

Instytut Biologii UMCS, Zakład Geobotaniki
Ukrainskij Deržavnij Lisotechnicznij Universitet

FLORIAN ŚWIĘS, MIROŚŁAWA SOROKA

Expansion of *Iva xanthiifolia* Nutt. in the city of Lvov

Ekspansja gatunku *Iva xanthiifolia* Nutt. na terenie miasta Lwowa

INTRODUCTION

The *Iva* genus consists of 15 species that come from North America (12). The natural range of one of the most expansive species of those plants, *Iva xanthiifolia*, probably covers only the western part of the United States (9). Brought in accidentally, this plant successively spread for a transition period or permanently in the vast areas of North America, Europe and North-Eastern Asia (8–11, 14, 15, 24, 26, 27, 32).

Iva xanthiifolia is a plant characteristic of the warm continental or temperate climate zones (9). In brought-in stations it grows mainly on the substratum with a weakly beaten, loamy-rubble surface, relatively moist, with favorable thermal and lighting conditions (9, 28–30). The expansion of *Iva xanthiifolia* has basically two causes: its purposeful breeding in botanical gardens and accidentally bringing in its seeds during transportation by rail or road of various fruits, seeds, and raw materials. It turns out that the most effective expansion of *Iva xanthiifolia* species in anthropogenic habitats took place during the period of intensified railroad and road transportation during World War II (8, 14, 17, 24, 29).

In Europe *Iva xanthiifolia* first appeared in the Ukraine in 1842 in the area of Kiev and its vicinity through seed dispersal from the specimens of the species

grown in the local Botanical garden (8, 26). Further stages of the *Iva xanthiifolia* expansion are essentially connected with accidental spreading of its seeds in the area of major railroad and highway transport routes. This first occurred along the railroad route built in 1863 from Odessa to Parkany, and subsequently along other successively built railroad routes and major highways (14, 24, 29). In the Ukraine, until World War II, the boundary of the general southern range of *Iva xanthiifolia*, not counting its isolated stations, ran between Vinnitsa, Kirovograd, Kamien Podolski, Odessa and the North Donbass (24). Currently, in the greater part of the Ukraine and outside it, *Iva xanthiifolia* occurs rarely, mainly as a ruderal plant, less often segetal, in towns and outside them, in the area of major transportation routes (8, 14, 24, 29).

THE AREA OF INVESTIGATION

Lvov is the largest city in the western part of Ukraine. It covers the area of 220 square km and has over 800 thousand inhabitants. The city developed from an 11th-century stronghold, the first records of resident population having been known there since the Neolithic Age (13, 31). Owing to its position on the crossroads of major trade routes between Vilna, Cracow, Warsaw and Gdansk, and other European cities, the historic settlement of Lvov witnessed its quick architectural, cultural, scientific and industrial development (31, 33), having obtained its city charter in 1340. Lvov is regarded as one of the most beautiful, historical cities in Europe (18, 31, 33). Around the oldest, central, most built-up part of the city with most historical and architectural monuments, there are successively developed new, modern housing estates. In Lvov there are currently 20 large working industrial plants that cause high environmental pollution. Worth noting are also numerous and important intersecting railroad and highway transportation routes with 8 railroad stations and 7 bus terminals (Fig. 1).

The climate in the area of Lvov is characterized by many specific features (6). First of all, it is temperate-continental type and periodically undergoes characteristic changes. In winter and spring it is most often dry and cool, while in summer it is usually warmer and more humid (Fig. 2). The average annual air temperature is 7.5°C, average annual precipitation being 645 mm. Vegetation period lasts 212 days. The average monthly air temperature range is 22.4°C. On average the warmest month is July (18.3°C), the coldest being January (-4.1°C). There are ca 150 cloudy days per year. In the area of Lvov there are prevailing westerly winds. In winter there are also often south-westerly winds, and in summer — north-westerly.

Geomorphologically Lvov is situated on the northern fringe of Podolia Upland, on the borderland of its four subordinate units (12, 15): Roztoche (north-western part of the city), Griadove Pobuzhe (south-eastern part of the city), Lvov Plain (southern part) and Lublin Plain (western part of the city). The area of Lvov consists of a highly folded upland with adjacent wide plateaus. It is situated 205–409 m above sea level. The geological structure of the substratum has a characteristic form (2, 6). The oldest substratum, 300–400 m deep, is composed of Cretaceous and Tertiary formations. These are diverse layer arrangements consisting mainly of marl rocks, sandstone, limestone and gypsum. Beneath those rock layers there are Carboniferous formations. The youngest, Quaternary surface cover is composed of loess and loess-like clay (2, 6). Their maximum thickness reaches 30 m. Upon the Quaternary formations, depending on their physical properties, position and plants, there are definite soil forms. In drier sites brown soils and podzolic soils are spatially

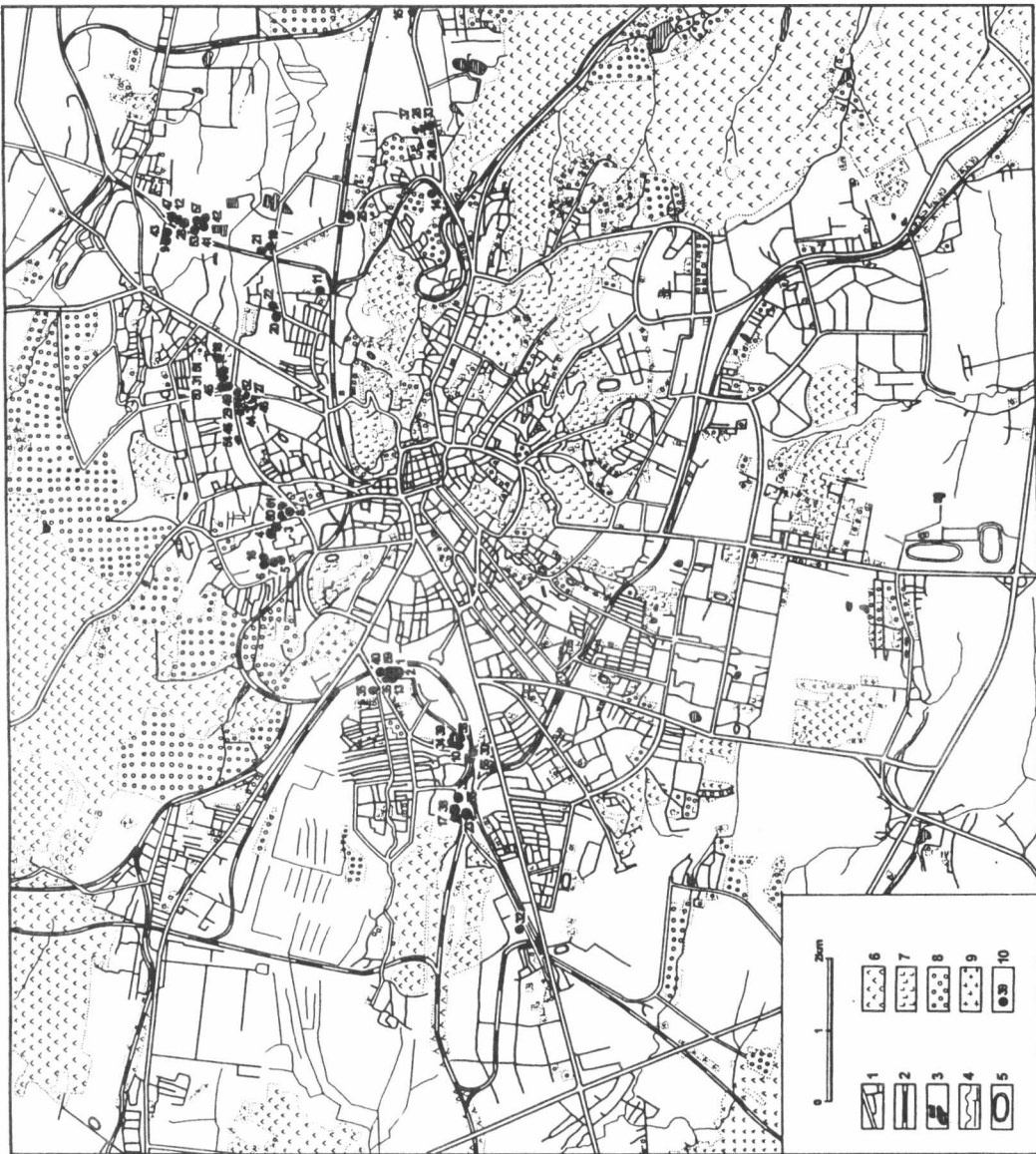


Fig. 1. Layout plan of the city of Lvov (after the quoted map no. 18). 1 — arterial roads and secondary roads, 2 — railroad area, 3 — water reservoirs, 4 — river network, drainage ditches, 5 — sports stadiums, 6 — forests, woodland parks, 7 — parks, tree-covered squares, 8 — gardens, garden-plots, 9 — cemeteries, 10 — stations of 61 phytosociological records of communities with *Iva xanthifolia* (Tables 1-3)

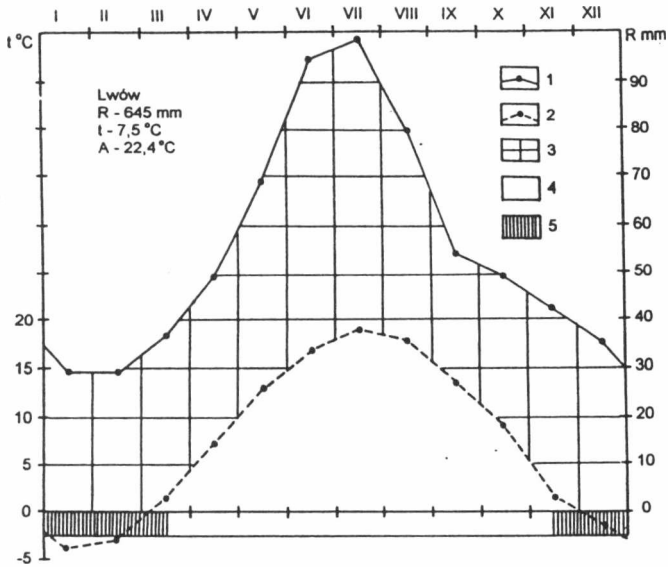


Fig. 2. Climate diagram of Lvov for 1960–1970. Data after Gerenchuk (6). 1 — average monthly precipitation totals, 2 — monthly air temperature averages, 3 — yearly humid season, 4 — vegetation season, 5 — winter season, R — average annual precipitation, t — average annual air temperature, A — average annual range of air temperature

dominant. In more humid local depressions and in stream network valleys there are small expanses of marshy and alluvial soils. Essentially all forms of soils in Lvov are anthropogenically transformed to a varying degree, in respect of their physical structure and chemical properties.

The surface water network in Lvov is poorly developed due to specific physiographical features of the area. It consists of very few water tanks as well as streams and small rivers flowing in different geographical directions (Fig. 1).

On the geobotanical map of the Ukraine Lvov is situated on the borderline of two districts (2, 6): Malopolesie and Podolia. In the latter district, three regions are distinguished in Lvov: Roztoche, Lvovian Opole and West-Podolian Elevation.

The plant cover in Lvov is largely diversified, both phytosociologically and floristically (1, 6, 16, 17, 24, 34). There occur communities deformed to a varying degree, both natural (forest plants, marsh plants, aquatic plants and brushwood plants) and semi-natural (meadows and pastures), and typical synanthropic communities (segetal and ruderal). Worth noting are numerous forests of different size and city parks. There are also numerous and diverse favorable habitats for synanthropic plants. Among those attention should often be drawn to highly littered sites and typical rubbish heaps, made accidentally or on purpose. In Lvov the development of flora and synanthropic plants is also favored by the intersecting local and international transport routes.

GOALS AND METHODS OF INVESTIGATION

Many interesting published data concerning the flora of vascular plants in the city of Lvov come from the pre-war years (1, 26, 34). However, plant communities in the city have so far been only fragmentarily investigated (17). The present study gives basic information on the occurrence

of *Iva xanthiifolia* in the city of Lvov. The main stages of the expansion of *Iva xanthiifolia* in the Ukraine and Lvov were also indicated.

Field studies on the occurrence of the plant in question were carried out during the vegetation season of 1996. The main part of the study discusses *Iva xanthiifolia* occurrence in definite ruderal communities regardless of its quantitative share in them. Phytosociological records of communities with *Iva xanthiifolia* were listed in Tables 1–3. Recorded *Iva xanthiifolia* stations were located in Figure 1 and discussed below.

Investigations of plant communities with *Iva xanthiifolia* were carried out in accordance with the binding rules in phytosociology (3, 23). Syntaxonomic classification of the plant species listed in the appended phytosociological tables was determined mainly after Matuszkiewicz (19) and Oberdorfer (21), less often after other authors (25, 30). The naming of the listed bryophyte species as well as pteridophytes, flower plants and bryophytes was given according to two studies (20, 22).

THE SURVEY OF PHYTOCENOSSES WITH *IVA XANTHIIFOLIA*

Phytosociological Taxonomy

- Cl. *Molinio-Arrhenatheretea* Tx. (1937) 1970
 ord. *Plantaginetalia majoris* Tx. et Prsg. 1950
 all. *Lolio-Plantaginion* Siss. 1969
 1. association: *Lolio-Plantaginetum* (Beg. 1930) Siss. 1969
- Cl. *Polygono-Poetea annuae* Riv.-Mart. 1975
 ord. *Polygono-Poetalia annuae* Tx. 1972
 all. *Matricario-Polygonion avicularis* (Br.-Bl 1931), Riv.-Mart. 1975
 2. association: *Polygono-Matricarietum discoideae* (Siss. 1969) Tx.
 1972
- Cl. *Agropyretea repentis* Oberd., Th. Müller et Görs in Oberd et al. 1967
 ord. *Agropyretalia repentis* Oberd., Th. Müller et Görs in Oberd et al.
 1967
 all. *Convolvulo-Agropyron* Görs 1966
 3. association: *Agropyretum repentis* Felföldy 1942
- Cl. *Chenopodietea* Oberd. 1957 em. Lohm., I et R. Tx 1961
 ord. *Sisymbrietalia* I. Tx 1961
 4. Comm. with *Iva xanthiifolia*
 5. Ass. *Sisymbrietum loeselii* Gutte 1969
 6. Ass. *Chenopodietum ruderale* Oberd. 1957
 7. Comm. with *Xanthium strumarium*
 8. Comm. with *Artemisia annua*
 ord. *Polygono-Chenopodietalia* (R. Tx et Lohm. 1950) I. Tx 1961
 all. *Eu-Polygono-Chenopodion* Siss. 1946
 9. Comm. with *Galinsoga ciliata*



Fig. 3. Lvov, Syaivo St. Dense clusters of *Iva xanthifolia* on a ruderal loamy-rubble square

Foto by F. Świąż

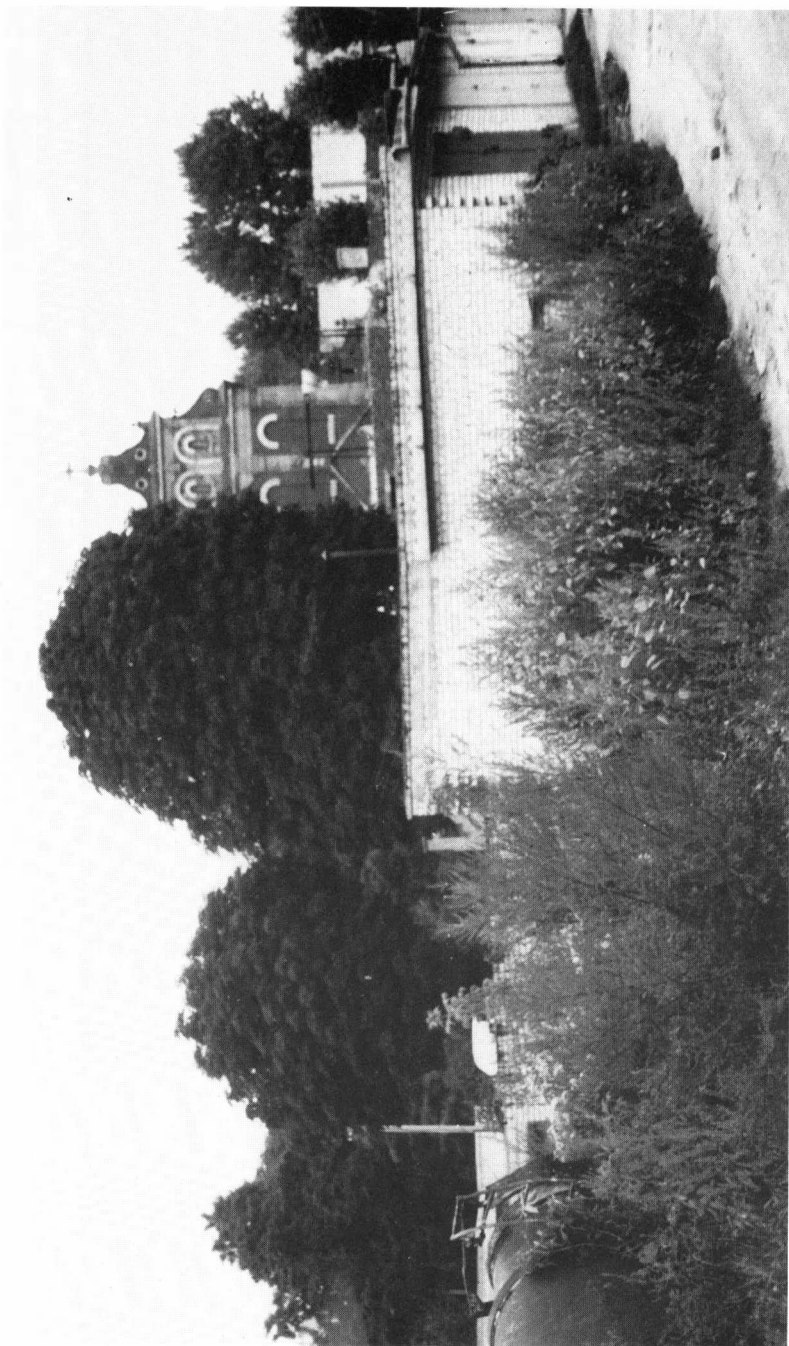


Fig. 4. Lvov, Pancha St. A dense expanse of *Iva xanthiifolia* on the ruderal loamy-rubble fringe of the road
Foto by F. Świąż



Fig. 5. Lvov, near Promislova St. Dense clusters of *Iva xanthifolia* on the ruderal loamy-sandy fringe of garden plots
Foto by F. Święs



Fig. 6. Lvov, Promislova St. A dense cluster of *Iva xanthiifolia* on the ruderal loamy-rubble fringe of the road

Foto by F. Świąż



Fig. 7. Lvov, near Novovoznesenska St. The edge of the dense expanse of *Iva xanthifolia* on a ruderal loamy-rubble square
Foto by F. Święs



Fig. 8. Lvov, near Okunevskogo St. A fragment of a large, ruderal loamy-rubble square with massive presence of *Iva xanthiifolia*. In Lvov this is the largest station of *Iva xanthiifolia*

Foto by F. Świąć

- Cl. *Artemisietea vulgaris* Lohm., Prsg. et R. Tx. 1950
 ord. *Onopordetalia acanthii* Br.- Bl. et RR. Tx. 1943
 all. *Eu-Arction* R. Tx. 1937 em. Siss. 1946
 10. Comm. with *Arctium lappa* and *Artemisia vulgaris*
 11. Ass. *Helianthetum tuberosi* (Moór 1958) Lohm. ap. Oberd
 1967
 all. *Alliarion* Oberd. (1957) 1962
 12. Ass. *Reynotrietum japonicae* (Moór 1958, Görs 1975 et al.)
 em Święs 1994
 Abbreviations: Cl. — class, ord. — order, all. — alliance, ass. — association,
 comm. — community.

PHYTOSOCIOLOGICAL CHARACTERISTICS

1. Association: *Lolio-Plantagineum*

(Table 1)

With respect to its general floristic composition and habitat conditions this association largely resembles subassociation *Lolio-Plantagineum typicum* formed in a variant with *Lolium perenne* and *Iva xanthiifolia*. Among scantily recorded plant species the relatively most abundant are: *Lolium perenne*, *Iva xanthiifolia* and *Deschampsia caespitosa*. This phytocenose was recorded only in one station.

Phytosociological record: 1. Estonska St., near a fence, the substratum with a loamy, somewhat beaten and littered surface.

2. Association: *Polygono-Matricarietum discoideae*

(Table 1)

The present association can be regarded as a fragmentarily formed subassociation *Polygono-Matricarietum discoideae typicum* in a variant with *Polygonum aviculare*. This phytocenose is characterized by the indivisible domination of *Polygonum aviculare*. It is a plant regarded as one of species characteristic of the association under discussion. Among other plants recorded in the association the relatively most abundant are only: *Lolium perenne* and *Iva xanthiifolia*. In Lvov this phytocenose was identified only in one station.

Phytosociological record: 2. Estonska St., near a fence, the substratum with a loamy, somewhat beaten and littered surface.

Table 1. Phytosociological structure of associations: 1 — *Lolio-Plantagnetum*, 2 — *Polygono-Matricarietum discoideae*, 3 — *Agropyretum repentis*. NB. x — syntaxonomic groups only with sporadic plant species, listed at bottom

Number of community	1. 2.			3.		
	1	2	3	4	5	6
Number of record	1	2	3	4	5	6
Date	1996.VIII.28-30					
Area of plot in m ²	30	20	10	12	8	12
Cover the layer in %	40	90	90	90	90	90
Number of species in record	16	13	21	28	19	22
I. Ch: Phragmitetea (x)						
II. Ch: a - Molinio-Arrhenatheretea, b - Molinietales, c - Arrhenatheretalia, d - Cynosurion, e - Plantagnetalia majoris, Lolio-Plantaginion, f - Agropyro-Rumicion crispi						
a	Achillea millefolium			+	+	+
a	Trifolium pratense			+	+	+
a	Ranunculus acris			+	+	+
b	Deschampsia caespitosa	1				
c	Taraxacum officinale		+	+	+	+
d	Trifolium repens		+		+	+
e	Lolium perenne (Ch: ass. 1)	2	1	2	2	+
e	Plantago major (Ch: ass. 1)		+	+	+	1
f	Potentilla anserina			+		+
III. Ch: Polygono-Poëtea annuas						
	Polygonum aviculare (Ch: ass. 2)		+	5	+	+
	Poa annua		+	+	+	+
	Chamomilla suaveolens (Ch: ass. 2)					2
	Bryum caespiticium		+	+	+	+
IV. Ch: a - Agropyreteae repentis, b - Sedo-Scleranthetea(x)						
a	Elytrigia repens (Ch: ass. 3)		+	5	4	4
a	Cirsium arvense			+	+	+
V. Ch: a - Aphanion (x), b - Chenopodietales, c - Sisymbrietales, Sisymbriion, d - Polygono-Chenopodietales, e - Eu-Polygono-Chenopodion						
b	Chenopodium album		+	+	2	+
c	Iva xanthifolia	1	1	+	+	2
c	Sisymbrium officinale			+	+	+
c	Lactuca serriola			+	+	+
c	Malva neglecta			+	+	+
d	Sonchus arvensis		+	+		
d	Echinochloa crus-galli				+	+
e	Galinsoga ciliata				+	+
e	Galinsoga parviflora				+	+
VI. Ch: a - Artemisietea vulgaris, b - Eu-Arction, c - Onopordion, d - Alliarion						
a	Artemisia vulgaris		+	+	+	2
a	Urtica dioica			+	+	+
b	Arctium lappa			+	+	+
b	Artemisia annua			+	+	+
c	Onopordium acanthium				+	+
d	Chelidonium majus		+		+	+
VII. Other species						
	Senecio vulgaris			+	+	+
	Conyza canadensis			+	+	+
	Polygonum persicaria			+	+	+
	Medicago lupulina			+	+	+
Species occurring in 1 record:						
I - Phragmites australis 4/+, Ranunculus sceleratus 5/+, IIC - Daucus carota 3/+, III - Bryum argenteum 3/+, IVA - Convolvulus arvensis 4/+, Equisetum arvense 7/+, Ceratodon purpureus 8/+, Va - Matricaria maritima subsp. inodora 5/+, Vb - Erysimum cheiranthoides 4/+, Solanum nigrum 4/+, Vc - Atriplex tatarica 1/+, Sisymbrium loeselii 2/+, Vd - Setaria pumila 2/+, Vlb - Ballota nigra 1/+, Armoracia rusticana 8/+, Leonurus cardiaca 8/+, VIc - Melilotus alba 8/+, VIId - Impatiens parviflora 1/+, VII - Galeopsis ladanum 1/+, Glechoma hederacea 1/+, Anaranthus retroflexus 4/+, Aegopodium podagraria 4/+, Lamium maculatum 4/+, Thladiantha dubia 4/+,						

3. Association *Agropyretum repentis*

(table 1)

This association is characterized by more or less distinct quantitative dominance of *Elytrigia repens* over other accompanying plant species. Moreover, in some expanses of this association there is evident a fairly large co-occurrence mainly of *Lolium perenne* (rec. 3–4), *Chenopodium album* (rec. 5), *Iva xanthiifolia* (rec. 6), *Iva xanthiifolia* and *Artemisia vulgaris* (rec. 7) and *Chamomilla suaveolens* (rec. 8).

The association in question does not often develop in the investigated area. It occurs mainly in small expanses in old building sites with a weakly beaten, loamy-sandy-gravelly surface.

Phytosociological records: 3. Okunevskogo St., a deserted building site with a loosened loamy-sandy surface. 5. Pancha St., a building site with a loosened loamy-gravelly surface. 6. Pancha St., a building site with a loosened loamy-gravelly-sandy surface. 7. Pancha St., a building site with a loosened loamy-sandy-gravelly surface. 8. Lipinskogo St., a highly littered square with a loosened loamy surface with concrete and brick grains, and various municipal waste crumbs.

4. Community with *Iva xanthiifolia*

(Table 2)

With regard to its general floristic composition this community is primarily characterized by domination of *Iva xanthiifolia* with a different degree of density (Fig. 3–8). Out of other plants in single phytosociological records or in small groups comparatively the most abundant are: *Elytrigia repens*, *Polygonum aviculare*, *Galinsoga ciliata*, *Aegopodium podagraria*, *Chelidonium majus* and *Artemisia vulgaris*. This phytocenose is equally frequently defined either as a phytosociologically indeterminate community with *Iva xanthiifolia* (28, 30) or at the rank of association *Ivetum xanthiifoliae* (4).

The community with *Iva xanthiifolia* occurs frequently in Lvov, in expanses of different size in fairly diversified habitats: building sites, rims of waste heaps and garden-plots, on scarps, sides of ditches and road and railroad embankments. Most frequently they are habitats with a weakly beaten surface, of loamy-gravelly-sandy type with a varying content of rock, brick and concrete grains.

Phytosociological records: 9. Poliska St., the road rim with a loamy-gravelly surface. 10. Syaivo St., near the railroad tracks, a highly littered square with a loosened, loamy surface with concrete and brick grains and crumbs of different municipal wastes. 11. Novovozenenska St., the rim of a road with a loosened,

IV. Ch: a - Agropyretæa repentis, b - Sedo-Scleranthetæa										
a	Cirsium arvense	.....	.....	.....	.....	.....	.....	.....	.....	.....
a	Elvtrigia repens	.....	2 2	1 1	2 1	.....	.....	.....	.....	.....
a	Tusilago farfara	.....	.....	.....	.....	.....	.....	.....	.....	.....
b	Ceratodon purpureus	.....	.....	.....	.....	.....	.....	.....	.....	.....
V. Ch: a - Chenopodietes, b - Sismyrietalia, Sismyriion, c - Polygono-Chenopodietalia, d - Eu-Polygono-Chenopodion										
a	Chenopodium album	.....	2 1	2 1	.....	.....	.....	.....	.....	.....
b	Lactuca scariola	.....	.....	.....	.....	.....	.....	.....	.....	.....
b	Iva xanthiifolia (D: com. 4)	.....	4 4	5 3	4 4	5 5	5 5	4 4	4 4	5 3
b	Atriplex nitens	.....	.....	.....	.....	.....	.....	.....	.....	.....
b	Atriplex tatarica	.....	.....	.....	.....	.....	.....	.....	.....	.....
b	Sismyrium loeseli	.....	.....	.....	.....	.....	.....	.....	.....	.....
b	Descurainia sophia	.....	.....	.....	.....	.....	.....	.....	.....	.....
b	Xanthium strumarium	.....	.....	.....	.....	.....	.....	.....	.....	.....
b	Sisymbrium officinale	.....	.....	.....	.....	.....	.....	.....	.....	.....
b	Malva neglecta	.....	.....	.....	.....	.....	.....	.....	.....	.....
c	Sonchus arvensis	.....	.....	.....	.....	.....	.....	.....	.....	.....
c	Echinochloa crus-galli	.....	.....	.....	.....	.....	.....	.....	.....	.....
d	Galinsoga ciliata	.....	.....	.....	.....	.....	.....	.....	.....	.....
d	Galinsoga parviflora	.....	.....	.....	.....	.....	.....	.....	.....	.....
VI. Ch: a - Artemisietea vulgaris, b - Onopordion (x), c - Alliarion, d - Convolvuletalia sepium, e - Sambuco-Salicion										
a	Artemisia vulgaris	.....	.....	.....	.....	.....	.....	.....	.....	.....
a	Urtica dioica	.....	.....	.....	.....	.....	.....	.....	.....	.....
a	Tanacetum vulgare	.....	.....	.....	.....	.....	.....	.....	.....	.....
c	Chelidonium majus	.....	.....	.....	.....	.....	.....	.....	.....	.....
d	Calystegia sepium	.....	.....	.....	.....	.....	.....	.....	.....	.....
e	Sambucus nigra b	.....	.....	.....	.....	.....	.....	.....	.....	.....
VII. Other species										
	Rumex confertus	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Conyza canadensis	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Amaranthus retroflexus	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Medicago lupulina	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Thlasiantlia dubia	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Aescoglo falcata	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Asperogloa parviflora	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Polygonum persicaria	.....	.....	.....	.....	.....	.....	.....	.....	.....

Species occurring in 1 record:

I - Bidens tripartita 9/+. Iia - Vicia cracca 20/+. Plantago lanceolata 24/+. Iib - Cirsium palustre 30/+. Iid - Dactylis glomerata 34/+. Iih - Agrostis alba 32/+. Iva - Convolvulus arvensis 27/+. Va - Erysimum cheiranthoides 16/+. Vb - Lepidium densiflorum 13/6, Chenopodium strictum 31/+. Vc - Setaria pumila 13/+. Vib - Onopordium acanthium 13/+. Melilotus alba 13/+. Berteroa incana 24/+. Vic - Sicyos angolata 29/+.

loamy-sandy surface. 12. Budivelna St., a highly littered square with a loosened loamy surface with concrete, brick and different building waste grains. 13. Estonska St., an old, accidentally made waste heap with a slightly beaten loamy surface with brick, stone and building waste grains. 14. Bogdanivska St., the rim of a neglected garden-plot with a loamy-humous surface. 15. Glinyansky trakt St., the loamy slope of a large roadside ditch. 16. Pancha St., a building site with a loosened loamy-sandy surface with concrete and stone grains. 17. Rudnenska St., the rim of a neglected garden-plot with a loamy-humous surface. 18. Chigirinska St., an old, neglected flower bed with a loamy-humous surface. 19. Bogdanivska St., at the railroad tracks, an accidentally made waste heap with a loosened, loamy surface with brick, concrete and domestic refuse grains. 20. Kovel'ska St., the rim of a neglected garden-plot with a loamy-humous surface. 21. Silikatna St., near the railroad tracks, a highly littered area with a loosened loamy surface with brick, stone and domestic refuse grains. 22. Kovel'ska St., near the fence, the substratum with a loosened, loamy-humous surface. 23. General Kurmanovich St., near the railroad embankment, a waste heap with a highly littered and loosened loamy surface with brick, stone and domestic refuse grains. 24. Glinyansky trakt St., at the cemetery fence, the substratum with a littered, hard loamy-humous surface. 25. Bogdanivska St., near the railroad track, a square with a loosened, littered, loamy surface with stone and concrete grains and other domestic refuse. 26. Glinyansky trakt St., an accidentally made waste heap with a loosened, loamy surface with concrete and brick grains with a large amount of municipal refuse. 27. Traktoristiv St., an old, somewhat beaten and littered loamy-gravelly heap. 28. Budivelna St., an old, littered loamy bank. 29. Lipinskogo St., an old, accidentally made waste heap with a weakly beaten loamy surface with stone, brick and municipal waste grains. 30. At the intersection of Syaivo and Rudnenska St., under the bridge, an accidentally made waste heap with a loosened, loamy surface with brick, concrete and stone grains and various municipal wastes. 31. Berstiana St., an old, highly littered building site, a loamy-gravelly heap. 32. General Kurmanovich St., near the fence, an old flower bed with a beaten and littered, loamy-sandy surface. 33. Glinyansky trakt St., an accidentally made waste heap with a loosened loamy surface, with a scant admixture of stone, brick and concrete grains, and with a large amount of various municipal wastes. 34. Syaivo St., at the railroad tracks, an accidentally made waste heap with a loosened loamy surface with brick, concrete and municipal waste grains. 35. Near Novorossiyskaya St., next to the building, an old flower bed a beaten, littered, loamy surface. 36. Estonska St., an accidentally made waste heap with a loosened loamy surface with stone, brick and other municipal waste grains. 37. Glinyansky trakt St., an accidentally made waste heap with a loosened loamy surface with brick, concrete and other municipal waste grains. 38. Rudnenska

St., near the building, the rim of a neglected garden-plot with a weakly beaten, loamy-humous surface. 39. Syaivo St., near the railroad tracks, an accidentally made waste heap with a loosened loamy surface with brick, concrete and other municipal waste. 40. Near the goods station, an accidentally made waste heap with a loosened loamy surface with brick, concrete and other municipal waste grains.

5. Association *Sisymbrietum loeselii*

(Table 3)

The association is distinguished primarily by the dense occurrence of one species recognized as characteristic of this association: *Sisymbrium loeselii*. It has three weak facies: with *Iva xanthiifolia* (rec. 41), typical with *Sisymbrium loeselii* (rec. 42) and with *Elytrigia repens* and *Chenopodium album* (rec. 43). In the studied area the *Sisymbrium loeselii* association characterized by the presence of *Iva xanthiifolia* occurs fairly rarely. It develops most often in small expanses on the substratum with a loamy-rubble surface, more or less beaten.

Phytosociological records: 41. Budivelna St., a littered heap of loam and rubble. 42. Budivelna St., an accidentally made waste heap with a loosened loamy surface with concrete, brick and other municipal waste grains. 43. Poliska St., the road rim with a hard, loamy-gravelly surface.

6. Association *Chenopodietum ruderale*

(Table 3)

The characteristic shape of this association is owed to the dense occurrence of *Chenopodium album*. It is the main species regarded as characteristic of the association. Out of the other recorded species in the association the comparatively most abundant are: most often — *Iva xanthiifolia*, *Artemisia annua* and *Artemisia vulgaris*, less often — *Ballota nigra*, *Elytrigia repens* and *Amaranthus retroflexus*.

The association *Chenopodietum ruderale* with the presence of *Iva xanthiifolia* does not occur in Lvov very frequently, it is found in expanses of varying size, with an area of several ares. It develops on the substratum with a loamy-rubble surface, most often weakly beaten. Basically, this takes place in the fringes of all kinds of waste heaps, on the slopes of heights and road embankments.

Phytosociological records: 44. Traktoristiv St., an old littered loamy-sandy-stony heap. 45. Promislova St., an old loamy-gravelly-stony heap with brick and concrete grains. 46. Lipinskogo St., an accidentally made waste heap with a loosened loamy surface with concrete, brick and other municipal waste grains. 47. Budivelna St., a highly littered site with a loosened loamy surface with brick, stone and other building waste grains. 48. Traktoristiv St., an old, compacted, littered

Table 3 — continued

VII. Other species	
<i>Medicago lupulina</i> +
<i>Polygonum persicaria</i> +
<i>Amaranthus retroflexus</i> .....	..... 1 + 2
<i>Medicago falcata</i> +
<i>Conyza canadensis</i> +
Species occurring in 1 record:	
I. <i>Chenopodium rubrum</i> 47/+, <i>Bidens tripartita</i> 48/+, IIA - <i>Trifolium pratense</i> 55/+, IIC - <i>Stachys palustris</i> 53/+, IIE - <i>Pastinaca sativa</i> 58/+, IIG - <i>Lolium perenne</i> 61/+, IIH - <i>Potentilla anserina</i> 53/+, IIIA - <i>Chamomilla suaveolens</i> 48/+, Capsella bursa-pastoris 52/+, IIIB - <i>Puccinellia distans</i> 46/+, VA - <i>Euphorbia falcata</i> 52/+, <i>Stachys annua</i> 57/+, VB - <i>Erysimum cheiranthoides</i> 53/+, VC - <i>Chenopodium opulifolium</i> (Ch: ess. 6), 50/+, Ch. strictum (Ch: ass. 6) 51/+, <i>Malva puavilla</i> 51/+, VIA - <i>Carduus crispus</i> 44/+, <i>Tanacetum vulgare</i> 60/1, VID - <i>Chelidonium majus</i> 50/+, VII - <i>Thladiantha dubia</i> 45/+, <i>Senecio vulgaris</i> 52/+, <i>Stellaria media</i> 54/1, <i>Rumex sanguineus</i> 56/+, <i>Atriplex hortensis</i> 59/+,	

rubble, sand and gravel heap. 49. Promislova St., a waste heap with a loosened loamy surface with brick, stone and concrete grains and domestic refuse grains. 50. Berestiana St., a waste heap on the building site with a loosened loamy surface with concrete, brick and other municipal waste grains. 51. Berestiana St., a waste heap with a loamy surface with concrete, brick, glass and municipal waste grains. 52. Promislova St., a waste heap with a loamy surface with glass, brick, concrete grains and domestic refuse grains. 53. Budivelná St., the wide slope of a height over the road, with a loosened and littered loamy surface.

7. Community with *Xanthium strumarium*

(Table 3)

The studied community with *Xanthium strumarium* is often upgraded to the rank of the association *Xanthetum strumari* (e.g. 4). With regard to its general floristic composition it is characterized by the domination of *Xanthium strumarium*. Among the other infrequent plant species the comparatively highest degrees of coverage were found with: *Ballota nigra*, *Sisymbrium officinale* and *Stella media*. *Iva xanthiifolia* grows there in small numbers, as single specimens. In the studied area the community was recorded only in one station.

Phytosociological record: 54. Lipinskogo St., a highly littered site with a loosened loamy surface with concrete, brick and other building waste grains.

8. Community with *Artemisia annua*

(Table 3)

The community with *Artemisia vulgaris* is sometimes defined as the *Artemisietum annuae* association (4). It is characterized by the domination of *Xanthium strumarium*. Out of the other recorded plants in it those with the comparatively greatest density are: *Polygonum aviculare*, *Ballota nigra*, *Sisymbrium officinale*

and *Stellaria media*. *Iva xanthiifolia* grows there in small numbers. The community was found only in one station.

Phytosociological records: 55. Rudnenska St., the scarp side over the road, with a loosened loamy surface. 56. At the intersection of Syaivo St. and Rudnenska St., the fringe of a neglected garden-plot with a loosened loamy-humous surface.

9. Community with *Galinsoga ciliata*

(Table 3)

It is distinguished by the domination of *Galinsoga ciliata* with a rather high percentage of *Iva xanthiifolia* and *Artemisia vulgaris*. Reported only in one station.

Phytosociological record: 57. Budivelna St., a highly littered site, with a loosened loamy surface with concrete, brick, glass and different municipal waste grains.

10. Community with *Arctium lappa* and *Artemisia vulgaris*

(Table 3)

With regard to the general composition of plant species and habitat conditions this community shows great resemblance to the association *Tanaceto-Artemisietum vulgaris*. It is characterized primarily by the fact that among the few plants recorded in it the greatest density is exhibited by: *Arctium lappa* and *Artemisia vulgaris*. Worth noting is also a large percentage of *Cirsium arvense*. In Lvov only one expanse of the community in question was reported, characterized by a low percentage of *Iva xanthiifolia*.

Phytosociological record: 58. Syaivo St., next to the railroad tracks, a highly littered site with a loosened loamy surface with stone, brick and various municipal waste grains.

11. Association *Helianthetum tuberosi*

(Table 3)

This association derives its characteristic physiognomy from a very dense occurrence of *Helianthetum tuberosi* among the other few recorded plant species. *Iva xanthiifolia* grows in it in very small numbers. Only one expanse of this association was reported in the studied area.

Phytosociological record: 59. The main goods station, next to the railroad tracks, a highly littered site with a loosened loamy surface with concrete, stone, brick and different municipal waste grains.

12. Association *Reynotrietum japonicae*

(Table 3)

The association is characterized by the domination of *Reynoutria japonica*, sometimes with a large co-occurrence of *Elytrigia repens* or *Tanacetum vulgare* or *Chenopodium album*. *Iva xanthiifolia* has a very low coverage in it. In Lvov this association occurs very rarely, mainly on the loamy, humous substratum.

Phytosociological records: 60. Rzhigorzha Frantishcheka St., the edge of an old neglected garden-plot, with a littered, loamy-humous surface. 61. Rzhigorzha Frantishcheka St., the edge of an old, neglected garden-plot with a weakly beaten, loamy-humous surface.

DISCUSSION OF RESULTS

In Lvov *Iva xanthiifolia* was first recorded in 1946. According to Kotov (14), initially they were the few stations of this plant occurring near the railroad tracks. The next and so far only data on *Iva xanthiifolia* occurrence in Lvov were given in 1991. This refers to several dense tufts of this plant assigned to the association *Ivetum xanthiifoliae* occurring in ruderal squares near the railroad tracks (27). Currently *Iva xanthiifolia* grows mainly in the central-northern part of Lvov in several dozen stations that form groupings of varying size (Fig. 3–8). It occurs most often in the closest or not very distant vicinity of the railroad tracks, less often next to the nearby highways of different class. Those data show that the pioneer stations in Lvov come from the time of World War II. They developed through accidental settlement of this species next to the railroad route with exceptionally intense transport of raw materials and goods at that time.

It turns out that the dynamics of *Iva xanthiifolia* expansion in Lvov is far slower than this occurs in other towns, for example in Odessa (7) or in Poland: Warsaw or Lublin (7, 28, 30). In Lvov, in the sites of *Iva xanthiifolia* occurrence, attention should be drawn to the exceptionally low range of natural afforestation and artificial tree-coverage (Fig. 1). These are probably Lvov's most peaceful, dry and warm areas.

In the Ukraine and in Poland, similar studies on communities with the presence of *Iva xanthiifolia* as were currently conducted in Lvov were carried out earlier only in Warsaw (28) and Lublin (30). Comparisons are interesting, for example concerning the number of common and different phytocenoses with *Iva xanthiifolia* located in two closest-situated towns in the Ukraine and Poland, Lvov and Lublin. It turns out that among phytocenoses with *Iva xanthiifolia* exclusively

in Lvov there were reported four associations (*Agropyretum repentis*, *Sisymbrietum loeselii*, *Tanaceto-Artemisietum* and *Helianthetum tuberosi*) and three basic communities (with *Xanthium strumarium*, with *Artemisia annua* and with *Galinsoga ciliata*). With phytocenoses with *Iva xanthiifolia* described only from Lublin this applies to eight associations (*Corispermo-Brometum tectorum*, *Sisymbrietum sophiae*, *Atriplicetum nitenstis*, *Erigeronto-Lactucetum*, *Centaureo-Berteroetum*, *Potentillo-Artemisietum absinthii* and *Onopordetum acanthii*) and to one community (with *Cannabis ruderalis*). It turns out that only five other phytocenoses with *Iva xanthiifolia* occur with different degrees of constancy in Lvov and in Lublin: this applies to four associations (*Lolio-Plantaginetum*, *Polygono-Matricarietum discoideae*, *Chenopodietum ruderales*, *Tanaceto-Artemisietum*) and to one community (with *Iva xanthiifolia*).

Altogether, *Iva xanthiifolia* in Lublin and in Lvov occurs in 16 associations and five phytosociologically indeterminate ruderal communities. The wide phytosociological range of *Iva xanthiifolia* occurrence demonstrates that this species cannot be recognized as the basic characteristic species of any one phytocenose (28, 30).

In Lvov *Iva xanthiifolia* occurs most often and in greatest numbers only in two phytocenoses: in its most characteristic community, i. e. with *Iva xanthiifolia* and in some expanses of the association *Chenopodietum ruderales* (Table 1–3). In other towns *Iva xanthiifolia* grows fairly often in the association *Erigeronto-Lactucetum*. Similar cases of the percentage of *Iva xanthiifolia* in definite ruderal phytocenoses as is the case in Lvov were also reported in other towns (4, 15, 28, 30, 35). It is evident that the most favorable habitat for phytocenoses with the presence of *Iva xanthiifolia* is the substratum with a moderately permanently overdried surface, well-exposed to sun and weakly beaten or loosened, of the loamy-rubble type (30). It should also be taken into account that *Iva xanthiifolia* is an annual plant and may still be poorly adapted to its new environment. For that reason *Iva xanthiifolia* can be easily driven out from the brought-in, pioneer stations by the local, more expansive plant species (29, 30)

REFERENCES

1. Błocki B.: Rzut oka na genezę i charakter flory lwowskiej. Lwów, jego rozwój i stan kulturalny oraz przewodnik po mieście. Lwów 1907.
2. Bondarczuk V. G.: Geologija Ukraini. Vidarn. AN Ukrainy, Kijiv 1959.
3. Braun-Blanquet J.: Pflanzsoziologie. 2. Aufl., Wien 1951.
4. Fijałkowski D.: Synantropia roślinne Lubelszczyzny. PWN, Warszawa–Łódź 1978.
5. Froebe H. A., Oesan A.: Zur Soziologie und Propagation von *Iva xanthiifolia* und Stadtgebiet von Mainz Decheniana **122**, 147–157 (1969).

6. Gerenczuk K. I. (red.): *Priroda Lvivskoi oblasti*. Vydavn. Lvivskogo Universyteta, Lviv 1972.
7. Gold J. M.: *Iva xanthiifolia* v Odess. Praci Odesk. Derž. Inst. Bioł. **28** (4), 1–57 (1949).
8. Golicyñ S. V.: *Iva xanthiifolia* Nutt. i jejo areal v SSSR. *Žurnat Sov. bot.* **15** (2), 32–37 (1947).
9. Gudzhinskias Z.: The immigration and distribution of *Iva xanthiifolia* Nutt. in Lithuania. *Thaiszia* **1**, 43–48 (1991).
10. Guzik J., Sudnik-Wójcikowska B.: Badania nad zasięgami roślin synantropijnych. 6. *Iva xanthiifolia* Nutt. w Polsce. *Fragm. Flor. et Geobot.* **34** (3–4), 255–276 (1989).
11. Hejny S.: *Iva xanthiifolia* Nutt. v CSR. Príspevek k studiu karantenich pleveli. *Acta Facult. Rerum Natur. Univ. Comenianae Bot.* **2** (7–9), 323–342 (1958).
12. Jackson R.: A revision of the genus *Iva* L. *Sci. Bull. Univ. Kansas.* **41** (7), 793–876 (1960).
13. Janusz B.: *Z pradziejów ziemi lwowskiej*. Lwów 1983.
14. Kotov M. I.: Adventivni rostliny v URSR. *Bot. Žurn.* **6** (1), 15–20 (1949).
15. Krippelova T.: Verbreitung der *Iva xanthiifolia* Nutt. und ihr Vorkommen in den Pflanzengesellschaften in der CSSR. *Biologia* **24** (10), 738–759 (1969).
16. Kuczerjavij V. A.: Zelenaja zona goroda. Vyd. „Naukova Dumka”, Kyjiv 1981, s. 1–248.
17. Kuczerjavij V. O., Sołomacha V. A., Sołomacha T. D., Szczeljad-Sosonko J. R., Kramarec V. O.: Ruderalna rostlinnost m. Lvova. *Ukrainski Bot. Žurn.* **48** (3), 22–28 (1991).
18. Lviv. Płan міста, 1:20000. Gołovne Upravlinija Geodezii, Kartografii ta Kadastru pri Kabineti Ministiv Ukraini, Kiiv 1994.
19. Matuszkiewicz W.: *Przewodnik do oznaczania zbiorowisk roślinnych Polski*. PWN, Warszawa 1981.
20. Mirek Z., Piękoś-Mirkowa H., Zajęc A., Zajęc M.: Vascular plants of Poland a checklist. *Polish Botanical Studies. Guidebook Series*. W. Szafer Institute of Botany. **15**. Kraków 1995.
21. Oberdorfer E.: *Süddeutsche Pflanzengesellschaften*. III. *Pflanzensoziologie* **10**, 1–455 (1983).
22. Ochyra R., Szmajda P.: An Annotated List of Polish Mosses. *Fragm. Flor. et Geobot.* **24** (1), 93–145 (1978).
23. Pawłowski B.: Skład i budowa zbiorowisk roślinnych oraz metody ich badania. (in:) *Szata roślinna Polski*. Red. W. Szafer, W. Zarzycki. **1**. PWN, Warszawa 1972, s. 237–269.
24. Protopoelova V. V.: Adventivni rostlini lisostepu i stepu Ukraini. *Naukova Dumka*. Kyjiv 1972.
25. Rivas-Martinez S.: Sobre la nueva clase *Polygono-Poetea annuae*. *Phytocoenologia* **2** (1–2), 123–140 (1975).
26. Rogovicz A. S.: Obozrenije semennyh i vyoszczych sporovyh rastenij, vchodjaszczich v sostav flory gubernij Kijevskogo uczebnogo okruga: Volinskoj, Kijevskoj, Czernigovskoj, i Poltavskoj. Vyd. Kijevskogo Univ., **4**, 201–224 (1869).
27. Scoggan H. J.: The flora of Canada. 4. National Museum of Natural Sciences Nat. Mus. of Canada, Publ. in Botany. Ottawa **7** (4), 1117–1711 (1979).
28. Sudnik-Wójcikowska B.: *Iva xanthiifolia* Nutt. and its communities within Warsaw. *Acta Soc. Bot. Pol.* **56** (1), 155–167 (1978).
29. Szczebrina A. F.: K ekologii *Iva xanthiifolia* Nutt. po nabljudenijam v okrestnostjach Voroneža. *Bot. Žurn.* **34** (1), 76–84 (1949).

30. Święs F.: Expansion of *Iva xanthiifolia* Nutt. in the City of Lublin. Ann. Univ. Mariae Curie-Skłodowska, sectio C 47, 105–126 + Tab. I–VI (1993).
31. Tregubova T. O., Mich R. M.: Lviv. Architekturno-istoricznij narys. Vyd. „Budivelnyk”, Kyjiv 1989.
32. Trepo-Pomogyi M.: Az *Iva xanthiifolia* Nutt. Közép-Európai megtelepedése és elterjedése. Bot. Közlem. 62, 19–23 (1975).
33. Wiczkowski J.: Lwów. Jego rozwój i stan kulturalny oraz Przewodnik po mieście. Lwów 1907.
34. Zawadzki A.: Flora der Stadt Lemberg, oder Beschreibung der um Lemberg Wildwachsenden Pflanzen, nach Ihrer Bluthzeit geordnet. Lemberg 1836.

STRESZCZENIE

Scharakteryzowano aktualny stan występowania *Iva xanthiifolia* na terenie Lwowa (Ukraina). Zasadniczo dane odnoszą się do obecności tej rośliny w płatach roślinności ruderalnej należących do 7 zespołów i 5 bliżej fitosocjologicznie nie określonych zbiorowisk (tab. 1–3). Na terenie Lwowa *Iva xanthiifolia* występuje szacunkowo na kilkudziesięciu stanowiskach zgrupowanych głównie w środkowo-północnej części miasta. Najczęściej i najobficiej rośnie ona w rejonie zlokalizowanych jej stanowisk ze zdjęciami fitosocjologicznymi (ryc. 1). Najobficiej występuje wśród bliżej fitosocjologicznie nie określonego zbiorowiska z *Iva xanthiifolia* (tab. 2). Stosunkowo często i licznie rośnie w zespole *Chenopodietum ruderales* (tab. 3). W innych fitocenozach *Iva xanthiifolia* występuje rzadko i nielicznie (tab. 1, 3). Odnosi się to do 6 zespołów (*Lolio-Plantagnetum*, *Polygono-Matricarietum discoideae*, *Agropyretum repentis*, *Sisymbrietum loeselii*, *Helianthetum tuberosi* i *Reynotrietum japonicae*) oraz do 4 zbiorowisk (z *Xanthium strumarium*, z *Artemisia annua*, z *Galinsoga ciliata* oraz z *Arctium lappa* i *Artemisia vulgaris*).

W Europie *Iva xanthiifolia* po raz pierwszy osiedliła się w 1842 r. na Ukrainie, w rejonie Kijowa. Pionierskie zawleczone stanowiska tej rośliny pochodziły z okazów hodowanych w miejscowym ogrodzie botanicznym. We Lwowie po raz pierwszy pojawiła się prawdopodobnie w okresie II wojny światowej, w wyniku zawleczenia jej nasion z transportem kolejowym. Po raz pierwszy zlokalizowano ją tam w 1949 r. na nielicznych miejscach koło torów kolejowych, na bliżej nie określonych stanowiskach. Obecnie odkryte stosunkowo nieliczne stanowiska *Iva xanthiifolia* na terenie Lwowa wskazują na znacznie powolniejszą dynamikę jej rozprzestrzeniania w wymienionym mieście, niż obserwuje się to np. w Odessie, Lublinie czy Warszawie. Zróżnicowana dynamika rozprzestrzeniania się tej rośliny w wymienionych czterech miastach wiąże się z mniej lub bardziej sprzyjającymi dla niej warunkami środowiska, szczególnie klimatycznymi. Na terenie Lwowa *Iva xanthiifolia* rośnie najczęściej, podobnie jak np. w Warszawie i Lublinie, na siedliskach stale silnie naświetlonych, umiarkowanie wilgotnych, o nawierzchni zruszanej lub słabo zbitej, silnie zaśmieconej, typu gliniasto-gruzowiskowego (ryc. 3–4).