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7. Review Regarding the Distribution and Impact of Some Non-Native Plant Species from Bistrita River Basin; A Comprehensive Species Inventory

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Abstract: In this paper, we present a comprehensive research and data regarding the distribution and impact of the most problematic invasive plant species in the Bistrita river basin. There are counted more than 300 allochthonous species of plants. These species cause losses, economically and from the biodiversity point of view. According to our observations, in the present time, the most aggressive nonnative plant species, worth to be mentioned are *Acer negundo*, *Ailanthus altissima*, *Amorpha fruticosa*, *Ambrosia artemisiifolia*, *Elodea canadensis*, *Impatiens glandulifera*, *Reynoutria japonica*, and *Robinia pseudoacacia*. There are also some other species that have only a local impact. We will also mention and discussed the spread of these nonnative plant species and we propose an index that is describing the invasiveness potential of each species.
Keywords: invasive plant species, weeds, ecosystem degradation, Eastern Romania, river basin.

INTRODUCTION

The uncontrolled spread of invasive nonnative plant species is among the most urgent nature conservation issues of this century (Doroftei M., 2009b). These invasive plant species are altering the native ecosystems, leading to habitat loss and to the replacement of native species (species diversity is decreasing as an effect of this invasion). This invasion is leading to biodiversity loss, at least locally, because of the competition of this invasive species with the native plant species. These invasive plant species are competing for resources (space, light, water, and nutrients), suppressing the growth of some native species.

The Bistrita River Basin is one of the largest river systems from Central Carpathians – Romania, and it is an area well known by us. The Bistrita or Moldavian Bistrita is a river in the Romanian regions of Maramureș, Bucovina and Moldavia (most of its length). It is a right tributary of the river Siret; it flows into the Siret near Bacău. Its source is in the Rodna Mountains, at the foot of the Gargalau peak. The Bistrita river is 283 km long, and its basin area is 7039 km² (National Administration of Romanian Waters, Report 2010).

Regarding the literature, there are only a few studies with regards to the presence and the impact of the invasive species in the Bistrita river basin. In the most recent studies, there is some relevant data that will help us to understand the invasion, the biology, and the negative impact of these species. It is very hard to estimate at least economically the real damage done to the natural environment (Pricop & Negrea, 2018). There are some studies that we mention here, the most recent ones at the national level, have been published by Anastasiu & Negrean (2005), Dihoru (2004), Doroftei (2009a, b), Dumitraşcu et al. (2014), Oprea (2005), Pricop (2009), Sirbu coord. (2011). We mention also the contributions of Aoncioaie (2007), Chifu et al 1987 (1989), Manoliu et al (2002), Pantu (1911), Papp

(1933), Pricop (2009), Sanda et al (2004), Savulescu et al (1952-1976), Ravarut (1936), Ravarut & Mititelu (1959), Sirbu & Oprea (2008a, b); Mititelu (1989); Mititelu et al (1968), Mititelu & Barabas (1972); Mititelu et al (1968, 1971, 1986, 1988, 1989); Caraus (2013) and Pricop & Negrea (2018).

The problem of invasive plants is current. At the global level, it started to create huge problems that require urgent solutions. Even an international working group of experts has been set up to investigate this complex and current issue (Invasive Species Specialist Group (ISSG)). Many of the invasive plants are aggressive with native and/or toxic plants that can cause allergic reactions that are extremely dangerous to humans. Ex. pollen of the species *Ambrosia artemisifolia.*
Many of these invasive plant species are particularly opportunistic and "occupy" quickly disturbed land areas, uncovered by the original vegetal carpet; in areas where it has been intervened with works of various types, constructions (buildings, roads, hydro-technical constructions, bridges, railways, etc.). They may have trophic and edaphic requirements usually associated with high climate plasticity, much different or higher from the native species, which is the main reason why they adapt very well to the new conditions created by these soil disturbances (Pricop & Negrea, 2018).
With globalization and the often-uncontrolled movement of unprocessed commodities of plant origin, we witness an invasion of opportunistic plants that often substitutes in part the native flora. This invasion is accelerated on the speed at which goods are moving globally. This speed is growing, in order to meet the needs of the growing human population. At this present time the human influence induced to the natural ecosystems is also growing.

The woody plants (*Amorpha sp., Robinia sp.*) eliminate native woody and grassy species, Ex. *Amorpha fruticosa* becoming a real threat to the willow meadows native to Danube Delta (Doroftei 2009 a, b). Many of them form plant structures that impress by abundance, dominance, and massiveness (*Conyza canadensis, Reynoutria japonica, Impatiens glandulifera, Robinia pseudoacacia*, etc.). Their impact on native species is physically observable and quantified by biomass assessments. In the case of many invasive species, the only way to stop the assault on habitats remains physical intervention. This often-costly method remains effective if it is repeated by a large enough number so that the aggressor species cannot successfully complete a vegetative cycle and thus cannot disseminate its seeds.

These nonnative plant species are also affecting some economically important sectors as rural agriculture (ex. this impact usually affects meadow and forest productivity). This negative impact of these invaders leads, in the end to economic losses. These invasive nonnative plant species are spreading out of control, especially in areas with large anthropic disturbances. A species list is presented (see Table 1). We will mention also the most invasive species, the local distribution and the effect on habitat.

MATERIAL AND METHODS

The present data were collected from 2007 until the present time on field trips. We studied and gathered the data mainly from Bistrita river basin. Field observations were carried out in spring, summer, and autumn. We also collected some material (plants or part from plants) that are deposited in the Scientific Collection of the Natural Sciences Museum of Piatra Neamt, Neamt National Museum Complex. To identify the material, we used the identification key from Ciocarlan (2009). The map from Figure. 1 and from the other figures was created with the help of Arc.ViewGis 3.1 program. Abbreviations used are: Adv. = adventive; Cult. = cultivated; Sub spont. = sub spontaneous, Fig. = figure, Figs. = figures (some data is presented in Figs. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 and 11).

RESULTS AND DISCUSSIONS

In the present time, there are more than 320 nonnative plant species (also known as adventive plants) that are spreading in the Bistrita river basin (Fig. 1 and Table 1). These adventive species are representing about 14% of the total number of vascular plant species recorded from the Bistritei river basin. In this paper we review our data.

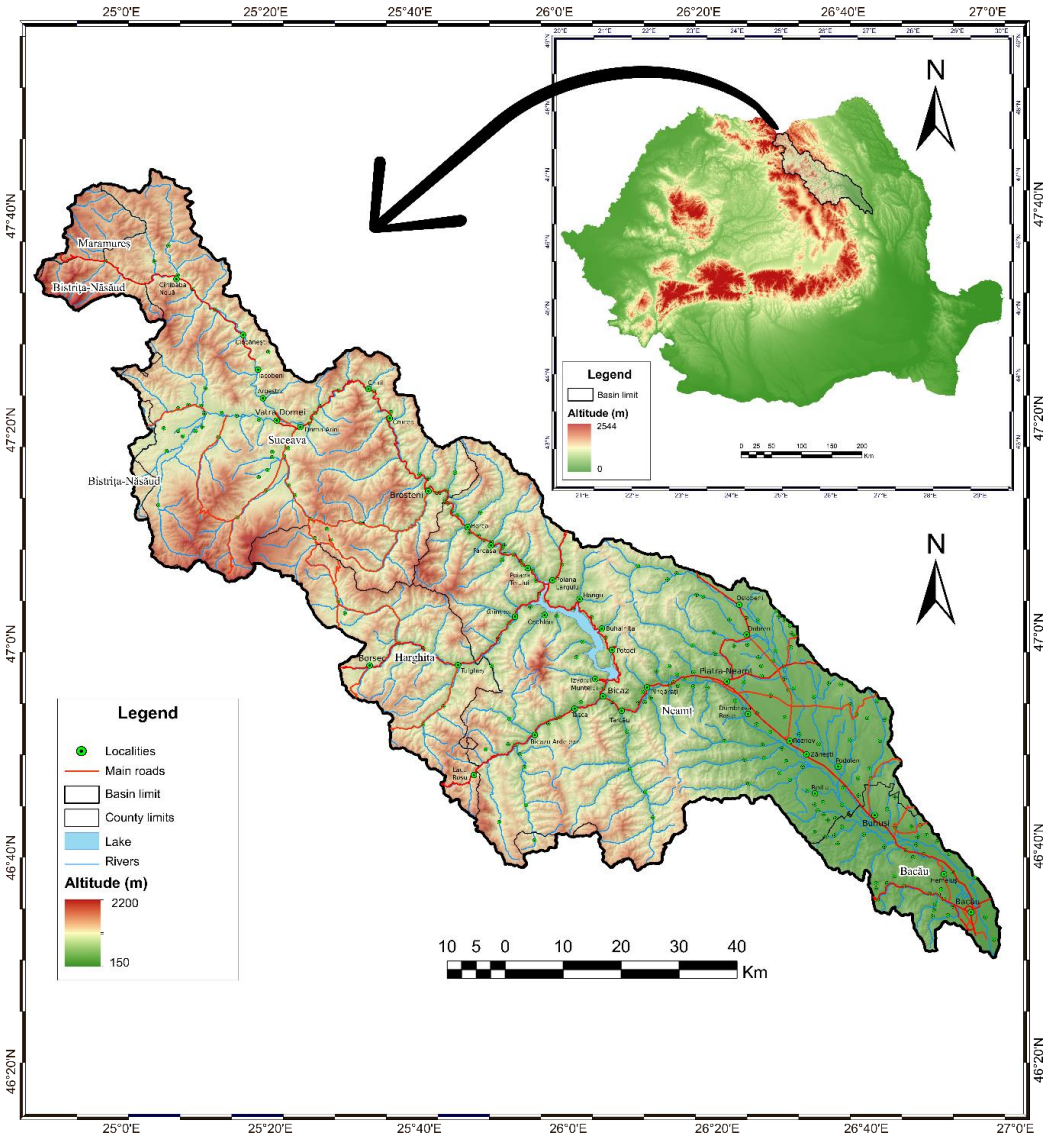


Figure. 1 Map of **Bistrita river basin**, with the most relevant localities (as access points), from Vatra Dornei (SV) to Bacau (BC).

For these nonnative plant species from Table 1, we propose an **index** that is describing the **invasiveness degree** or **invasiveness potential** of each species; this invasiveness potential is linked with a **tendency of spread**; this scaling is according **to CABI Invasive Species Compendium** (https://www.cabi.org/isc/) and adapted from Branquart *et al.* 2016 (from very low to high, or to highly invasive) is implemented by us and it is designated to each nonnative adventive species from our field observations. These observations are correlated also with the old data from the scientific literature. Most species are reported from the sub spontaneous flora, some species are cultivated only in gardens or as crops (table 1 adapted from Pricop & Negrea, 2018). We have excluded the nonnative plant species cultivated indoors.

Table 1. The allochthonous plant species recorded in recent times from Bistrita river basin

No.	Species and origins	Counties	Invasiveness degree/potential and/or tendency to spread (index)
	A		
1	*Abies concolor* (Gordon et Glend.) – North America	NT	Very low, not spreading, ornamental cultivation
2	*Abies faxoniana* Rehd. *et* Wils. – East Asia	NT	Very low, not spreading, ornamental cultivation

3	*Abies nordmanniana* (Steven) Spach – East of Black Sea and Caucasus	NT	Very low, not spreading, ornamental cultivation
4	*Abutilon theophrasti* Medik. – Southern Europe and North Africa	NT+MM*	No data - presumably very low
5	*Acer negundo* L. – North America	BC+NT+HR*+SV	Medium to high, sub spont.at lower elevation, spreading fast below 700m elev.
6	*Acer palmatum* Thunb. – Japan	NT (Piatra Neamt)	Very low, only ornamental cultivation, not spreading
7	*Acer saccharinum* (L.) Small – North America	NT (Piatra Neamt)	Very low, ornamental cultivation, not spreading
8	*Acorus calamus* L. – America	NT+SV	Very low to low, sub spont.but rare in this region
9	*Aesculus hippocastanum* L. - Balkan origin	BC+NT	Very low, not spreading, ornamental cultivation
10	*Aesculus* × *carnea* Hayne – hybrid origin	BC	Very low, not spreading, ornamental cultivation
11	*Agastache spp.* (*Agastache foeniculum* (Pursh) Kuntze, *A. rugosa* (Fisch. & C.A. Mey.) Kuntze.) – North America	NT	Very low, ornamental cultivation, no data regarding spreading
12	*Ailanthus altissima* (Miller) Swingle – Asia and China	BC+HR*+NT	Highly invasive at lower elevation, below 600m elev., common in this region, spreading fast
13	*Albizia julibrissin* (Durazz.) – Asia	NT (Piatra Neamt)	Very low, ornamental cultivation, not spreading
14	*Alcea rosea* L. (*Althaea rosea* (L.) Cav.) - Southwestern China	BC+NT+MM*	Low to medium (at low elevation-below 600m), ornamental cultivation but also sub spont.
15	*Allium sativum* L. – Asia	NT+BC+SV	Very low, cultivated for food, accidentally sub spont.
16	*Alopecurus myosuroides* Huds. – multiple origins	NT+MM*	No recent data - presumably very low
17	*Agrostemma githago* L. – Eastern Mediterranean	BC+NT	Low, sub spont. species present in some cultivated fields and ruderal areas at low elevation
18	*Amaranthus albus* L. – North America	BC+NT+HR*+SV*+MM*	Low to medium, sub spont.
19	*Amaranthus blitoides* S. Watson *var. blitoides* - North America	BC+NT+SV*+MM*	Low to medium, sub spont.
20	*Amaranthus blitum* L. – Mediterranean	BC+NT+SV*+MM*	Low to medium, sub spont.
21	*Amaranthus caudatus* L. – Sowth America	NT	Very low, usually cultivated, rarely sub spont.
22	*Amaranthus crispus* (Lesp. *et* Thév.) N. Terracc. – America	BC+NT+SV*+MM*	Low to medium, sub spont.
23	*Amaranthus cruentus* L. (incl. *A. sanguineus* L. pro parte, *A. paniculatum* L.) – Central America	NT+SV*+MM*	No recent data - presumably very low, cultivated
24	*Amaranthus deflexus* L. - South America	BC+NT+SV*+MM*	Low to medium, sporadic, sub spont.

25	*Amaranthus graecizans* L. – Africa and West Asia	SV*+MM*	No recent data - presumably very low, sub spont.
26	*Amaranthus hybridus* L. s. str. (*A. patulus* Bertol.) – North America	BC+NT+SV*+MM*	Medium, sporadic, sub spont.
27	*Amaranthus hypochondriacus* L. – North America	BC*+NT+SV*+MM*	Low, sub spont.
28	*Amaranthus graecizans* L. – tropical origin	SV	No recent data - presumably very low, sub spont.
29	*Amaranthus powellii* S. Watson *ssp. powellii* (*A. chlorostachys* Willd.) - North America	BC+NT+HR*+SV*+MM*	Low to medium, sub spont.
30	*Amaranthus retroflexus* L. (*A. glabrescens* Borb.) – cosmopolit	BC+NT+HR*+SV+MM*+BN*	Medium, frequent in ruderal areas, sub spont.
31	*Ambrosia artemisiifolia* L. (*A. elatior* L.) – North America	BC+NT+SV+MM*+BN*	Medium but also highly invasive at low elevation, below 700m elev., sub spont.
32	*Amorpha fruticosa* L. - North America	BC+NT+HR*+SV*	Highly invasive at lower elevations, below 600m elev., sub spont.
33	*Anethum graveolens* L. – S-W Asia and India	BC+NT+SV+MM+BN*	Low, usually cultivated as an aromatic plant but rarely sub spont.
34	*Antirrhinum majus* L. – Mediterranean	BC+NT+SV*	Low to medium, ornamental cultivation, rarely sub spont.
35	*Apium graveolens* L. - Mediterranean and also from Russia	HR*+NT+BC+SV*	Very low, commonly cultivated in this region
36	*Aralia racemosa* L. – North America	NT (Piatra Neamt)	Very low, experimental and ornamental cultivation
37	*Aristolochia macrophylla* Lam. – North America	BC	Presumably very low, ornamental cultivation, no recent data
38	*Armeria elongata* (Hoffm.) K. Koch – Europe and North America	MM*	No recent data, presumably very low
39	*Armoracia lapathifolia* Usteri (*A. rusticana* Gaertn. Mayer et Scherb) (sub spont.) - Continental Eurasia	BC+NT+HR+SV+MM	Low, cultivated for food, rarely sub spont.at different elevations
40	*Aronia melanocarpa* L. – North America	NT	Very low, ornamental cultivation
41	*Artemisia abrotanum* L. – Medit.	NT*+BC+SV*	Low, usually cultivated
42	*Artemisia annua* L. – Central Europe	BC+NT+SV+MM*	Low, cultivated and sub spont.
43	*Artemisia dracunculus* L. – Asia	BC+NT+SV	Low, cultivated, rarely sub spont.
44	*Atriplex hortensis* L. - Asia	BC+NT+SV+MM*	Low, cultivated, rarely sub spont.
45	*Asclepias syriaca* L. – North America	NT (Piatra Neamt)	Very low, cultivated for experiments and ornamental
46	*Aster lanceolatus* Willd. – North America	MM*+BC+HR*+NT*+SV*	Low, no recent data
47	*Aster novae-angliae* L. – North America	NT	Very low, ornamental cultivation
48	*Aster novi-belgii* L. – North America	NT+HR*+MM*	Very low to low, cultivated, rarely sub spont.

49	*Aster tradescanti* L. – North America	NT	Very low, ornamental cultivation
50	*Aster x salignus* Willd. – hybrid origin	BC+NT*	Very low
51	*Aster x versicolor* Willd. – hybrid origin	BC*+HR*+MM*	No recent data, presumably very low
52	*Avena sativa* L. – Asia	NT+BC	Very low, only cultivated, accidentally sub spont.
53	*Aquilegia vulgaris* L. – West and Southern Europe	BC+NT+SV+MM	Very low, ornamental cultivation
	B		
54	*Bassia scoparia* (L.) A.J. Scott (*Kochia scoparia* (L.) Schrad.) – Asia temp. and East-Europe (syn. *Bassia sieversiana* (Pallas) W.A. Weber, *Kochia sieversiana* (Pallas) C.A. Mey.)	BC+NT+SV*+MM*	Low, cultivated, rarely sub spont.
55	*Barbarea vulgaris* R. Br. *ssp. vulgaris* - Eurasia	BC+NT+SV+MM+BN*	Low to medium, sub spont.in ruderal areas
56	*Berberis thunbergii* DC. – Japan	NT	Very low, ornamental cultivation
57	*Bidens frondosa* L. – North America	NT+MM*	Low to medium, sub spont.in riveran areas
58	*Borago officinalis* L. – Mediterranean	NT+SV*+MM*	Very low, cultivated, rarely sub spont.
59	*Brachyactis ciliata* (Ledeb.) Ledeb. – Asia	NT+SV*	Medium, sub spont.in ruderal areas at medium elevation
60	*Brassica rapa* L. – Mediterranean region	NT+SV*	Low to medium, cultivated as a crop, but also sub spont.
61	*Brassica nigra* (L.) Czern. – Sowth Asia	MM*+BC+NT+SV*	Very low, rare
62	*Brassica oleracea* L. – Mediterranean to West Europe	NT+BC+SV*+ MM*	Very low, cultivated, very rarely sub spont.
63	*Brassica juncea* (L.) Czern. - Sowth Asia	MM*+BC+NT	Low, usually cultivated
64	*Buddleja davidii* Franch. - East Asia	NT (Piatra Neamt)	Very low, ornamental cultivation
65	*Buxus sempervirens* L. - medit.	NT+BC	Very low, only cultivated, not spreading
	C		
66	*Calendula officinalis* L. – Mediterranean	BC+NT+HR*+SV+MM*	Low, cultivated but also sub spont., spreading at low elev. in sunny areas
67	*Callistephus chinensis* (L.) Nees – East Asia	NT+SV+MM*	Low, ornamental cultivation
68	*Camelina sativa* (L.) Crantz.	NT	Very low, no recent data
69	*Cannabis sativa* L. – Asia	BC+NT+SV*	Low to medium, distributed in fields and in some ruderal areas at low elevation (below 600m. elev.)
70	*Campsis radicans* (L.) Seem – North America, only cultivated	BC+NT	Very low, ornamental cultivations, not spreading
71	*Capsella rubella* Reut. – Mediteranean	BC	Very low, sub spont.
72	*Caragana arborescens* Lam. - Siberia	SV*	Very low, no recent data
73	*Castanea sativa* Mill. -	NT+MM+SV*	Very low, only cultivated

	Mediterranean region		
74	*Catalpa bignonioides* Walter – North America	NT (Piatra Neamt)	Very low, ornamental cultivation
75	*Celtis sp.* – Africa	Moldova province	No recent data
76	*Centaurea cyanus* L. – Cosmopolite, Mediterranean origin	BC+NT+SV*+MM*	Low to medium, sub spont.at low elevation in ruderal areas
77	*Centaurea solstitialis* L. – Mediterranean	BC+NT+SV*+MM*	Low to medium, sub spont., rare in this region
78	*Cerasus vulgaris* Mill. – Eastern Europe, Asia	BC+NT+SV	Low to medium, cultivated and sub spont.
79	*Cercis siliquastrum* L. – Asia	BC	Very low, ornamental cultivation
80	*Chaenomeles japonica* (Thunb.) Lindl. – East Asia	NT (Piatra Neamt)	Very low, ornamental cultivation, not spreading
81	*Chamaecyparis lawsoniana* (A. Murray bis) Parl. - North America	NT+BC	Very low, ornamental cultivation, not spreading
82	*Chenopodium botrys* L. – Asia and Southern Europe	BC+NT+SV*+MM*	Low, sub spont.
83	*Chenopodium foliosum* (Moench) Aschers. (syn. *Blitus virgatus* L.) - Mediterranean	BC+NT+SV+MM*	Low, sub spont.
84	*Chenopodium schraderanum* Schult. – East. Africa	NT+SV	Low, no recent data
85	*Cheiranthus cheiri* L. – Mediterranean region (in Romania is cultivated)	BC	No recent data, presumably very low
86	*Chrysanthemum X grandiflorum* (Ramat.) Kitamura, Asia	BC+NT	Very low, ornamental cultivation, not spreading
87	*Chrysanthemum indicum* L. – Asia	BC+NT+SV	Very low, ornamental cultivation
88	*Citrullus lanatus* (Thunb.) Matsum. & Nakai – Africa	BC	Very low, only cultivated at lower elevations
89	*Clematis viticella* L. – South Europe	NT (Zanesti, Piatra Neamt) +BC	Very low, ornamental cultivation, not spreading
90	*Commelina communis* L. – Asia	BC+MM*	Very low, sometimes cultivated as an ornamental plant
91	*Conyza canadensis* (L.) Cronq. (*Erigeron canadensis* L.) - North America	BC+NT+HR*+SV+MM+BN*	Medium to high, sub spont.in ruderal areas but also in cultivated fields, it is spreading
92	*Coreopsis tinctoria* Nutt. – North America (sub spont.)	NT	No recent data, presumably very low
93	*Coronopus didimus* (L.) Sm - North America and Asia	Moldova	No recent data, presumably very low
94	*Coriandrum sativum* L. – Western Asia and Southern Europe	NT+HR	Very low, cultivated
95	*Cosmos bipennatus* L. – Mexico	NT	Low, ornamental cultivation
96	*Cryptomeria japonica* (L.) Don. – Japan	BC	Very low, ornamental cultivation
97	*Cucumis melo* L. – Africa	BC	Very low, only cultivated
98	*Cucumis pepo* L. (= *Cucurbita pepo* L.) – North and Central America	BC+NT+SV+MM*	Low, cultivated, rarely, accidentally sub spont.
99	*Cucumis sativus* L. - Asia	NT+BC	Very low, only cultivated
100	*Cupressus sempervirens* L. –	NT	Very low, ornamental

	Mediterran. and East Asia		cultivation
101	*Cuscuta campestris* Yunck. - North America	BC+NT+SV+HR+MM*+BN*	Medium to high, sub spont., spreading in meadows
102	*Cyclamen purpurascens* Mill. – Central Europe	SV*+BC*	Very low, ornamental cultivation, not spreading
103	*Cydonia oblongata* Mill. - Sowth-West Asia	BC+NT	Very low, only cultivated, not spreding
104	*Cymbalaria muralis* P. Gaertn. (syn. *Linaria cymbalaria* (L.) Mill.) – Sowth Europe	NT (Piatra Neamt) +BC	Low, sub spont., spreading in ruderal areas
105	*Cyperus difformis* L. – Azore Islands	BC	No recent data, presumably very low
106	*Cytisus scoparius* (L.) Link. - Central Europe	NT+HR*+BC+SV*+MM*	Very low, ornamental cultivation, rarely sub spont.
107	*Cytisus scilarius* (L.) Link. – Mediterranean origin	NT	No recent data, presumably very low
	D		
108	*Dahlia variabilis* L. – Central America	BC+NT	Very low, ornamental cultivation, not spreading
109	*Datura stramonium* L. - North America	BC+NT+SV*+MM*	Medium to high, sub spont., it spreading in ruderal areas
110	*Datura innoxia* Mill. - America	NT (Piatra Neamt)	Very low to low, ornamental cultivation but also sub spont.at lower elevation
111	*Dianthus barbatus* L. – Meridional Europe	BC+NT+SV+MM*	Low, ornamental cultivation
112	*Dicentra spectabilis* (L.) Lem. - Asia	NT (Piatra Neamt)	Very low, ornamental cultivation
113	*Digitalis purpurea* L. - North Africa	NT	Very low, cultivated, not spreading
114	*Dipsacus strigosus* Willd. – Pontic. – Central Asia	BC+NT+SV	Low to medium, sub spont., it is spreading in semi-natural areas
115	*Diplotaxis viminea* (L.) DC. – Mediterranean region	BC*	No recent data, presumably very low
116	*Dracocephalum moldavica* L. – Asia	MM*+BC+NT+SV*	Very low, usually cultivated, rarely sub spont.
	E		
117	*Echinacea purpurea* (L.) Moench., North America	NT	Very low, ornamental and experimental cultivation
118	*Echinochloa crus-galli* (L.) P. Beauv. (*E. colona* (L.) - Cosmopolite	NT	Low to medium, sub spont., in ruderal areas at lower elev.
119	*Echinocystis lobata* (Michx.) Torr. et A. Gray - North America	BC+NT+HR+SV+MM*+BN*	Low, spreading sub spont., at mediul elevation (below 700m), cultivated in the past
120	*Elaeagnus angustifolia* L. – Asia Temp.	BC+NT+SV*	Medium, sub spont.at low elevation near rivers
121	*Elodea canadensis* Michx. – North America	BC+NT	Medium to high, sub spont.in lakes at low elevation, spreading below 500m elev.
122	*Elodea nutalii* (Planch.) H St John – North America	NT	No recent data, presumably very low
123	*Elsholtzia ciliata* (Thunb.) Hyl. - Asia	BC*+NT+SV+MM*	Low
124	*Epilobium ciliatum* Rafin., (incl. *Epilobium adenocaulon* Hausskn.) – North America	BC+NT+SV+MM	Medium to high, sub spont.

125	*Erigeron annuus* (L.) Pers. (*Stenactis annua* (L.) Less.) - North America	BC+NT+HR*+SV+MM*+BN*	Medium to high, sub spont.
126	*Erectites hieraciifolius* (L.) Raf. Ex DC., America	NT*+HR*+SV+MM*	Low, sub spont.
127	*Eruca vesicaria* (L.) Cav. – Mediterranean + Asia	BC	Very low
128	*Erucastrum nasturtiifolium* (Poir.) O.E. Schulz, S.-Weatern Europe, Atlantic and Mediterranean	NT+SV*+MM*	Low, no recent data
129	*Eschscholzia californica* Cham.	NT	Very low, ornamental cultivation, not spreading
130	*Euphorbia maculata* L. – North America	BC	Low, no recent data
131	*Euphorbia marginata* Pursh. – North America	NT+SV*+MM*	Low, only cultivated
132	*Euphorbia nutans* Lag. – North America	MM+SV	Low
133	*Exochorda giraldii* Hesse - Asia	BC	Very low, ornamental cultivation, not spreading
	F		
134	*Fallopia aubertii* (L. Henry) Holub - West China, Tibet	NT+SV	Low to medium, sub spont.
135	*Fallopia baldschuanica* (Regel) Holub - Asia	Moldova Province	Presumably very low, sub spont., no recent data
136	*Fagopyrum tataricum* (L.) Gaertn. - Asia	MM	Very low, no recent data
137	*Foeniculum vulgare* Mill. – Mediterranean	NT	Very low, cultivated and sub spont.
138	*Forsythia suspensa* (Thunb.) Vahl. – China	NT (Piatra Neamt)	Very low, ornamental cultivation, not spreading
139	*Fraxinus pennsylvanica* Marshall – North America	NT*	Presumably very low, no recent data
	G		
140	*Galinsoga parviflora* Cav. - South America	BC+NT+HR+SV+MM*+BN*	Medium to high, sub spont.in ruderal areas, spreading at low elevations in ruderal areas and fields
141	*Galinsoga quadriradiata* Ruiz. et Pav. (syn. *Galinsoga ciliata* (Rafin.) Blake) - South America	BC+NT+HR*+SV+MM*	Low to medium, sub spont., is spreading in ruderal areas
142	*Ginkgo biloba* L. - Asia (China)	BC+NT	Very low, not spreading, ornamental cultivation
143	*Geranium sibiricum* L. – West Siberia	BC+NT+SV+MM	Low to medium, sub spont.
144	*Gladiolus communis* L. – Mediterranean	NT+BC	Very low (only cultivated), not spreading
145	*Gleditzia triacanthos* L. - North America	MM*+NT+BC	Very low, cultivated
	H		
146	*Hablitzia thamnoides* M. Bieb. - Caucaz	HR (Lacu Rosu – molidis, Topa 1962)	No recent data - presumably very low, sub spont.
147	*Helianthus annuus* L. - North America	BC+NT+HR*+SV*+MM*	Very low to low, cultivated, rarely, accidentally sub spont.
148	*Helianthus decapetalus* L. – North	BC+NT*+SV*+MM*	Very low, sub spont.
149	*Helianthus tuberosus* L. - North	BC+NT+SV+MM*+BN*	Low to medium, ornamental

	America		cultivation and sub spont., spreading mainly in ruderal areas
150	*Hemerocallis fulva* (L.) L. – China (Asia)	SV*+HR*	Very low, ornamental cultivation and sub spont.
151	*Hemerocallis lilioasphodelus* L. – Eurasia, Mediterranean	NT	Low to medium, depending on the humidity, cultivated
152	*Hibiscus syriacus* L. - Asia	BC+NT	Very low, ornamental cultivation at low elevation
153	*Hosta plantaginea* (Lam.) Aschers - Asia	NT (Piatra Neamt)	Very low, ornamental cultivation, not spreading
154	*Hydrangea macrophylla* L. – Japan	BC+NT+SV	Very low, ornamental cultivation, not spreading
155	*Hyssopus officinalis* L. – Eurasia, Mediterranean	BC+NT	Low, only cultivated for medicinal and aromatic uses
	I		
156	*Iberis umbellata* L. – Mediterranean	SV* (Moldovei river plain)	Very low, no recent data
157	*Impatiens balsamina* L. – East India	NT	Low, ornamental cultivation
158	*Impatiens glandulifera* Royle (*I. roylei* Walp.) - Himalaya	BC+NT+HR*+SV+MM*+BN	Medium to high, sub spont., up to 800m elev., it is spreading in semi-natural and ruderal areas
159	*Impatiens noli-tangere* L. - Eurasia	BC+NT+SV+MM*	Medium, sub spont., it is spreading in some semi-natural habitats
160	*Impatiens parviflora DC.* - Central Asia	BC+NT+SV+MM*	Medium to high, sub spont.
161	*Ipomoea hederacea* (L.) Jacq. – Tripycal America	NT+BC	Very low
162	*Ipomoea purpurea* Roth – Tropical America	NT+MM	Medium, cultivated, rarely sub spont.
163	*Iris germanica* L. – Mediterranean	NT	Very low, only cultivated, not spreading
164	*Iris X lurida* Aiton – hybrid origin	BC+NT+SV+MM*	Low, usually cultivated, rarely sub spont.
165	*Iva xanthiifolia* Nutt. (*Cyclachaena xanthifolia* (Nutt.) Fresen) - North America	BC+NT+SV+MM*	Medium, sub spont., it is spreding at lower elev., below 500m elev. in ruderal areas
	J		
166	*Juncus tenuis* Willd. (*J. macer* S.F. Gray) - North America	BC+NT+HR+SV+MM*	Medium, sub spont.
167	*Juniperus virginiana* L. – North America	BC	Very low, ornamental cultivation
168	*Juglans regia* L. – Asia and Souhern Europe	BC+NT+SV+MM*+BN*	Very low, cultivated, rarely sub spont.
	K		
169	*Kerria japonica* (L.) DC. – East Asia	BC+NT	Very low, ornamental cultivation, not spreading
	L		
170	*Lablab purpureus* (L.) Sweet. - South India	BC	Very low, no recent data, ornamental cultivation
171	*Lactuca sativa* L. – Eurasia	BC+NT+SV+MM*	Low, cultivated, rarely sub spont.
172	*Lactuca tatarica* (L.) C.A. Mey. – East Europe and Central Asia	BC	Very low, sub spont.

173	*Lathyrus aphaca* L. – Asia	MM*+HR*+BC*	Very low, sporadically cultivated
174	*Lathyrus sativus* L. – Asia Minor, Western Mediteran	SV	Very low, no recent data
175	*Lavandula angustifolia* Mill. – Mediterranean	BC+NT+SV*	Low, only cultivated at low elevation, not spreading
176	*Lens culinaris* Medik. – Asia	BC+NT	Very low, cultivated for food
177	*Lepidium densiflorum* Schrad. – North America	HR*+BC+NT*+SV*	Low, at low elevation
178	*Lepidium virginicum* L. – North America	BC+NT+SV*+MM*	Low, sub spont.
179	*Levisticum officinale* W.D.J. Koch – West Asia	NT+BC	Very low, accidentally sub spont., cultivated for food
180	*Linum usitatissimus* L. – Mediterranean	SV+NT+BC	Very low, only cultivated, rarely sub spont., not spreading
181	*Lilium bulbiferum* L. – Europe	BC+NT+HR*+SV+MM	Low, usually cultivated
182	*Lobelia erinus* L. – South Africa	NT	Very low, not spreading, ornamental cultivation
183	*Lonicera caprifolium* L. – Mediterranean	BC+NT+SV*	Low to medium, at lower elevation, cultivated and sub spont.
184	*Lolium multiflorum* Lam. – Africa and Asia	NT+HR*+BC+SV	Low, sub spont.
185	*Lonicera japonica* L. – East Asia	BC+NT+SV+MM*	Medium, ornamental cultivation and sub spont., spreading in gardens and ruderal areas
186	*Lupinus polyphyllus* Lindl. – North America	NT+MM*+SV	Very low, only cultivated
187	*Lycium barbatum* L. – China	BC+NT+SV+MM*	Medium, sub spont., spreading
188	*Lycopersicon aesculentum* Miller – South America	BC+NT+SV*	Very low, only cultivated for food
189	*Lilodendron tulipifera* L. – Asia	NT, cultivated in Piatra Neamt	Very low, ornamental cultivation
	M		
190	*Mahonia aquifolium* (Pursh) Nutt. – North America	NT, cultivated in Piatra Neamt	Very low, ornamental cultivation, not spreading
191	*Magnolia spp.*, (incl. *Magnolia obovata, M.* X *soulangeana*, *M. grandiflora*, *M. liliiflora*) - Asia	BC+NT	Very low, not spreading, ornamental cultivation at lower elev., below 500m elev.
192	*Malva alcea* L. – Southwestern Asia	Moldova	No recent data
193	*Malva moschata* L. – Asia	MM*+HR*+SV*	Low, no recent data
194	*Malva verticillata* L. – (syn. *M. crispa* (L.) L.) – East Asia	BC+NT+SV*+MM*	Low, sub spont.
195	*Malus X domestica* Borkh. – (hybrid origin) – Europe and Asia	NT+BC+SV	Very low, cultivated
196	*Malus pumila* Mill. – Asia	BC+NT+ SV+MM*	Low, usually cultivated
197	*Matricaria suaveolens* (Pursh) Rydb. (syn. *Chamomilla suaveolens* (Pursh) Rydb., *M. matricarioides* (Less.) Porter p.p.) - N.-E. Asia, North America	BC+NT+HR+SV+MM*	Medium, sub spont., below 800m elevation, spreading in ruderal areas
198	*Medicago sativa* L. – West Asia	BC+NT+HR*+SV+MM*+BN*	Low, cultivated
199	*Medicago media* Pers. – hybrid origin	BC+NT+HR*+SV*+MM*	Low, usually cultivated, very rarely sub spont.

200	*Melissa officinalis* L. – Mediterranean	BC+NT+HR*+SV	Low to medium, usually cultivated, not spreading
201	*Mentha suaveolens* Ehrh. – Africa N – West Asia	NT*	Very low, no recent data, cultivated
202	*Mimosa pudica* L. – Brasil – Tropical America	NT	Very low, only ornamental cultivation
203	*Mirabilis jalapa* L. – Central America	BC+NT	Not spreading, ornamental cultivation
204	*Monarda didyma* Balmy – North America	SV	Very low, ornamental cultivation, not spreading
205	*Morus alba* L. – China (East Asia)	BC+NT+ SV	Low to medium, cultivated and sub spont., spreading at low elevation
206	*Morus nigra* L. - Asia	BC+NT	Low to medium, cultivated and sub spont., spreading at low elevation
207	*Mentha X piperita* L. – Mediterranean	BC+NT+SV	Low, cultivated, rarely sub spont.
208	*Mentha spicata* L. (syn. *M. viridis*) - Mediterranean	BC+NT+SV	Low, cultivated and sub spont.in ruderal areas
	N		
209	*Narcissus poeticus* L. – Mediterranean	NT+HR*+SV	Very low, only cultivated
210	*Nicandra physalodes* (L.) Gaertn. – South America	NT(Roman)+SV*+MM*	Very low, no recent data
211	*Nicotiana alata* Link & Otto - South America	BC+NT	Very low to low, ornamental cultivation, rarely sub spont.
212	*Nigella damascena* L. – Mediterranean	Moldova (no location)	Presumably very low, ornamental cultivation and sub spont.
213	*Nigella sativa* L. - Asia	Moldova (no location)	Presumably very low, ornamental cultivation and rarely sub spont.
	O		
214	*Ocimum basilicum* L. – Asia	NT+BC	Very low, usually cultivated, not spreading
215	*Oenothera biennis* L. - North America	BC+NT+HR+SV+MM*	Low to medium, cultivated and rarely sub spont., spreading
216	*Oenothera erythrosepala* Borb. (*O. glazioviana* Micheli) - North America	NT+ SV+MM*	Low to medium, spreading sub spont.but also, ornamental cultivation
217	*Oenothera parviflora* L. – North America	BC+SV+MM*	Low, cultivated and sub spont.below 1000m elev.
218	*Oxalis dillenii* Jacq. (*O. corniculata* Jacq. *var. dillenii* (Jacq.) Trelease) – North America	BC+NT+SV*+MM*	Low to medium
219	*Oxalis stricta* L. – North America	BC+NT+HR*+SV+MM*	Low, sub spont.
220	*Oxalis corniculata* L. – Southern Europe	BC+NT+SV*+MM*	Low to medium
221	*Oxybaphus nyctagineus* (Michx.) Sweet – North America	Moldova Province	No recent data, not confirmed
	P		
222	*Panicum capillare* L. – North America	NT*+SV*	No recent data, probably very low
223	*Panicum miliaceum* L. – Central Asia, China	BC+NT+HR*+MM*	Low, cultivated, very rarely sub spont.
224	*Papaver somniferum* L. – West	BC+NT+ SV+MM*	Very low to low, mostly

	Mediterranean		cultivated, not spreading
225	*Paulownia tomentosa* (Thunb.) Steud - Asia	NT (Piatra Neamt)	Not spreading - very low, only cultivated
226	*Phacelia tanacetifolia* Benth – North America	BC	Very low, no recent data
227	*Philadelphus inodorus* L. – North America	NT (Piatra Neamt, Poiana Largului, Hangu) +SV	Low, cultivated and supspont., spreading in some areas
228	*Philadelphus pubescens* Loisel. – America de Nord	SV*	Very low, no recent data
229	*Phytolacca americana* L. – North America	BC+NT+MM*	Low to medium, ornamental cultivation, rarely sub spont.only at lower elevation
230	*Physalis alkekengi* L. – North America	BC+NT+HR*+SV*+MM*	Low to medium, cultivated and sub spont.
231	*Picea pungens* Engelm. – North America	BC+NT	Very low, ornamental cultivation, not spreading
232	*Picris echioides* L. – Central and Sowth Europe	MM*	Very low, no recent data
233	*Parthenocissus inserta* (A. Kern) Fritsch – North America	BC+NT+SV*	Medium to high, sub spont., present and spreading in ruderal areas
234	*Parthenocissus quinquefolia* (L.) Planch. – North America	BC+NT+MM*	Low to medium, sub spont., less frequent
235	*Parthenocissus tricuspidata* (Sieb. et Zucc.) Planch. – North America	BC+NT	Presumably very low, ornamental cultivation, no recent data
236	*Pelargonium zonale* (L.) Kuntze	BC+NT	Not spreading, ornamental cultivation in some gardens only in the summer time
237	*Petroselium crispum* (Mill.) A.W. Hill – medit. – Mediterranean area and West Asia	NT+BC+SV	Very low, cultivated, very rarely, accidentally sub spont.
238	*Phellodendron amurense* Rupr. - East Asia	BC	Very low, ornamental cultivation
239	*Pinus banksiana* Lamb. – North America	SV	Very low, no recent data
240	*Pinus strobus* L. - North America	NT (Piatra Neamt)	Very very low, only ornamental cultivation, not spreading
241	*Pisum sativum* L. – Mediterranean, Afganistan and India	HR*+NT+BC+SV	Very low, cultivated, not sub.-spont.
242	*Platanus* X *acerifolia* (Aiton) Willd. – North America and Asia, hybrid origin	NT (Piatra Neamt)	Very low, ornamental cultivation, at low elevation, not spreading
243	*Polygonum orientale* L. – Asia	NT	Very low
244	*Polygonum baldschuanicum* Regel – Asia	Moldova province	Cultivated, no recent data
245	*Populus X canadensis* Moench	NT*	Very low
246	*Populus X euramericana* Moench – hybrid origin	NT	Not spreading, ornamental cultivation
247	*Prunus armeniaca* L. – Central Asia	NT	Low, only cultivated
248	*Prunus cerasifera Ehrh.* – Southern Europe and Asia	BC+NT+HR*+SV*	Low to medium, cultivated and sub spont.at low elevation
249	*Prunus cerasus* L. - Asia – cultiv. Sub spont.	NT+BC+SV*	Low to medium, cultivated and sub spont.at low and

			medium elevation (below 800m)
250	*Prunus domestica* L. - Caucaz-Asia	BC+NT+SV*	Low, usually cultivated
251	*Prunus persica* (L.) Batsch – Tibet, China -East ASIA	BC+NT+SV*	Very low, cultivated
252	*Pseudotsuga menziesii* (Mirb.) Franco – North America	NT+SV	Very low, ornamental cultivation
253	*Polygonum orientale* L. - East ASIA	MM*+BC*+NT*	Very low, no recent data
254	*Portulaca oleracea* Hook. - Eurasia	NT+BC	Very low (ornamental cultivation)
255	*Pyracantha coccinea* M. Roem – Asia	NT (Piatra Neamt)	Very low, ornamental cultivation
	R		
256	*Raphanus sativus* L. – Central Asia – Medititerranean	NT+ SV*+BC	Very low, cultivated, not spreading
257	*Raphanus raphanistrum* L. – Mediterranean	NT+SV*	Low, cultivated, rarely sub spont.
258	*Reseda odorata* L. – Northern Africa	SV+NT*+MM*	Very low, sub spont.
259	*Reynoutria x bohemica* Chrtek et Chrtkoá (*Fallopia x bohemica* (Chrtek et Chrtkoá) J.P. Bailey) – East Asia	NT+SV+HR*+MM*	Medium to high, sub spont.
260	*Reynoutria japonica* Houtt. (*Fallopia japonica* (Houtt.) Ronse Decr., syn. *Polygonum cuspidatum* Sieb. *et* Zucc.) – East Asia	BC*+NT+SV+MM*+BN	Highly invasive, sub spont. from low to high elevation (also below 1000m elev.)
261	*Rhododendron sp.* – Asia	NT	Very low, not spreading, ornamental cultivation in gardens
262	*Ribes rubrum* L. – West Europe	NT+HR+SV+MM*	Low, no recent data
263	*Ricinus communis* L. - Africa	NT (Piatra Neamt)	Very low, ornamental cultivation, rarely sub spont.
264	*Robinia hispida* L. – North America	NT	Very low, ornamental cultivation
265	*Robinia pseudoacacia* L. - North America	BC+NT+HR*+SV	Medium to high, widely distributed, cultivated and sub spont., up to 700m elev.
266	*Robinia viscosa* L. - North America	NT	Low to medium, cultivated and sub spont.
267	*Rosmarinus officinalis* L. - medit.	NT	Very low, ornamental and medicinal use, not spreading
268	*Rubia tinctorum* L. – Mediterranean	NT+HR*	Low, no recent data
269	*Ruta graveolens* L. – Mediterranean	NT	Low, usually cultivated
270	*Rudbeckia laciniata* L. - North America	NT+HR+SV*+MM*	Medium, ornamental cultivation and sub spont.
271	*Rudbeckia hirta* L. – North America	NT	Low, cultivated and sub spont.
272	*Rudbeckia triloba* L. – North America	NT	Very low, only ornamental cultivated
273	*Rumex longifolius* DC. in Lam. et DC. - Northern Europe and Russia	SV+MM*	Low to medium

274	*Rhus typhina* L. - North America	NT+SV+MM*	Low, usually cultivated, but very rarely sub spont.
	S		
275	*Salix babylonica* L. (cult.) – East Asia	BC+NT	Low, cultivated and also sub spont., at lower elevations
276	*Salvia officinalis* L. – Mediterranean	BC+NT+SV	Very low - low, cultivated
277	*Salvia verbenaca* L. – Mediterranean and N. Africa	MM*	Very low, no recent data
278	*Satureja hortensis* L. – Mediterranean	BC+NT+SV*	Low, cultivated
279	*Sempervivum* tectorum L. – Mediteranean, Central Europe, Asia Minor	NT	Very low, ornamental cultivation, not spreading
280	*Senecio vulgaris* L. - Eurasia, now cosmopolit	NT	Low to medium, spreading sub spont.in ruderal areas
281	*Setaria italica* (L.) P. Beauv. – West Asia	BC+NT+SV*	Low, at lower eleation
282	*Sida spinosa* L. – South America	MM*	Probably low, no recent data
283	*Sicyos angulatus* L. – North America	HR*+SV*+ MM*	Very low, no recent data
284	*Sinapis alba* L. – Mediterranean	NT+SV+MM*	Very low, cultivated
285	*Silybum marianum* (L.) Gaertn. – Mediterranean	BC+NT+MM*	Low, cultivated
286	*Sisymbrium irio* L. – Mediterranean and western Asia	NT	Presumably very low, no recent data
287	*Sisyrinchium montanum* Greene - North America	BC+NT+SV+MM	Low, ornamental cultivation and rarely sub spont.
288	*Solanum tuberosum* L. - South America	NT+HR*+SV*	Very low, usually cultivated
289	*Solidago canadensis* L. – North America	BC+NT+HR*+SV	Low to medium, cultivated but also spreading sub spont.
290	*Solidago gigantea* Aiton - N. America	HR+NT+SV*+MM*	Low, usually ornamental cultivation
291	*Solidago graminifolia* (L.) Salisb. – North America and Canada	MM*	Very low, no recent data
292	*Sophora japonica* L. - Asia	BC	Very low, ornamental cultivation
293	*Sorghum halepense* (L.) Pers., Mediterranean	BC+NT+SV*	Low to medium, cultivated and sub spont.
294	*Spinacia oleracea* L. – Asia	BC+NT	Very low, cultivated at lower elev., accidentally sub spont.
295	*Spiraea X vanhouttey* (Briot.) Zabel, cultivated – Asia	BC+NT+SV	Very low, ornamental cultivation at medium and low elevation (below 900m)
296	*Spiraea ulmifolia* Scop. - Asia	BC+NT+SV	Very low, usually cultivated, not spreading
	T		
297	*Tanacetum parthenium* (L.) Sch. Bip. (syn. *Chrysanthemum parthenicum* (L.) Bernh. non (Lam.) Gaterau) – E. Mediterran	NT+BC+SV+MM*	Low, usually cultivated and sub spont.
298	*Tagetes patula* L. – Mexico	BC+NT	Very low, ornamental cultivation, not spreading
299	*Taxodium distichum* (L.) Rich. - America	BC	Very low, ornamental cultivation, not spreading

300	*Thladianta dubia* Bunge - North of China	NT(Potoci)+SV	Low, sub spont., in ruderal areas
301	*Thymus vulgaris* L. – Mediterranean	NT	Very low, cultivated, very rarely sub spont.
302	*Tradescantia virginiana* L. – North America	SV*	Very low, no recent data
303	*Triticum aestivum* L. - almost cosmopolite	NT+BC	Low, cultivated, very rarely, accidentally sub spont.
304	*Trifolium hybridum* L. – Atlantic and Mediterranean	BC+NT+HR*+SV*+MM+BN*	Medium, sub spont., in ruderal areas
305	*Trifolium incarnatum* L. – Mediterranean and West. Europe	BC+NT+ SV*	Low, sub spont.
306	*Tsuga canadensis* L. Carr. – North America	BC	Very low, ornamental cultivation
307	*Tulipa gesneriana* L. – Asia	NT+BC	Very low, only cultivated
308	*Thuja occidentalis* L. – North America	NT+BC+SV	Very low, only cultivated
309	*Thuja orientalis* L. - Asia	NT+BC+SV	Very low, ornamental cultivation
310	*Thujopsis dolabrata* (Thunb. ex L. fil.) – Japan	BC+NT	Very low, not spreading, ornamental cultivation
	V		
311	*Vicia lutea* L. – Medit.	BC	Very low, no recent data
312	*Vallisneria spiralis* L. - Tropical America	NT+BC	Low, sub spont.in rivers at lower elevation (below 400m)
313	*Veronica peregrina* L. – Sowth America	BC	Very low, no recent data
314	*Veronica persica* Poir. - S. West Asia	NT+HR*+BC+MM*+SV	Low to medium, sub spont., at low elevation (below 800m) in ruderal areas
315	*Vicia sativa* L. - Mediterranean	BC+NT+HR*+SV	Low to medium, sub spont.
	W		
316	*Wisteria sinensis* (Sims.) DC. – China	BC+NT	Very low to low, ornamental cultivation
	X		
317	*Xanthium orientale* L. *subsp. italicum* (Moretti) Greuter (*X. italicum* Moretti) – North and South America	NT+BC+SV*+MM*	Medium, sub spont., spreading at low and medium elevation
318	*Xanthium spinosum* L. - South America	NT+SV	Low to medium, sub spont., only at lower elev. (below 500m, in plains)
319	*Xanthium strumarium* L. - Eurasia	NT+BC+SV+HR*+MM*+BN*	Medium, sub spont., at lower elevation (below 1000m)
	Y		
320	*Yucca filamentosa* L. – North America	NT+BC	Very low, ornamental cultivation
	Z		
321	*Zeya mays* L. – Central America	NT+BC+SV	Very low, cultivated, very rarely and accidentally sub spont., at lower elevation (below 700m)
322	*Zinnia elegans* Jacq. – Mexico	BC+NT	Very low, ornamental cultivation, not spreading

*species are recorded only at county level (Abbreviations: BC=Bacau, NT=Neamt; HR=Harghita; SV = Suceava; BN= Bistriţa-Năsăud; MM – Maramures, sub spont. = sub spontaneous, spont. = spontaneous, elev. = elevation, syn. = synonymous).

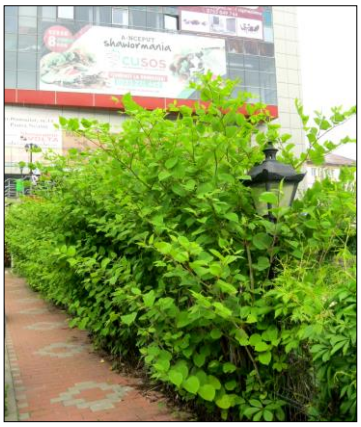
Acer negundo in Bicazu Ardelean

Ailanthus altissima in Piatra Neamt

Ambrosia artemisiifolia in Piatra Neamt train station

Amorpha fruticosa near Bistrita River in Piatra Neamt

Impatiens glandulifera in the upper Bistrita river basin near Cojoci



Reynoutria japonica in the urban environment of Piatra Neamt

Figure. 2 Some invasive alien plant species from Bistrita river basin, species habitus and habitat (original).

Besides the above species, in Bistrita lower basin have been cultivated also other nonnative species besides the ones from Table 1. We mention here: *Caragana arborescens* in Bacau and Piatra Neamt, *Cotoneaster dielsiana* in Piatra Neamt, *Ficus carica* in Piatra Neamt, but we did not find this species in recent times because most probably did not adapt to our climatic conditions. The species of *Rhus spp*. are cultivated but until the present time, we did not observe any major naturalization of this species, except for a few sub spontaneous plants naturalized in a ruderal area of Cracaoani village. The impact of this species over the environment is considered to be low. From all the *Magnolia spp*., cultivated in this regioun we mention the most common one: *Magnolia X soulangeana* Soul. -Bod. originating from China, but it is not spreading.
This group of 322 non-native plant species (Table 1) is representing more than 14% of the total plant species (over 2300 vascular plant species) recorded from Bistrita River Basin (Pricop & Negrea, doc). The largest part of these taxons, about 35% have an American origin, and 39% are of Asian origin. From these 320 non-native taxons, there are a few adventive species that are present in this region but has not been previously recorded from Bistrita River Basin as sub spontaneous or spontaneous species.

This species list is an inventory that contains all the adventive plant species from the Bistritei river basin. A big part of them are sub spontaneous, but we also included the cultivated species from gardens or from fields (ex.: as crops); but not the indoor cultivated species (the exotic, usually

ornamental or medicinal plant species) from buildings or from apartments, because most exotic plant species do not persist or spread in the natural environment of Bistritei river basin, due to the harsh climatic conditions. In the following section we review our data.

Distribution notes with regards to the most **aggressive/invasive plant species** from Bistrita river basin (Figure. 2):

I. Fam. Polygonaceae

Reynoutria Houtt.

I.1. *Reynoutria japonica* Houtt. (syn. *Fallopia japonica* (Houtt.) Ronse Decr., *Polygonum cuspidatum* Sieb. et Zucc.) - Figure. 2, 3; Geofit, Adv., Asia, 2n=44; Historical species distribution records are from Coman (1971) – Maramures county; Dobrescu & Ghenciu (1974); Nechita (2003), Sirbu coord. (2011) – Harghita and Neamt county; Zanoschi (1971, 1977), Mititelu et al (1968), Stefan & Mititelu (1980), Mititelu (1989), Mititelu & Nechita (1992), Sirbu & Oprea (2008a, b), Oprea & Sirbu (2009) – Neamt county; Sirbu & Oprea (2008) and Sirbu coord. (2011) – Suceava county.

Recent records are from Pricop & Negrea, 2018: Piatra Neamt – in the center of the city, Precista and near Bistrita river bank, Hamzoaia-Tasca, Bicaz Chei, Bicazu Ardelean, Agarcia-Alexandru cel Bun, Pietroasa, Lunca, Madei, Farcasa, Frumosu, Galu, Poiana Teiului, Poiana Largului, Chiriteni, Buhalnita, Bicaz, Tarcau (Neamt county); Dorna Arini – Ortoaia river bank, Chiril, Holda, Holdita, Satu Mare, Crucea, Brosteni, (Suceava county). *R. japonica* is invading not only streams and road sides with high humidity but also side of semi-natural mountain meadows with high a medium productivity, we encountered this phenomen of invasion in Ceahlau and Bistricioara, near Durau in Neamt county. It is one of the species that is doing a lot of damage to the natural environment, the riverine ecosystems of this area are threatened. Populations of this species are continuously extending from the main rivers to the smaller streams, reproducing vegetatively. At present, the species populations are growing out of control and are occupying the main river banks and the lower beds of some streams of Bicaz and upper Bistrita river. This species has the tendency to spread not only on the main river banks but also on the tributaries, and it is present in Ceahlau and in Cheile Bicazului – Hamas National Park. According to our observations, R. japonica - once installed, gradually substitutes the native herbaceous plant species.

Regarding the hybrid species *Reynoutria* x *bohemica* Chrtek et Chrtkoá (*Fallopia* x *bohemica* (Chrtek et Chrtkoá) J.P. Bailey) recorded by Sirbu & Oprea 2008a, we have to mention that we did not encounter this hybrid species in our area of study. As regarding our collected material, in the case of *R. japonica* the leaves are relatively small and without a cordate base (the leaf-base is truncated) and without hairs on the lower face of leaf-veins, characters that are typical for *R. japonica*.

II. Fam. Fabaceae

***Amorpha* L.**

II.1. *Amorpha fruticosa* L. - Figure. 2, 4; Phanerophyte, Adv., North America, 2n=40; Historical species distribution records are from Mititelu et al. (1971) – Bacau county; Grecescu (1898), Nechita (1995); Oprea & Sirbu (2009), Sirbu & Oprea (2008), Oprea & Sirbu (2009), Sirbu coord. (2011) – Neamt county.

Recent records of *A. fruticosa* from Pricop & Negrea (2018): Bistrita river Valey, Sarata - Piatra Neamt, Agarcia, Alexandru cel Bun, Dumbrava, Savinesti and Roznov, Poiana Largului and Poiana Teiului. The species was planted in the recent past in the Izvoru Muntelui lake area, to prevent soil erosions and landslides (Pricop & Negrea doc).

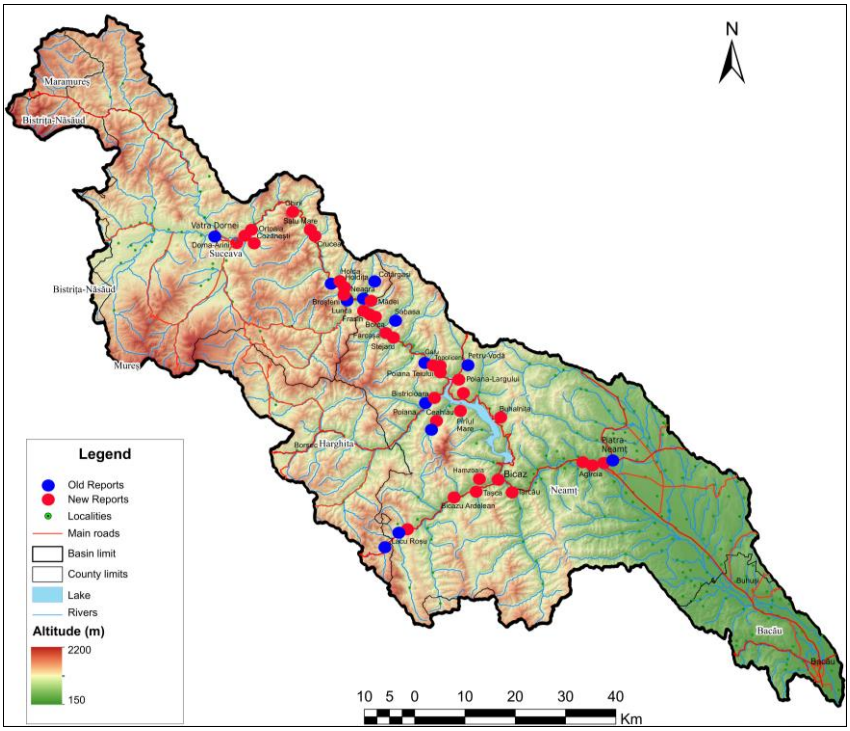


Figure. 3 Distribution of ***Reynoutria japonica* Houtt**. in Bistrita river basin.

We encounter *A. fruticosa* up to Poiana Largului and Poiana Teiului, an area from Izvorul Muntelui-Bicaz lake. *A. fruticosa* is very adaptable but depends on wather (its roots can grow up to 3 m reaching the acviferous). It grows in the concrete cracks from Batca Doamnei dam, producing the dislocation of the concrete slabs. Despite the effort to wipe this species off, the plants are still proliferating (due to the root system); this plant is resistant (plants are viable) up to a few weeks after are pulled out of the ground. In the proper conditions, being dependent on wather, this species is colonizing large areas. After being cut, new shoots are growing from the roots, (new stalks grow rapidly in the same year they were cut and bloom much later than uncut plants).

***Robinia* L.**

II.2. *Robinia pseudoacacia* L. - Figure. 5, Macrofanerofit, Adv., 2n=20, 22; Historical species distribution records are from Mititelu et al. (1993), Sirbu & Opera (2006), Sirbu & Opera (2009) – Bacau county; Mititelu et al. (1987), Mititelu & Mancas (1987), Zamfirescu (2007), Daraban (2007), Sirbu & Oprea (2008), Mititelu et al (1986), Oprea & Sirbu (2009), Oprea & Sirbu (2009), Pricop (2009), Sirbu coord. (2011) – Neamt county; Chifu et al (2006) – Suceava county.

The recent records are from Negrea & Pricop (2018)**:** Doamna-Piatra Neamt, Agarcia – Alexandru Cel Bun, Hamzoaia (Tasca), Bicaz, Tarcau-Cazaci, Straja, Secu-Vaduri, Girov, Dumbrava Rosie, Savinesti, Roznov, Balanu, Zanesti, Traian, Podoleni but also Ceahlau, Galu, Borca, Farcasa, Poiana Largului and Poiana Teiului, Brosteni, Crucea and Dorna - Arini.
We add new records for *R. pseudoacacia*, from Bacau county: Hemeiusi-Bacau, Itesti, Garleni, Lespezi, Racova, Gura Vaii, Buhusi, from Neamt we mention also the presence of this invader in: Manoaia, Borlesti, Ruseni, Rediu, Betesti, Costisa, Negritesti, Balan, Slobozia, Bistrita, Pangarati, Izvorul Muntelui - Bicaz, Potoci, Ruginesti, Grozavesti, Hangu, Chiriteni, Secu, Buhalnita, Poiana largului, Roseni, Topoliceni, Poiana Teiului, Dreptu, Frumosu, Farcasa, Paraul Pantei, Borca, Madei, Lungeni, Brosteni and Vatra Dornei – cultivated and subspont (Negrea & Pricop doc.). *R. pseudoacacia* is distributed in almost all the localities from Bacau up to Brosteni, from Brosteni upstream is less frequent but it is present in Vatra Dornei and Dorna-Arini (Pricop & Negrea, doc.).

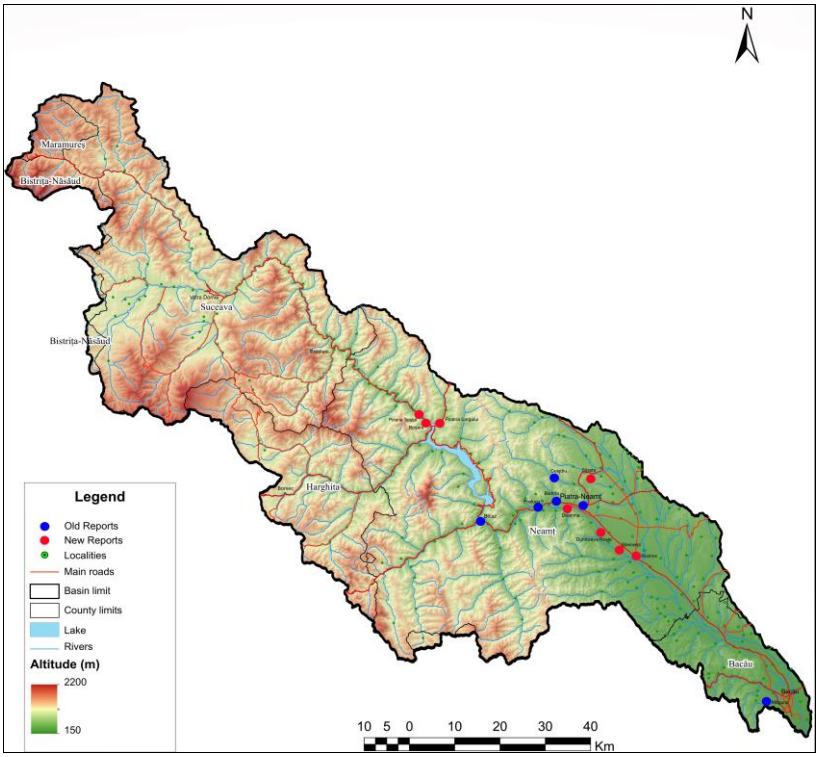


Figure. 4 Distribution of ***Amorpha fruticosa* L**. in Bistrita river basin**.**

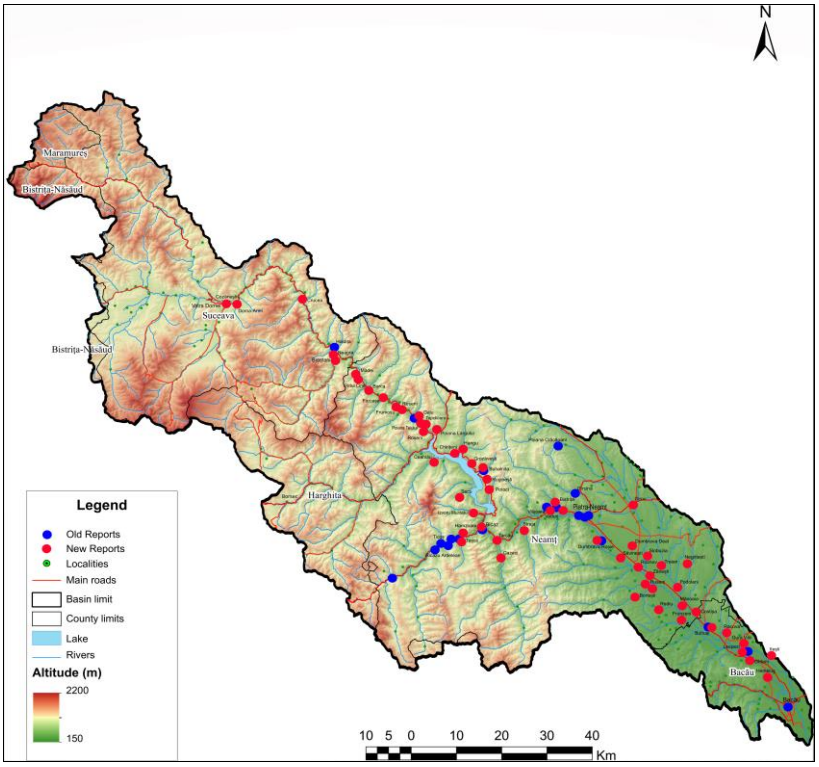


Figure. 5 Distribution of ***Robinia pseudoacacia* L.** in Bistrita river basin**.**

R. pseudoacacia was introduced in Moldova province (Romania) to prevent soil erosion due to deforestation and land/soil degradation but it has been spreading out of control, leading to biodiversity loss, the species spreads especially at lower altitudes and where the climate is hotter and relatively dry; At altitude and in the upper part of Bistrita valley the species *R. pseudoacacia* suffers from cold.

Although the populations of this species are out of control in many areas of Neamt county - at lower altitudes. Each year many plant populations are being cut down (we mentioned here the areas from the city Piatra Neamt and the areas near the railways and some areas near lakes and rivers). The species is predominant in some specific urban and rural areas. It was/is cultivated in part also because of the melliferous proprieties and also for the root system - mainly to prevent the soil erosion and landslides; also, to prevent the formation of sand dunes. *R. pseudoacacia* populations are being tolerated by the locals. In the communist era, the species was extensively cultivated on some deforested areas from lower altitudes (200-700m elevation).

Beside *R. pseudoacacia*, we also found *R. viscosa* L.. This species is spreading in Bistritei River Basin, and is recorded from Pangarati, Vaduri – Vadurele near Preluca on the side of the road. In Piatra Neamt is cultivated in the center of the city but also sub spontaneous in an abandoned tren station area near Bistrita River (Precista), and sub spontaneous, Rediu in a ruderal areas.

III. *Fam. Simaroubaceae*
***Ailanthus* Desf.**

III.1. *Ailanthus altissima* (Miller) Swingle, Tree-of-Heaven; - Figure. 2, 6; Macrofanerofit, Adv., China; Historical species distribution records are from Mititelu & Nechita (1992), Nechita (2003) – Harghita county; Nechita (2003), Sirbu & Oprea (2008b), Oprea & Sirbu (2009), Sirbu coord. (2011) – Neamt county. Recent records from Pricop & Negrea (2018): Piatra Neamt (downtown-center of the city, at the base of Cozla hill, the minibus stations in the northern part of the city, and near the railway), Cuiejdi river bank to Ocol, Garcina, Savinesti, Roznov (the center of Roznov city – central park area), Zanesti and Podoleni.

Newly recorded species from Neagra – in Neamt, and from Brosteni, located on the side of the mai road near Holdita – Suceava county (Pricop & Negrea doc). The species prefers the sunny and dry areas of Piatra Neamt - at the foot of the Cozla hill, but also the areas from a lower elevation, from 200 up to 400m altitudes (Pricop & Negrea doc). This species is predominant and growing in sunny areas, in arid areas at lower altitudes from Neamt county – urban and rural environment with high anthropic impact. The aridisation of these areas and the climate change (the global warming) are linked factors that influence the spread and propagation of *A. altissima*; new locations related to these factors being Tasca to Neagra on the edge of the railroad and Tarcau-Bicaz area, and on the bank of Bistrita river. This species is mainly subspont. but also cultivated in this region (for the ornamental value).

IV. *Fam. Aceraceae*
***Acer* L.**

IV.1. *Acer negundo* L. - Figure. 2, 7; Phanerophyte, Adv., North America, 2n=26; Historical species distribution records are from Aoncioaie (2007) and Sirbu coord. (2011) – Bacau county; Zamfirescu (2007), Daraban (2007), Sirbu & Oprea (2008b), Oprea & Sirbu (2009), Pricop (2009), Sirbu coord. (2011) - Neamt county; Sirbu coord. (2011) – Suceava county;

Recent records from Pricop & Negrea (2018): Borca and Farcasa towards Galu and Poiana Teiului, up to Poiana Largului, Tasca-Hamzoaia, Bicaz, Alexandru cel Bun, Piatra Neamt city up to Ocol, Garcina, Sarata-Piatra Neamt, Girov, Dumbrava Rosie, Savinesti, Zanesti, Roznov, Podoleni.
New records from Bacau county: Racova, Buda, Lespezi, Garleni, Hemeius, Bacau and from Neamt county: Cracaoani, Oslobeni, Bodesti, Dobreni, Caciulesti, Girov, Silistea, Costisa, Slobozia and Bicaz Chei (Pricop & Negrea, doc.). *A. negundo* is a common species in this area and is spreading more and more, some specimens are recorded also from the upper part of Bistrita River Basin. The specimens are present especially in the ruderal areas of towns and villages and near the river bead from the lowlands up to the lower part of the mountains, and near the main roads spreading also due to climate change. *Acer negundo* is present but rare in the upper part of the Bistritei river basin (in Dornelor intramontane depression), this species is abundant mostly in the lower and middle part of the Bistritei river basin, from Borca downstream Bistritei River, up to Bacau. Due to climate change in the last years, it is progressively extending its areal to the upper parts of the Bistrita river basin following the railroad up to Bicaz-Chei being more and more abundant (Pricop & Negrea, doc.).

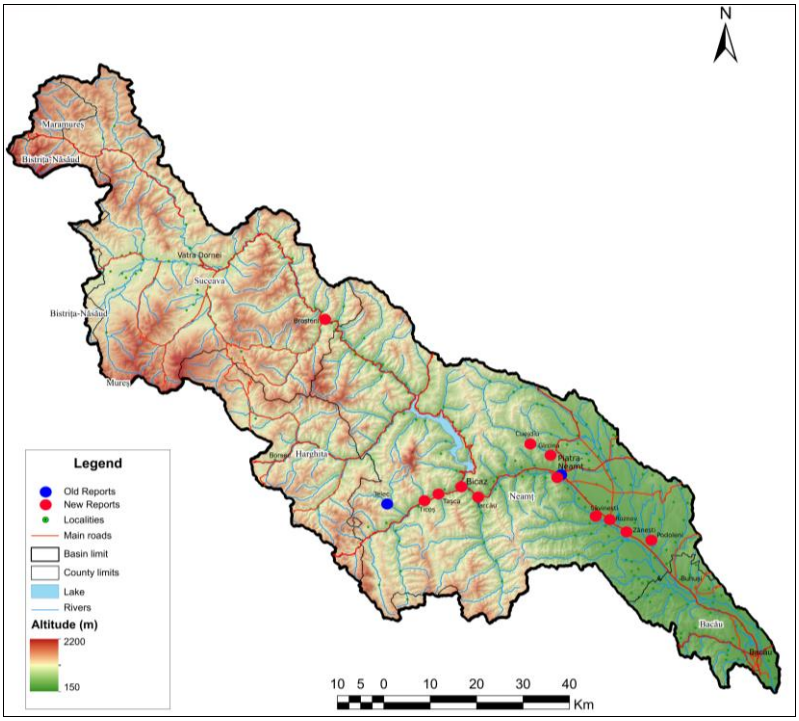


Figure. 6 Distribution of ***Ailanthus altissima* (Miller) Swingle** in Bistrita river basin.

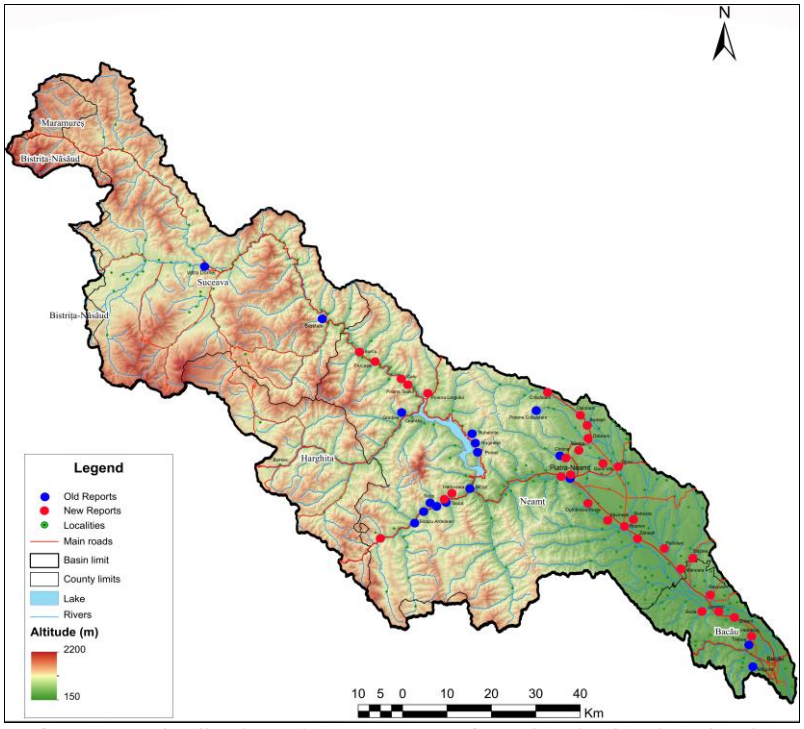


Figure. 7 Distribution of ***Acer negundo* L.** in Bistrita river basin.

V. *Fam. Balsaminaceae*
***Impatiens* L.**

V.1. *Impatiens glandulifera* Royle (*I. roylei* Walp.) – Figure. 2, 8; Terophit, Himalayas, 2n = 18, 20, Historical species distribution records are from Mititelu et al. (1987) in Bacau conty; Mititelu et al. (1987), Oprea (2005), Sirbu & Oprea (2008b), Oprea & Sirbu (2009), Sirbu & Oprea (2008b), Oprea and Sirbu (2009), Sirbu coord. (2011) - from Neamt.

Recordings of *I. glandulifera* from Pricop & Negrea (2018): Bicaz, Sabasa, Farcasa – Neamt county; Bistrita river valley - Dorna Arini, Rusca, Sunatori, Calinesti, Chiril, Satu Mare, Cojoci, Crucea, Holda, Brosteni - from Suceava county.

New records from Suceava County: Piatra Tibaului, Tibau, Fluturica, Carlibaba, Valea Stanei - Botos, Ciocănești (Pricop & Negrea doc.). *Impatiens glandulifera* is one of the most dangerous invaders along with *R. japonica* that alters native-riparian plant communities; the main impact is near rivers, near roads and landfills near rivers.

VI. *Fam. Asteraceae*
***Ambrosia* L.**
VI.1. *Ambrosia artemisiifolia* L. (*A. elatior* L.) – Figure. 2, 9; Terophit species, Adv., North America, 2n=36; Historical species distribution records are from Sirbu & Oprea (2008b), Oprea & Sirbu (2009), Sirbu coord. (2011) - Neamt conty; Sirbu coord. (2011) – Suceava county

Records from Pricop & Negrea (2018): Bicazu Ardelean, Ticos-Floarea, Neagra, Tasca, Tarcau, Straja, Stejaru, Alexandru cel Bun, Piatra Neamt (the train station areas and the railways), Dumbrava Rosie, Savinesti, Roznov, Zanesti, Podoleni, Buhusi, Bacau. *Ambrosia artemisiifolia* is distributed in the study area along the railways and roads. It appears rarely on the road-side, the distribution of this species being more localized, mainly on the railways.

New records of *A. artemisiifolia* from Bacau county: Lilieci, Hemeius, Garleni, Lespezi, Racova; from Neamt: Costisa and from Suceava county: Iacobeni, Argestru train stations, and Rosu, near Vatra Dornei (in this area this invasive species is small in size, reaching max. 30cm due to the cold and harsh climatic conditions; in this area of Dornelor Depression, the largest population of ambrosia is in Vatra Dornei train station).

As observed by us, in this area of Moldova province, the main way of propagating the species *A. artemisiifolia* was the railways, and we found her frequently in ruderal areas of the large railway stations. We have not encountered frequently this species on the side of the roads, but only in very rare cases. This species is not able to grow and spread well in these new locations from Bistrita River Basin. So, we can conclude that the species has a thermophilous character and has reached a climatical barrier in her expansion. It is spreading also due to climate change and global warming in general. It is rather curious that *A. artemisiifolia* in Bistrita River Basin is rather distributed along the railways in contrast with other areas at lower altitudes from Moldova, Banat, Muntenia and Dobrogea provinces, where it has a rather ruderal presence, along the sides of the roads and abandoned fields.

VII*. Fam. Hydrocharitaceae*
***Elodea* Michx.**
VII.1. *Elodea canadensis* Michx. - Figure. 10; Waterweed, Helohydrofit, Adv., North America, 2n=24, 48. Historical species distribution records are from Ursachi & Barabas (1998), Gurău & Burghelea (2003) - Bacau county; Sirbu & Oprea (2008b); Pricop (2009) - Neamt county.

Records from Pricop & Negrea (2018): Reconstructia lake from Piatra Neamt, Alexandru cel Bun, Doamna - Batca Doamnei lake, Valeni (Pricop & Negrea, 2018). It is a species with a high impact on the aquatic ecosystems and is progressively increasing its areal, colonizing lakes and sometimes ponds (stagnant bodies of water in general) but also canals.

New data with regards to *Elodea canadensis* distribution in Neamt: Costisa; in Bacau: Buhusi, Racova, Garleni, Hemeiusi, Itesti and Bacau - Gheraiesti (Pricop & Negrea, doc). Racova, Garleni, Lilieci (Bacau I) and Bacău II are lakes invaded by *E. canadensis* (these artificial lakes are located in the lower sector of Bistritei river basin). Caraus (2013) mentioned the presence of *Elodea nuttallii* in the artificial lakes from the lower sector of Bistrita river valley, but we did not find this species in this area, *Elodea nuttallii* must be first confirmed.

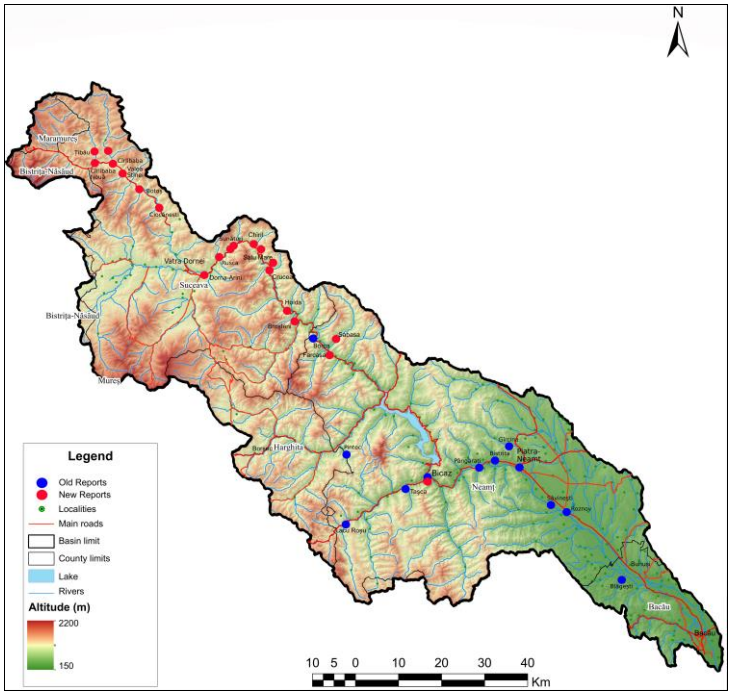


Figure. 8 Distribution of ***Impatiens glandulifera*** **Royle** in Bistrita river basin.

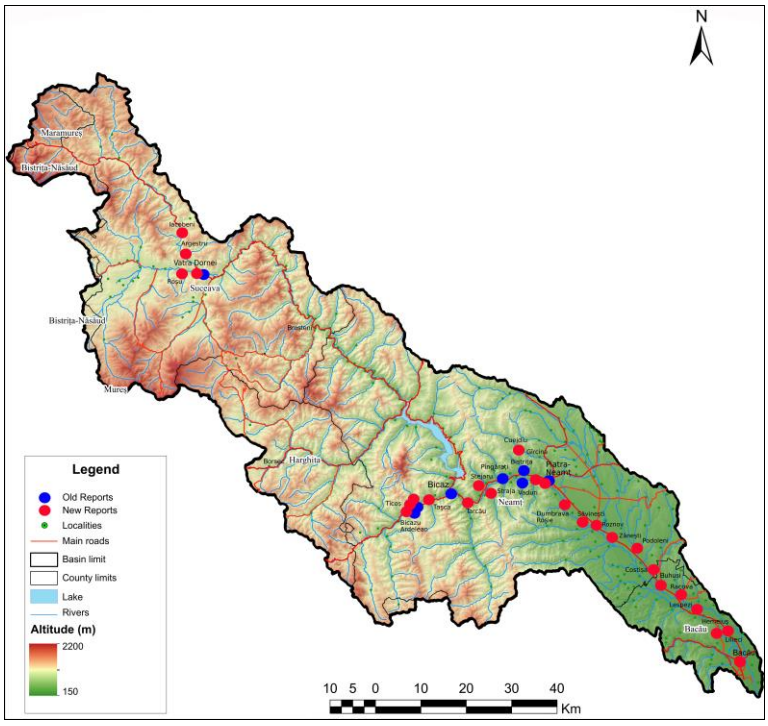


Figure. 9 Distribution of ***Ambrosia artemisiifolia*** **L.** in Bistrita river basin.

E. canadensis is present in this region, mostly on the lakes of Bistrita River with a stagnant body of wather (ex.: Pangarati, Vaduri, Batca Doamnei, Reconstructia, Racova, Garleni, Lilieci (Bacau I and Bacău II lakes) - basically downstream from the Izvorul Muntelui - Bicaz lake.

The species (*E. canadensis*) has greatly multiplied occupy large areas. In Pingarati lake and Batca Doamnei-Piatra Neamt lakes, it occupies almost 60 up to 70% of the surface of the stagnant water. Due to this "blooming", we have noticed the negative phenomena of fish mortality (we observed fish mortality in the case of perch and pike).

This is caused by the increased temperature and a low concentration in oxygen during the warm summer months (from May until September). The remaining oxygen low as it is consumed by this species in the respiratory processes. The species *E. canadensis* was not so present in the 80s (Pricop & Negrea, 2018), or at least it did not occupy an area as extensive as it is today.

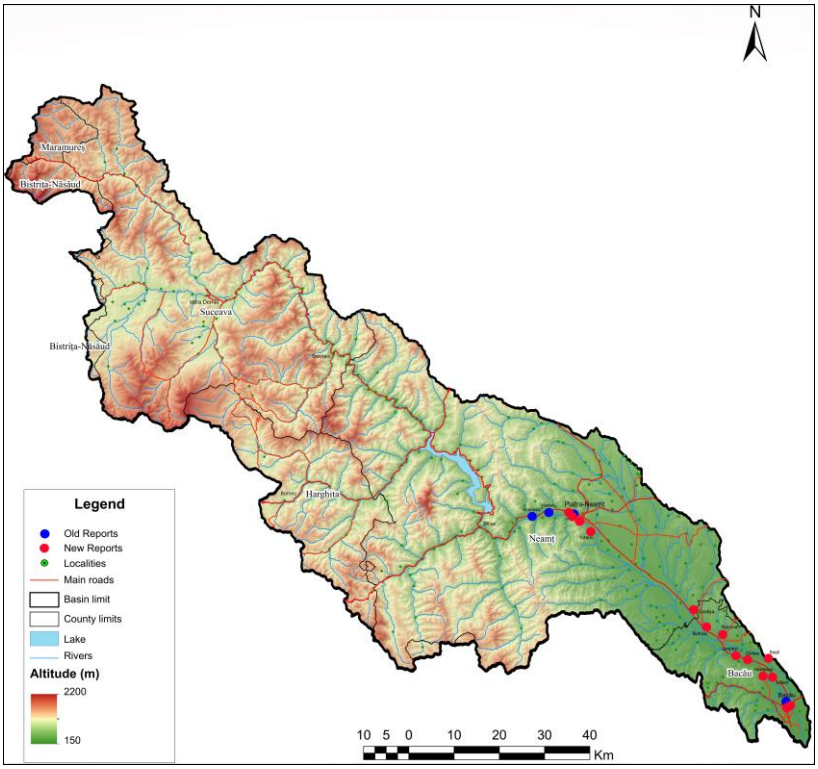


Figure. 10 Distribution of ***Elodea canadensis* Michx.** in lakes of Bistrita river basin.

CONCLUSIONS

In the present time, there are 322 nonnative plant species in Bistritei river basin. Known as allochthonous plant species; some are adventive species that are spreading across Bistrita river basin. According to our observations, the most aggressive species, which damage the natural environment, and we can name them as the most invasive species are: *Acer negundo L., Ailanthus alissima* (Miller) Swingle, *Amorpha fruticosa* L., *Ambrosia artemisiifolia* L., *Elodea canadensis* Michx., *Impatiens glandulifera* Royle, *Reynoutria japonica* Houtt. and *Robinia pseudoacacia* L.; although some measures have been taken to prevent the invasion as in the case of *Amorpha fruticosa* and *Robinia pseudoacacia* populations, cutting and cleaning the affected areas. No measure was taken in the case of *Reynoutria japonica* and *Impatiens glandulifera* because for now, these species affect only some marginal habitats and their biodiversity. If any measure is not taken in a short time these species could destroy important surfaces of riverine habitats.

Although *A. artemisiifolia* is present in the urban environment and affects human health, active measures have not been taken, with the exceptions of some mowing practices.

We observed that the invasion phenomenon is directly linked to the anthropic impact and the abundance of human activities. The collonisation is also linked with the access points, roads, and railways; because the seeds are mainly spread due to human activity there seems to be a link between the populated areas and cities with a high overdeveloped density of infrastructure (roads and railways) and these plant species. The anthropic impact factors influence directly the spread of the invasive species, correlated with the biodiversity loss due to habitat change. Because of the change in land use, intensive agriculture and chaotic rural development, deforestation, and overexploitation, the lower areas of the Bistrita river basin (downstream Poiana Largului and Bicaz city) are the most affected areas by these factors.

The non-native plant species mentioned above (Table 1) were recorded from Bacau, Neamt, Harghita, Suceava, Bistrita-Nasaud and Maramures counties in the areas of the Bistrita river basin.

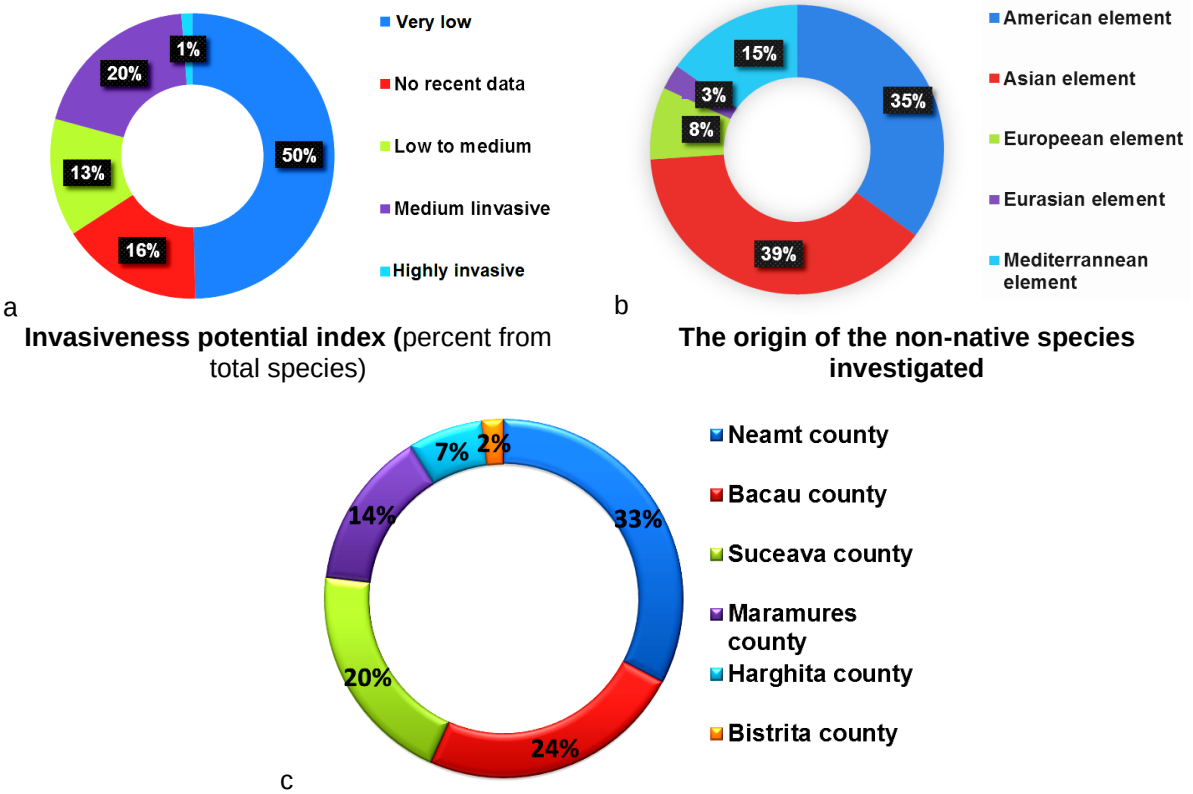


Figure. 11 Statistics: a - percentage of the invasiveness potential level from all non-native species, b - percentage of species depending on origin, c - percentage for each county from all the non-native species of Bistritei riber basin (original).

For the first time in the Romanian specialized literature, we propose an index that describes the invasiveness potential of each species; the potential for invasiveness is linked to a tendency to spread; this scaling according to the CABI Invasive Species Compendium (https://www.cabi.org/isc/) (from very low to high or very invasive) is implemented by us and is designated for each non-native species in the field according to our observations. Some statistics are presented in Figure. 11.

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Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a conflict of interest.

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