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Review article

Alien (invasive) vascular plants in Slovakia – a story of successful plant immigrants

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ABSTRACT

This article summarises the history of research into alien plants and plant communities in Slovakia (Central Europe). Earlier periods are reviewed briefly with reference to literature sources dealing with those periods more comprehensively. A milestone in the research was the publication of the Inventory of the alien flora of Slovakia in 2012 with a complete list of alien vascular plants. The last ten years are discussed more extensively in the article in four sections devoted to i) newly found alien plants, ii) distribution and habitat relations, iii) plant invasions, iv) citizen science based on the comprehensive excerpt of literature sources. A list of 51 newly published alien taxa within the last ten years is also included with information on the year of their first occurrence in the wild in Slovakia.

KEY WORDS: non-native flora, neophytes, distribution, plant invasion, the Slovak Republic

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1. Introduction

The first published botanical work completely devoted to the region of Slovakia was Flora Posoniensis by Lumnitzer (1791). The work dealt with vascular plants that were present in the city of Bratislava and its surroundings. The list of recorded taxa often included information on their distribution, habitat preferences or naturalization status. It also included cultivated taxa and taxa that had escaped from cultivation. Thus, this work is an important source of the first information about many species of alien flora of Slovakia. It was followed by the work of Endlicher (1830), who continued the research on the flora of Bratislava. Endlicher’s flora included more alien species and also taxa previously only cultivated, but already spreading spontaneously. Reuss (1853) published the first flora of Slovakia with naturalization status of the taxa. Gradually, interest in botanical research increased and other works were added. At that time, there were no special publications about alien species, but these were often included in local floras. A complete list of published botanical works from Slovakia until 1952 were summarized by Futák & Domin (1960).

The occurrence and spread of alien plants are mainly associated with humans and their activities and are therefore part of the predominantly synanthropic vegetation (in settlements or in cultivated fields). However, they gradually spread into the semi-natural and natural vegetation. Improvement and acceleration of the transport network between and within continents has enabled the more rapid spread of alien species (both plants and animals) to new territories. Alien plants were often unintentionally introduced together with the transported goods or attached to vehicles (Jehlík & Hejný, 1974), but they have also been intentionally introduced as ornamental or useful plants. Therefore, more attention was paid to research into alien plants in Slovakia as well.

After World War II, systematic research on the synanthropic flora and vegetation of Slovakia began.
Among the first publications devoted to synanthropic flora was the work of Frantová (1947), who focused on the ruderal and segetal habitats of the city of Trnava and its surroundings. The founder of the research into the synanthropic flora and vegetation of Slovakia was Terézia Krippelová, who focused on the distribution of synanthropic plants and communities in several areas of Slovakia, syntaxonomic classification of synanthropic communities, ecology of arable weeds, classification of anthropogenic soils (Kopecký, 1982, Zaliberová, 2012). Other successors in the research were e.g.: Marica Zaliberová, Viera Feráková, Pavol Eliáš sen., Ladislav Mucina, Sergej Mochnacký, Ivan Jarolímek, Pavol Eliáš jun., Jana Májeková, Jana Medvecká, Alena Rendeková.

An important milestone in the research of the synanthropic flora and vegetation, including alien and invasive species, was the establishment of the Section for Synanthropic Flora and Vegetation Research in the Slovak Botanical Society in 1969 and the organization of international Symposia on Synanthropic Flora and Vegetation, which took place in 1970, 1973, 1976, 1984, 1988 (Zaliberová, 2012). The idea of these symposia was continued by András Terpó (Hungary) and Sergej Mochnacký (Slovakia), who began to organize international conferences in one of the countries of Slovakia, Hungary, Poland and Ukraine. They have been organised at 2-year intervals since 1994 (Zaliberová et al., 2012). Another important scientific conference was “Invasions and Invasive Organisms” which was organised by Pavol Eliáš sen. in Nitra every 2 years between 1996–2008 (Eliáš, 2018). These conferences focused not only on plant invasions, but also on animals and the topic of invasions in general.

In 1966, an extensive multi-volume work “Flora of Slovakia” began to be published (Futák, 1966), which also included data on alien plants including information on their morphology, taxonomy, origin and distribution in Slovakia. So far, 16 volumes have been published and several more are still awaiting publication. Similarly, a series of volumes on “Slovak plant communities” has been published, which also included synanthropic communities (Jarolímek et al., 1997, Jarolímek & Zaliberová, 2001, Hájková et al., 2014). These can serve as a source of information on the representation of alien and invasive species in different plant communities.

Interest in alien species has gradually increased and various authors have focused on the distribution, ecology, sociology or taxonomy of alien plants and communities in Slovakia. For a detailed overview of this research see: Jehlík, 1972, Krippelová, 1975, Eliáš, 1994, 2018, Jarolímek et al., 1997, Medvecká et al., 2012.

In 1997, at the Centre for Nature Protection of the Slovak Environmental Agency in Banská Bystrica a management group for the issue of invasive plants was established (Cvachová, 2001). The aim of the group was to ensure the mapping of invasive plants in Slovakia, to propose ways of managing the invaded localities, to cooperate in the creation of legislation, to support research and to draw attention to the issue of invasion to both professionals and the lay public. In association with the activities of the group, there was a growing need to compile a list of alien and invasive plant species occurring in the region of the Slovak Republic. Eliáš (1997, 1998, 2001) published several partial lists of the most dangerous species. Hejňů et al. (1973) prepared a publication on quarantine weeds and Jehlík (1998) a publication on 40 selected dangerous weeds of the former Czechoslovakia. Halada (1997) compiled a preliminary list of archaeophytes in Slovakia. He relied on various botanical works and especially on archaeobotanical research. The publication contained 183 taxa, classified as archaeophytes and dozens of other taxa with unclear origins.

In 1998, the management group also prepared the Proposal of list of invasive and potentially invasive groups of plants. The preliminary list of invasive plants was revised on the basis of published works and comments from many specialists, and in 2002 a second draft of the “List of alien, invasive alien and expansive native vascular plant species of Slovakia” was published (Gojdícová et al., 2002). Together, 616 taxa were included in the list, of which 19 were archaeophytes, 529 neophytes, 29 native (expansive taxa) and 39 were not ranked. taxa were divided into 8 different categories based on their origin and invasive status in Slovakia. In total, 47 taxa were classified as invasive (28 neophytes and 19 archaeophytes) and 49 as potentially invasive, e.g. invasive at the regional level.

Ten years later, a team of authors compiled a new list of alien plants – “Inventory of the alien flora of Slovakia” (Medvecká et al., 2012). This was the first complete inventory of alien vascular plants of the Slovak Republic. The list included all alien taxa that were not considered to be native in Slovakia and which were recorded in the wild (not cultivated) in at least one locality. The alien flora consisted of 916 taxa with 262 archaeophytes and 634 neophytes that made up 21.5% of the total Slovak flora. The presented taxa were supplemented by information on family affiliation, residence status, invasion status, time and mode of introduction, planting purpose, abundance, distribution within phytogeographic regions, types of invaded habitats and syntaxa, life forms and geographical origin of the taxa. Most of the alien taxa were casuals (57.6%),
39.1% were naturalized and only 3.3% invasive. The majority (78.9%) of the archaeophytes are naturalized and most of the neophytes (73.2%) were casual. Most of them came from Europe (32.8%) and Asia (32.8%), followed by Africa (12.2%) and North America (10.8%). The work also included 33 species of uncertain residence status, that is, it is not certain whether they are native or alien. This publication was the basis for the creation of an online database of alien plant species (www.dass.sav.sk) which continues to be supplemented and updated.

The aim of this article is to present a review of the research into the alien and invasive plants of Slovakia over the last 10 years. As it is not possible to analyse all the publications in detail, we emphasize the most important publications, and we outlined the direction of research on this issue over that period.

2. Results and discussion

2.1. Introduction of new taxa

Since the publication of Medvecká et al. (2012), other alien taxa of vascular plants have been recorded in Slovakia. New taxa arrived mainly as a consequence of human activity, whether intentionally e.g. as ornamentals or crops, or unintentionally by transport or transported goods. A list of 51 newly published taxa recorded in the wild in the territory of Slovakia is shown in Table 1 with the year of first occurrence.

A North American species Lindernia dubia was recorded in southern Slovakia in the Ipeľ river valley in 2010 (Schmotzer, 2015) and later in 2015 in Central Slovakia in an artificial water reservoir (Kochjarová et al., 2015). The species was introduced to these localities probably by ornithochory via aquatic birds or by anthropochory (Hrivnák et al., 2016). Other localities were found in southern Slovakia near the confluence of the Danube and Hron rivers in 2018 (Dítě & Dítě, 2019) and in Bratislava on the Danube river bank in 2019 (Májeková et al., 2021). Further spread of this species in Slovakia is expected.

Another new alien taxa in Slovakia is Solidago ×niederederi (Skokanová et al., 2020), a hybrid between the native S. virgaurea and North American S. canadensis. The hybrid was first recorded at the end of the 19th century in Austria, but most occurrences have been reported during the last decades, all in Europe. The authors listed the first records of the hybrid in Slovakia, Hungary, and Romania with three localities in Slovakia where one, or two, hybrid plants were identified. Although the hybrid grows together with the parental species, spreading of hybrids themselves is expected.

The North American species Euphorbia davidii was discovered at the railway station of Maťovce close to the Slovak-Ukrainian border in 2012 (Jehlík et al., 2013) and is spreading further in eastern Slovakia (Dudás, 2019). It was most probably introduced by railway transport from Ukraine where it also grows along railways (Jehlík et al., 2017).

The occurrence of Dittrichia graveolens, native to the Mediterranean, was already expected due to its spreading along the roads of Austria and the Czech Republic. Finally, it was recorded in western Slovakia on the highway near the state border with the Czech Republic in 2013 (Király et al., 2014).

The American species Euphorbia prostrata was reported in Central Slovakia in a pavement in Banská Bystrica in 2013 (Király et al., 2014). The plant was probably introduced here by vehicles from abroad. The species was later found in Nitra in 2016 growing in pavement crevices (Eliaš, 2019).

Cardamine occulta comes from East Asia, where it grows primarily as a weed in rice fields and secondarily in urban greenery. The first finds in Europe were in 1977 from Italy (Šlenker et al., 2019). It was observed in Slovakia for the first time in 2014 in Bratislava (Marhold et al., 2016), but a revision of herbarium specimens confirmed a 2002 finding also from Bratislava, but with an incorrect name (Šlenker et al., 2019). So far, it has only been observed in urban greenery in Slovakia, thus it is assumed that it was brought and spread by gardening companies with ornamental plants as a weed or soil contaminant. Most occurrences come from western Slovakia, but it is possible that the species is overlooked or incorrectly identified.

Several ornamental plants have been recorded out of cultivation and thus represent new neophytes in our country, e.g. Coreopsis lanceolata, Miscanthus sinensis, Oenothera lindheimeri, Rudbeckia bicolor, Sedum lydium or Verbena bonariensis var. conglomerata (Blanár & Kochjarová, 2016, Májeková et al., 2018, 2020, 2021).

The introduction of alien plant species into countries by road, railway and river transport was also confirmed by Ferus et al. (2015) who discussed potential exchange of invasive plant propagules between Slovakia and Romania by trade exchange. Road transport was the most dominant and the highest potential propagule export in both directions was associated with cereals.
| Name of taxon                                      | First occurrence in the wild | Source                                      |
|-------------------------------------------------|------------------------------|---------------------------------------------|
| Aegilops geniculata Roth.                       | 1960                         | Eliáš et al. (2013)                         |
| Alisma subcordatum Raf.                         | 2017                         | Hrivnák et al. (2019)                       |
| Allium aflatunense B. Fedtsch.                  | 2016                         | Eliáš (2017)                                |
| Amaranthus patalus Bertol.                      | 1948                         | Letz (2016)                                 |
| Amaranthus rudis J. D. Sauer                    | 2017                         | Bača (2018)                                 |
| Amaranthus ×galii Sennen et Gonzalo             | 2016                         | Letz (2016)                                 |
| Amaranthus ×kappii Aellen                       | 2012                         | Letz (2016)                                 |
| Amaranthus ×ralletii Contré                     | 1977                         | Letz (2016)                                 |
| Amaranthus ×soproniensis Priszter et Kárpáti    | 1949                         | Letz (2016)                                 |
| Amaranthus ×zobelii Thell.                      | 1952                         | Letz (2016)                                 |
| Anagallis monelli L.                            | 2014                         | Goliašová (2016)                            |
| Aristolochia durior Hill                       | 2005                         | Blanár & Kochjarová (2016)                  |
| Cardamine occulta Hornem.                       | 2015                         | Šlenker et al. (2019)                       |
| Cercis siliquastrum L.                          | 2014                         | Nobis et al. (2019)                         |
| Conyza sumatrensis (Retz.) E. Walker           | 2016                         | Feráková (2018)                             |
| Coreopsis lanceolata L.                         | 2015                         | Májejková et al. (2018)                     |
| Corispermum pallasii Steven                     | 1934                         | Eliáš (2016)                                |
| Dittrichia graveolens (L.) Greuter             | 2013                         | Király et al. (2014)                        |
| Echinochloa colona (L.) Link                    | 1957                         | Jehlík et al. (2017)                        |
| Eleusine indica (L) Gaertn.                     | 2017                         | Ditě et al. (2019)                         |
| Euphorbia davidii Subils                        | 2012                         | Jehlík et al. (2013)                        |
| Euphorbia myrsinites L.                         | 2020                         | Dudáš (2021)                                |
| Euphorbia prostrata Aiton                       | 2013                         | Király et al. (2014)                        |
| Chenopodium berlandieri subsp. zszechkei (Murt) Zobel | 1984                         | Jehlík et al. (2017)                        |
| Ipomoea hederacea (L.) Jacq. var. hederacea    | 1977                         | Jehlík et al. (2017)                        |
| Iria versicolor L.                              | 2015                         | Eliáš (2015)                                |
| Lemna turionifera Landolt                      | 2012                         | Bernátová & Kučera (2012)                   |
| Leymus arenarius Hochst.                        | 2009                         | Mártonfi et al. (2014)                      |
| Lindernia dubia (L.) Pennel                     | 2010                         | Schmutzer (2015)                            |
| Lolium persicum Boiss. & Hohen.                 | 1957                         | Jehlík et al. (2017)                        |
| Ludwigia repens J. R. Forst.                   | 2017                         | Nobis et al. (2019)                         |
| Miscanthus sinensis N. J. Andersson             | 2013                         | Blanár & Kochjarová (2016)                  |
| Ononos lindheimeri (Engelm. et A. Gray) W. L. Wagner et Hoch | 2019                         | Májejková et al. (2020)                     |
| Ononis repens L.                                | 1980                         | Jehlík et al. (2017)                        |
| Phyteuma nigrum F. W. Schmidt                  | 2006                         | Galvánek & Žák (2014)                       |
| Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne | 2019                         | Somogyi & Letz (2020)                       |
| Rudbeckia bicolor Nutt.                        | 2014                         | Blanár & Kochjarová (2016)                  |
| Rumex confertus Willd.                         | 1866                         | Miháliková & Goliašová (2016)               |
| Rumex rossicus Murb.                            | 1991                         | Miháliková & Goliašová (2016)               |
| Rumex ×borbasii Blocki                         | 1977                         | Miháliková & Goliašová (2016)               |
| Rumex ×confusus Simonk.                        | 1974                         | Miháliková & Goliašová (2016)               |
| Rumex ×dolusus Valta                            | 1997                         | Miháliková & Goliašová (2016)               |
| Rumex ×skofitzii Blocki                        | 1965                         | Miháliková & Goliašová (2016)               |
| Sagittaria latifolia Willd.                     | 2013                         | Nobis et al. (2019)                         |
| Salix matsudana Koidz.                         | 2018                         | Dudáš et al. (2020)                         |
2.2. Distribution of alien plants in different habitats

**HRVNÁK ET AL.** (2019) studied alien aquatic plants in Slovakia. They recorded 20 alien aquatic taxa; all of them were neophytes with naturalised invasion status and predominantly introduced deliberately as ornamentals. Their species list also included the first record of observation, invasion status, residence time, mode of introduction and water type. *Elodea canadensis* and *E. nuttallii* were the most widespread. Artificial water bodies were more frequently colonised by alien species than natural habitats. The authors anticipate further spread of alien aquatic plants in Slovakia in the future due to climate change and land use intensification.

**MEREDŽA ET AL.** (2019) studied the distribution and cytological and morphological variation of *Fallopia* sect. *Reynoutria* members in the northwestern part of the Krivánska Malá Fatra Mountains in northern Slovakia. They recorded hexaploidy in *F. bohemica*, octoploidy in *F. japonica* var. *japonica*, and tetraploidy in *F. sachalinensis*, the last with the lowest representation. A determination key for all three taxa was also included. Morphometrics of studied leaf characters revealed that the most reliable distinguishing character of *Fallopia* sect. *Reynoutria* taxa is leaf indumentum.

In the last decade, research has resumed on the flora of vascular plants at railway stations in Slovakia. The railway is a specific habitat that provides suitable conditions for different groups of plants: native and alien species, archaeophytes, neophytes, invasive, thermophilic, and rare or threatened species. New data on the distribution of both native and alien species from eastern Slovakia were published by **JEHLIK ET AL.** (2013), **MÁJEKOVÁ & LIMÁNEK** (2016), **MÁJEKOVÁ ET AL.** (2016), **MÁJEKOVÁ ET AL.** (2014) studied the occurrence of rare and threatened species (including archaeophytes) at Slovak railway stations. Recently, the neophyte species *Geranium purpureum* has been spreading on railway lines in the warm areas of Slovakia, and is also already penetrating the tram line and semi-natural vegetation (**ELIÁŠ, 2011; ZALIBEROVÁ & MÁJEKOVÁ, 2014; MÁJEKOVÁ, 2021**). **JEHLIK ET AL.** (2017) compared historic and recent floristic data at four railway trans-shipment yards in southeastern Slovakia (Čierna nad Tisou, Dobrá, Veľké Kapušany and Maťovce) and emphasised the importance of the Eastern migration route to the Slovak flora.

Plant communities of arable fields, the diversity and species composition of weed vegetation, together with representation of alien or invasive species in various crop types were studied by **MÁJEKOVÁ & ZALIBEROVÁ** (2014) and **MÁJEKOVÁ ET AL.** (2019).

In recent years, Rendeková has done detailed research on the flora and vegetation of synanthropic habitats within Bratislava. In addition to ruderal communities, she also dealt with the distribution of alien taxa and communities of invasive neophytes, the diversity of tram tracks, changes in distribution of alien species in the ruderal vegetation of Bratislava (**RENDEKOVÁ ET AL., 2015, 2017a, b, 2019a, b, 2020**). She also paid attention to the representation and changes in the distribution of alien species in the ruderal vegetation in the city of Malacky (in western Slovakia) over 50 years (**RENDEKOVÁ & MÍČIETA, 2017**).

**Ambrosia artemisiifolia** is a highly invasive and allergenic plant, native to North America. From its first occurrence in Slovakia in 1949 (**HEJNÝ & OPLUŠTILOVÁ-HEJNÁ, 1950**) it has spread dramatically throughout the country (**HRABOVSKÝ & MÍČIETA, 2014, 2018**). There are two main invaded areas in Slovakia, situated in the southwest and southeast of the country. The spread along highways and main roads seems to be the most important source of its distribution nowadays. Its airborne pollen pattern from five monitoring stations in Slovakia was also analysed by **HRABOVSKÝ ET AL.** (2016).

Several works about distribution and communities of alien and invasive species at a regional level have been published, e.g. **UHLIAROVÁ ET AL.** (2012), **ŽGANČIKOVÁ ET AL.** (2012), **ŽABKA ET AL.** (2015), **ELIÁŠ** (2019, 2020), **FERUS ET AL.** (2020), **VALACHOVIČ** (2021). **MÁJEKOVÁ ET AL.** (2021) proposed changes in the residence or invasion status of several alien taxa in Slovakia in comparison with the work of **MEDVECKÁ ET AL.** (2012).

2.3. Plant invasions

The study of plant invasion dynamics in the Slovak vegetation (**MEDVECKÁ ET AL., 2014**) showed that the most invaded habitats were those which were highly influenced by human activities (e.g.
anthropogenic herbaceous stands of annuals and perennials, arable land, trampled habitats). The least invaded were extreme habitats, such as bogs and mires, subalpine and alpine habitats. The invasion level decreased with altitude in most of the studied habitats, however, the observed trends indicated an increased invasion level over the last 50 years.

A similar result was obtained in the study of neophyte representation in hardwood floodplain forests in the Pannonian region (of Slovakia and Hungary). There has been a significant increase in the number and cover of neophytes along the studied time period. Besides the time factor, the amount of nutrients, light, soil reaction, cover of the herb layer and soil moisture were found to be important ecological factors affecting the number of neophytes [Petrášová et al., 2013).

Another study evaluated the invasion level of various forest habitats in Slovakia [Medvecká et al., 2018a]. The most invaded were plantations of alien tree species, especially Populus ×canadensis and Robinia pseudoacacia. Native forests at lower elevations and closer to rivers were more invaded, while broadleaved, mixed and especially coniferous forests at higher elevations and ecologically narrowly specialised forests were less invaded.

Medvecká et al. (2018b) focused on the patterns of alien plant distribution in the Tatra Mountains. Most of the alien plants were found in locations at lower elevations and in association with intensive human activity. Paved roads with unlimited access and railways hosted the greatest number of alien species, whereas footpaths in valleys were almost free of alien plants. The most frequent aliens were Trifolium hybridum, Mellilotus albus, Capsella bursapastoris, and Lupinus polyphyllus.

In Slovakia, there is a long tradition of planting alien trees, the most common of which are: Populus ×canadensis, Robinia pseudoacacia, Pinus nigra, and Quercus rubra. However, until recently, no attention had been paid to the floristic composition of these stands, nor to their effects on the environment. Replacing native forests by alien tree plantations can lead to changes in the species composition of the understory vegetation and also in microclimatic conditions. To determine these effects, Bazalová et al. (2018) used the "twin plots" method based on the collection of phytosociological relevés in stands of alien tree species and in the stands of native tree species that lie close to each other in the same ecological conditions (the same altitude, aspect, slope, soil type) at the same time. This method proved to be a suitable tool for analyses of the impact of alien trees on the understory vegetation.

Slabejová et al. (2019) studied the Robinia pseudoacacia plantations in Slovakia and neighbouring countries. They analysed how environmental factors (light, temperature, and humidity), species composition and level of invasion changed in Robinia stands compared with neighbouring native forests. The Robinia stands were in general warmer, drier, and lighter, they included more non-forest and ruderal species with higher frequency and cover of alien species in the understory vegetation than in the native forest stands. Planting of R. pseudoacacia also played a crucial role in the homogenization of forest stands, as it removed the geographically specified variability and at the same time supported generalist plant species in the understory. Robinia plantations also caused the unification of internal micro-environmental conditions of stands (Šibíková et al., 2019).

Similar research in Pinus nigra plantations was done by Mikulová et al. (2019) in the Carpathian-Pannonian region. P. nigra changed the structural and environmental characteristics of forest communities in comparison to stands of native trees. The tree canopy was more open, the cover of the shrub layer was higher, the needles form a thicker litter layer, and the cover of the herb layer was lower than in native forests. P. nigra stands also modified the local climate and hosted more alien species, and there were more light-demanding and fewer moisture-demanding species in the understory. The differences between the twin stands decreased at higher altitude.

These results could be useful for forest management because their choice of planted species may both positively and negatively influence the level of invasion in managed forests and the replacement of native forest stands by alien tree species often has ecological and economic impacts with consequences for nature and society (Medvecká et al., 2018a, Slabejová et al., 2019).

Biological invasions were also observed in the vegetation of the city of Bratislava (Rendeková et al., 2017c). The authors studied changes in the proportion of invasive alien species in forest, grassland, and ruderal vegetation over time. The most invaded was the ruderal vegetation with the highest average percentage number of invasive species in the classes of Sisymbrietea and Epilobietea angustifolii. The second most invaded type of vegetation was the floodplain forest of the class Salicetea purpureae. Rendeková et al. (2018) also detected an increase in invasive alien species in the majority of the ruderal vegetation of the cities of Bratislava, Malacky and Trnava in Slovakia and Brno in the Czech Republic over time.
2.4. Citizen science

A team of scientists, mostly from the Institute of Botany (Plant Science and Biodiversity Centre, SAS) in Bratislava developed a system for the collection of alien distribution data, utilising modern technologies. The aim was to acquire new knowledge on the distribution, abundance and ecology of selected alien species in Slovakia with the utilization of a broad cross-section of the public, e.g. students, photographers, fishermen, tourists, etc. “Visitor” is a smartphone application (app) for mapping alien/invasive species and currently includes 17 plant and 13 animal species. By using their in-built smartphone camera and GPS tracker which provides co-ordinates the registered users record the occurrence of the monitored species and after filling out a simple form they send the finding to the database. Each finding is verified afterwards by an expert and these verified findings are displayed on the map, which is available to everyone on the website (www.visitor.sav.sk). The website is also a source of information on the monitored species, including their descriptions and photos. The system is still under development.

3. Conclusion

Research on the alien species and invasions has been undertaken in Slovakia over several decades. The results of the research has resulted in a comprehensive publication by Medvecká et al. (2012). These authors summarised a list of all archaeophytes and neophytes known until that time. This article provides a short review of the most important and relevant publications published within the last ten years. During this period, 51 new neophytes were found in the territory of Slovakia. Alien plants occupy various types of habitats with a clear preference for anthropogenic ones. Based on this we expect a similar intensity of introductions of new neophytes into the territory in the future and their further spread into ruderal, semi-natural, and natural environments.

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