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Invasive vascular plant species in the south-western part of the Silesian Upland (south Poland)

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Abstract: The main goal of this study is to present a diversity of invasive plants occurring in the south-western part of the Silesian Upland and to estimate their impact on transformation of the native plant cover. Among 101 species considered to be invasive, three groups were distinguished: "not harmful" (46 species), "weeds" (32) and "transformers" (23). Subsequently, their characteristics is given (origin, geographical-historical groups, life forms, frequency of occurrence) and they are briefly compared. Special attention is paid to the species included in the "transformers" group which enter natural and semi-natural habitats and transform the native plant cover to the largest extent. It has been determined that these are usually large perennial plants or trees, of predominantly North American origin, with numerous localities in which they often form compact patches occupying large areas.

Key words: invasive species, alien plants, Rybnik Plateau, Katowice Upland, Silesian Upland, Poland

1. Introduction

Until 1945, floristic studies in the south-western part of Silesian Upland had been conducted predominantly by German botanists. After the World War II they have been carried on by Polish florists, mainly from Wrocław, Opole and Katowice scientific centres. Detailed studies on the flora of some mesoregions of the Silesian Upland – including the Rybnik Plateau and the south-western part of the Katowice Upland – have been published only in recent years (Urbisz 1996; Urbisz 2001). Hitherto, no work has been published dealing exclusively with invasive plants in this region and with estimation of the threat they pose to the native plant cover.

2. Characteristics of the study area

The study area (Fig. 1), measuring ca. 1250 km^2, encompasses the Rybnik Plateau and the south-western part of the Katowice Upland (Kondracki 1988). It is an extensively industrialised region and therefore its plant cover is subjected to strong anthropopressure. Apart from natural terrain surface forms, anthropogenic forms also exist here. They are usually formed as a result of mining activity and development of housing and transport facilities. The analysed area is located at an average altitude of 250-300 m a.s.l. Podzolic and brown soils dominate here. Water conditions in the study area are determined among others by its location on the main watershed of the upper Oder and Vistula basins. The vicinity of the Oder river, forest complexes in the eastern part of Opole province and the Pogórze region as well as the relatively short distance from the mouth of

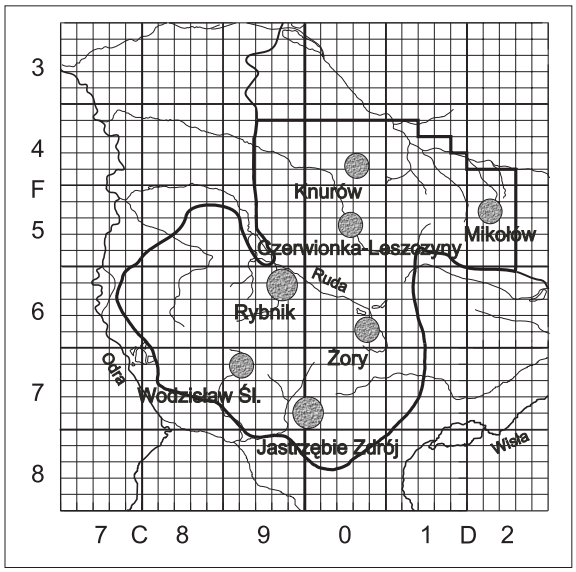

Fig. 1. Borders of the study area with ATPOL square grid (after Zając 1978)

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Moravian Gate all combine to cause milder climate conditions in the study area. The influence of densely built-up areas, especially large cities, on the climate is also to be reckoned with.

3. Material and methods

Literature records and herbarium collections were used during the floristic studies conducted between 1986 and 1999. The method applied for data collection included preparation of cartogrammes based on a square grid with 2 km side (310 squares in total), according to the methodological convention of *Distribution Atlas of Vascular Plants in Poland* (ATPOL) (Zając 1978). Observations were carried out using floristic lists which were used to record plant species occurring in individual cartogramme squares. The definition and classification of invasive species was adopted from Pyšek *et al.*

Table 1. The invasive species of south-western part of Silesian Upland

Species name	No. loc.	Species name	No. loc.
"not harmful"		*Avena fatua*	43
Armoracia rusticana	205	*Centaurea cyanus*	237
Asclepias syriaca	2	*Chamomilla recutita*	169
Ballota nigra	59	*Echinochloa crus-galli*	209
Bromus carinatus	90	*Euphorbia helioscopia*	82
Bromus sterilis	27	*Euphorbia peplus*	79
Bromus tectorum	44	*Fallopia convolvulus*	252
Bunias orientalis	9	*Galinsoga ciliata*	299
Capsella bursa-pastoris	307	*Galinsoga parviflora*	227
Chamomilla suaveolens	301	*Lithospermum arvense*	35
Chenopodium strictum	69	*Matricaria maritima* ssp. *inodora*	305
Cichorium intybus	102	*Myosotis arvensis*	195
Clematis vitalba	10	*Papaver rhoeas*	123
Descurainia sophia	46	*Raphanus raphanistrum*	250
Echinops sphaerocephalus	25	*Scleranthus annuus*	110
Eragrostis minor	13	*Setaria pumila*	124
Erigeron annuus	89	*Setaria viridis*	29
Geranium pusillum	159	*Sinapis arvensis*	154
Helianthus tuberosus	54	*Spergula arvensis*	190
Hordeum murinum	15	*Thlaspi arvense*	130
Juglans regia	104	*Veronica arvensis*	144
Lactuca serriola	249	*Veronica persica*	109
Lamium album	26	*Vicia dasycarpa*	65
Lamium purpureum	273	*Vicia hirsuta*	173
Lepidium ruderale	69	*Vicia sativa*	86
Lolium multiflorum	69	*Vicia tetrasperma*	117
Malus domestica	193	*Vicia villosa*	45
Malva alcea	42	*Viola arvensis*	287
Malva neglecta	92	"transformers"	
Malva sylvestris	62	*Acer negundo*	75
Medicago sativa	228	*Acorus calamus*	19
Parthenocissus inserta	61	*Aesculus hippocastanum*	172
Populus 'NE 42'	151	*Aster novi-belgii*	52
Populus ×canadensis	157	*Bidens frondosa*	211
Rosa rugosa	92	*Conyza canadensis*	292
Rudbeckia laciniata	54	*Echinocystis lobata*	116
Senecio vernalis	11	*Elodea canadensis*	32
Senecio vulgaris	192	*Epilobium ciliatum*	161
Sisymbrium altissimum	47	*Fraxinus pennsylvanica*	76
Sisymbrium loeselii	31	*Heracleum sosnowskyi*	15
Sisymbrium officinale	255	*Impatiens glandulifera*	66
Sonchus asper	83	*Impatiens parviflora*	240
Sonchus oleraceus	235	*Lupinus polyphyllus*	186
Sorbaria sorbifolia	25	*Oxalis fontana*	171
Spiraea ×pseudosalicifolia	63	*Padus serotina*	143
Symphoricarpos albus	163	*Quercus rubra*	209
Urtica urens	59	*Reynoutria japonica*	154
"weeds"		*Reynoutria sachalinensis*	18
Amaranthus retroflexus	65	*Robinia pseudoacacia*	262
Anthemis arvensis	49	*Solidago canadensis*	169
Anthoxanthum aristatum	10	*Solidago gigantea*	283
Apera spica-venti	271	*Solidago graminifolia*	5

Explanation: No. loc. – number of localities (gird squares)

(2004). Names of plant species are taken from Mirek *et al*. (2002), geographical origin of species is taken from Zając (1979) and Zając *et al*. (1998), while life forms are cited from Zarzycki *et al*. (2002).

4. Results and discussion

Flora of the study area numbers 101 invasive plant species (including 55 new arrivals, so-called kenophytes, and 46 older arrivals – archaeophytes). Within this number, 46 species are considered to be "not harmful", 32 species belong to the group of "weeds", while 23 are included in the group of "transformers" (Table 1). The list includes 28 species of American origin, 67 arrivals from Europe or Asia, 3 species of anthropogenic origin and 3 species of unknown origin. A majority of analysed species are therophytes (59%), phanerophytes (16%) as well as hemicryptophytes (13%). Geophytes constitute 8%, while hydrophytes and chamaephytes – 2% each of the total number of species. There is a clear preponderance of frequent, very frequent and common species, which together account for 84% of the total number. Localities of invasive species are concentrated in the outskirts of larger cities as well as along river valleys and main transport pathways (Fig. 2).

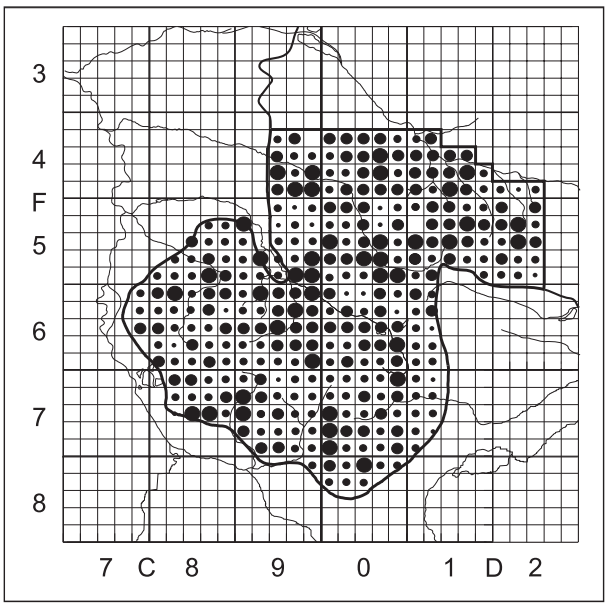

Fig. 2. The concentration of invasive species localities in the study area (circles diameter is proportional to the number of species occurring in a given square – from 0 to 82)

The comparison of spectra for geographical-historical groups, the origin, occurrence frequency and life forms for the distinguished groups of invasive species was shown on figures 3 a, b, c, d.

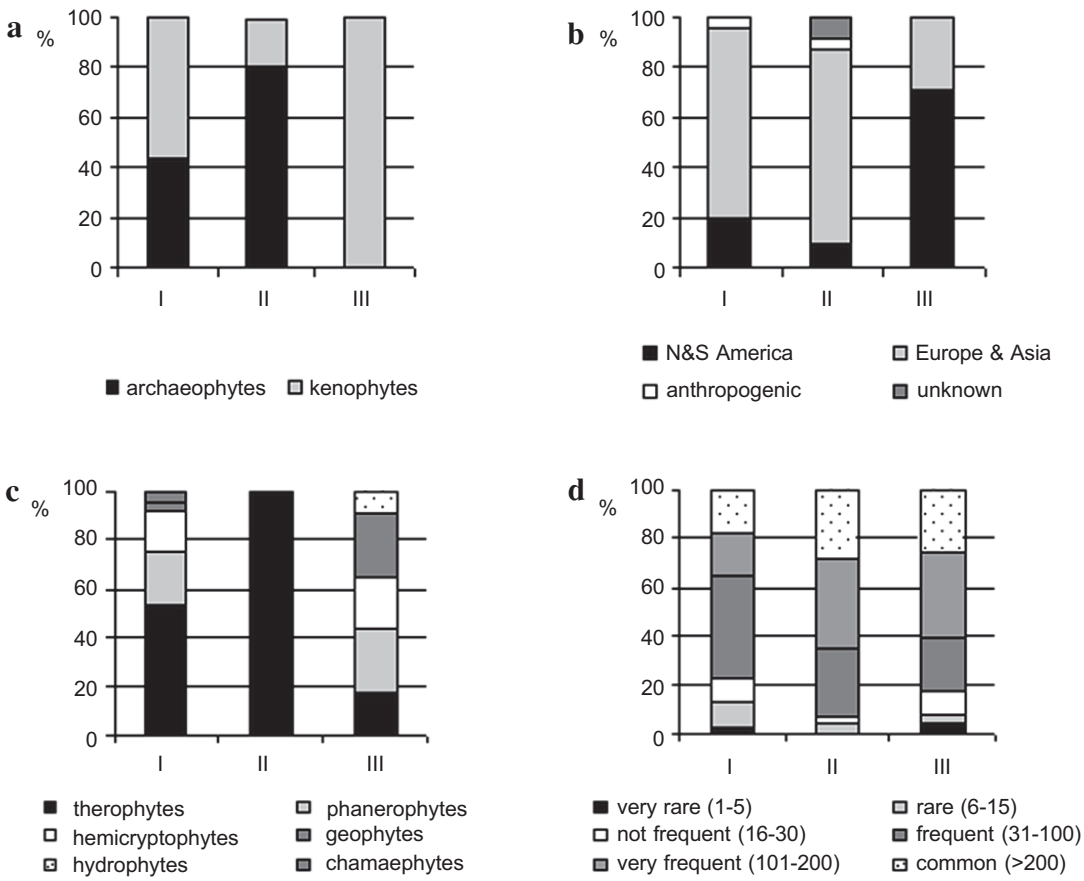

Fig. 3. The comparison of spectra for a – geographical-historical groups, b – origin, c – life forms, and d – species frequency in distinguished groups (I – not harmful, II – weeds, III – transformers)

Group of "not harmful" species contains plants diverse in relation to comparative factors. This group varies from the other groups of species by significantly lower participation of very frequent and common species. This mainly results from lack of adaptability to habitat conditions in the area given, revealed by these plants. Species belonging to this group have not hitherto posed a major threat to the native plant cover and they are not too troublesome for a man.

In the "weeds" group archaeophytes distinctly dominate, however American species are only few. The highest number of frequent, very frequent and common species appears in that particular group and their participation achieves almost 94%. Also the average number of localities is the highest in the "weeds" group (146), while "transformers" occur in 136 grid squares and "not harmful – in 102 squares. "Weeds" are tightly linked with agricultural arable land where they are often actively combated due to their abundant occurrence. As therophytes these plants are in the majority of cases not able to adapt into conditions created by natural habitats where the plant cover is usually dense, therefore indigenous flora is not significantly threatened by them.

Species counted to the group of "transformers", which are capable of transforming the plant communities of natural origin, are characterized by the following features: (*i*) they belong to kenophytes, most often of North American origin; (*ii*) they occur in numerous localities; (*iii*) they form compact patches which often occupy a large surface; (*iv*) they are mainly large perennial plants or trees.

The highest threat to the native flora is caused by the following species: *Bidens frondosa, Echinocystis lobata, Impatiens parviflora, Lupinus polyphyllus, Padus serotina, Quercus rubra, Reynoutria japonica, Robinia pseudoacacia, Solidago canadensis, S. gigantea.*

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