

## The list of American flowering plant species established in Poland (kenophytes)

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ABSTRACT: In the present paper, a list of American flowering plant species established in Poland (kenophytes) is given in alphabetical order. Besides, this group of kenophytes is generally characterized and its current dynamic tendencies are defined.

KEYWORDS: Species list, American flowering plants, kenophytes, Poland.

### Introduction

Activity of man has been the most important factor in influencing the flora of Poland for a few recent millennia. The historical alterations of Polish flora due to anthropogenic pressure cannot easily be reconstructed. This process originated in prehistorical times (KOZŁOWSKA 1972, RALSKA-JASIEWICZOWA 1982, ŚRODOŃ 1972, TRZCIŃSKA-TACIK and WASYLIKOWA 1982, WASYLIKOWA and GLUZA 1977). In the Neolithic age, when the settled agricultural population appeared, the changes of Polish flora began to intensify (KORNAŚ 1972).

As a subject of changes which, among others, manifested themselves in species expansion, Polish flora was enriched with alien taxa established permanently - metaphytes (KORNAŚ 1968b, 1977, 1981; KORNAŚ and MEDWECKA-KORNAŚ 1968; ZAJĄC 1979, 1983, 1986; ZAJĄC and ZAJĄC 1975).

In prehistorical and medieval times, along with the development of agriculture, the total number of the Polish flora species increased by, at least, 140 alien immigrants - archaeophytes - brought to Poland by man (KORNAŚ 1990; ZAJĄC 1979, 1983, 1986; ZAJĄC and ZAJĄC 1975).

In modern times, Polish flora gained over 100 other aliens - kenophytes - coming from various regions of the world (KORNAŚ 1968b, 1990; KORNAŚ and MEDWECKA-KORNAŚ 1968). In the 19th and 20th centuries, due to intensive transformations of the natural environment in Poland, the process of expansion of the species of this group of anthropophytes was especially observed.

At present, Polish flora, including permanently established plants of foreign origin (metaphytes), contains almost 2300 species of vascular plants (KORNAŚ 1972, 1990). The Polish flora statistics do not include over 500 species brought, temporarily - ephemerophytes (KORNAŚ 1990, OLACZEK 1976, ROSTAŃSKI and SOWA 1986-1987) and over 100 species of plants previously cultivated which get temporarily wild - ergasiophygophytes (ROSTAŃSKI and SOWA 1986-1987).

Since the 16th century the species whose homeland is America have also reached Poland and established especially in anthropogenic habitats (HANTZ 1979; HEREŻNIAK 1992; GRODZIŃSKA 1967, 1971; KORNAŚ 1968b; KOWNAS 1959; KUCHARSKI 1992; KUCOWA 1963; ROSTAŃSKI 1965, 1985, 1989, 1992; ROSTAŃSKI and GŁOWACKI 1977; ROSTAŃSKI and KLOSS 1965; ROSTAŃSKI and SZOTKOWSKI 1973; SOWA and WARCHOLIŃSKA 1992; TACIK 1971; TRZCIŃSKA-TACIK 1971).

This survey is confined American flowering plants established permanently in Poland (kenophytes).

The paper aims at:

- compilation of a list of the flowering plant species of American origin established permanently in Poland (kenophytes);
- giving the general characteristics of this group of kenophytes;
- defining the current dynamic tendencies of the American flowering plant species established permanently in Poland (kenophytes).

## Material and methods

The literature data (see References) and field observations of the authors constituted basic material for making the list of flowering plant species of American origin, established permanently in Poland (kenophytes), and for carrying out an analysis of their features.

The species list has mainly been compiled on the basis of the paper by KORNAŚ (1968b). In the present list thirteen species, namely: *Aronia melanocarpa* (MICHX) ELL., *Bromus carinatus* HOOKER et ARNOTT., *Mimulus moschatus* DOUGLAS ex LINDLEY, *Oenothera canovirens* STEELE, *Oe. oakesiana* (A. GRAY) ROBBINS, *Oe. pycnocarpa* ATH. et BARTL., *Oe. strigosa* (RYDB.) MACH. et BUSH, *Oxalis dillenii* JACQ., *Pinus banksiana* LAMB., *P. strobus* L., *Pseudotsuga menziesii* (MIRBEL) FRANCO, *Thuja plicata* D. DON. ex LAMBERT and *Tsuga canadensis* (L.) CARRIERE, have been included basing on other sources (CHMIEL 1991; HANTZ 1979; HEREŻNIAK 1992; JACKOWIAK 1990; KUCHARSKI 1992; MIREK 1982 (1984); ROSTAŃSKI 1985, 1989; ROSTAŃSKI and SOWA 1986-1987; WITOSŁAWSKI 1992) as well as on the unpublished results of R. SOWA's observations in Central Poland. For practical reasons, an alphabetical order has been adopted in the list (see Species List).

The species nomenclature has been based on the work "Flora Europaea" (TUTIN et al. 1964-1980). Other names were, among others, given in the cases when different formulation of taxon was employed or when the species has not been included in the scientific description of the European flora (GRODZIŃSKA 1967, 1971; HANTZ 1979; HEREŻNIAK 1992; JASIEWICZ 1984 (1986); KUCHARSKI 1992; PAWŁOWSKI 1971; SENETA 1981, 1991; ROSTAŃSKI 1965, 1971, 1985, 1989, 1992; ROSTAŃSKI and SOWA 1986-1987; ROTHMALER 1976, 1978; TACIK 1971).

To evaluate a systematic character of the group of kenophytes under consideration, the indices determining an average number of species in a family and in a genus as well as an average number of genera in a family have been employed (KORNAŚ and MEDWECKA-KORNAŚ 1986, WARCHOLIŃSKA 1991).

The persistence of plants was given according to "Polish Plants" (SZAFER, KULCZYŃSKI and PAWŁOWSKI 1953). The data contained in the papers by GRODZIŃSKA (1967, 1971), HANTZ (1979), HEREŻNIAK (1992), JACKOWIAK (1990), MIREK 1982 (1984), OBERDORFER (1962), PAWŁOWSKA (1959), PAWŁOWSKI (1971), ROTHMALER (1976), SOWA and WARCHOLIŃSKA (1992) and TACIK (1959, 1963, 1971) have also been used.

A division into life form groups was based on the classification of plants according to ZARZYCKI's list (1984), completed, if lacking in the data required, with the information from the papers by JACKOWIAK (1990), OBERDORFER (1962), ROTHMALER (1976), SOWA and WARCHOLIŃSKA (1992).

When analysing geographical-historical and contemporary data on the occurrence of the presented species in Poland, a commonly accepted geographical-historical division of synanthropic plants (KORNAŚ 1968a, 1977, 1981, 1990) has mostly been adopted and completed with the data included in the papers by ANIOŁ-KWIATKOWSKA (1974), BŁASZCZYK (1963), CHMIEL (1991), ĆWIKLIŃSKI (1970, 1974), FIJAŁKOWSKI (1968, 1978), FREY (1971, 1974), GRODZIŃSKA (1967, 1971), GUZIK and SUDNIK-WÓJCIKOWSKA (1989), HANTZ (1979), HEREŻNIAK (1992), JACKOWIAK (1985, 1990), KORNAŚ (1968b, 1972), KOWNAS (1959), KUCOWA (1963, 1971), LATOWSKI (1982, 1985), MACIEJCZAK (1988), MICHALAK (1970), MIREK 1982 (1984), MISIEWICZ (1976), NOWIŃSKI (1960), OBERDORFER (1962), PANCER-KOTEJOWA (1971), PAWŁOWSKA (1959), PAWŁOWSKI (1971), ROSTAŃSKI (1960, 1965, 1971, 1985, 1989, 1992), ROSTAŃSKI and GŁOWACKI (1977), ROSTAŃSKI and KLOSS (1965), ROSTAŃSKI and SOWA (1986-1987), ROSTAŃSKI and SZOTKOWSKI (1973), SCHWARZ (1967), SENDEK (1984), SENETA (1981, 1991), SICIŃSKI (1976), SOWA (1960, 1971, 1974), SUDNIK-WÓJCIKOWSKA (1987), SZOTKOWSKI (1981, 1988), TACIK (1959, 1963, 1971), TRZCIŃSKA-TACIK (1979), TUTIN et al. (1964-1980), WARCHOLIŃSKA (1974, 1976, 1981, 1990, 1991, 1993), WITOSŁAWSKI (1991, 1992) and WNUK (1978).

Besides, the synanthropodynamic division of flora, suggested by JACKOWIAK (1990), and the indices of numbers of localities, numerical force, of individuals and current dynamic tendencies, given by ZARZYCKI (1984), have been utilized.

The frequency of the occurrence of the species has been determined according to the following scale agreed upon: rare, quite frequent, frequent, and common (see JACKOWIAK 1990, SOWA and WARCHOLIŃSKA 1992, WARCHOLIŃSKA 1993).

To assign the species to syntaxonomic units, the phytosociological classification by MATUSZKIEWICZ (1981), the diagnoses compiled by ZARZYCKI (1984), and the papers by JACKOWIAK (1990), KUCHARSKI (1992), OBERDORFER (1962), SOWA and WARCHOLIŃSKA (1992), SUDNIK-WÓJCIKOWSKA (1987), TRZCIŃSKA-TACIK (1971), WARCHOLIŃSKA (1990) have been used.

The division of the species into sociological-ecological groups has mainly been based on the papers by JACKOWIAK (1990), KUNICK (1974), SOWA and WARCHOLIŃSKA (1992).

## List of species

<i>Acer negundo</i> L.	<i>Aceraceae</i>
<i>Amaranthus albus</i> L.	<i>Amaranthaceae</i>
<i>A. blitoides</i> S. WATSON	
<i>A. hybridus</i> L. ( <i>A. chlorostachys</i> WILLD.)	
<i>A. retroflexus</i> L.	
<i>Ambrosia artemisiifolia</i> L.	<i>Compositae</i>
<i>A. psilostachya</i> DC.	
<i>Anaphalis margaritacea</i> (L.) BENTHAM in BENTHAM et HOOKER fil.	
<i>Aronia melanocarpa</i> (MICHX) ELL.	<i>Rosaceae</i>
<i>Asclepias syriaca</i> L.	<i>Asclepiadaceae</i>
<i>Aster novae-angliae</i> L.	<i>Compositae</i>
<i>A. novi-belgii</i> L.	
<i>A. salignus</i> WILLD. ( <i>A. salicifolius</i> SCHOLLER, non LAM., <i>A. fruterorum</i> WIMM.)	
<i>A. simplex</i> WILLD. ( <i>A. lanceolatus</i> WILLD.)	
<i>A. tradescantii</i> L. ( <i>A. parviflorus</i> NEES)	
<i>Bidens connata</i> MUHL. ex WILLD.	
<i>B. frondosa</i> L. ( <i>B. melanocarpus</i> WIEG.)	
<i>Bromus carinatus</i> HOOKER et ARNOTT.	<i>Gramineae</i>
<i>Chamomilla suaveolens</i> (PURSH) RYDB. ( <i>Matricaria</i> <i>matricarioides</i> (LESS.) POSTER pro parte, <i>M.</i> <i>discoidea</i> DC.)	<i>Compositae</i>
<i>Collomia grandiflora</i> DOUGLAS ex LINDLEY	<i>Polemoniaceae</i>
<i>Conyza canadensis</i> (L.) VRONG. ( <i>Erigeron canadensis</i> L.)	<i>Compositae</i>
<i>Cuscuta campestris</i> YUNCKER	<i>Convolvulaceae</i>
<i>C. gronovii</i> WILLD. in ROEMER et SCHULTES	
<i>Datura stramonium</i> L.	<i>Solanaceae</i>
<i>Echinocystis lobata</i> (MICHX) TORREY et A. GRAY	<i>Cucurbitaceae</i>
<i>Elodea canadensis</i> MICHX	<i>Hydrocharitaceae</i>
<i>Epilobium ciliatum</i> RAF.	<i>Onagraceae (Oenotheraceae)</i>
<i>Erechtites hieracifolia</i> (L.) RAFIN. ex DC.	<i>Compositae</i>
<i>Erigeron annuus</i> (L.) PERS. ( <i>Stenactis annua</i> (L.) LEES.)	
<i>E. strigosus</i> MUHLENB. ( <i>E. ramosus</i> WALT. BRITT. STERPS et POGGENB., non RAF.; <i>Stenactis bellidi-</i> <i>flora</i> (WALLR.) A. BR.)	
<i>Euphorbia maculata</i> L.	<i>Euphorbiaceae</i>
<i>Galinsoga ciliata</i> (RAFIN.) S.F. BLAKE ( <i>G. quadrira-</i> <i>diata</i> RUIZ et PAV.)	<i>Compositae</i>
<i>G. parviflora</i> CAV.	
<i>Helianthus tuberosus</i> L.	
<i>Iva xanthifolia</i> NUTT.	
<i>Juncus tenuis</i> WILLD. ( <i>J. macer</i> S.F. GRAY)	<i>Juncaceae</i>
<i>Lepidium densiflorum</i> SCHRADER	<i>Cruciferae</i>

<i>L. virginicum</i> L.	
<i>Lupinus polyphyllus</i> LINDLEY	Leguminosae
<i>Mimulus guttatus</i> DC.	Scrophulariaceae
<i>M. moschatus</i> DOUGLAS ex LINDLEY	
<i>Nicandra physalodes</i> (L.) GAERTNER	Solanaceae
<i>Oenothera canovirens</i> STEELE	Onagraceae (Oenotheraceae)
<i>Oe. oakesiana</i> (A. GRAY) ROBBINS	
<i>Oe. parviflora</i> L.	
<i>Oe. pycnocarpa</i> ATH. et BARTL.	
<i>Oe. salicifolia</i> DESF. ex G. DON ( <i>Oe. hungarica</i> BORBÁS)	
<i>Oe. strigosa</i> (RYDB.) MACH. et BUSH	
<i>Oe. subterminalis</i> GATES ( <i>Oe. silesiaca</i> RENNER)	
<i>Oxalis dillenii</i> JACQ.	Oxalidaceae
<i>O. europaea</i> JORDAN in F.W. SCHULTZ ( <i>O. stricta</i> L.)	
<i>Pinus banksiana</i> LAMB.	Pinaceae
<i>P. strobus</i> L.	
<i>Prunus serotina</i> EHRH. ( <i>Padus serotina</i> EHRH.)	Rosaceae
<i>Pseudotsuga menziesii</i> (MIRBEL) FRANCO	Pinaceae
<i>Robinia pseudoacacia</i> L.	Leguminosae
<i>Rudbeckia hirta</i> L.	Compositae
<i>R. laciniata</i> L.	
<i>Sicyos angulatus</i> L. ( <i>S. angulata</i> L.)	Cucurbitaceae
<i>Sisyrinchium montanum</i> E.L. GREENE ( <i>S. angustifolium</i> MILLER pro parte, <i>S. bermudiana</i> sensu COSTE, non L.)	Iridaceae
<i>Solidago canadensis</i> L.	Compositae
<i>S. gigantea</i> AITON ( <i>S. serotina</i> AIT.)	
<i>S. graminifolia</i> (L.) SALISB.	
<i>Thuja plicata</i> D. DON. ex LAMBERT	Cupressaceae
<i>Tsuga canadensis</i> (L.) CARRIERE	Pinaceae
<i>Xanthium spinosum</i> L.	Compositae
<i>X. strumarium</i> L. subsp. <i>italicum</i> (MORETTI) D. LÖVE, ( <i>X. italicum</i> MORETTI, <i>X. riparium</i> ITZIGSOHN et HERTSCH.)	

### Characteristics of the group of American flowering plants established in Poland (kenophytes)

#### Species richness

Polish flora is characterized by a pretty large participation of flowering plants of American origin established permanently in the habitats which are disturbed by man to various degrees (kenophytes). As agreed by the authors, basing themselves on the available literature and their own observations, the number of these plants amounts to 67 species (see Species List and References). It constitutes almost 70% of all the kenophytes having arrived to Poland after 1500 A.D. Most of them are synanthropic plants, which exist in ruderal and segetal habitats. They above all contribute to the flora

of towns (JACKOWIAK 1990; SUDNIK-WÓJCIKOWSKA 1987; SOWA and WARCHOLIŃSKA 1980, 1984). Relatively few American flower kenophytes are members of segetal floras (WARCHOLIŃSKA 1981, 1993; WNUK 1978).

The number of American flowering plant immigrants is not the same all over Poland. Along with the regional differences of climate, it remains in close relation to the variations of utilization forms of an area and to the degree a given space has been transformed. The influence of economic relations finds expression mostly in the abundant occurrence of American flowering plants in port, urban and industrial centres and in their smaller contribution of theirs to the flora of cities with no industry, country towns, and agricultural regions (ĆWIKLIŃSKI 1970; JACKOWIAK 1990; MACIEJCZAK 1988; MICHALAK 1970; MISIEWICZ 1976; SCHWARZ 1967; SENDEK 1984; SICIŃSKI 1976; SOWA 1971; SOWA and WARCHOLIŃSKA 1980, 1984; SUDNIK-WÓJCIKOWSKA 1990; SZOTKOWSKI 1988; TRZCIŃSKA-TACIK 1979; WARCHOLIŃSKA 1976, 1981, 1993; WITOSŁAWSKI 1992 and WNUK 1978). The American flowering plant species with the highest invasion level occur independently of the degree of area transformation, e.g. *Solidago canadensis*.

The most numerous are rare species and the common plants are sporadic. Among the rare species worth noticing are immigrants established in few habitats, in scattered localities, and in spatially limited regions of Poland, e.g. *Asclepias syriaca*, *Euphorbia maculata*, *Lepidium virginicum*, *Nicandra physalodes*, *Oenothera parviflora*, *Oxalis dillenii*, *Xanthium spinosum*. The common species exist in the whole area of Poland, the majority of them growing in many habitats, e.g. *Amaranthus retroflexus*, *Conyza canadensis*, *Galinsoga parviflora*, *Chamomilla suaveolens*, *Solidago canadensis*.

### Systematic differentiation

The flowering plant taxa of the group of American kenophytes recorded in anthropogenic habitats in Poland belong to 21 families and 42 genera, among which the taxa represented by a small number of species predominate. They are mainly congeneric taxa like *Euphorbia* L., *Asclepias* L., *Collomia* NUTT., *Nicandra* ADANSON, *Conyza* LESS., *Iva* L., *Juncus* L., *Bromus* L. The genera richer in species are only *Solidago* L. (3 species), *Amaranthus* L. (4 species), *Aster* L. (5 species), and *Oenothera* L. (7 species).

The group of American flower immigrants has a considerably simple family and genus composition since 6 families, namely *Pinaceae*, *Amaranthaceae*, *Cucurbitaceae*, *Onagraceae* (*Oenotheraceae*), *Solanaceae* and *Compositae*, comprise 68.6% of all species and 57.1% of all genera. In this kenophytes group a significant role is played by the *Compositae* comprising 26 species of newcomers belonging to 14 genera. Out of this family the genus *Aster* is the richest in species (5 species).

The indices defining an average number of species in the family (3.2) and genus (1.6) as well as an average number of genera in the family (2.0) suggest that the degree of systematic differentiation of this kenophytes group (67 species), irrespective of relatively simple family and genus composition, is very high.

### Biological structure

A characteristic ecological feature of the group of kenophytes under consideration is its predominance over other life forms (RAUNKIAER 1905). The interesting taxa from

this plant group are, for example, *Sicyos angulatus* - creeper, *Cuscuta campestris* and *C. gronovii* - parasites of cultivated plants. Hemicryptophytes constitute a relatively numerous group to which, among others, 5 species of *Aster* and 2 species of *Erigeron* L. belong.

The group of American kenophytes consists mainly of annual and biennial species. These are especially the species which reproduce early and produce considerable amounts of tiny seeds capable of germination at various intervals from the seeding time. For instance, an individual of *Conyza canadensis* produces about 243 thousands of seeds germinating three times a year - in spring, summer, and autumn, and an individual of *Galinsoga parviflora* produces over 300 thousands of seeds from May till September, that germinate twice to three times a year as well (DOMAŃSKA 1970 and NOWIŃSKI 1960). They are typically pioneer plants, colonizing open areas with low degree of competition. They most frequently inhabit the places strongly disturbed by man, i.e. ruderal habitats as well as considerably changed habitats of arable fields and gardens. Within this group, there are also indirect hosts of virus diseases of potatoes, tomatoes, green pepper, and tobacco, e.g. *Datura stramonium*.

The group of perennial plants is rich in species as well. Due to great competitive potential connected, among others, with an intensive vegetative reproduction and considerable plant luxuriance, lots of species of that group have succeeded in overcoming biotic barriers and penetrated into less changed semi-natural habitats, as exemplified by the genus species of *Solidago*, *Aster* and *Rudbeckia* L. as well as *Helianthus tuberosus* and *Epilobium ciliatum*.

### Geographical structure

Within the group of flowering plants of American origin established in Poland the immigrants from North America predominate. They mostly come from the regions with temperate climate that is similar to that of Poland. Among these newcomers, numerous species have not only got established in synanthropic habitats but also managed to penetrate into semi-natural plant communities. What is characteristic of these newcomers is mostly their great expansive nature (e.g. *Helianthus tuberosus*, *Solidago canadensis*, *Aster novi-belgii*, *Rudbeckia laciniata*).

A small group of species coming from South America has also got established permanently in Poland, mainly in synanthropic habitats, but only thanks to their biological features as, for example, their extremely intensive reproduction by seeds that tolerate satisfactorily low temperature in winter. *Galinsoga parviflora* is the most expansive species of this group (KORNAŚ 1972 and NOWIŃSKI 1960).

The group of flowering plant species of American origin, arrived and established permanently in Poland in modern times (kenophytes), consists of various elements. A fundamental group of the analysed American kenophytes are epacophytes. Some of them occur commonly in the whole area of Poland and in many habitats, e.g. *Amaranthus retroflexus*, *Galinsoga parviflora* and *Chamomilla suaveolens*. The species established in semi-natural habitats (hemiagriophytes) constitute a relatively smaller group, with such interesting taxa as *Erechtites hieracifolia*, *Epilobium ciliatum*, *Echinocystis lobata*, *Juncus tenuis*. The hemiagriophyte occurring most frequently is *Solidago canadensis*.

## Sociological-ecological character

Out of the group of 67 taxa of American flower kenophytes, 32 species (47,8%) have so far been included into particular phytosociological units. They occur in the communities of eight classes, namely: *Chenopodietea* OBERD. 1957 em. LOHM., J. et R. TX. 1961; *Secalietea* BR.-BL. 1951; *Plantaginetea maioris* R. TX. et PRSG. 1950; *Artemisietea* LOHM., PRSG. et R. TX. 1950; *Epilobietea angustifolii* R. TX. et PRSG. 1950; *Bidentetea tripartiti* R. TX., LOHM. et PRSG. 1950; *Potamogetonetea* TX. et PRSG. 1942; *Phragmitetea* R. TX. et PRSG. 1942 (MATUSZKIEWICZ 1981). The species composing these communities have been classified as sociological-ecological groups (JACKOWIAK 1990, KUNICK 1974, SOWA and WARCHOLIŃSKA 1992). The species composition and number of species in these groups depend on forms of utilization of an area.

In the vegetation cover of Poland the most significant are the species of nitrophilic communities developing in ruderal habitats and on water edges. Almost the same role in the Polish flora is played by the plants from nitrophilic communities of vegetable-garden cultivation and field culture of root crops as well as from stenothermal ruderal communities. The scantiest groups are those comprising the community species of corn-growing, clearings, nitrophilic trodden spots, and places in river valleys. The greatest contribution to the plants reacting positively to anthropogenic pressure have the groups comprising the species of ruderal communities, garden weeds, and field root-crop culture.

Most of the distinguished sociological-ecological groups comprise, in the first place, the components of synanthropic communities, i.e. epoecophytes. In addition the species of the above groups show differences in reference to their ecological tolerance. A considerable number of the species of these groups is greatly attached to the corresponding syntaxa, thus characterized by small or very small ecological amplitudes. The species characteristic of 10 associations are 14 taxa, including:

- *Galinsogo-Setarietum* (R. TX. et BECK. 1942) R. TX. 1950: *Galinsoga parviflora*, *G. ciliata*;
- *Oxalido-Chenopodietum polyspermi* SISS. 1950: *Oxalis europaea*;
- *Erigeronto-Lactucetum* LOHM. 1950: *Lepidium virginicum*, *L. densiflorum*;
- *Lolio-Plantaginietum* (LINCOLA 1921) BEGER 1930: *Chamomilla suaveolens*;
- *Juncetum macri* (DIEM. SISS. et WESTH. 1940) SCHWICK. 1944 em. R. TX. 1950: *Juncus macer*;
- *Erysimo-Melilotetum* FALIŃSKI (1963) 1965: *Erigeron strigosus*;
- *Rudbeckio-Solidaginetum* R. TX. et RAABE 1950: *Rudbeckia laciniata*, *Solidago canadensis*, *S. gigantea*;
- *Xanthio riparii-Chenopodietum* LOHM. et WALTHER 1950: *Xanthium strumarium* subsp. *italicum*;
- *Elodeetum canadensis* (PIGN. 1953) PASS. 1964: *Elodea canadensis*;
- *Sparganio-Glycerietum fluitantis* BR.-BL. 1925 n.n.: *Mimulus guttatus*.

The species characteristic of syntaxon group have a larger amplitude, e.g., for the alliances: *Senecion fluviatilis* R.TX. (1947) 1950 - *Aster salignus*, *Bidention tripartiti* NORDH. 1940 - *Bidens connata*, *Chenopodion fluviatilis* R. TX. 1950 - *Bidens frondosa*, and for the order *Eragrostietalia* J. TX. 1961 - *Amaranthus albus* and *A. hybridus*. The species distinguished as diagnostic of the *Galinsogo-Setarietum* association is



*Amaranthus retroflexus* and of the alliance *Sisymbrium* R. TX., LOHM., PRSG. 1950 - *Conyza canadensis*. The taxa and syntaxa mentioned above can be utilized as phytointicators of the in habitats.

Out of several characteristics of taxa, conditioning their persistence in the mentioned communities, those which determine the taxa reproductive success are especially worth of attention.

The frequency of American kenophytes in synanthropic and semi-natural communities depends, among other factors, on the degree of their competitive potential connected with reproductive strategy and other biological features as luxuriance or persistence.

### Dynamic tendencies

The lack of complete literature data concerning the history of the expansion of most kenophytes analysed makes it difficult to estimate the phenomenon.

The immigration process of these species has begun with their unconscious introduction, e.g. *Xanthium spinosum*, *Juncus macer*, or purposeful import of diaspores, e.g. *Amaranthus retroflexus*, *Asclepias syriaca*, *Sicyos angulatus*, *Aster salignus*, *Solidago canadensis*, *Chamomilla suaveolens*, *Rudbeckia laciniata*, *Erigeron annuus*, and with the appearance of pionner individuals in the region of Poland. First they successively established at synanthropic habitats disturbed intensely, and then in semi-natural habitats transformed to a smaller degree.

The arrival time of the flower plants of American origin differs. However, the intensification of their immigration and expansion took place not before the 19th and 20th centuries as, e.g., in the case of *Chamomilla suaveolens*, *Juncus tenuis*, *Echinocystis lobata*, *Cuscuta campestris*, *Ambrosia psilostachya*, *Iva xanthifolia*, *Galinsoga ciliata* and *Erechtites hieracifolia*. Relatively latest newcomers, expanding in modern times, are, among others, *Amaranthus blitoides* (found in Poland in 1930), *A. hybridus* (probably arrived in Poland before 1950) (see FREY 1974), and *Bromus carinatus* (recorded for the first time in 1963) (see MIREK 1982-1984).

Lots of other species of the latest American newcomers are still wandering and occupying new localities as, e.g., *Epilobium ciliatum*. At the moment this kenophyta is locally at the stage of intensive expansion (JACKOWIAK 1990). A very large expansiveness is also characteristic of *Solidago canadensis*, *A. gigantea*, and the others (see ZARZYCKI 1974). *Conyza canadensis* belongs to the species of high degree of hemerophily.

The plants of the greatest hemerophilic character are presently most of American segetal species established in Poland, occurring also commonly in ruderal habitats, e.g. *Amaranthus retroflexus*, *Galinsoga parviflora* and *Chamomilla suaveolens*. According to ZARZYCKI (1984) *Galinsoga parviflora* shows the largest expansiveness.

Due to this process the number of nitrophilic species increases to a great extent. Thanks to the expansion of American and other immigrants Polish flora gradually gains more cosmopolitan character.

### Summary

In the paper, the species list of American flowering plants established in Poland (kenophytes) is given. Besides, this group of kenophytes is generally characterized and its current dynamic tendencies are defined. The analysed group of American

immigrants, established permanently in anthropogenic habitats of Poland, amounts to 67 species, the majority of which come from North America. A fundamental group of the presented kenophytes are epocophytes. The most numerous are annual and biennial species. Up to now the phytosociological affiliation of 32 species has been determined. The major part of species composition of the kenophytes considered is of hemerophilic character. The most common are the species with a low level of hemerophily whereas the scantiest are those with a high hemerophily level. One of the latest newcomers, which is expanding locally in Poland, is *Bromus carinatus*.

Due to the immigration of the presented group of American newcomers the native species composition of Polish flora has permanently got enriched. Moreover, the flow of American plant immigrants has altered the qualitative-quantitative character of the flora in Poland.

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