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Two thermophilic alien species new to the flora of Slovakia

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Abstract: *Dittrichia graveolens* (L.) GREUTER and *Euphorbia prostrata* AITON were reported for the first time from the territory of Slovakia. The first one was recorded near Kúty (W Slovakia) at the highway D2; its occurrence was already expected in view of its well-documented expansion along the roads of Austria and the Czech Republic. The second species grows in a city pavement in Banská Bystrica (Central Slovakia); as a notable very isolated population existing probably due to the urban heat island effect.

Keywords: alien species, invasion, highways, urban heat effect

Introduction

Annual weeds of human-made habitats play an important role in the rapidly changing inventory of alien plants (e.g. MEDVECKÁ et al. 2012; PYŠEK et al 2012); many of them have become paradigm for long-distance spreading. Several spectacular Central European invasions of ruderal plants were connected to roads (most often to highways) (e.g. MELZER 2003; HOHLA 2006; ŠERÁ 2008), however, railways have not lost their importance in the case invasions from the East as well (e.g. JEHLÍK & DOSTÁLEK 2008; JEHLÍK et al. 2013).

In our study we report on the first records of two alien thermophilic annual species (*Dittrichia graveolens* and *Euphorbia prostrata*) from the territory of Slovakia. Beside the description of the invasion history of these taxa and the

newly discovered localities, we also analyse the coenological features of the investigated localities. Both recently reported species represent a different type of invasion; their study can help to understand the transformation of ruderal habitats by new invaders in Central Europe.

Material and Methods

The field studies were conducted in autumn 2013. Geo-coordinates of the localities were determined using a Trimble Nomad GPS handheld device in WGS 84 projection. Quadrant numbers are given according to the Central-European Flora Mapping System (NIKLFELD 1971). The phytogeographical classification of Slovakia is considered according to the work of FUTÁK (1984). The specimens of *E. prostrata* were identified using the keys of HÜGIN (1998) and RÖTHLISBERGER (2007). *Euphorbia* subgenus *Chamaesyce* material was reviewed in the following herbaria to locate possibly overlooked records of the species from Slovakia (acronyms follow THIERS 2014): BP, NI and W. The phytosociological relevés were sampled using the Zürich-Montpellier approach employing the adapted nine-grade Braun-Blanquet scale (BARKMAN et al. 1964). Names of syntaxa are listed according to JAROLÍMEK et al. (2008). Nomenclature of flowering plants follows MARHOLD & HINDÁK (1998).

Results and Discussion

Dittrichia graveolens (L.) GREUTER [Syn.: *Inula graveolens* L.]

The genus *Dittrichia* GREUTER (separated from the large genus *Inula*) consists only two species after the traditional treatment (BALL 1976), *D. graveolens* and *D. viscosa* s.l.; BRULLO & DE MARCO (2000) split the latter one into four taxa on species rank. *D. graveolens* (Fig. 1. and 2.) is native to the Mediterranean territory with marginal outposts to the Atlantic-European coast and to Middle East (MEUSEL et al. 1992). From the late 1800^{s} it has been naturalised in many temperate parts both of the southern (South Africa, New Zealand, Australia; KLOOT 1987) and northern hemisphere (Atlantic and Pacific regions of the USA; DITOMASO et al. 2013); in certain areas it became to a noxious weed (CSURHES & ZHOU 2008; BROWNSEY et al. 2012). Its spreading in Central Europe started in the 1950^{s} in Germany (FRANK 2006), (along highways) it recently has been introduced in Austria (STÖHR et al. 2009), Slovenia (FRAJMAN & KALIGARIČ 2009) and the Czech Republic (RAABE 2008, 2009).

D. graveolens was observed in 2013 by G. Király along the highway D1 near Břeclav in the Czech Republic abundantly, thus, it was also expected that is already present in Slovakia. Worthy of note that J. RYDLO (in PYŠEK et al. 2012) has reported the species as "*along the D1 highway (...) it spreads further southeastwards to Bratislava*", but it is not clear, whether this mention is referred to Slovak territory as well. In order to clarify its occurrence in Slovakia, we systematically searched through the highway D2 from Bratislava to Kúty border station, and we recorded it at the following new locality:

4. Záhorská nížina district, 2.2 km NW of Kúty, at the petrol station and parking place near the state border to Czech Republic on the west side of the D2 highway, N48.679258º and E16.987324º, 151 m s. l., MTB: 7367b; some 50 flowering individuals on the roadside; 25th September 2013, G. Király & P. Eliáš jun. (Fig 1.). Vouchers collected at this locality were deposited in NI and BP.

The speed and extent of its expansion in Central Europe is noticeable. 8 years after the first record in Upper Austria (HOHLA 2001) it already has been reported from the Pannonian lowlands of the Lesser Plain near to Lake Neusiedl (300 km distance; STÖHR et al. 2009). After the first records from southern Bohemia (RAABE 2008), it has reached Břeclav in Moravia in 4 years (150 km distance, PYŠEK et al. 2012). Its invasion in Slovenia showed to be so rapid that the authors of the first documentation of the species (FRAJMAN & KALIGARIČ 2009) could only state that is already present at all major highways of the country. Consequently, a similarly quick expansion is expected in Slovakia (and in the neighbouring Hungary), too.

Fig. 1. *Dittrichia graveolens* (L.) GREUTER on the roadside of D2 highway near Kúty (W Slovakia) (photo: G. Király, 25th September 2013)

Fig. 2. Part of inflorescense of *Dittrichia graveolens* (L.) GREUTER (Kúty, W Slovakia) (photo: G. Király, 25th September 2013)

The stand of *D. graveolens* near Kúty is described in the relevé below:

Relevé no. 1. Kúty (W Slovakia), 151 m s. l., relevé area 9 m^2, exp. -, elevation -, E_1 60%, 25th September 2013, P. Eliáš jun. & G. Király.

E_1: *Dactylis glomerata* 2b, ***Dittrichia graveolens*** 2a, *Setaria glauca* 2a, *Stellaria media* 2a, *Achillea millefolium* agg. 1, *Atriplex tatarica* 1, *Cynodon dactylon* 1, *Plantago lanceolata* 1, *Acetosa pratensis* +, *Atriplex patula* +, *Linaria vulgaris* +, *Plantago major* +, *Urtica dioica* +, *Brassica napus* r, *Chenopodium album* r.

This habitat represents ruderalised vegetation of the alliance *Arrhenatherion elatioris* Koch 1926, it indicates the dominance of *Dactylis glomerata* and presence of *Plantago lanceolata* (UHLIAROVÁ et al. 2014). Conversely, a strong anthropogenic influence is demonstrated by the significant presence of ruderal species such as *Setaria glauca*, *Stellaria media* and several *Chenopodiaceae* taxa.

Phytocoenological studies of *D. graveolens*-stands in Central Europe are not known, but we believe that it grows along the highways in Austria, Germany and the Czech Republic in the same vegetation type as in Slovakia. Major Floras of the region mention it mainly from roadsides (especially highways) and industrial areas (e.g. JÄGER & WERNER 2002; FISCHER et al. 2008), signs of nature conservational threats have not been reported yet (see NEHRING et al. 2013). Nevertheless, in Australia, its spread was observed in cereal crops and semi-natural habitats (open woodlands and grasslands, especially areas that are grazed; see PARSONS & CUTHBERTSON 1992) as well.

Euphorbia prostrata AITON [Syn.: *Chamaesyce prostrata* (AITON) SMALL, *Tithymalus prostratus* (AITON) SAMP.]

Representatives of the worldwide-distributed *Euphorbia* subgenus *Chamaesyce* with about 10 native or naturalized species in Europe are often considered as typical objects of modelling the invasion of thermophilic invaders (HÜGIN 1998, 1999; ARIANOUTSOU et al. 2010). From the subgenus, merely *E. maculata* is throughout naturalized in the Pannonian Basin (FISCHER et al. 2008; SOMLYAY 2009), other species (e.g. *E. chamaesyce*, *E. humifusa, E. glyptosperma*, *E. serpens*) were reported as locally naturalized species or casuals only (SOMLYAY 2009; WOLF & KIRÁLY 2014). The only known species of this group in Slovakia is *E. maculata* (ELIÁŠ 2009).

Euphorbia prostrata (Fig. 3.), a species native to the Americas, was recorded in Europe (France) in 1806 for the first time, later it was found in several parts of the Mediterranean areas (for a comprehensive list of records see HÜGIN 1998; ANONYMUS 2009 and BÁTORI et al. 2012). The species was also reported from other continents, e.g from Africa (HENDERSON 2007), Asia (MA & WU 1992; PAHLEVANI & RIINA 2011) and Australia (ANONYMUS 2009). Its Central European expansion has begun in the second half of the 20th century (HÜGIN 1998; MELZER 2003; BÁTORI et al. 2012). In the western Balkan Peninsula, it is gradually spreading along roads and railways from the Adriatic coast (MILOVIĆ & RANDIĆ 2001; FRAJMAN & JOGAN 2007). Despite its relatively long-established distribution

in Croatia and Slovenia, it was reported from the Pannonian Basin at two isolated stands only: SE Hungary (Szeged, city park, BÁTORI et al. 2012) and NE Austria (Vienna, city alleys, ADLER et al. 2008).

As a new, unexpected locality, we verified the presence of *E. prostrata* also in Slovakia:

22. Nízke Tatry district, Banská Bystrica, pavement in parking place in front of the Matej Bel University building (Kuzmány Street), N48.733118º and E19.145169º, 347 m s. l., MTB: 7280d; fruiting specimens scattered in approximately 200 m^2 surface of the pavement, 19th September 2013, G. Király & 26th September 2013, D. Dítě. Vouchers collected at this locality were deposited in NI.

The specimens of *E. prostrata* at this often visited place were probably introduced by vehicles from abroad. In accordance with HÜGIN (1999), we consider repeated occurrences of prostrate *Euphorbia* species in Central Europe as the result of long-distance dispersal correlate to human activity (trade and transportation) and we do not prefer to interpret them being connected with climatic change. However, as in several similar cases (e.g. ELIÁŠ 2011), the importance of urban heat island effect (SUKOPP & WERNER 1983; RICOTTA et al. 2010) is also notable. We indicate the vegetation composition by the following phytosociological relevés:

Relevé no. 2. Banská Bystrica, pavement in parking place in front of the Matej Bel University building, 347 m s. l., relevé area 16 m^2, exp. -, elevation -, E_1: 20 %, 26th September 2013, D. Dítě.

E_1: ***Euphorbia prostrata*** 2a, *Polygonum arenastrum* 2a, *Chenopodium album* 1, *Conyza canadensis* +, *Eragrostis minor* +, *Plantago lanceolata* +.

Relevé no. 3. The same location, 347 m s. l., relevé area 16 m^2, exp. -, elevation -, E_1: 10 %, 26th September 2013, D. Dítě.

E_1: *Eragrostis minor* 1, ***Euphorbia prostrata*** 1, *Portulaca oleracea* 1, *Conyza canadensis* +, *Polygonum arenastrum* +, *Setaria viridis* +, *Taraxacum* sect. *Ruderalia* r, *Trifolium repens* r.

Stands represent vegetation of trampled plots close to the communities of the alliance *Matricario-Polygonion arenastri*. These communities of anthropogenic origin are species-poor and structurally simple; therophytes are prevailing in stands here (JAROLÍMEK et al. 1997). In Hungary, BÁTORI et al. (2012) found the species in a lawn of a city park. Based on their relevé, we believe that this ruderalised and trampled stand represent vegetation close to the class *Molinio-Arrhenateretea.* In Romania, the species was found in trampled ruderal stand dominated by *Digitaria sanguinalis* (ANASTASIU & NEGREAN 2008), which belongs to the vegetation of the *Eragrostion cilianensi-minoris* Tüxen ex Oberdorfer 1954 alliance. ČARNI & JOGAN (1998) described the *Euphorbia prostrata* community within thermophilic trampled habitats of *Stellarietea mediae* class in the Bay of Kvarner (SW Croatia). In addition, ČARNI (1997) also mentioned *E. prostrata* as characteristic member of five plant associations within *Euphorbion prostratae*

Rivas-Martinez 1976 alliance developing in areas of the Iberian Peninsula with precipitation not exceeded 600 mm per year and with average year temperature about 20℃. The occurrence of these communities in Central Europe is unlikely.

Fig. 3. *Euphorbia prostrata* AITON on the pavement of the City of Banská Bystrica (Central Slovakia) (photo: R. Aszalós, 19th September 2013)

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References

ADLER W., MRKVICKA A. CH. & FISCHER M.A. (2008): Nachträge zur „Flora Wiens“ (III). – Neilreichia 5: 173–180.

ANASTASIU P. & NEGREAN G. (2008): New alien plants to Romania. – Analele Univ. din Craiova. Seria Agricultură, Montanologie, Cadastru. 38/B: 1–10.

ANONYMUS (2009): GRIN Taxonomy for Plants. *Euphorbia prostrata* Aiton. Http: http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?16401 [accessed 4 October 2014]

BALL P. W. (1976): *Dittrichia* Greuter. In: TUTIN T. G., HEYWOOD V. H., BURGES N. A., MOORE D. M., VALENTINE D. H., WALTERS S. M., WEBB D. A. & BALL P. W. (eds), Flora Europaea 4. Cambridge University Press, Cambridge, p. 136–137.
BARKMAN J.J., DOING H. & SEGAL S. (1964): Kritische Bemerkungen und Vorschläge zur quantitativen Vegetationsanalyse. – Acta Bot. Neerl. 13: 394–419.
BÁTORI Z., ERDŐS L. & SOMLYAI L. (2012): *Euphorbia prostrata* (Euphorbiaceae), a new alien in the Carpathian Basin. – Acta Bot. Hung. 54: 235–243.
BROWNSEY R., KYSER G. B. & DITOMASO J. M. (2012): Stinkwort is rapidly expanding its range in California. – California Agriculture 67(2): 110–115.
BRULLO S & DE MARCO G (2000): Taxonomical revision of the genus *Dittrichia* (Asteraceae). – Portugaliae Acta Biol. 19: 341–354.
ČARNI A. (1997): *Chamaesyce prostrata* communities in the world. – Lagascalia 19: 623–630.
ČARNI A. & JOGAN N. (1998): Vegetation of thermophilic trampled habitats in the Bay of Kvarner. – Nat. Croat. 7(1): 45–58.
CSURHES S. & ZHOU Y. (2008): Pest plant risk assessment. Stinkwort, *Dittrichia graveolens*. – Biosecurity Queensland Department of Primary Industries and Fisheries, Brisbane, Queensland, 10 pp.
DITOMASO J., KYSER G., ONETO S., WILSON R., ORLOFF S., ANDERSON L., WRIGHT S., RONCONI J., MILLER T., PRATHER T.,RANSOM C., BECK G., DUNCAN C., WILSON K. & MANN J. (2013): Weed Control in Natural Areas in the Western United States. – Weed Research and Information Center, University of California, Berkeley, 544 pp.
ELIAŠ P. jun. (2009): First record of *Euphorbia maculata* L. (Euphorbiaceae) in Slovakia. – Thaiszia – J. Bot. 19: 21–25.
ELIÁŠ P. jun. (2011): *Geranium purpureum* Vill. – new alien species to the Slovak flora. – Thaiszia – J. Bot. 21: 21–28.
FISCHER M. A., ADLER W. & OSWALD K. (2008): Exkursionsflora für Österreich, Liechtenstein und Südtirol. 3., verbesserte und erweiterte Auflage. – Land Oberösterreich, OÖ Landesmuseen, Linz, 1392 pp.
FRAJMAN B. & JOGAN N. (2007): Mlečki (rod *Euphorbia*) Slovenije. – Scopolia 62: 1–68.
FRAJMAN B. & KALIGARIČ N. (2009): *Dittrichia graveolens*, nova tu je rodna vrsta slovenske flore. – Hladnikia 24: 35–43.
FRANK Ch. (2006): Beobachtungen zur Einbürgerung neuer Arten in Sachsen-Anhalt. – Mitt. florist. Kart. Sachsen-Anhalt (Halle) 11: 81–90.
FUTÁK J. (1984): Fytogeografické členenie Slovenska. – In: Bertová L. (ed.), Flóra Slovenska IV/I. Veda, Bratislava, p. 418–420.
HENDERSON L. (2007): Invasive, naturalized and casual alien plants in southern Africa: a summary based on the Southern African Plant Invaders Atlas (SAPIA). – Bothalia 37: 215–248.
HOHLA M. (2001): *Dittrichia graveoloens* (L.) Greuter, *Juncus ensifolius* Wikstr. und *Ranunculus penicillatus* (Dumort.) Bab. neu für Österreich und weitere Beiträge zur Kenntnis der Flora des Innviertels und des angrenzenden Bayerns. – Beitr. Naturk. Oberösterreichs 10: 275–353.
HOHLA M. (2006): Neues über die Verbreitung von *Eragrostis albensis, E. multicaulis* und *E. pilosa* in Österreich. – Linzer biol. Beitr. 38: 1233-1253.
HÜGIN G. (1998): Die Gattung *Chamaesyce* in Europa. – Feddes Repert. 109: 189–223.
HÜGIN G. (1999): Verbreitung und Ökologie der Gattung *Chamaesyce* in Mitteleuropa, Oberitalien und Südfrankreich. – Feddes Repert. 110: 225–264.
JÄGER E. & WERNER K. (eds) (2002): Exkursionsflora von Deutschland. Kritischer Band. – Spektrum Akademischer Verlag, Heidelberg – Berlin, 948 pp.

JAROLÍMEK I., ZALIBEROVÁ M., MUCINA L. & MOCHNACKÝ S. (1997): Rastlinné spoločenstvá Slovenska, 2. Synantropná vegetácia. – Veda, Bratislava, 415 pp.
JAROLÍMEK I., ŠIBÍK J., TICHÝ L., KLIMENT J., ŠIBÍKOVÁ I., HEGEDÜŠOVÁ K., VALACHOVIČ M., MICHÁLKOVÁ D., ŠKODOVÁ I., SADLOŇOVÁ J., ZALIBEROVÁ M. & MÁJEKOVÁ J. (2008): Diagnostic, constant and dominant species of the higher vegetation units of Slovakia. – Veda, Bratislava, 332 pp.
JEHLÍK V. & DOSTÁLEK J. (2008): Influence of railway transport in the South-East of Slovakia on formation of adventives flora in Central Europe. – Biodiv. Res. Conserv. 11-12: 27-32.
JEHLÍK V., MÁJEKOVÁ J. & ZALIBEROVÁ M. (2013): New discovered adventive plants from eastern Slovakia. – Thaiszia – J. Bot. 23: 61–66.
KLOOT P. M. (1987): The naturalised flora of South Australia 4. Its manner of introduction. – J. Adelaide Bot. Gard. 10(2): 223–240.
MA J. S. & WU C. Y. (1992): A synopsis of Chinese *Euphorbia* L. s. l. (Euphorbiaceae). – Collect. Bot. 21: 97–120.
MARHOLD K. (ed.) 1998. Ferns and Flowering plants, p. 333–687. – In: MARHOLD K. & HINDÁK F. (eds.), Checklist of non-vascular and vascular plants of Slovakia. VEDA, Bratislava.
MEDVECKÁ J., KLIMENT J., MÁJEKOVÁ J., HALADA Ľ., ZALIBEROVÁ M., GOJDIČOVÁ E., FERÁKOVÁ V. & JAROLÍMEK I. (2012): Inventory of the alien flora of Slovakia. – Preslia 84: 257–309.
MELZER H. (2003): *Sporobolus vaginiflorus* (Poaceae), ein Neubürger aus Nordamerika, lange übersehen in Österreich – und anderes Neue zur Flora von Kärnten. – Neilreichia 2-3: 131–142.
MEUSEL H. & JÄGER E. (1992): Vergleichende Chorologie der zentraleuropäischen Flora 3. – Gustav Fischer Verlag, Jena, Stuttgart, New York, 333 + 266 pp.
MILOVIĆ M. & RANDIĆ M. (2001): New localities of *Euphorbia prostrata* Aiton (= *Chamaesyce prostrata* (Aiton) Small) in Croatia. – Nat. Croat. 10: 89–95.
NEHRING S., KOWARIK I., RABITSCH W. & ESSL F. (eds) (2013): Naturschutzfachliche Invasivitätsbewertungen für in Deutschland wild lebende gebietsfremde Gefäßpflanzen. – Bundesamt für Naturschutz, Skript 352, Bonn – Bad Godesberg, 202 pp.
NIKLFELD H. (1971): Bericht über die Kartierung der Flora Mitteleuropas. – Taxon 20: 545–571.
PAHLEVANI A. H. & RIINA R. (2011): A synopsis of *Euphorbia* subgen. *Chamaesyce* (Euphorbiaceae) in Iran. – Ann. Bot. Fennici 48: 304–316.
PARSONS W. T. & CUTHBERTSON E. G. (1992): Noxious weeds of Australia. – Inkata Press, Melbourne – Sydney, 692 pp.
PYŠEK P., DANIHELKA J., SÁDLO J., CHRTEK J. JR., CHYTRÝ M., JAROŠÍK V., KAPLAN Z., KRAHULEC F., MORAVCOVÁ L., PERGL J., ŠTAJEROVÁ K. & TICHÝ L. (2012): Catalogue of alien plants of the Czech Republic (2nd edition): checklist update, taxonomic diversity and invasion patterns. – Preslia 84: 155–255.
RAABE U. (2008): (84) *Dittrichia graveolens*. p. 270–271. – In: FISCHER M. A. & NIKLFELD H. (eds), Floristische Neufunde (76–98). – Neilreichia 5: 263–288.
RAABE U. (2009): *Dittrichia graveolens* (L.) Greuter. p. 235-238. – In: HADINEC J. & LUSTYK P. (eds.), Additamenta ad floram Reipublicae Bohemicae VIII. – Zprávy Čes. Bot. Společ. 44: 185–319.
RICOTTA C., GODEFROID S. & ROCCHINI D. (2010): Invasiveness of alien plants in Brussels is related to their phylogenetic similarity to native species. – Diversity and Distributions 16: 655–662.

RÖTHLISBERGER J. (2007): Aktuelle Verbreitung der Gattung *Chamaesyce* (Euphorbiaceae) in der Schweiz. – Bauhinia 20: 19–33.
SOMLYAY L. (2009): Occurrence of *Chamaesyce glyptosperma*, and a survey of the genus *Chamaesyce* (Euphorbiaceae) in Hungary. – Annls hist.-nat. Mus. natn. hung. 101: 23–32.
STÖHR O., PILSL P., ESSL F., WITTMANN H. & HOHLA M. (2009): Beiträge zur Flora von Österreich, III. – Linzer biol. Beitr. 41: 1677–1755.
SUKOPP H. & WERNER P. (1983): Urban environments and vegetation. – In: HOLZNER W. – WERGER M.J.A. & IKUSIMA I. (eds), Man's impact on vegetation. – Dr. W. Junk Academic Publisher, The Hague, p. 247–260.
ŠERÁ B. (2008): Road vegetation in Central Europe – an example from the Czech Republic. – Biologia 63: 1085–1088.
THIERS B.M. (2014): Index Herbariorum: A global directory of public herbaria and associated staff. – New York Botanical Garden's Virtual Herbarium. Http://sweetgum.nybg.org/ih/ [accessed on 15 September 2014]
UHLIAROVÁ E., JANIŠOVÁ M., UJHÁZY K., ŠKODOVÁ I. & HÁJEK M. (2014): *Arrhenatherion elatioris*. – In: HEGEDUŠOVÁ VANTAROVÁ K. & ŠKODOVÁ I. (eds.), Rastlinné spoločenstvá Slovenska 5. Travinno-bylinná vegetácia. Veda, Bratislava, p. 202–238.
WOLF M. & KIRÁLY G. (2014): *Euphorbia serpens* (Euphorbiaceae), a new alien species in Hungary. – Acta Bot. Hung. 56: 243–250.

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