

CONTRIBUTIONS TO THE IDENTIFICATION OF HOTSPOTS OF INVASION OF ALIEN PLANT SPECIES IN MUREȘ COUNTY (ROMANIA)

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Abstract: A priority for the states of the European Union is the identification of invasive and potentially invasive alien species, their main routes of entry and spread, and the impact they have on various types of habitats. The aim of this study was to contribute to the knowledge of hotspots (areas with a large number of invasive species) or those where their abundance-dominance is very high and produces a major impact on native vegetation. Through the research carried out on invasive and potentially invasive alien species in Mureș County, 1204 records made in 168 locations in Mureș County were analyzed and 31 species of invasive alien plants were identified, of which three species are of concern for the European Union, namely: *Asclepias syriaca*, *Ailanthus altissima* și *Impatiens glandulifera*. In the study area, the species with the highest presence are: *Erigeron annuus* subsp. *annuus* identified in 248 points, *Xanthium orientale* subsp. *italicum* (201 points), *Robinia pseudoacacia* (142 points), *Solidago canadensis* (83 points), *Erigeron canadensis* and *Reynoutria japonica* (each with 74 points), and *Ambrosia artemisiifolia* (67 points). In the observation points, up to 4-6 species of invasive plants grouped in the same type of habitat were found. These were generally habitats subject to strong anthropogenic impact, roadsides, fallows, abandoned lands, and agricultural crops. Each identified species was analyzed from the chorological point of view, the bioforms, the ways and the purpose of their introduction, and the phytogeographical elements.

Keywords: alien invasive species, hotspots, Mureș County

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Introduction

According to the DAISIE project (2019), there are more than 12,000 non-native species in Europe. An estimated 1200–1800 of these are invasive, and this number continues to rise with the increase in global trade and tourism (EC. Thorpe et al. 2015). Climate change is also likely to worsen the problem of invasive species. Thus, as the climatic conditions of some locations change, they may become more favorable for certain previously harmless alien species, making native species more vulnerable to invasion (Hellmann et al. 2008, Finch et al. 2021).

Biological invasions represent a major threat to global biodiversity and the functioning of ecosystems. A priority for the states of the European Union is to identify

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the invasive and potentially invasive alien species, their main routes of entry and spread, and the impact they have on various types of habitats (Pyšek et al. 2011).

The paper presents the results of research carried out on invasive and potentially invasive alien species in Mureș County. The study aims to contribute to the knowledge of hotspots (areas with a large number of invasive species or those where their abundance-dominance is very high) and produces a major impact on native vegetation.

Material and methods

The research for the identification and analysis of invasive alien species (IAS) hotspots, areas with a large number of invasive species, which represent introduction routes that require priority actions, were carried out in Mureș County, in the period 2019-2022.

Mureș County is located in the central-northern part of Romania, with an area of 6696 km². The county stretches between the mountain peaks of Căliman and Gurghiu up to the Târnavelor Plateau and the Transylvanian Plain. The physical-geographical axis of the county is the Mureș River, which crosses the county from NE to SW over a distance of 140 km.

The county has 11 municipalities and cities, of which 4 municipalities (Târgu Mureș, Reghin, Sighisoara, Târnăveni), 7 cities (Iernut, Luduș, Miercurea Nirajului, Sângiorgiu de Pădure, Sărmașu, Sovata, Ungheni) and 91 communes with 464 villages. The county benefits from a infrastructure network comprising 1,846 kilometers of public roads, of which 18% represent roads of national interest, 40% those of county importance and 42% communal ones (CJM, 2022).

In the last decades, large areas of land covered by invasive species at the expense of native species have been identified in the Mureș county. They have settled massively, especially due to the fragmentation of abandoned, unused arable land, constituting the center of invasive alien species spreading. Climate change in recent years has amplified the massive accession of invasive plants.

The observation points were established in areas associated with transport and commercial infrastructure (stations, railway edges, roads, industrial areas, etc.), in riparian habitats: banks and major watercourse beds (rivers, streams), the shores of the lakes, the edges of the forests, as well as the territories of the protected areas in the county.

Our research analyzed 1204 records made in 168 locations in Mureș County and 31 invasive alien plant species were identified, of which three species are of European Union concern (EC, 2020). The taxa were selected from those listed in the "Guide for inventorying and mapping the distribution of invasive and potentially invasive alien plant species in Romania" elaborated by Anastasiu (coord.) et al. (2019).

Each identified species was analyzed from the point of view of chorology, bioform, phytogeographical element, ways and purpose of their introduction. Also, the requirements of the species against the ecological factors were taken into account, making a characterization of them, using the Ellenberg indices (light, temperature, humidity, soil reaction, and nitrogen). Ecological indices, bioforms, and floristic elements are following Sârbu et al. (2013) and Sîrbu & Oprea (2011). For the

identification and nomenclature of the species, Euro+Med (2006-) and Sîrbu et al. (2013) were taken into account.

We also mention particular aspects of the biology of pollination and diaspores dispersal of these invasive plants. The pollination and dispersion ways follow Anastasiu & Negrean (2007) and Sîrbu & Oprea (2011).

Results and discussion

Field research carried out during 2019-2022 sought to identify hotspots, areas with a large number of invasive species, or those where their abundance-dominance is very high and produces a major impact on native vegetation.

Through the research conducted on alien and potentially invasive species in Mureş County, 1204 records made in the administrative territory of 168 localities in Mureş County were analyzed (Fig. 1 and Table 1).

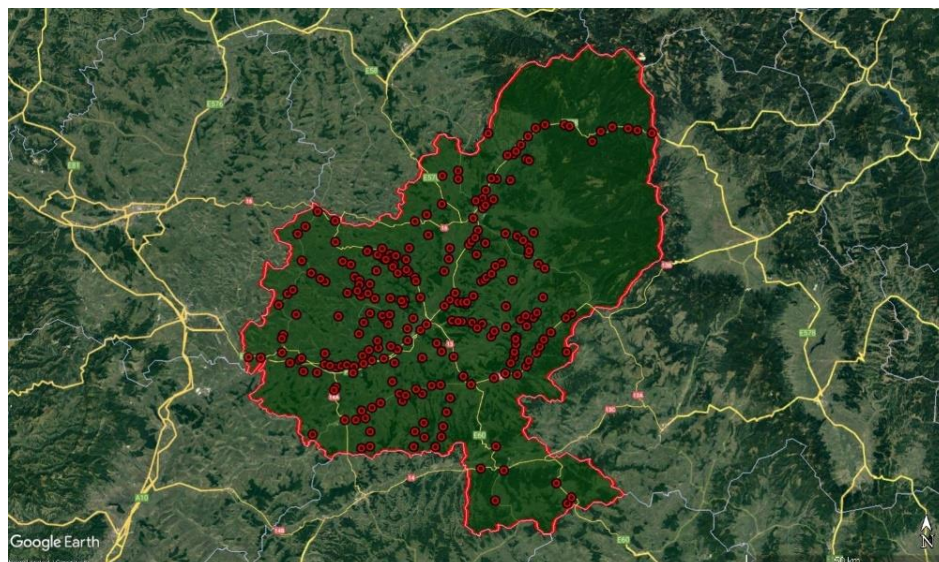


Fig. 1. Alien invasive species locations in Mureş County

Table 1. The localities in Mureș County and the number of records of alien invasive species

Location /Species	Records	Location /Species	Records
Abuș	4	Trei Sate - Sângiorgiu de Pădure	2
<i>Amaranthus retroflexus</i>	1	<i>Ailanthus altissima</i>	1
<i>Erigeron annuus</i> subsp. <i>annuus</i>	1	<i>Robinia pseudoacacia</i>	1
<i>Xanthium orientale</i> subsp. <i>italicum</i>	2	Viișoara - Zagăr	3
Andreneasa	19	<i>Reynoutria japonica</i>	1
<i>Armoracia rusticana</i>	1	<i>Solidago canadensis</i>	2
<i>Helianthus tuberosus</i>	2	Zagăr -Coroisânmărtin	4
<i>Impatiens glandulifera</i>	9	<i>Ambrosia artemisiifolia</i>	1
<i>Reynoutria japonica</i>	7	<i>Echinocystis lobata</i>	1
Băgaciu	6	<i>Solidago canadensis</i>	1
<i>Solidago canadensis</i>	2	<i>Xanthium orientale</i> subsp. <i>italicum</i>	1
<i>Xanthium orientale</i> subsp. <i>italicum</i>	4	Ivănești- Lăureni	2
Băgaciu to Deleni	19	<i>Robinia pseudoacacia</i>	2
<i>Ambrosia artemisiifolia</i>	1	Laslăul Mare	3
<i>Erigeron annuus</i> subsp. <i>annuus</i>	2	<i>Ambrosia artemisiifolia</i>	1
<i>Robinia pseudoacacia</i>	4	<i>Helianthus tuberosus</i>	1
<i>Solidago canadensis</i>	4	<i>Xanthium orientale</i> subsp. <i>italicum</i>	1
<i>Xanthium orientale</i> subsp. <i>italicum</i>	8	Lăureni	1
Bahnea	3	<i>Ambrosia artemisiifolia</i>	1
<i>Ambrosia artemisiifolia</i>	1	Lechința	1
<i>Solidago canadensis</i>	1	<i>Robinia pseudoacacia</i>	1
<i>Symphyotrichum lanceolatum</i>	1	Livezeni	28
Băla	16	<i>Amaranthus retroflexus</i>	4
<i>Erigeron annuus</i> subsp. <i>annuus</i>	8	<i>Ambrosia artemisiifolia</i>	1
<i>Helianthus tuberosus</i>	1	<i>Erigeron annuus</i> subsp. <i>annuus</i>	10
<i>Matricaria discoidea</i>	1	<i>Erigeron canadensis</i>	4
<i>Robinia pseudoacacia</i>	1	<i>Solidago canadensis</i>	9
<i>Xanthium orientale</i> subsp. <i>italicum</i>	5	Livezeni - Ivănești	4
Bălăușeri	5	<i>Solidago canadensis</i>	4
<i>Erigeron annuus</i> subsp. <i>annuus</i>	1	Luduș	12
<i>Erigeron canadensis</i>	1	<i>Ambrosia artemisiifolia</i>	6
<i>Parthenocissus inserta</i>	1	<i>Amorpha fruticosa</i>	1

Location /Species	Records	Location /Species	Records
<i>Robinia pseudoacacia</i>	2	<i>Robinia pseudoacacia</i>	2
Balda	2	<i>Xanthium orientale</i> subsp. <i>italicum</i>	3
<i>Echinocystis lobata</i>	1	Lunca Bradului	2
<i>Xanthium orientale</i> subsp. <i>italicum</i>	1	<i>Impatiens glandulifera</i>	2
Band	4	Mădăraş	1
<i>Lycium barbarum</i>	1	<i>Erigeron annuus</i> subsp. <i>annuus</i>	1
<i>Robinia pseudoacacia</i>	3	Măgherani	8
Batoş	8	<i>Erigeron annuus</i> subsp. <i>annuus</i>	3
<i>Echinocystis lobata</i>	1	<i>Reynoutria japonica</i>	2
<i>Erigeron annuus</i> subsp. <i>annuus</i>	2	<i>Robinia pseudoacacia</i>	3
<i>Reynoutria japonica</i>	1	Maioreşti	2
<i>Robinia pseudoacacia</i>	2	<i>Helianthus tuberosus</i>	1
<i>Xanthium orientale</i> subsp. <i>italicum</i>	2	<i>Solidago canadensis</i>	1
Beica de Jos	5	Mărăşeşti	1
<i>Helianthus tuberosus</i>	1	<i>Erigeron annuus</i> subsp. <i>annuus</i>	1
<i>Reynoutria japonica</i>	3	Meştera	7
<i>Robinia pseudoacacia</i>	1	<i>Echinocystis lobata</i>	1
Beica de Sus	4	<i>Reynoutria japonica</i>	6
<i>Erigeron annuus</i> subsp. <i>annuus</i>	2	Mica	29
<i>Robinia pseudoacacia</i>	2	<i>Ambrosia artemisiifolia</i>	3
Bereni	5	<i>Erigeron annuus</i> subsp. <i>annuus</i>	9
<i>Erigeron annuus</i> subsp. <i>annuus</i>	1	<i>Helianthus tuberosus</i>	2
<i>Reynoutria japonica</i>	2	<i>Robinia pseudoacacia</i>	1
<i>Robinia pseudoacacia</i>	1	<i>Solidago canadensis</i>	8
<i>Rudbeckia laciniata</i>	1	<i>Xanthium orientale</i> subsp. <i>italicum</i>	6
Berghia	3	Miercurea Nirajului	52
<i>Helianthus tuberosus</i>	1	<i>Amaranthus retroflexus</i>	2
<i>Lycium barbarum</i>	2	<i>Ambrosia artemisiifolia</i>	3
Berghia-Band	2	<i>Armoracia rusticana</i>	1
<i>Erigeron annuus</i> subsp. <i>annuus</i>	1	<i>Echinocystis lobata</i>	1
<i>Robinia pseudoacacia</i>	1	<i>Erigeron annuus</i> subsp. <i>annuus</i>	14
Cross roads of Zau-Sărmaş	1	<i>Erigeron canadensis</i>	8
<i>Amaranthus retroflexus</i>	1	<i>Robinia pseudoacacia</i>	3
Bistra Mureşului	2	<i>Xanthium orientale</i> subsp. <i>italicum</i>	20

Location /Species	Records	Location /Species	Records
<i>Ambrosia artemisiifolia</i>	1	Miheșu de Câmpie	4
<i>Parthenocissus inserta</i>	1	<i>Ambrosia artemisiifolia</i>	1
Bogata	6	<i>Amorpha fruticosa</i>	1
<i>Lycium barbarum</i>	2	<i>Echinocystis lobata</i>	1
<i>Xanthium orientale</i> subsp. <i>italicum</i>	4	<i>Robinia pseudoacacia</i>	1
Bozed	4	Morești	1
<i>Ambrosia artemisiifolia</i>	1	<i>Reynoutria japonica</i>	1
<i>Erigeron annuus</i> subsp. <i>annuus</i>	3	Mura Mare	3
Brâncovenesti	4	<i>Erigeron annuus</i> subsp. <i>annuus</i>	3
<i>Helianthus tuberosus</i>	2	Mura Mică	1
<i>Parthenocissus inserta</i>	1	<i>Erigeron annuus</i> subsp. <i>annuus</i>	1
<i>Rudbeckia laciniata</i>	1	Nazna	2
Câmpenița	4	<i>Erigeron annuus</i> subsp. <i>annuus</i>	1
<i>Robinia pseudoacacia</i>	2	<i>Robinia pseudoacacia</i>	1
<i>Xanthium orientale</i> subsp. <i>italicum</i>	2	Neagra	6
Cerghid	4	<i>Helianthus tuberosus</i>	1
<i>Helianthus tuberosus</i>	1	<i>Reynoutria japonica</i>	5
<i>Solidago canadensis</i>	2	Neaua	2
<i>Xanthium orientale</i> subsp. <i>italicum</i>	1	<i>Erigeron annuus</i> subsp. <i>annuus</i>	1
Cerghizel	4	<i>Rudbeckia laciniata</i>	1
<i>Robinia pseudoacacia</i>	2	Negrenii de Câmpie	7
<i>Solidago canadensis</i>	2	<i>Erigeron annuus</i> subsp. <i>annuus</i>	1
Ceuașu de Câmpie	14	<i>Erigeron canadensis</i>	1
<i>Erigeron annuus</i> subsp. <i>annuus</i>	6	<i>Lycium barbarum</i>	2
<i>Erigeron canadensis</i>	1	<i>Robinia pseudoacacia</i>	1
<i>Matricaria discoidea</i>	2	<i>Xanthium orientale</i> subsp. <i>italicum</i>	2
<i>Parthenocissus inserta</i>	1	Nima Râciului	5
<i>Xanthium orientale</i> subsp. <i>italicum</i>	4	<i>Ambrosia artemisiifolia</i>	1
Chețani	3	<i>Erigeron annuus</i> subsp. <i>annuus</i>	1
<i>Ambrosia artemisiifolia</i>	1	<i>Robinia pseudoacacia</i>	1
<i>Erigeron canadensis</i>	1	<i>Xanthium orientale</i> subsp. <i>italicum</i>	1
<i>Xanthium orientale</i> subsp. <i>italicum</i>	1	<i>Xanthium strumarium</i>	1
Chiheru de Jos	5	Odrihei	4
<i>Reynoutria japonica</i>	3	<i>Acer negundo</i>	1

Location /Species	Records	Location /Species	Records
<i>Robinia pseudoacacia</i>	2	<i>Robinia pseudoacacia</i>	1
Chiheru de Sus	3	<i>Solidago canadensis</i>	2
<i>Oxalis corniculata</i>	1	Ogra	16
<i>Robinia pseudoacacia</i>	2	<i>Ambrosia artemisiifolia</i>	1
Ciobotani	2	<i>Erigeron annuus</i> subsp. <i>annuus</i>	5
<i>Reynoutria japonica</i>	2	<i>Erigeron canadensis</i>	2
Cipău	2	<i>Helianthus tuberosus</i>	1
<i>Matricaria discoidea</i>	2	<i>Xanthium orientale</i> subsp. <i>italicum</i>	7
about 3 km of Iernut	2	Ormeniș	1
<i>Xanthium orientale</i> subsp. <i>italicum</i>	2	<i>Xanthium orientale</i> subsp. <i>italicum</i>	1
Cloașterf	1	Oroi	2
<i>Symphytotrichum lanceolatum</i>	1	<i>Erigeron annuus</i> subsp. <i>annuus</i>	2
Coasta Mare	1	Pădureni	7
<i>Xanthium orientale</i> subsp. <i>italicum</i>	1	<i>Erigeron annuus</i> subsp. <i>annuus</i>	7
Comori	4	Pănet	2
<i>Erigeron annuus</i> subsp. <i>annuus</i>	1	<i>Erigeron annuus</i> subsp. <i>annuus</i>	1
<i>Matricaria discoidea</i>	1	<i>Robinia pseudoacacia</i>	1
<i>Reynoutria japonica</i>	1	Păucișoara	2
<i>Rudbeckia laciniata</i>	1	<i>Ambrosia artemisiifolia</i>	1
Coroisânmărtin	3	<i>Xanthium orientale</i> subsp. <i>italicum</i>	1
<i>Erigeron annuus</i> subsp. <i>annuus</i>	2	Periș	4
<i>Lycium barbarum</i>	1	<i>Erigeron annuus</i> subsp. <i>annuus</i>	2
Cotuș	1	<i>Matricaria discoidea</i>	1
<i>Erigeron annuus</i> subsp. <i>annuus</i>	1	<i>Reynoutria japonica</i>	1
Crăiești	2	Petea	4
<i>Robinia pseudoacacia</i>	2	<i>Xanthium orientale</i> subsp. <i>italicum</i>	4
Cristești	1	Petelea	3
<i>Erigeron annuus</i> subsp. <i>annuus</i>	1	<i>Reynoutria japonica</i>	2
Cotuș	1	<i>Ambrosia artemisiifolia</i>	1
<i>Erigeron annuus</i> subsp. <i>annuus</i>	1	Petelea - Peris	1
Crăiești	2	<i>Reynoutria japonica</i>	1
<i>Robinia pseudoacacia</i>	2	Petrilaca de Mureș - Periș	1
Cristești	1	<i>Erigeron annuus</i> subsp. <i>annuus</i>	1
<i>Erigeron annuus</i> subsp. <i>annuus</i>	1	Poarta	1

Location /Species	Records	Location /Species	Records
Cucerdea	12	<i>Robinia pseudoacacia</i>	1
<i>Helianthus tuberosus</i>	4	Pogăceaua	5
<i>Robinia pseudoacacia</i>	4	<i>Erigeron annuus</i> subsp. <i>annuus</i>	1
<i>Xanthium orientale</i> subsp. <i>italicum</i>	4	<i>Erigeron canadensis</i>	1
Cuci	11	<i>Robinia pseudoacacia</i>	2
<i>Ailanthus altissima</i>	2	<i>Xanthium orientale</i> subsp. <i>italicum</i>	1
<i>Ambrosia artemisiifolia</i>	2	Râciu	6
<i>Erigeron annuus</i> subsp. <i>annuus</i>	2	<i>Amaranthus retroflexus</i>	2
<i>Reynoutria japonica</i>	1	<i>Ambrosia artemisiifolia</i>	2
<i>Xanthium orientale</i> subsp. <i>italicum</i>	4	<i>Erigeron canadensis</i>	1
Cuci to Orosia	7	<i>Xanthium orientale</i> subsp. <i>italicum</i>	1
<i>Amaranthus retroflexus</i>	2	Râciu - Sânmărtin	2
<i>Ambrosia artemisiifolia</i>	1	<i>Xanthium orientale</i> subsp. <i>italicum</i>	2
<i>Erigeron annuus</i> subsp. <i>annuus</i>	2	Răstolița	5
<i>Xanthium orientale</i> subsp. <i>italicum</i>	2	<i>Impatiens glandulifera</i>	2
Cuci to Petrilaca	6	<i>Reynoutria japonica</i>	3
<i>Matricaria discoidea</i>	2	Recea	1
<i>Xanthium orientale</i> subsp. <i>italicum</i>	4	<i>Erigeron canadensis</i>	1
Cuieșd	4	Reghin	6
<i>Erigeron annuus</i> subsp. <i>annuus</i>	2	<i>Erigeron annuus</i> subsp. <i>annuus</i>	1
<i>Robinia pseudoacacia</i>	2	<i>Helianthus tuberosus</i>	1
Cund	2	<i>Parthenocissus inserta</i>	1
<i>Erigeron canadensis</i>	1	<i>Reynoutria japonica</i>	1
<i>Robinia pseudoacacia</i>	1	<i>Solidago canadensis</i>	2
Deda	2	Rigmani	2
<i>Ambrosia artemisiifolia</i>	1	<i>Rudbeckia laciniata</i>	2
<i>Galinsoga parviflora</i>	1	Roșiori	3
Drăculea Bandului	2	<i>Amorpha fruticosa</i>	1
<i>Erigeron annuus</i> subsp. <i>annuus</i>	2	<i>Robinia pseudoacacia</i>	2
Cucerdea neighbourhoud	1	Rușii-Munți	5
<i>Erigeron annuus</i> subsp. <i>annuus</i>	1	<i>Ambrosia artemisiifolia</i>	1
Eremieni	2	<i>Erigeron annuus</i> subsp. <i>annuus</i>	3
<i>Erigeron annuus</i> subsp. <i>annuus</i>	1	<i>Erigeron canadensis</i>	1
<i>Reynoutria japonica</i>	1	Săbed	9

Location /Species	Records	Location /Species	Records
Eremitu	16	<i>Ailanthus altissima</i>	1
<i>Ambrosia artemisiifolia</i>	3	<i>Ambrosia artemisiifolia</i>	1
<i>Erigeron annuus</i> subsp. <i>annuus</i>	4	<i>Erigeron annuus</i> subsp. <i>annuus</i>	3
<i>Erigeron canadensis</i>	3	<i>Helianthus tuberosus</i>	1
<i>Robinia pseudoacacia</i>	1	<i>Robinia pseudoacacia</i>	1
<i>Rudbeckia laciniata</i>	4	<i>Xanthium orientale</i> subsp. <i>italicum</i>	2
<i>Symphyotrichum lanceolatum</i>	1	Șaeș	2
Ernei	3	<i>Solidago canadensis</i>	1
<i>Erigeron annuus</i> subsp. <i>annuus</i>	1	<i>Symphyotrichum lanceolatum</i>	1
<i>Erigeron canadensis</i>	1	Sălard	11
<i>Solidago canadensis</i>	1	<i>Impatiens glandulifera</i>	8
Fânațe	9	<i>Reynoutria japonica</i>	3
<i>Erigeron annuus</i> subsp. <i>annuus</i>	5	Sâmărgăhita	3
<i>Erigeron canadensis</i>	1	<i>Acer negundo</i>	1
<i>Lycium barbarum</i>	3	<i>Echinocystis lobata</i>	1
Fânațele Mădărașului	3	<i>Robinia pseudoacacia</i>	1
<i>Robinia pseudoacacia</i>	3	Sâmărgăhita - Sânpaul	9
Fântânele	2	<i>Ailanthus altissima</i>	1
<i>Parthenocissus inserta</i>	2	<i>Datura stramonium</i>	1
Fărăgău	3	<i>Helianthus tuberosus</i>	4
<i>Lycium barbarum</i>	1	<i>Robinia pseudoacacia</i>	1
<i>Matricaria discoidea</i>	2	<i>Xanthium orientale</i> subsp. <i>italicum</i>	2
Fițcău	4	Sâmpetru de Câmpie	6
<i>Erigeron annuus</i> subsp. <i>annuus</i>	1	<i>Ambrosia artemisiifolia</i>	1
<i>Impatiens parviflora</i>	1	<i>Erigeron canadensis</i>	1
<i>Oenothera biennis</i>	1	<i>Robinia pseudoacacia</i>	1
<i>Oxalis corniculata</i>	1	<i>Xanthium orientale</i> subsp. <i>italicum</i>	3
Foi	2	Sâncraiu de Mureș	13
<i>Robinia pseudoacacia</i>	1	<i>Amaranthus retroflexus</i>	1
<i>Solidago canadensis</i>	1	<i>Ambrosia artemisiifolia</i>	4
Găești	2	<i>Erigeron annuus</i> subsp. <i>annuus</i>	1
<i>Helianthus tuberosus</i>	2	<i>Erigeron canadensis</i>	1
Gălăoia	7	<i>Reynoutria japonica</i>	1
<i>Impatiens glandulifera</i>	7	<i>Xanthium orientale</i> subsp. <i>italicum</i>	5

Location /Species	Records	Location /Species	Records
Gălești	48	Sânger	3
<i>Amaranthus retroflexus</i>	2	<i>Helianthus tuberosus</i>	2
<i>Echinocystis lobata</i>	4	<i>Robinia pseudoacacia</i>	1
<i>Erigeron annuus</i> subsp. <i>annuus</i>	22	Sângiorgiu de Mureș	1
<i>Erigeron canadensis</i>	8	<i>Parthenocissus inserta</i>	1
<i>Helianthus tuberosus</i>	2	Sângiorgiu de Pădure	2
<i>Xanthium orientale</i> subsp. <i>italicum</i>	10	<i>Erigeron annuus</i> subsp. <i>annuus</i>	1
Gălești - Tâmpa	10	<i>Robinia pseudoacacia</i>	1
<i>Erigeron annuus</i> subsp. <i>annuus</i>	4	Sânișor	1
<i>Xanthium orientale</i> subsp. <i>italicum</i>	6	<i>Xanthium orientale</i> subsp. <i>italicum</i>	1
Gănești	3	Sânpaul	43
<i>Ambrosia artemisiifolia</i>	1	<i>Acer negundo</i>	1
<i>Xanthium orientale</i> subsp. <i>italicum</i>	2	<i>Ailanthus altissima</i>	2
Gănești-Băgaciu	6	<i>Echinocystis lobata</i>	1
<i>Robinia pseudoacacia</i>	2	<i>Erigeron annuus</i> subsp. <i>annuus</i>	6
<i>Solidago canadensis</i>	4	<i>Erigeron canadensis</i>	10
Ghindari	4	<i>Lycium barbarum</i>	3
<i>Erigeron canadensis</i>	2	<i>Robinia pseudoacacia</i>	4
<i>Robinia pseudoacacia</i>	1	<i>Xanthium orientale</i> subsp. <i>italicum</i>	16
<i>Rudbeckia laciniata</i>	1	Sânsimion	4
Ghindari - Trei Sate	2	<i>Erigeron annuus</i> subsp. <i>annuus</i>	1
<i>Ailanthus altissima</i>	2	<i>Rudbeckia laciniata</i>	3
Glodeni	9	Sărățeni	7
<i>Echinocystis lobata</i>	2	<i>Ailanthus altissima</i>	2
<i>Helianthus tuberosus</i>	1	<i>Erigeron annuus</i> subsp. <i>annuus</i>	1
<i>Reynoutria japonica</i>	1	<i>Robinia pseudoacacia</i>	3
<i>Reynoutria sachalinensis</i>	1	<i>Rudbeckia laciniata</i>	1
<i>Reynoutria x bohemica</i>	1	Sărmășel Gară	4
<i>Rudbeckia laciniata</i>	2	<i>Ambrosia artemisiifolia</i>	2
<i>Symphyotrichum lanceolatum</i>	1	<i>Robinia pseudoacacia</i>	1
Gogan	5	<i>Xanthium orientale</i> subsp. <i>italicum</i>	1
<i>Asclepias syriaca</i>	1	Sărmașu	2
<i>Helianthus tuberosus</i>	1	<i>Ambrosia artemisiifolia</i>	1
<i>Reynoutria japonica</i>	1	<i>Echinocystis lobata</i>	1

Location /Species	Records	Location /Species	Records
<i>Solidago canadensis</i>	2	Saschiz	6
Goreni	2	<i>Acer negundo</i>	1
<i>Lycium barbarum</i>	1	<i>Echinocystis lobata</i>	1
<i>Robinia pseudoacacia</i>	1	<i>Helianthus tuberosus</i>	2
Grebenișu de Câmpie	2	<i>Reynoutria japonica</i>	1
<i>Robinia pseudoacacia</i>	1	<i>Solidago canadensis</i>	1
<i>Xanthium orientale</i> subsp. <i>italicum</i>	1	Mihai Viteazu	1
Hădăreni	3	<i>Ambrosia artemisiifolia</i>	1
<i>Helianthus tuberosus</i>	1	Satu Nou	1
<i>Robinia pseudoacacia</i>	1	<i>Xanthium orientale</i> subsp. <i>italicum</i>	1
<i>Xanthium orientale</i> subsp. <i>italicum</i>	1	Șăulia	7
Hărțău	3	<i>Lycium barbarum</i>	1
<i>Erigeron annuus</i> subsp. <i>annuus</i>	3	<i>Robinia pseudoacacia</i>	6
Hetiur	1	Șăulia-Zau de Câmpie	1
<i>Reynoutria japonica</i>	1	<i>Robinia pseudoacacia</i>	1
Hodoșa	18	Șăușa - Sâmărgăhita	6
<i>Ambrosia artemisiifolia</i>	1	<i>Echinocystis lobata</i>	1
<i>Erigeron annuus</i> subsp. <i>annuus</i>	5	<i>Erigeron annuus</i> subsp. <i>annuus</i>	1
<i>Erigeron canadensis</i>	2	<i>Helianthus tuberosus</i>	2
<i>Solidago canadensis</i>	2	<i>Robinia pseudoacacia</i>	1
<i>Symphyotrichum lanceolatum</i>	7	<i>Symphyotrichum lanceolatum</i>	1
<i>Xanthium orientale</i> subsp. <i>italicum</i>	1	Secăreni	5
Iclânzul	4	<i>Ailanthus altissima</i>	1
<i>Robinia pseudoacacia</i>	3	<i>Erigeron annuus</i> subsp. <i>annuus</i>	4
<i>Xanthium orientale</i> subsp. <i>italicum</i>	1	Șerbeni	6
Ideciu de Jos	3	<i>Echinocystis lobata</i>	1
<i>Erigeron annuus</i> subsp. <i>annuus</i>	2	<i>Reynoutria japonica</i>	4
<i>Helianthus tuberosus</i>	1	<i>Rudbeckia laciniata</i>	1
Ideciu de Sus	4	Seuca	1
<i>Erigeron annuus</i> subsp. <i>annuus</i>	1	<i>Reynoutria japonica</i>	1
<i>Matricaria discoidea</i>	1	Sighișoara	4
<i>Xanthium strumarium</i>	2	<i>Ambrosia artemisiifolia</i>	1
Idicel Sat	3	<i>Reynoutria japonica</i>	3
<i>Galinsoga parviflora</i>	1	Șilea Nirajului	1

Location /Species	Records	Location /Species	Records
<i>Helianthus decapetalus</i>	2	<i>Erigeron annuus</i> subsp. <i>annuus</i>	1
Idrifaia	4	Șincai	4
<i>Asclepias syriaca</i>	1	<i>Erigeron annuus</i> subsp. <i>annuus</i>	2
<i>Gleditsia triacanthos</i>	1	<i>Robinia pseudoacacia</i>	2
<i>Robinia pseudoacacia</i>	2	Solocma	20
Iernut	34	<i>Echinocystis lobata</i>	1
<i>Ambrosia artemisiifolia</i>	1	<i>Erigeron annuus</i> subsp. <i>annuus</i>	4
<i>Amorpha fruticosa</i>	1	<i>Helianthus decapetalus</i>	1
<i>Datura stramonium</i>	1	<i>Helianthus tuberosus</i>	1
<i>Echinocystis lobata</i>	3	<i>Reynoutria japonica</i>	2
<i>Erigeron annuus</i> subsp. <i>annuus</i>	4	<i>Reynoutria x bohemica</i>	1
<i>Erigeron canadensis</i>	2	<i>Robinia pseudoacacia</i>	3
<i>Helianthus tuberosus</i>	11	<i>Rudbeckia laciniata</i>	7
<i>Matricaria discoidea</i>	1	towards Grebeniș	2
<i>Robinia pseudoacacia</i>	2	<i>Robinia pseudoacacia</i>	2
<i>Symphotrichum lanceolatum</i>	2	towards Sărățeni	2
<i>Xanthium orientale</i> subsp. <i>italicum</i>	6	<i>Robinia pseudoacacia</i>	2
Iernut - Sălcud	16	towards Șăulia	2
<i>Echinocystis lobata</i>	2	<i>Robinia pseudoacacia</i>	2
<i>Erigeron canadensis</i>	4	towards Torba	2
<i>Matricaria discoidea</i>	2	<i>Erigeron annuus</i> subsp. <i>annuus</i>	1
<i>Xanthium orientale</i> subsp. <i>italicum</i>	8	<i>Rudbeckia laciniata</i>	1
ieșirea din Coasta Mare	1	Stânceni	5
<i>Xanthium orientale</i> subsp. <i>italicum</i>	1	<i>Echinocystis lobata</i>	2
ieșirea din Șăușa	5	<i>Reynoutria japonica</i>	2
<i>Amaranthus retroflexus</i>	1	<i>Solidago canadensis</i>	1
<i>Echinocystis lobata</i>	2	Suplac	6
<i>Robinia pseudoacacia</i>	2	<i>Acer negundo</i>	1
Ilioara	6	<i>Asclepias syriaca</i>	1
<i>Erigeron annuus</i> subsp. <i>annuus</i>	6	<i>Erigeron annuus</i> subsp. <i>annuus</i>	1
in apropierea loc. Sântu	1	<i>Helianthus tuberosus</i>	1
<i>Erigeron canadensis</i>	1	<i>Robinia pseudoacacia</i>	1
Berghia - Band	2	<i>Solidago canadensis</i>	1
<i>Robinia pseudoacacia</i>	2	Suseni	1

Location /Species	Records	Location /Species	Records
Câmpenița - Săbed	2	<i>Ambrosia artemisiifolia</i>	1
<i>Ambrosia artemisiifolia</i>	1	Târgu Mureş	15
<i>Robinia pseudoacacia</i>	1	<i>Acer negundo</i>	4
Chirileu - Recea	1	<i>Amaranthus retroflexus</i>	2
<i>Erigeron canadensis</i>	1	<i>Ambrosia artemisiifolia</i>	4
Cipău - Ogra	2	<i>Amorpha fruticosa</i>	1
<i>Helianthus tuberosus</i>	2	<i>Parthenocissus inserta</i>	1
Cotuș și Secăreni	2	<i>Reynoutria japonica</i>	3
<i>Erigeron annuus</i> subsp. <i>annuus</i>	2	Târnăveni	19
Cund - Viișoara	3	<i>Ambrosia artemisiifolia</i>	4
<i>Solidago canadensis</i>	2	<i>Parthenocissus inserta</i>	2
<i>Symphytotrichum lanceolatum</i>	1	<i>Robinia pseudoacacia</i>	9
Daneș - Sântioana	4	<i>Solidago canadensis</i>	4
<i>Asclepias syriaca</i>	1	Tăureni	9
<i>Robinia pseudoacacia</i>	1	<i>Amaranthus retroflexus</i>	2
<i>Solidago canadensis</i>	2	<i>Erigeron canadensis</i>	3
Ernei - Sânghiorgiu de Mureş	1	<i>Xanthium orientale</i> subsp. <i>italicum</i>	4
<i>Parthenocissus inserta</i>	1	Teleac	3
Foi - Târgu Mureş	2	<i>Amaranthus retroflexus</i>	1
<i>Solidago canadensis</i>	1	<i>Erigeron annuus</i> subsp. <i>annuus</i>	2
<i>Xanthium orientale</i> subsp. <i>italicum</i>	1	Țiptelnic	3
Ghindari-Chibed	8	<i>Xanthium orientale</i> subsp. <i>italicum</i>	3
<i>Echinocystis lobata</i>	1	Tofalău	17
<i>Erigeron annuus</i> subsp. <i>annuus</i>	2	<i>Erigeron annuus</i> subsp. <i>annuus</i>	14
<i>Robinia pseudoacacia</i>	1	<i>Erigeron canadensis</i>	1
<i>Rudbeckia laciniata</i>	4	<i>Lycium barbarum</i>	1
Glodeni - Voivodeni	2	<i>Matricaria discoidea</i>	1
<i>Helianthus tuberosus</i>	2	Tonciu	1
Idecu - Reghin	1	<i>Xanthium orientale</i> subsp. <i>italicum</i>	1
<i>Helianthus decapetalus</i>	1	Trei Sate	5
Idrifaia - Bahnea	1	<i>Amaranthus retroflexus</i>	1
<i>Asclepias syriaca</i>	1	<i>Erigeron annuus</i> subsp. <i>annuus</i>	1
Iernut - Cipău	2	<i>Erigeron canadensis</i>	1
<i>Helianthus tuberosus</i>	2	<i>Reynoutria japonica</i>	1

Location /Species	Records	Location /Species	Records
Ilieni - Nicoleşti	2	<i>Xanthium orientale</i> subsp. <i>italicum</i>	1
<i>Helianthus tuberosus</i>	1	Ungheni	30
<i>Solidago canadensis</i>	1	<i>Amaranthus retroflexus</i>	4
Livezeni - Ivănești	20	<i>Erigeron annuus</i> subsp. <i>annuus</i>	6
<i>Erigeron annuus</i> subsp. <i>annuus</i>	4	<i>Erigeron canadensis</i>	2
<i>Erigeron canadensis</i>	2	<i>Lycium barbarum</i>	2
<i>Solidago canadensis</i>	14	<i>Reynoutria japonica</i>	1
Miercurea Niraj - Bereni	3	<i>Robinia pseudoacacia</i>	1
<i>Erigeron annuus</i> subsp. <i>annuus</i>	1	<i>Xanthium orientale</i> subsp. <i>italicum</i>	14
<i>Erigeron canadensis</i>	1	Urisiu de Sus	5
<i>Rudbeckia laciniata</i>	1	<i>Erigeron annuus</i> subsp. <i>annuus</i>	3
Neaua - Vădaș	2	<i>Robinia pseudoacacia</i>	2
<i>Rudbeckia laciniata</i>	2	Vădaș	2
Ogra - Giuluș	2	<i>Erigeron annuus</i> subsp. <i>annuus</i>	1
<i>Erigeron annuus</i> subsp. <i>annuus</i>	2	<i>Solidago canadensis</i>	1
Reghin și Beica	3	Văleni - Acățari	1
<i>Erigeron annuus</i> subsp. <i>annuus</i>	1	<i>Robinia pseudoacacia</i>	1
<i>Matricaria discoidea</i>	1	Vărgata	37
<i>Robinia pseudoacacia</i>	1	<i>Amaranthus retroflexus</i>	2
Reghin-Dedrad	1	<i>Ambrosia artemisiifolia</i>	1
<i>Robinia pseudoacacia</i>	1	<i>Armoracia rusticana</i>	2
Roșiori - Luduș	3	<i>Erigeron annuus</i> subsp. <i>annuus</i>	8
<i>Robinia pseudoacacia</i>	3	<i>Erigeron canadensis</i>	4
Săbed -Râciu, crossroad with Nima Râciului	2	<i>Reynoutria japonica</i>	2
<i>Amaranthus retroflexus</i>	1	<i>Symphotrichum lanceolatum</i>	14
<i>Robinia pseudoacacia</i>	1	<i>Xanthium orientale</i> subsp. <i>italicum</i>	4
Săbed - Câmpenița	2	Vătava	1
<i>Ambrosia artemisiifolia</i>	2	<i>Erigeron annuus</i> subsp. <i>annuus</i>	1
Sângiorgiu de Pădure - Trei Sate	7	Viforoasa	1
<i>Erigeron annuus</i> subsp. <i>annuus</i>	3	<i>Erigeron annuus</i> subsp. <i>annuus</i>	1
<i>Robinia pseudoacacia</i>	2	Viișoara	5
<i>Rudbeckia laciniata</i>	1	<i>Echinocystis lobata</i>	1
<i>Xanthium orientale</i> subsp. <i>italicum</i>	1	<i>Reynoutria japonica</i>	2
Sântioana - Ormeniș	3	<i>Robinia pseudoacacia</i>	1

Location /Species	Records	Location /Species	Records
<i>Asclepias syriaca</i>	1	<i>Solidago canadensis</i>	1
<i>Solidago canadensis</i>	1	Voivodeni	1
<i>Xanthium orientale</i> subsp. <i>italicum</i>	1	<i>Xanthium orientale</i> subsp. <i>italicum</i>	1
Suseni - Brâncoveneşti	2	Zagăr	2
<i>Ambrosia artemisiifolia</i>	2	<i>Reynoutria japonica</i>	1
Târgu Mureş - Voiniceni	1	<i>Solidago canadensis</i>	1
<i>Solidago canadensis</i>	1	Zau de Câmpie	6
Tîrnăveni - Cucerdea	1	<i>Ambrosia artemisiifolia</i>	2
<i>Robinia pseudoacacia</i>	1	<i>Lycium barbarum</i>	2
		<i>Robinia pseudoacacia</i>	2
		Total	1204

The taxa and the number of records is shown in Table 1. A number of 31 species of invasive plants have been identified, of which three species are of European Union concern, namely: *Ailanthus altissima*, *Asclepias syriaca* and *Impatiens glandulifera*. In table 2, the families belonging to the invasive species are indicated. The families that have the highest share of representation are: Compositae (68.18%), Fabaceae (12.29%), Polygonaceae (6.64%) and Solanaceae (7.40%), and the other families have fewer representatives.

The analysis of the biological forms of the invasive species in Mureş County (Table 3) reveals the ecological specificity of the ecosystems in this territory. Thus, the analysis of invasive species according to bioform indicates the high percentage of therophytes (38.70%) and hemicryptophytes (38.70%), followed by phanerophytes (22.58%), which are more diversified.

The floristic elements analysis (Table 2) highlights the presence of 22 species of American origin, 7 originate from Asia, and the other invasive alien species originate from different regions.

Table 2. List of invasive species in Mureș County and their biological characteristics

Taxa	No. of records	Family	Origin	Introduction way	Reproduction	Pollination type	Seed dispersal
<i>Acer negundo</i>	9	Aceraceae	Am N	H	G-V	anemophilous	anemochory hydrochory antropochory
<i>Ailanthus altissima</i>	12	Simaroubaceae	As E	H	G	anemophilous	anemochory hydrochory
<i>Amaranthus retroflexus</i>	29	Amaranthaceae	Am N	X	G	entomophilous anemophilous	anemochory zoochory antropochory
<i>Ambrosia artemisiifolia</i>	67	Compositae	Am N	X	G	anemophilous rarely entomophilous	barochory antropochory
<i>Amorpha fruticosa</i>	5	Fabaceae	Am N	H	V-G	entomophilous rarely autogamous	anemochory hydrochory zoochory
<i>Amoracia rusticana</i>	4	Brassicaceae	Eur SE, Asia V	H	V	antropophilous	antropochory
<i>Asclepias syriaca</i>	6	Asclepiadaceae	Am N	H	G-V	entomophilous	anemochory
<i>Datura stramonium</i>	2	Solanaceae	Am S -Mexic	X	G	anemophilous	anemochory antropochory hydrochory
<i>Echinocystis lobata</i>	30	Cucurbitaceae	Am N	X	G	entomophilous	barochory hydrochory
<i>Erigeron annuus</i> <i>subsp. annuus</i>	248	Compositae	Am N	H	G-V	autogamous	antropochory anemochory hydrochory
<i>Erigeron canadensis</i>	74	Compositae	Am N	X	G	autogamous	anemochory hydrochory

Taxa	No. of records	Family	Origin	Introduction way	Reproduction	Pollination type	Seed dispersal
<i>Galinsoga parviflora</i>	2	Compositae	Am S	X	G-V	entomophilous	anemochory zoochory antropochory
<i>Gleditsia triacanthos</i>	1	Fabaceae	Am N	X	G-V	entomophilous	anemochory
<i>Helianthus decapetalus</i>	4	Compositae	Am N	H	G-V	entomophilous	hydrochory, anthropochory
<i>Helianthus tuberosus</i>	58	Compositae	Am N	H	V-G	entomophilous	hydrochory, anthropochory
<i>Impatiens glandulifera</i>	28	Balsaminaceae	As (Himalaia)	H	G	entomophilous autogamous	autochory zoochory hydrochory antropochory
<i>Impatiens parviflora</i>	1	Balsaminaceae	As C	X	G	entomophilous autogamous	autochory, hydrochory, anthropochory
<i>Lycium barbarum</i>	22	Solanaceae	As E	H	V	entomophilous	zoochory
<i>Matricaria discoidea</i>	17	Compositae	Am N	X	G	entomophilous autogamous	anemochory zoochory antropochorie
<i>Oenothera biennis</i>	1	Oenotheraceae	Am N	H	G	entomophilous autogamous	anthropochory anemochory zoochory
<i>Oxalis corniculata</i>	2	Oxalidaceae	Md	H	V	entomophilous autogamous	autochory
<i>Parthenocissus inserta</i>	12	Vitaceae	Am N	X	G	entomophilous	zoochory antropochory

Taxa	No. of records	Family	Origin	Introduction way	Reproduction	Pollination type	Seed dispersal
<i>Reynoutria japonica</i>	74	Polygonaceae	As E	H	V	anemophilous entomophilous rare hydrophilous	hydrochory anemochory antropochory
<i>Reynoutria sachalinensis</i>	1	Polygonaceae	As E	H	V	entomophilous rarely hydrophilous	hydrochory antropochory
<i>Reynoutria × bohemica</i>	2	Polygonaceae	× (Eur C)	H	V	anemophilous	hydrochory antropochory
<i>Robinia pseudoacacia</i>	142	Fabaceae	Am N	H	G-V	entomophilous	anemochory zoochory
<i>Rudbeckia laciniata</i>	34	Compositae	Am N	H	V-G	entomophilous	anemochory hydrochory antropochory
<i>Solidago canadensis</i>	83	Compositae	Am N	H	G-V	entomophilous	anemochory antropochory
<i>Symphytotrichum lanceolatum</i>	30	Compositae	Am N	H	V-G	entomophilous	Anemochory
<i>Xanthium orientale</i> subsp. <i>italicum</i>	201	Compositae	Am N	X	G	anemophilous	zoochory barochory antropochory
<i>Xanthium strumarium</i>	3	Compositae	Am N	X	G	anemophilous	zoochory barochory antropochory
Grand Total	1204						

Abbreviations: **origin**: Am – America; As-Asia; Eur-Europe; Md - Mediterranean region; **introduced**: H – hemerophytes; X – xenophytes; **reproduction**: V - vegetative; G – germinative.

Due to human intervention in nature, invasive plants have negative effects on the structure and function of ecosystems in the host country (Pyšek & Richardson 2010). Thus, of the 31 invasive species, 61.29% species are hemerophytes (introduced by humans for various purposes, especially ornamental, medicinal, fodder plants and secondarily escaped from the culture in the spontaneous flora) and 38.70% species are xenophytes (accidentally introduced).

This study of alien invasive plants also includes some particular aspects related to the biology of pollination and the dissemination of their fruits and seeds (Table 2) and their impact on the diversity of native species. The biology of pollination, as well as the dissemination of diaspores, have a special role in understanding the way of invasion of these species, as well as information regarding the existing biocoenotic relationships between the plant components and the pollinating and diaspore dispersal agents (Sîrbu & Oprea 2008). Until the last glaciation, anemophilic species, which did not depend on pollinators prevailed (Pyšek et al. 2012). These invasive species produce a huge amount of seeds, with a long germination time, which are disseminated over long distances and can have a high invasive impact on the local flora. In the studied area anemophilic species represent 22.58% of alien invasive species. Out of these we mention *Acer negundo*, *Ailanthus altissima*, *Reynoutria* sp., *Xanthium* sp. etc. Along with the postglacial climate warming, entomophily broad-ranged, as did ornithochory. Thus 45% of identified alien invasive plants are entomophilous. In the case of insect-pollinated plants, we can find impressive insect-attracting techniques and the most astonishing forms of adaptation. Among the identified alien invasive species 22.58% of them have more than one type of pollination. For example, entomophily and anemophily are sometimes combined also with autochory or hydrochory. The autogamous species represent 6.45% of the identified invasive species. They are those that favored the survival of some plant populations during the period when the pollinating entomofauna was rare or even absent. Only one species is anthropophilic (*Armoracia rusticana*).

Regarding the diaspores dissemination (Table 2), if during the glaciation the species were almost exclusively anemochores, this study demonstrates that an invasive species can present more possibilities for the dissemination of diaspores, which also explains their great power of colonization. For example, *Ambrosia artemisiifolia* produces about 3,000-60,000 seeds/ year with a germination power of 10 years (Skálová et al. 2017), being both barochorous and anthropochorous. Thus, there are invasive species and subspecies considered exclusively anemochore but sometimes anemochory can be combined with other types of diaspore dispersion (i.e., *Reynoutria japonica* which can be hydrochorous, anemochorous and anthropochorous, or *Erigeron annuus* subsp. *annuus* which is anthropochorous, anemochorous and hydrochorous). In many cases, seed dispersal is also influenced by geo-climatic conditions.

The analysis of the ecological categories of the alien invasive species in Mureş County (Table 3) reveals the ecological specificity of the ecosystems in this territory, in the context of the complex local pedo-climatic factors. The Ellenberg indices (light, temperature, humidity, soil reaction, and nutrients) in close interaction between them and also in close connection with the edaphic and vegetation elements were taken into account.

The analysis of the distribution of the studied species according to the photic regime indicates the predominance of heliophilous species (70.96%), followed by

meso-heliophilous (16.12%), extreme-heliophilous (9.67%) and 3.22% meso-heliophobic. In terms of temperature, 54.83% of invasive species are thermophilous, followed by mega-thermophilous (25.80%), meso-thermophilous (12.90%), and eurytherms (6.45% each). The analysis of invasive species considering the humidity factor, highlights the predominance of mesophilous (54.83%), meso-xerophilous (25.80%), meso-hygrophilous (16.12%), and 3.22% xerophilous species. From the point of view of soil reaction, we note that the largest share is held by euryacidophilic species (45.16%), moderately acidophilic (41.93%), followed by neutrophilous (9.67%), and a weakly-strongly acidophilic species (3.22%).

Invasive species were also studied from the point of view of their adaptation to the content of nutrients in the soil. Thus, depending on soil trophicity, the most numerous species are eutrophic (40%), mesotrophic (33.33%), oligotrophic (10%), extremely eutrophic, and oligomesotrophic (6.66% for each) and one eurytrophic species (3.33%).

Since the number of localities where the invasive species were identified is very high, we mention the invasive species with the highest frequencies: *Erigeron annuus* subsp. *annuus* (248 points), *Xanthium orientale* subsp. *italicum* (201 records), *Robinia pseudoacacia* (142 records), *Solidago canadensis* (83 records), *Erigeron canadensis* and *Reynoutria japonica* (each with 74 records), *Ambrosia artemisiifolia* (67 records), etc.

Analyzing the size of the populations (Table 4), we find that the best-established populations, with high density and coverage, populations with a number of 100-500 individuals and >500 individuals are those of *Ambrosia artemisiifolia* that form long strips (more kilometers length) along the railways and roadsides. The species *Xanthium orientale* subsp. *italicum* achieve populations of 100-500 individuals and >500 in numerous records, settling in very diverse habitats, such as: abandoned or cultivated agricultural land, abandoned meadows, river meadows or roadsides. *Erigeron annuus* subsp. *annuus* and *Erigeron canadensis* form very large populations on abandoned farmland or abandoned ruderalized grasslands. Also, *Solidago canadensis* reach large populations of 100-500 and >500 individuals at the expense of natural and semi-natural communities, invading grasslands and abandoned agricultural lands, river meadows, and roadsides. The invasion of the species *Reynoutria japonica* represents a severe threat to riparian plant communities, stretching on large surfaces along watercourses, and causing major imbalances in vegetation due to their monospecific communities. The increase in the speed of invasion of the species *Helianthus tuberosus* and *Impatiens glandulifera* on huge areas has as a consequence the decline of the native species. Also with high coverage are the species: *Rudbeckia laciniata* and *Symphotrichum lanceolatum* which in certain points create monodominant coenoses.

Table 5 emphasizes the habitats where the invasive species were recorded. For the habitat types was used the EUNIS habitat classification (EEA, 2021). In some of the observation points up to 4-6 alien invasive species were identified, grouped in the same type of habitat. These are habitats generally subject to human impact, roadsides, fallow fields, abandoned lands, and crops. These alien invasive species have a high negative impact on the biodiversity of those habitats. They cause the impoverishment of the soil in water, and nutrients, which in some cases leads to a decrease in productivity and finally the elimination of the native flora, and the rapid degradation of the ecosystem.

Table 3. Ecological categories of alien invasive species identified in Mureş County

Taxa	Bioforms	Ecological categories				
		L	T	U	R	N
<i>Acer negundo</i>	PhM	heliophilous	thermophilous	meso-thermophilous	moderat-acidophile	mesotrophic
<i>Ailanthus altissima</i>	PhM	mezo-heliophilous	thermophilous	meso-thermophilous	moderat- acidophile	mesotrophic
<i>Amaranthus retroflexus</i>	T	extrem-heliophilous	megatherme	meso-thermophilous	euryacidophile	extrem eutrophic
<i>Ambrosia artemisiifolia</i>	T	extrem-heliophilous	thermophilous	meso-xerophilous	euryacidophile	oligotrophic
<i>Amorpha fruticosa</i>	PhN	heliophilous	thermophilous	xerophilous	moderat-acidophile	mesotrophic
<i>Armoracia rusticana</i>	H	heliophilous	meso-termophilous	meso-thermophilous	euryacidophile	extrem eutrophic
<i>Asclepias syriaca</i>	H	heliophilous	thermophilous	meso-thermophilous	moderat- acidophile	oligomesotrophic
<i>Datura stramonium</i>	T	heliophilous	mega-thermophilus	meso-thermophilous	moderat- acidophile	eutrophic
<i>Echinocystis lobata</i>	T	heliophilous	thermophilous	meso-xerophilous	neutrophile	mesotrophic
<i>Erigeron annuus</i> subsp. <i>annuus</i>	TH	heliophilous	thermophilous	meso-thermophilous	moderat- acidophile	oligomesotrophic
<i>Erigeron canadensis</i>	T	heliophilous	mega-thermophilus	meso-thermophilous	euryacidophile	eutrophic
<i>Galinsoga parviflora</i>	T	heliophilous	mega-thermophilus	meso-thermophilous	moderat- acidophile	eutrophic
<i>Gleditsia triacanthos</i>	PhM	heliophilous	thermophilous	meso-hygrophilous	moderat-acidophile	mesotrophic
<i>Helianthus decapetalus</i>	H	heliophilous	thermophilous	mezo-xerophilous	euriacidophile	eutrophic
<i>Helianthus tuberosus</i>	H	heliophilous	thermophilous	meso-thermophilous	euriacidophile	mesotrophic
<i>Impatiens glandulifera</i>	T	meso-heliophilous	mega-thermophilus	meso-hygrophilous	moderat-acidophile	eutrophic

Taxa	Bioforms	Ecological categories			
		L	T	U	R
<i>Impatiens parviflora</i>	T	meso-heliophobe	mezoterme	meso - thermophilous	euriacidophile
<i>Lycium barbarum</i>	PhN	extrem-heliophilous	thermophilous	meso-thermophilous	moderat-acidophile
<i>Matricaria discoidea</i>	T	heliophilous	mega-thermophilus	meso-xerophilous	neutrophile
<i>Oenothera biennis</i>	T	heliophilous	mezoterme	meso-xerophilous	high acidophile
<i>Oxalis corniculata</i>	H	heliophilous	euriterme	meso - xerophilous	euriacidophile
<i>Parthenocissus inserta</i>	PhLi	mezo-heliophilous	thermophilous	meso-thermophilous	moderat-acidophile
<i>Reynoutria japonica</i>	G-H	heliophilous	mega-thermophilus	meso - thermophilous	moderat-acidophile
<i>Reynoutria sachalinensis</i>	G-H	heliophilous	thermophilous	meso - hygrophilous	neutrophile
<i>Reynoutria x bohemica</i>	G-H	heliophilous	mega-thermophilus	meso - hygrophilous	moderat-acidophile
<i>Robinia pseudoacacia</i>	PhM	mezo-heliophilous	thermophilous	meso - xerophilous	euriacidophile
<i>Rudbeckia laciniata</i>	H	heliophilous	thermophilous	meso - xerophilous	euriacidophile
<i>Solidago canadensis</i>	H	heliophilous	eurythermophilous	mezo-hygrophilous	euriacidophile
<i>Symphytotrichum lanceolatum</i>	H	heliophilous	thermophilous	meso-thermophilous	euriacidophile
<i>Xanthium orientale</i> subsp. <i>italicum</i>	T	heliophilous	thermophilous	meso-thermophilous	euriacidophile
<i>Xanthium strumarium</i>	T	heliophilous	meso-thermophilus	meso-thermophilous	euriacidophile

Legend: life forms: T-therophytes; H-hemicryptophytes, TH-hemitherophytes; G-geophytes; Ph-phanerophytes;

Table 4. Population size for invasive species in Mureş County

Taxa/ population size	No. of records	Taxa/population size	No. of records	Taxa/ population size	No. of records
<i>Acer negundo</i>	9	<i>Erigeron canadensis</i>	74	4 (101 - 500 indv)	3
1 (1-10 indv)	7	3 (51-100 indv)	1	5 (>501 indv)	8
2 (11-50 indv)	2	4 (101 - 500 indv)	5	<i>Reynoutria japonica</i>	74
<i>Ailanthus altissima</i>	12	5 (>501 indv)	68	2 (11-50 indv)	1
1 (1-10 indv)	2	<i>Galinsoga parviflora</i>	2	3 (51-100 indv)	11
2 (11-50 indv)	5	3 (51-100 indv)	1	4 (101 - 500 indv)	17
3 (51-100 indv)	3	5 (>501 indv)	1	5 (>501 indv)	45
5 (>501 indv)	1	<i>Gleditsia triacanthos</i>	1	<i>Reynoutria sachalinensis</i>	1
<i>Amaranthus retroflexus</i>	29	5 (>501 indv)	1	3 (51-100 indv)	1
4 (101 - 500 indv)	4	<i>Helianthus decapetalus</i>	4	<i>Reynoutria x bohemica</i>	2
5 (>501 indv)	25	3 (51-100 indv)	2	4 (101 - 500 indv)	1
<i>Ambrosia artemisiifolia</i>	67	4 (101 - 500 indv)	1	5 (>501 indv)	1
3 (51-100 indv)	9	5 (>501 indv)	1	<i>Robinia pseudoacacia</i>	142
4 (101 - 500 indv)	17	<i>Helianthus tuberosus</i>	58	2 (11-50 indv)	3
5 (>501 indv)	41	3 (51-100 indv)	1	3 (51-100 indv)	8
<i>Amorpha fruticosa</i>	5	4 (101 - 500 indv)	18	4 (101 - 500 indv)	50
2 (11-50 indv)	1	5 (>501 indv)	39	5 (>501 indv)	82
4 (101 - 500 indv)	2	<i>Impatiens glandulifera</i>	28	<i>Rudbeckia laciniata</i>	34
5 (>501 indv)	2	4 (101 - 500 indv)	1	4 (101 - 500 indv)	7
<i>Armoracia rusticana</i>	4	5 (>501 indv)	27	5 (>501 indv)	27
5 (>501 indv)	4	<i>Impatiens parviflora</i>	1	<i>Solidago canadensis</i>	83

Taxa/ population size	No. of records	Taxa/population size	No. of records	Taxa/ population size	No. of records
<i>Asclepias syriaca</i>	6	4 (101 - 500 indv)	1	3 (51-100 indv)	2
3 (51-100 indv)	3	<i>Lycium barbarum</i>	22	4 (101 - 500 indv)	15
4 (101 - 500 indv)	3	3 (51-100 indv)	1	5 (>501 indv)	66
<i>Datura stramonium</i>	2	4 (101 - 500 indv)	7	<i>Symphytotrichum lanceolatum</i>	30
2 (11-50 indv)	1	5 (>501 indv)	14	4 (101 - 500 indv)	3
3 (51-100 indv)	1	<i>Matricaria discoidea</i>	17	5 (>501 indv)	27
<i>Echinocystis lobata</i>	30	4 (101 - 500 indv)	5	<i>Xanthium orientale</i> subsp. <i>italicum</i>	201
2 (11-50 indv)	2	5 (>501 indv)	12	3 (51-100 indv)	1
3 (51-100 indv)	7	<i>Oenothera biennis</i>	1	4 (101 - 500 indv)	27
4 (101 - 500 indv)	7	4 (101 - 500 indv)	1	5 (>501 indv)	173
5 (>501 indv)	14	<i>Oxalis corniculata</i>	2	<i>Xanthium strumarium</i>	3
<i>Erigeron annuus</i> subsp. <i>annuus</i>	248	3 (51-100 indv)	1	3 (51-100 indv)	1
3 (51-100 indv)	3	4 (101 - 500 indv)	1	4 (101 - 500 indv)	2
4 (101 - 500 indv)	22	<i>Parthenocissus inserta</i>	12		
5 (>501 indv)	223	3 (51-100 indv)	1	Total	1204

Table 5. Types of habitats where invasive plants registered in Mureş County occur

Taxa	Habitat type	Taxa	Habitat type
<i>Acer negundo</i>	E5.1, F.9, J4.3, J 2.51	<i>Impatiens parviflora</i>	E5.4
<i>Ailanthus altissima</i>	G5.1, E5.1	<i>Lycium barbarum</i>	J4.2, J2.51
<i>Amaranthus retroflexus</i>	E2.13, X25, E.5.13, J4.2, J4.3	<i>Matricaria discoidea</i>	J4.2, C3.2111, E5.1, I1
<i>Ambrosia artemisiifolia</i>	J4.3, J4.2, I.1, E5.13, E5.1	<i>Oenothera biennis</i>	I2.21
<i>Amorpha fruticosa</i>	G1.C3, J4.1, J4.2, J4.3	<i>Oxalis corniculata</i>	E5.1
<i>Armoracia rusticana</i>	X25, J4.2	<i>Parthenocissus inserta</i>	J2.51, J4.2
<i>Asclepias syriaca</i>	I1.5, J4.2, F9	<i>Reynoutria japonica</i>	J4, J4.2, E2.2, G1.1, G1.11, E5.1, F9.35, E1.5
<i>Datura stramonium</i>	I.1, E.5.13	<i>Reynoutria sachalinensis</i>	F9.35
<i>Echinocystis lobata</i>	J4.2, I1.53, E5.1, G1.11, G1.1112	<i>Reynoutria × bohemica</i>	F9.35
<i>Erigeron annuus</i> subsp. <i>annuus</i>	I1.53, E5.13, J4.2, E5.1, E2.2, E2.13, J1.2, E5.1, X25, C3.2, E2.13	<i>Robinia pseudoacacia</i>	G1.C3, G5.1, J4.2, G1.1, I, F9
<i>Erigeron canadensis</i>	E5.1, I, I1.5, J4.2, E2.1, I2.3, E5.1	<i>Rudbeckia laciniata</i>	G1.11, J4.2, I.1.53, E2.2, C3.2111, F9, E.5.1
<i>Galinsoga parviflora</i>	J4.3, E2.2	<i>Solidago canadensis</i>	J6.1, E5.1, J4.2, I1.5, E2.13, G1.11, F9
<i>Gleditsia triacanthos</i>	J4.2	<i>Symphotrichum lanceolatum</i>	J4.2, E5.1, J1.2, G1.1, J5.3, F9, C3.2111, F9.35
<i>Helianthus decapetalus</i>	E2.2, E5.1, J4.2	<i>Xanthium orientale</i> subsp. <i>italicum</i>	I1.5, I.1, I1.1, J4.3, J4.2, E2.1, E2.13, E5.1, F9,
<i>Helianthus tuberosus</i>	E5.1, E2.2, J4.2, I, I1.5, E5.1, J5.3, G1.1, G1.11	<i>Xanthium strumarium</i>	E5.1, I1.5
<i>Impatiens glandulifera</i>	G1.11 (A10-A36), J4.2, I1.5		

Conclusions

The study contributes to the knowledge of hotspots for alien species in Mureş County. These are areas with a large number of invasive species or those where their abundance-dominance is very high and produces a major impact on native vegetation. The results of the research also represent a contribution to a better knowledge of the chorology of invasive alien plant species in Mureş County.

Our study analyzed 1204 records made in 168 locations in Mureş County and 31 species of invasive alien plants were identified, of which three species are of concern

for the European Union, namely: *Asclepias syriaca*, *Ailanthus altissima*, and *Impatiens glandulifera*. *Impatiens glandulifera* is frequent and with high abundance-dominance in habitats from Natural Park Defileul Mureșului Superior, one of the largest protected areas in Mureș County.

The species with the highest frequencies are *Erigeron annuus* subsp. *annuus*, *Xanthium orientale* subsp. *italicum*, *Robinia pseudoacacia*, *Solidago canadensis*, *Erigeron canadensis*, *Reynoutria japonica*, and *Ambrosia artemisiifolia*.

Considering the size of the populations the most established populations, with high density and coverage, counting up to over 500 individuals are those of the species: *Ambrosia artemisiifolia*, *Xanthium orientale* subsp. *italicum*, *Erigeron annuus* subsp. *annuus*, *Erigeron canadensis*, *Solidago canadensis*, etc. These species develop large populations, sometimes in wide areas, having a highly negative impact on natural and semi-natural communities, invading grasslands and abandoned crops, river meadows, roadsides, etc.

The study represents a basis for future research, necessary to establish and apply adequate management to monitor and control the spread of these invasive species.

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