bot. z. – Vol. 5, N 3. – P. 333-369.
- МОЙСИЙЕНКО І.І., СУДНИК-ВÓЈЦИКОВСКА Б. The Flora of Kurgans in the Desert Steppe Zone of Southern Ukraine // Chornomors'k. bot. z. – 2006. Vol. 2, N 1. – P. 5-35.
- СУДНИК-ВÓЈЦИКОВСКА Б., МОЙСИЙЕНКО І.І. The flora of kurgans in the west Pontic grass steppe zone of southern Ukraine // Chornomors'k. bot. z. – 2006. Vol. 2, N 2. – P. 14-44.

Рекомендує до друку
Ан.В. Єна

Отримано 15.10.2010 р.

Адреса авторів:

Barbara Sudnik-Wójcikowska,
Zakład Ekologii Roślin i Ochrony Środowiska,
Uniwersytet Warszawski,
Al. Ujazdowskie 4,
00-478 Warsaw, Poland;
e-mail: barbara.sudnik@uw.edu.pl

Author's address:

Barbara Sudnik-Wójcikowska,
Department of Plant Ecology and Environmental
Conservation,
University of Warsaw, Al. Ujazdowskie 4,
00-478 Warsaw, Poland;
e-mail: barbara.sudnik@uw.edu.pl

І.І. Мойсієнко
Кафедра ботаніки,
Херсонського державного університету,
Вул. 40 років Жовтня, 27, 73000 Херсон,
Україна, e-mail: Vanvan@ksu.ks.ua

Ivan Moysiienko,
Department of Botany,
Kherson State University,
Str. 40 let Oktriabrya 27, 73000 Kherson,
Ukraine; e-mail: Vanvan@ksu.ks.ua



Fig. 9. Sozophytes on the kurgans in the forest steppe zone: A) *Stipa capillata*, B) *Adonis vernalis*, C) *Asyneuma canescens*, D) *Linaria biebersteinii*, E) *Iris hungarica*, F) *Anemone sylvestris*, G) *Astragalus dasyanthus*.

Рис. 9. Созофіти курганів лісостепової зони: А) *Stipa capillata*, В) *Adonis vernalis*, С) *Asyneuma canescens*, D) *Linaria biebersteinii*, Е) *Iris hungarica*, F) *Anemone sylvestris*, G) *Astragalus dasyanthus*.

APPENDIX 1. Flora of the kurgans in desert steppe zone and their microhabitats

Abbreviations used in the Table A:

Microhabitats:

- T – the top of the barrow;
 Ss – the southern slopes;
 Sn – the northern slopes;
 Bs – the southern foot;
 Bn – the northern foot.

Data regarding the occurrence of species in particular microhabitats are presented in the following order:

T	
Ss	Sn
Bs	Bn

Life forms:

- t – therophytes;
 th – short-living perennials (2,3,4 years old);
 g – geophytes;
 w – hydrophytes;
 h – hemicryptophytes;
 hg – geophytes-hemicryptophytes – perennials, some of whose perennating buds (shoot system) remain on the soil surface and underground;
 hc – hemicryptophytes-chamaephytes – perennials whose perennating buds remain on or above (within 0.25 m) the soil surface;
 c – chamaephytes;
 mf – megaphanerophytes;
 nf – nanophanerophytes;

Syntaxa:

- Agro int-rep* – *Agropyretea intermedio-repentis* (Oberd. et al. 1967) Мьller et Gцrs 1969)
Alne glut – *Alnetea glutinosae* Br.-Bl. et R. Tx. 1943
Alth offi – *Althaetalia officinalis* V. Golub et Mirkin in V. Golub 1995 {*Molinio-Arrhenatheretea* T. Tx 1937}
Ammoph – *Ammophiletea* Br.-Bl. et R. Tx. 1943
Artemi – *Artemisietea vulgaris* Lohm., Prsg et R. Tx. in R. Tx. 1950
Aste trip – *Asteretea trifolium* Westh. et Beeft. ap. Beeft. 1962
Bident – *Bidentetea tripartiti* R. Tx., Lohm. et Prsg. 1950
Caki mari – *Cakiletea maritimae* R. Tx. et Prsg. 1950
Crit-Limo – *Crithmo-Limonietea* Br.-Bl. 1947
Crit-Stat – *Crithmo-Staticetea* Br.-Bl. 1947
Fest vagi – *Festucetea vaginatae* Soy 1968 em. Vicherek 1972 or *Festucetalia vaginatae* Soy {*Festuco-Brometea* Br.-Bl. et R. Tx. 1943}
Fest-Brom – *Festuco-Brometea* Br.-Bl. et R. Tx. 1943
Fest-Pucc – *Festuco-Puccinellietea* Soy (incl. *Festuco-Limonietea* Karpov et Mirkin 1985)
Gali veri – *Galiotalia veri* Mirkin et Naumova 1986 {*Molinio-Arrhenatheretea* T. Tx. 1937}
Gali-Urti – *Galio-Urticetea* Passarge 1967 or *Galio-Urticenea* (Passarge 1967) {*Artemisietea* Lohm., Prsg. et R. Tx. in R. Tx. 1950}
Glecho – *Glechometalia hederaceae* R. Tx. in R. Tx.
Moli-Arrh – *Molinio-Arrhenatheretea* R. Tx. 1937
Phragmi – *Phragmitetalia* Koch 1926
Plan majo – *Plantaginetea majoris* T. Tx. et Prsg. 1950 or *Plantaginetalia majoris* R. Tx. (1943) 1950 {*Molinio-Arrhenatheretea* R. Tx. 1937}

- Poly-Arte* – *Polygono-Artemisietea austriacae* Mirkin, Sakhapov et Solomeshch in Mirkin et al. 1986
Quer rob-pe – *Quercetea robori-petraeae* Br.-Bl. et R. Tx. 1943
Quer pub-pe – *Quercetalia pubescenti-petraeae* Klika 1933 corr. Moravec in Beg. et Theurill 1984
Quer-Fage – *Querco-Fagetea* Br.-Bl. et Vlieg. 1937
Rham-Prun – *Rhamno-Prunetea* Rivas, Goday et Garb. 1961 }
Robin – *Robinietea* Jurko ex Hadac et Sofron 1980
Sali purp – *Salicetea purpureae* Moor 1958
Sedo-Scle – *Sedo-Scleranthetea* Br.-Bl. 1955
Stel medi – *Stellarietea mediae* T. Tx. , Lohm., et Prsg. 1950 (incl. *Chenopodietea* Br.-Bl. 1952 em. Lohm., J. et R. Tx. 1961 ex Matuszk.1962 & *Secalietea* Br.-Bl. 1951)
Trif-Gera – *Trifolio-Geranietea sanguinei* Th. Мӓller 1962
Urti-Samb – *Urtico-Sambucetea* Doing1962 em. Pass.1968
Vacc-Pice – *Vaccinio-Piceetea* Br-Bl. 1939

[] – indicates that the introduced species were established in the particular plant community types (see Table);

{ } – indicates that the syntaxon belongs to a given class (see above list of syntaxa abbreviations).

Historical-geographical classification of species:

Native species:

- Ns – native species, not established in anthropogenic habitats;
- Ap – true apophytes = euapophytes, natives established in anthropogenic habitats;
- Ha – hemiapophytes, natives established only in semi-natural habitats;
- Ae – oekiophytes, natives grown (e.g. in plantations or in windbreaks) and recorded in anthropogenic habitats.

Aliens:

- Ar – archaeophytes, aliens that immigrated before the year 1500;
- Ke – kenophytes, aliens introduced after the year 1500;
- Eg – ergasiophygophytes, cultivated plants not established in the new territory, appearing only temporarily.

Origin of alien species – groups and abbreviations:

- 1 Mediterr (= Mediterranean), sub-Mediterr (= sub-Mediterranean);
- 2 European, Atlantic, sub-Atlantic;
- 3 Eurasian, Eurosiberian, boreal-Eurasian, continent. (= continental) , subcontinent (= subcontinental);
- 4 W-Asian (=Western-Asian), Middle-Asian, C-Asian (= Central Asian), Irano-Turanian, Indian, Malay;
- 5 African,
- 6 North American, Central American, South American.

Status of the protected species:

- * – World Red List
- ** – European Red List
- *** – Red Data Book of Ukraine
- **** – Red Lists of Poltava Region, Kirovograd Region and Cherkasy Region.

At the bottom of the Table A the flora of each kurgan is described taking into account:

- 1 the number of species;
- 2 the number of species in each of its microhabitats.