

# Alien species on walls in southern and western Moravia (Czech Republic)

Deana Simonová

Department of Botany, Faculty of Science, Masaryk University, Kotlářská 2, CZ-611 37 Brno, Czech Republic, e-mail: deanas@seznam.cz

Walls are man-made habitats, typical of human settlements and exposed to strong anthropogenous influences. Nevertheless, they provide new ecological niches in built-up areas and can be occupied by different types of synanthropic vegetation. Flora of walls is composed of a high number of accidental species with a low degree of habitat fidelity and low cover. Species composition of wall flora is influenced by many factors. Besides the local abiotic conditions, macroclimate and availability of diaspores from the surrounding ruderal or seminatural vegetation types, a human influence play a significant role in shaping the species composition on walls.

## Methods

Flora and vegetation of walls was studied in southern and western Moravia (Fig. 1) in 2001-2003. In total, 302 phytosociological relevés was recorded on vertical and horizontal wall surfaces in villages, towns and castle ruins together with the information on local habitat conditions, walls' surroundings (type of settlement and land use) and macroclimate (phytogeographic region, mean annual temperature and precipitation). Biological features of species were taken from Klotz et al. (2002).

## Alien flora on walls (Figs. 2 and 3)

Altogether, 288 species of vascular plants and 39 bryophytes were recorded. Flora of the studied walls included 40 % of alien species. Compared with the representation of alien species on walls reported from other parts of the Czech Republic (Duchoslav 2002, Chludová 2003), this proportion is rather high and results from presence of several garden escapes, deliberate introductions by man and higher annual temperature in the study area. In the flora of the Czech Republic there is approximately 33 % of alien species (Pyšek et al. 2002).

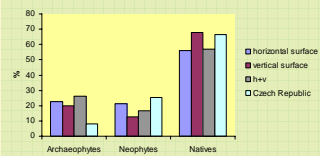


Fig. 3. Relative representation of alien and native species (archaeophytes, neophytes) on horizontal wall tops, vertical wall surfaces, horizontal and vertical surfaces together (h+v) and the total representation in flora of the Czech Republic (according to Pyšek et al. 2002).

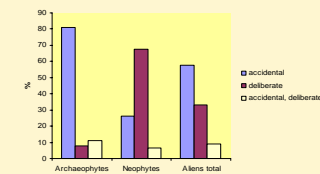


Fig. 4. The ratio of alien species with regard to the presumed type of introduction (according to Pyšek et al. 2002).

## Invasive status

Alien species occurring on walls consist of 67 % of naturalized, 23 % of invasive and 10 % of casual species (Fig. 6). The majority of archaeophytes is classified as naturalized species. Neophytes include a considerable number of invasive species (e.g. *Conyza canadensis*, *Epilobium ciliatum*, *Sisymbrium loeselii*, *Solidago canadensis* or *Syringa vulgaris*) and casuals - cultivated species escaping occasionally from cultivation or planted in the walls in earlier times (e.g. *Anthriscus cerefolium*, *Calendula officinalis*, *Cerastium biebersteinii*, *Erysimum cheiri* or *Hyssopus officinalis*).

## Alien species and environmental factors

Detrended correspondence analysis was used to reveal the relationship between species composition and environmental factors. The main factors influencing the flora and vegetation of walls are altitude and habitats types on walls - vertical and horizontal surfaces (Figs. 7 and 8).

Gradient in altitude and associated climatic factors (mean annual temperature and precipitation) strongly influence the representation of alien and native species. Archaeophytes and neophytes are more frequent on walls at lower altitudes in the study area.

The ratio of native and alien species was assessed with regard to the type of human settlement (town, village, castle ruin) and land use in the surroundings of the studied walls (percentage cover of land use categories within a 0.5 km distance from the wall: forest, urban area, grassland and arable land). Occurrence of alien species on walls is more frequent in towns, in contrast to native species, whose proportion is higher on walls of castles and castle ruins (Table 3). These habitats are mostly situated in larger distance from urban areas and are surrounded by natural vegetation types.

Table 3. Total numbers of alien and native species with regard to the type of settlement.

	Archaeophytes	Neophytes	Aliens total	Natives	Total number of species	Number of relevés
Towns	57	38	95	136	231	197
Villages	39	28	67	100	167	93
Castles	4	2	6	45	51	12

## References:

- Duchoslav M. (2002): Flora and vegetation of stony walls in east Bohemia (Czech Republic). - Preslia 74: 1-25.  
 Chludová K. (2003): Flora a vegetace zdi na střední Moravě (Flora and vegetation of walls in central Moravia). - Ms., thesis, Palacký Univ., Olomouc.  
 Klotz S., Kühn L. et Durka W. (2002): Bioflor - eine Datenbank mit biologisch-ökologischen Merkmalen zur Flora von Deutschland. - Schriften. Vegetationsk. 38: 1-334.  
 Pyšek P., Sádlo J. et Mandák B. (2002): Catalogue of alien plants of the Czech Republic. - Preslia 74: 97-186.  
 This study was funded from project MSM 0021622416.

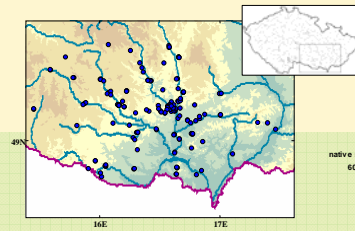


Fig. 1. Studied localities of walls in the study area.

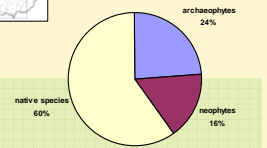


Fig. 2. The total representation of alien and native species on walls.

## Archaeophytes and neophytes on walls - biological features

The representation of archaeophytes (species introduced before 1500) was 24 % and the most common species were *Chelidonium majus*, *Ballota nigra* and *Capsella bursa-pastoris* (Table 1). Neophytes (species introduced after 1500) made up 16 % of the total species number and the most frequent were *Conyza canadensis*, *Syringa vulgaris* and *Erigeron annuus*. In the flora of the Czech Republic the representation of archaeophytes is 8 % and neophytes 25 % (Pyšek et al. 2002).

In comparison with native species, aliens were recorded more often on horizontal wall tops than on vertical wall surfaces (Fig. 3). Generally, alien species have higher temperature requirements so they can more easily colonize these extreme wall microhabitats. Moreover, some neophytes were introduced on wall tops for ornamental purposes in the past (e.g. *Sedum rupestre* subsp. *erectum*, *S. spurium* or *Sempervivum tectorum*).

Species introduced into the country deliberately as cultivated species prevail among neophytes, whereas archaeophytes include many taxa introduced accidentally. The structure of the alien flora on walls with regard to the presumed type of introduction is shown in Fig. 4.

Alien species recorded on walls belong to 35 families. The most common are *Asteraceae* (19 %), *Brassicaceae* (9 %) and *Poaceae* (8 %).

## The most represented life forms in alien species are therophytes (41 %) and hemicryptophytes (37 %) (Fig. 5).

Therophytes contribute to the total number of archaeophytes with 50 % and neophytes with approximately 28 %. Among neophytes, there is a significant ratio of phanerophytes (26 %).

With respect to the life strategies, CR and R strategy are the most frequent ones (Table 2). Similarly to the total alien flora of the Czech Republic, archaeophytes include most taxa with CR and R strategy (both 35 %) and the majority of neophytes are C strategists (32 %).

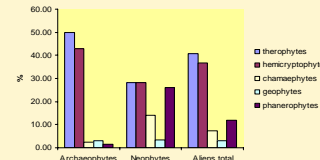


Fig. 5. Percentage proportion of life forms (according to Klotz et al. 2002) in alien species on walls. Data shown are based on 63 archaeophytes and 46 neophytes.

Table 1. The most frequent alien species on walls - percentages of the total number of species.

Archaeophytes	%	Neophytes	%
<i>Chelidonium majus</i>	32	<i>Conyza canadensis</i>	22
<i>Ballota nigra</i>	13	<i>Syringa vulgaris</i>	7
<i>Capsella bursa-pastoris</i>	12	<i>Erigeron annuus</i>	6
<i>Senecio jacobaea</i>	11	<i>Corydalis lutea</i>	4
<i>Bromus arvensis</i>	9	<i>Sisymbrium loeselii</i>	4
<i>Cymbalaria muralis</i>	8	<i>Chaetochloa</i>	3
<i>Medicago lupulina</i>	6	<i>Sedum spurius</i>	3
<i>Lactuca scariola</i>	5	<i>Sedum rupestre</i> subsp. <i>erectum</i>	3
<i>Berteroa tinctoria</i>	5	<i>Epilobium ciliatum</i>	3
<i>Polypogon monspeliensis</i> agg.	5	<i>Arrhenatherum elatius</i>	2
<i>Fallopia convolvulus</i>	4	<i>Cerastium pinnatifidum</i>	2
<i>Berula lutea</i>	4	<i>Helleborus viridis</i>	2
<i>Comarostaphylis arvensis</i>	4	<i>Lycium barbarum</i>	2
<i>Bromus sectorum</i>	3	<i>Solidago canadensis</i>	2
<i>Scirpus paniceus</i>	3	<i>Antirrhinum majus</i>	2

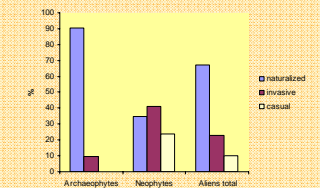


Fig. 6. Percentage representation of categories of invasive status of alien species. Data are based on 63 archaeophytes and 46 neophytes.

Table 2. Distribution of Grime's life strategies in the alien flora of walls. Percentage representation of life strategies are based on 63 archaeophytes and 41 neophytes.

Life strategy (%)	C	CR	CS	CSR	R	S	SR
Archaeophytes	13	35	2	14	35	0	2
Neophytes	32	20	5	17	15	10	2
Aliens total	20	29	3	15	27	4	2



Fig. 7. Detrended correspondence analysis (DCA) diagram of species. Species with low weight are not shown.

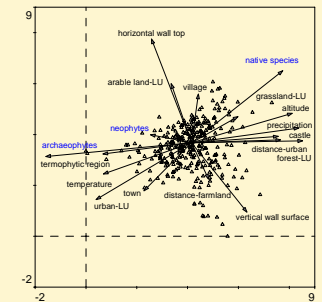


Fig. 8. DCA diagram of species with passively selected explanatory variables (LU = land use in 0.5 km distance from the wall - percentage ratio of forests, urban areas, grasslands and arable land) and groups of alien flora classified with respect to the residence time (archaeophytes, neophytes, natives). The first ordination axis explains 1.6 % of total variation in species data and determines the altitudinal gradient. The second axis explains 3.1 % and it is associated with the type of habitat (horizontal vs. vertical wall surfaces).