Vegetation of the Landfill Supíkovice (Olomouc Region, Czech Republic)

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Abstract: The paper presents the results of floristic and vegetation analyses of the landfill Supíkovice. Ruderal, segetal and meadow vegetation units were recorded in June 2015. The most interesting findings were threatened weed species growing in decontamination patches on loamy and nutrient-poor soils in the central part of the landfill. *Dianthus armeria* (C4a) and *Filago arvensis* (C3) are listed in the national Red List of the Czech Republic. Moreover, these taxa were evaluated in the same category of rarity on the regional level. Apart from the above mentioned, *Centaurea cyanus* (C4a) and *Papaver dubium* (C4a), registered only in the regional Red List of vascular plants of the Moravian-Silesian Region (see methods), were found. Besides threatened species, relatively small populations of invasive taxa as *Erigeron annuus*, *Impatiens parviflora* or *Reynoutria* sp., were also recorded on the landfill Supíkovice.

Key words: landfill, threatened weeds, Red Lists

Introduction

Landfills are open human-made sites in the landscape, which are covered with synanthropic vegetation. Some vegetation studies of these habitats were focused on bio-indication, which is a proven tool to assess habitat conditions (Chan *et al.* 1997; Maurice 1999; Kotovicová *et al.* 2011; Tintner & Klug 2011; Xiaoli *et al.* 2011; Vaverková & Adamcová 2012, 2014). These studies were mostly based on biomass contents analyses and/or on species diversity using Ellenberg indicator values (Ellenberg *et al.* 1992). Additionally, the species composition and community structure analyses were used for understanding the ongoing successional processes in these human-made, open habitats (Prach 1987; Rebele & Lehmann 2002; Tintner & Klug 2011; Gantes *et al.* 2014). Finally, floristic and vegetation research of landfills can extend our knowledge of local and regional floras. These habitats are still understudied, because they are poorly accessible and only rarely visited by botanists.

The main objective of this study is to analyze the vegetation structure and species composition focusing on threatened taxa in the area of the landfill Supíkovice.

Material and methods

In the late spring (June) of 2015 the floristic and vegetation research was conducted in the landfill Supíkovice. Floristic data of threatened and invasive taxa were recorded. Vegetation data were evaluated on the basis of an expert assessment of the species composition; i.e., of the dominant and diagnostic species cover and abundance in plots (5x5 m for meadows, 5x4 m for ruderal and segetal communities) using the phytosociological Zürich-Montpellier school techniques (Braun-Blanquet 1964). Vegetation units (syntaxa) follow actual phytosociological literature (Chytrý 2007, 2009, 2013). Vascular plant nomenclature follows the Checklist of Danihelka *et al.* (2012). Rare and threatened taxa were categorized according to the Red List of the Czech Republic (Grulich 2012). For evaluation of the regional importance of the findings, the Red List of Vascular Plants of Moravian-Silesian Region (Sedláčková & Plášek 2005) was used although the study area is located in the Olomouc Region. Red List of the latter region has not been published yet and the geographic distance of the study area from the border of Moravian-Silesian Region is approximately 10 km. The occurrence of threatened taxa was compared using maps of distribution from the Plant Diversity Analysis and Synthesis Centre (PLADIAS 2016). Invasive taxa were identified in accordance with Pyšek *et al.* (2012).

Study area

The landfill Supíkovice (Fig. 1) is situated in the northeastern part of the Czech Republic, Olomouc Region, Jeseník district, between municipalities Písečná, Supíkovice and Hradec-Nová Ves. The locality belongs to Supíkovická pahorkatina upland and it is formed by gneisses, migmatites, amphibolites, quartzites and crystalline limestone casing Žulová massif and Rejvíz series and the Neogene and Quaternary sediments (Demek & Mackovčín 2006). The climate in this region is moderately warm with abundant precipitation (Quitt 1975). The landfill is located in terrain depression sloping to the east-southeast (ESE). The altitude is about 412 m a.s.l. According to phytogeographical division of the Czech Republic (Skalický 1998) the study area belongs to Bohemian-Moravian mesophyticum district, 74a. Vidnavsko-osoblažská pahorkatina subdistrict.

Fig 1: View into the central part of the landfill Supíkovice with mosaic of microhabitats and the occurrence of synanthropic vegetation.

Results

Actual vegetation of the landfill Supíkovice is a mosaic of ruderal, segetal and depleted meadow communities which are adjacent to a floodplain forest.

The western slopes bordering the open area of the landfill are covered with sown clover/grass mixture with *Trifolium repens*, *T. hybridum* and *T. pratense* dominating. The ruderal species of the classis *Artemisietea vulgaris* (*Melilotetum albo-officinalis* association) with prevailing occurrence of biennial or perennial species (*Melilotus albus*, *Artemisia vulgaris*, *Plantago lanceolata*, *Tanacetum vulgare*) and species belonging to acidophilous segetal communities of the *Scleranthion annui* alliance (*Aphano arvensis*-*Matricarietum chamomillae* association) with its typical composition (*Apera spica-venti*, *Tripleurospermum inodorum*, *Matricaria recutita*, *Papaver rhoeas*, *Myosotis arvensis*, *Centaurea cyanus*, *Scleranthus annuus*, *Vicia hirsuta*, *Viola arvensis* or *Elytrigia repens*) grow mainly on the open areas and along roads. The oblique slopes of the site alternate with flat moist depressions covered with sparse hygrophilic vegetation with occurrence of *Rorippa palustris*, *Ranunculus repens* or *Lysimachia nummularia*. In decontamination areas in the central part, it is possible

to find small tiny populations of annuals or biennials like *Scleranthus annuus*, *Microrrhinum minus*, *Filago arvensis* or *Dianthus armeria*. Other taxa occurring in this area belong to tall annual weeds of the *Atriplicion alliance* (*Chamaepletum officinalis* association). *Sisymbrium officinale* and *Matricaria discoidea* growing there are diagnostic species of this trampled vegetation type. In the central part of the landfill ruderal vegetation of *Artemisietea vulgaris* was recorded (*Poo compressae-Tussilaginietum farfarae* association) with *Tussilago farfara*, *Dactylis glomerata*, *Melilotus albus* or *Urtica dioica*. In these open areas, there were also small populations of invasive alien species (Pyšek et al. 2012) such as *Erigeron annuus*, *Impatiens parviflora* or *Reynoutria* sp. The first mentioned neophyte grew in *Artemisietea vulgaris* classis, whereas the other two grew in fragments of the classis *Galio-Urticetea*.

Besides ruderal and segetal communities, mesic meadows of the *Arrhenatherion elatioris* alliance also occurred in the central part of the landfill. Likewise, the species composition of artificially sown grasslands on upper sites of the slopes on eastern part of the landfill resembled that of depleted *Arrhenatherum* meadows.

Grasslands on the lower western part of the landfill, bound by the brook, had higher ratios of hygrophilous and nitrophilous species such as *Aegopodium podagraria*, *Festuca arundinacea*, *Ranunculus repens*, *Rumex crispus* or *Urtica dioica* and by their structure they are closer to the *Aegopodion podagrariae* alliance from the *Galio-Urticetea* classis. These regularly mown parts are adjacent to broad-leaved floodplain forests of the *Alnion incanae* alliance (*Alnenion glutinoso-incanae* suballiance) with the transition to the willow-poplar riparian forests of the alliance *Salicion albae*.

Red List of the Czech Republic (Grulich 2012):

Filago arvensis (C3 – vulnerable taxa)

Dianthus armeria (Fig. 2) (C4a – less endangered rare taxa requiring further attention/ lower risk – near threatened taxa)

Red List of the Moravian-Silesian Region (Sedláčková & Plášek 2005):

Centaurea cyanus (C4a)

Dianthus armeria (C4a)

Filago arvensis (C3)

Papaver dubium (C4a)

Discussion and conclusions

Potential natural vegetation (Neuhäuslová 1998) on this locality was diagnosed as the association of herb-rich beech forests *Dentario enneaphylli-Fagetum*. In the current classification of vegetation, (Chytrý 2013) two types of plant communities were distinguished where *Dentaria enneaphyllos* occurs. The first unit is represented by the association of mesotrophic beech forests (*Galio odorati-Fagetum sylvaticae*). The second one, more appropriate by the species structure, belongs to the association of eutrophic beech forests (*Mercuriali perennis-Fagetum sylvaticae*). *Fagus sylvatica* in this vegetation unit dominates the tree layer (E3), less abundant are *Acer pseudoplatanus*, *Abies alba* and *Picea abies*. The herbal layer (E1) usually consists of continuous canopy of typical beech forests species, such as *Senecio fuchsii*, *Mercurialis perennis*, *Galium odoratum*, *Oxalis acetosella*, *Athyrium filix-femina* and *Dryopteris filix-mas*. The occurrence of *Dentaria enneaphyllos* or *Festuca altissima* is typical.

The substitute glade vegetation of potential natural vegetation is represented by units of the classis *Epilobietea angustifolii* (*Atropion bellae-donae*/syn. *Fragarion vescae* alliance, *Senecionetum fuchsii*/syn. *Digitali-Senecionetum ovati* association). Substitute ruderal com-

munities belong to the classis *Galio-Urticetea* whilst the expected segetal vegetation is represented by the *Scleranthion annui* alliance.

The actual vegetation of the landfill Supíkovice generally corresponds to substitute vegetation units of the potential natural vegetation types (Neuhäuslová 1998). The most interesting composition of the vegetation has been found in ruderal and mainly in segetal vegetation types.

In accordance with results of Gantes *et al.* (2014) it is possible to say, that early stages of succession were colonized by the open pioneer vegetation of *Artemisietea vulgaris* (the associations *Poo compressae-Tussilaginetum farfarae* and *Melilotetum albo-officinalis*) or by mostly annual vegetation of weed communities of *Stellarietea mediae* (the associations *Aphano arvensis-matricarietum chamomilae* or *Chamaepletum officinalis*). The advanced stages of succession were abundantly covered with perennial species of mesic *Arrhenatherion elatioris* meadows, on deeper wet and nutrient rich substrata partly transient to the *Galio-Urticetea* classis. Nitrophilous perennial vegetation of wet to mesic habitats, belonging to the *Galio-Urticetea* classis and given as one of substitute vegetation types of the potential natural vegetation (Neuhäuslová 1998) has been classified only to a small extent on the landfill. It is probably due to the prevalence of loose skeletal or nutrient poor substrate in areas covered with the vegetation.

Ruderal vegetation units occurring in the landfill mostly consist of xerophilous and partly thermophilous vegetation units with remarkable portion of annual, biennial and perennial species that create pioneer plant communities belonging to *Artemisietea vulgaris* classis (Chytrý 2009). In the landfill, they colonized bare, skeletal and nutrient poor substrata.

Annual segetal vegetation of *Stellarietea mediae* was confirmed first by *Scleranthion annui* alliance, which is the community of acidophilous vegetation growing in cool and precipitation rich areas that occurs in drier warmer places on nutrient poor soils (Chytrý 2009). Secondly the results were affirmed by the community of tall, erect annual herbs of mesic loamy soils with moderate availability of nutrients of the *Atriplicion* alliance, that often grow locally in landfills and backfills in the Czech Republic (Chytrý 2009). All above mentioned classes of segetal and ruderal vegetation are typical vegetation units occurring on landfills (Tintner & Klug 2011).

In the vegetation of the landfill, the occurrence of four Red List species (Sedláčková & Plášek 2005; Grulich 2012) belonging to rare weeds is remarkable. Two of them are mentioned in the Red list of the Czech Republic (Grulich 2012) and both are not primarily connected with arable weed vegetation. *Filago arvensis* (C3) usually grows in warmer areas on acidic, nutrient poor sandy soils, in open dry grasslands in *Koelerio-Coryneporetea* and *Festuco-Brometea* classes. In the locality Supíkovice *Filago arvensis* was found in the weed community of the *Scleranthion annui* where this species is rarely found (Klotz *et al.* 2002). *Dianthus armeria* (C4a) was recorded for the first in the phytogeographical subdistrict 74a. Vidnavsko-osoblažská pahorkatina (compared with PLADIAS 2016). It also prefers open, sunny areas in similar soil types and plant communities (*Koelerio-Coryneporetea* and *Festuco-Brometea*). However, *Dianthus armeria* can be found in forest margins and ecotones in the *Trifolio-Geranietea sanguinei* classis or in shrub vegetation of the *Rhamno-Prunetea spinosae* classis and finally also in ruderal vegetation along roads or on embankments (Klotz *et al.* 2002), that are habitats similar to landfill sites. In the study area, the unambiguous vegetation unit for this species has not been diagnosed.

Apart from two species mentioned above, two other species are threatened in the regional level. Both *Centaurea cyanus* and *Papaver dubium* have been assigned as endangered in the same (C4a) category in the Red List of vascular plants of the Moravian-Silesian Region (Sedláčková & Plášek 2005). These species were found in small populations in the *Scleran-*

Fig 2: *Dianthus armeria*, detail of inflorescence.

thion annui alliance, where they usually grow in the Czech Republic (Chytrý 2009).

Besides rare taxa, also invasive alien neophyte species (Pyšek 2012) were recorded. There were found small populations of *Erigeron annuus*, *Impatiens parviflora* and *Reynoutria* sp., that can become potential source of their next spreading.

The vegetation structure of the landfill Supíkovice is typical for this kind of human-made site. Ruderal and segetal communities of *Artemisietea vulgaris*, *Stellarietea mediae* or *Galio-*

Urticetea classes were found as prevailing vegetation units together with *Arrhenatherion elatioris* meadows. Floristic records containing four rare weed taxa (including the new regional record of *Dianthus armeria*) contributed to understanding of species composition of landfills. Additionally, they contributed to the knowledge of species distribution and diversity of the flora of the Olomouc Region.

References

- Braun-Blanquet J. (1964): Pflanzensoziologie. Grundzüge der Vegetationskunde. 3rd edn. – Springer-Verlag, Wien 865 pp.
- Cenia (2016): Národní geoportál INSPIRE, Copyright ČÚZK [online] [cit. 2016-15-2] < <http://geoportal.gov.cz/web/guest/map>>.
- Chan Y.S.G., Chu L.M., Wong M.H. (1997): Influence of land-fill factors on plants and soil fauna – An ecological perspective. *Environ. Pollut.*, 97, (1-2), 39-44.
- Chytrý M. (ed.) (2007): Vegetace České republiky 1. Travná a keříčková vegetace. Vegetation of the Czech Republic 1. Grassland and heathland vegetation. – Academia, Praha, 525 pp.
- (2009): Vegetace České republiky 2. Ruderální, plevelová, skalní a suťová vegetace. – Academia, Praha, 520 pp.
- (2013): Vegetace České republiky 4. Lesní a křovinná vegetace. – Academia, Praha, 551 pp.
- Danihelka J., Chrtek Jr. J. & Kaplan Z. (2012): Checklist of vascular plants of the Czech Republic. – *Preslia* 84: 647-811.
- Demek J. & Mackovčin P. (eds) (2006): Zeměpisný lexikon ČSR: Hory a nížiny. – Agentura ochrany přírody a krajiny ČR, Brno, 580 pp.
- Ellenberg H., Weber H.E., Düll R., Wirth V., Werner W. & Paulißen D. (1992): Zeigerwerte von Pflanzen in Mitteleuropa, 2nd edn. – *Script. Geobot.* 18: 1-258.
- Gantes P., Falco L.B., Coviella C.E. & Caro A.S. (2014). Plant secondary succession age-related changes in landfills. *Urban Ecosyst.* 17: 1209-1218.
- Grulich V. (2012): Red List of vascular plants of the Czech Republic: 3rd edition. – *Preslia* 84: 631-645.
- Klotz S., Kühn I. & Durka W. (eds) (2002): BIOLFLOR – Eine Datenbank zu biologisch-ökologischen Merkmalen der Gefäßpflanzen in Deutschland. Schriftenreihe für Vegetationskunde 38. – Bundesamt für Naturschutz, Bonn, 334 pp.
- Kotovicová J., Toman F., Vavřková M. & Stejskal B. (2011): Evaluation of Waste Landfills' Impact on the Environment Using Bioindicators. – *Pol. J. Environ. Stud.* 20 (2): 371-377.
- Maurice C., Ettala M., Lagerkvist A. (1999): Effects of leachate irrigation on landfill vegetation and subsequent methane emissions. – *Water Air Soil Pollut.* 113: 203-216.
- Neuhäuslová Z. (1998): Mapa potenciální přirozené vegetace České republiky. – Academia, Praha 341 pp.
- PLADIAS (2016): Plant Diversity Analysis and Synthesis Centre [online] [cit. 2016-15-2] <<http://pladias.ibot.cas.cz>>
- Prach K. (1987): Succession of vegetation on dumps from strip coal mining, N.W.Bohemia, Czechoslovakia. – *Folia Geobot. Phytotax.* 22: 339-354.
- Pyšek P., Danihelka J., Sádlo J., Chrtek J. Jr., Chytrý M. *et al.* (2012): Catalogue of alien plants of the Czech Republic (2nd edition): checklist update, taxonomic diversity and invasion patterns. – *Preslia* 84: 155–255.
- Quitt E. (1975): Mapa klimatických oblastí ČSR 1:500 000 (Map of Czechoslovak climatic regions 1 : 500 000). – Geografický ústav ČSAV, Brno.
- Rebele F. & Lehmann C. (2002): Restoration of a landfill site in Berlin, Germany by spontaneous and directed succession. – *Restor. Ecol.* 10: 340-347.
- Sedláčková M. & Plášek V. (2005): Červený seznam rostlin Moravskoslezského kraje (Red List of Vascular Plants of Moravian-Silesian Region). – *Čas. Slez. Muz. Opava, ser. A*, 54: 97-120.
- Skalický V. (1988): Regionálně fytogeografické členění. In: Hejný S. & Slavík B. (eds.) *Květena České socialistické republiky*, 1: 103-121. – Academia, Praha.
- Tintner J. & Klug B. (2011): Can vegetation indicate landfill cover features? – *Flora*. 206: 559-566. DOI: 10.1016/j.flora.2011.01.005
- Vavřková M. & Adamcová D. (2012): Potential impact of two landfills on the near vicinity with the use of bioindicators. – *Infrastruktura i Ekologia terenow wiejskich/ Infrastructure and Ecology of Rural Areas. Polska Akademia Nauk, Oddział w Krakowie, Komisja Technicznej Infrastruktury Wsi/ Commission of Technical Rural Infrastructure, Polish Academy of Sciences, Cracow Branch.* 2012 (1): 15-25.

- (2014): Can Vegetation Indicate a Municipal Solid Waste Landfill's Impact on the Environment? – Pol. J. Environ. Stud. 23 (2): 501-509.
- Xiaoli C., Xin Z., Ziyang L., Shimaoka T., Nakayama H., Xianyan C. & Youcai Z. (2011): Characteristics of vegetation and its relationship with landfill gas in closed landfill. – Biomass Bioenerg. 35, (3): 1295-1301.

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