# Considerations concerning the distribution and impact of the most infamous invasive plant species from Bistrita River Basin (Neamt and Suceava Counties, Romania)

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**Abstract**. Is well known that the uncontrolled spread of invasive alien plant species is among the most urgent nature conservation issues of this century. Our aim is to study and publish a few notes linked to some observations regarding the presence, distribution and the negative impact of some invasive plant species from Bistrita river Basin. There are more than 80 adventive species of plants that are spreading in the middle basin of Bistrita River. In this paper we present new data regarding the distribution and impact of the most problematic invasive plant species. These species cause losses, economically and from the biodiversity point of view. According to our observations, in the present time, the most aggressive alien plant species, worth to be mentioned are: *Acer negundo*, *Ailanthus altissima*, *Amorpha fruticosa*, *Ambrosia artemisiifolia, Elodea canadensis, Impatiens glandulifera*, *Reynoutria japonica* (= *Fallopia japonica*), *Robinia pseudoacacia* and *Xanthium strumarium.* There are also some other species that have a more local impact. We will also mention and discussed the spread of these alien plant species.
**Key Words**: adventive plants, aggressive species, weeds, ecosystem degradation, Bistrita River Basin, Eastern Romania.

**Introduction**. In order to understand the problematic of the invasive plant species we must first refer and define them. What are the invasive plant species and most of all what are the implication of them in the local native plant ecosystems?

These invasive plant species are altering the native ecosystems, leading to habitat loss and to the replacement of native species (species diversity is decreasing dramatically as an effect of this invasion). This leads to the loss of biodiversity, at least locally, because of the competition with the native plants and sometimes rare and endangered plant species. These are alien plant species that are competing for resources (space, water, nutrients and light), suppressing the growth of native species. Regarding the literature, there are only a few studies regarding the presence and the impact of these invasive species in Bistrita River Basin. In the most recent studies, there is some relevant data that will help us to understand the invasion, biology and the negative impact of these species, althow it is very hard to estimate at least economically the real damage done to the natural environment. There are some studies that we have to mention, the most recent ones at least at national level, have been published by: Anastasiu & Negrean (2005), Dihoru (2004), Doroftei (2009a, 2009b), Oprea (2005), Pricop (2009), Sirbu & Oprea (2011). We mention also the contribution of Aoncioaie (2007), Burduja (1948), Chifu et al 1987 (1989), Dascalescu et al (1977), Manoliu et al (2002), Pantu (1911), Papp (1933), Pricop (2009), Pricop et al (2016), Sanda et al (2004), Savulescu et al (1952-1976), Ravarut (1936), Ravarut & Mititelu (1959), Burduja & Gavrilescu (1976-1977), Sirbu & Oprea (2008a, b), Mititelu (1989), Mititelu et al (1968), Mititelu & Barabas (1972), Mititelu et al (1986, 1988, 1989), Caraus (2013).

The problem of invasive plants is tricky and extremely current. At global level, it started to create big, real 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. E.g. pollen of the species *Ambrosia artemisiifolia*.

Most of them (the invasive plant species) are particularly opportunistic and "they" 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, hydrotechnical constructions, bridges, railways etc.). They may have different trophic and edaphic requirements usually associated with high climate plasticity, much different from the native species, which is the main reason why they adapt very well to the new conditions created by soil disturbance.

A special category is represented by opportunistic plants that are spread by special seed adaptations, or with the transport of fodder, some of which are found as sagittal weeds in large-scale crops of extensive agriculture. With the globalization and the often-uncontrolled movement of unprocessed commodities of plant origin, we witness an invasion of opportunistic plants that often substitutes the native flora. This invasion is accelerated because the speed at which goods are moving globally is growing, in order to meet the need for food of the growing human population; at this the human influence induced to the natural ecosystems is also added.

The woody plants (*Amorpha*, *Robinia*) eliminate native woody and grassy species, e.g. *Amorpha fruticosa* becoming a real threat to the willow meadows native to Danube Delta (Doroftei 2009a, 2009b). Many of them form plant structures that impress by abundance, dominance and massiveness (*Conium maculatum, Conyza canadensis, Reynoutria japonica*, *Impatiens glandulifera*), their impact on native species being physically observable and quantified by biomass assessments. In the case of many invasive species, the only way to stop the assault on habitats without damaging them chemically remains the physical intervention. One just has to remove them from that spot. 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 own seeds.

These alien plant species are also affecting some economically important sectors as the rural agriculture (e.g. this impact usually affect meadow and forest productivity etc.). This negative impact of these invaders leads to the economic loss due to management and control costs and due to the damage caused to the environment and also to human healt (Olsson 2006).

These invasive alien plant species are spreading out of control, especially in areas with large anthropic disturbances. A preliminary species list is under preparation - Table 1. We will mention also for each invasive species the local distribution and the effect on habitat when possible. A part of the material collected from this area of Bistrita river basin is deposited in the collection of the Natural Sciences Museum of Piatra Neamt.

**Material and Method**. The present data was collected from 2007 until present time. We studied and gathered the data mainly from Bistrita River - middle basin, the studied sector is the one from Zanesti and Piatra Neamt – Neamt County to Vatra-Dornei – Suceava County. Field observations were carried out in spring, summer and autumn but only in a few areas of Bistrita river basin. 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. To identify the material, we used the identification key's from Ciocarlan et al (2004) and Ciocarlan (2009). All images are original. This invasive plant species and the main distribution are presented in five different Figures, numerotated from 1 to 6.

We decided to work on Bistrita River Basin (Figure 1) because is one of the largest river systems from Central Carpathians – Romania, and it is an area well known by us.

Abbreviations: Adv. = adventive, Cult. = cultived, Ch = camephite, G = geophyte, H = hemicriptophite, Ph = phanerophite, Th = annual therophite, TH = biannual therophite, Subspont. = subspontaneous.

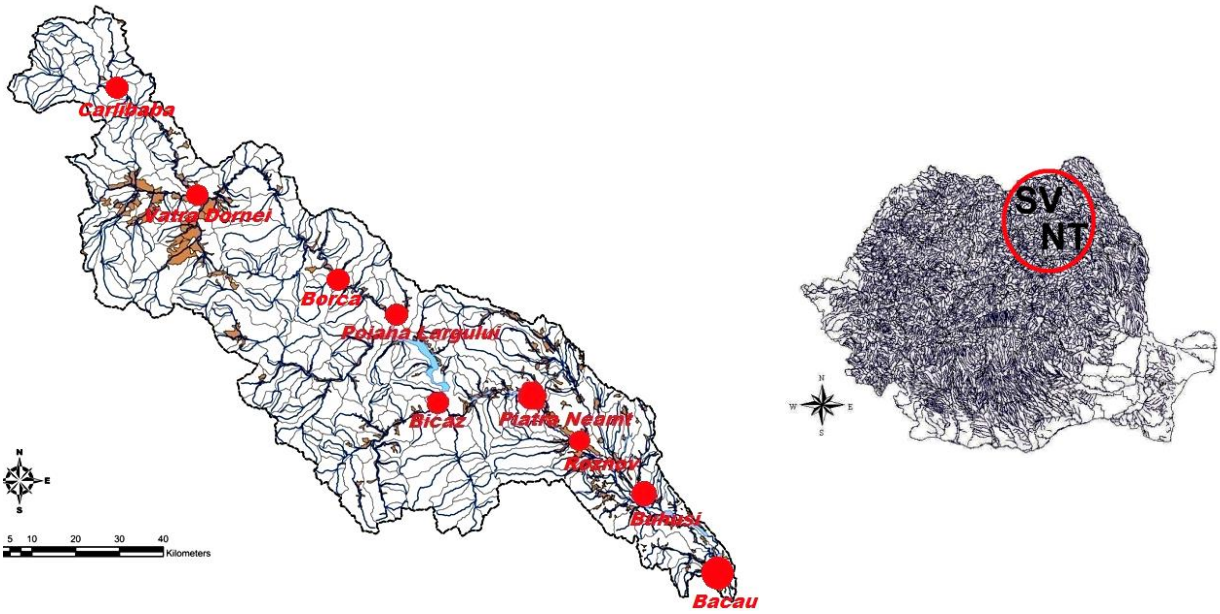



Figure 1. Maps of Bistrita River Basin with the localities (distribution of the main localities - in red), studied sector - from Vatra Dornei (SV) to Buhusi (Bacau) and Romania with the location of the two counties (SV = Suceava and NT = Neamt).

**Results and Discussion**. In the present time, there are more than 100 alien species of plants (also called adventive plants) that are spreading in the middle basin of Bistrita river. These adventive species are representing about 5% from the total number of vascular plant species recorded in the Bistrita river (middle basin) – the sector from Zanesti to Vatra Dornei. According to our observations, the most aggressive ones which damage the natural environment, and we can name them invasive species are: *Acer negundo* L., *Ailanthus altissima* (Miller) Swingle, *Amaranthus retroflexus* L., *Amorpha fruticosa* L., *Ambrosia artemisiifolia* L., *Elodea canadensis* Michx., *Erigeron canadensis* L., *Galinsoga parviflora* Cav., *Impatiens glandulifera* Royle, *Iva xanthiifolia* Nutt., *Reynoutria japonica* Houtt. (= *Fallopia japonica*), *Robinia pseudoacacia* L. and *Xanthium strumarium* L. etc.

Table 1 contains a preliminary list of the main alien, invasive plant species that grow in our region (Neamt and Suceava County).

Table 1

Adventive plant species list previously recorded from Bistrita River Basin (Neamt and Suceava Counties) – present in the spontaneous flora

| *No.* | *Species and origins* | *County* |
|---|---|---|
| | A | |
| 1 | *Abutilon theophrasti* Medik. – Southern Europe and North Africa | NT |
| 2 | *Acer negundo* L. – Ph, North America | NT+ SV |
| 3 | *Acorus calamus* L. – G(HH), America, Rare | NT+SV |
| 4 | *Ailanthus altissima* (Miller) Swingle – MM, Asia-China | NT |
| 5 | *Alcea rosea* L. (*Althaea rosea* (L.) Cav.) – T, (Medit.?) | NT |
| 6 | *Amaranthus albus* L. – T, North America | NT + SV* |
| 7 | *Amaranthus blitoides* S. Watson *var. blitoides* - T, North America | NT+ SV* |
| 8 | *Amaranthus blitum* L. – Mediteran. | NT+ SV* |

| *No.* | *Species and origins* | *County* |
|---|---|---|
| | A | |
| 9 | *Amaranthus crispus* (Lesp. *et* Thév.) N. Terracc. - T, Spor., America | NT+ SV* |
| 10 | *Amaranthus cruentus* L. (*A. sanguineus* L. pro parte, *A. paniculatum* L.) – T, Central America | NT?+ SV* |
| 11 | *Amaranthus deflexus* L. - H, South America, Sporadic. | NT+ SV* |
| 12 | *Amaranthus hybridus* L. s. str. (*A. patulus* Bertol.) – North America | NT |
| 13 | *Amaranthus hypochondriacus* L. – North America | NT+ SV* |
| 14 | *Amaranthus powellii* S. Watson *ssp. powellii* (*A. chlorostachys* Willd.) - T, North America | NT |
| 15 | *Amaranthus retroflexus* L. (*A. glabrescens* Borb.) – T, Frecv., Cosmopolit. | NT + SV |
| 16 | *Ambrosia artemisiifolia* L. (*A. elatior* L.) – T, North America | NT + SV |
| 17 | *Amorpha fruticosa* L. - Ph, North America | NT + SV* |
| 18 | *Anethum graveolens* L. – T, S-W Asia and India | NT+ SV* |
| 19 | *Antirrhinum majus* L. – T, Mediteran. | NT |
| 20 | *Armoracia lapathifolia* Usteri (*A. rusticana* Gaertn.. Mayer et Scherb) (subspont.)- H(G), Eurasia Cont. | NT+ SV |
| 21 | *Artemisia annua* L. – Ch, Central Europe | NT + SV |
| 22 | *Artemisia dracunculus* L. – Asia | NT |
| 23 | *Atriplex hortensis* L. - T, Asia | NT |
| 24 | *Aster spp.* – America and other Regions | NT |
| 25 | *Aquilegia vulgaris* L. – West an Southern Europe | NT + SV |
| | B | |
| 26 | *Bassia scoparia* (L.) A.J. Scott (*Kochia scoparia* (L.) Schrad.) – T, Adv. Asia temp. and East-Europe | NT+ SV* |
| 27 | *Bassia sieversiana* (Pallas) W.A. Weber (*Kochia sieversiana* (Pallas) C.A. Mey.) – T, Asia Centrala si Siberia | NT |
| 28 | *Barbarea vulgaris* R. Br. *ssp. vulgaris* - Ht-H, Euras. Cosmopolite. | NT |
| 29 | *Bidens frondosa* L. – T, North America; *Bidens spp.* | NT |
| 30 | *Borago officinalis* L. – Mediteran. | NT + SV* |
| 31 | *Brachyactis ciliata* (Ledeb.) Ledeb. – T, Asia | NT + SV* |
| 32 | *Brassica rapa* L. – Mediteranean. | NT + SV* |
| | C | |
| 33 | *Calendula officinalis* L. - T, Adv. Mediteran. | NT+SV |
| 34 | *Callistephus chinensis* (L.) Nees – East Asia | NT+SV* |
| 35 | *Cannabis sativa L.* – Asia | NT |
| 36 | *Centaurea cyanus* L. – Cosmopolite. | NT+SV |
| 37 | *Centaurea solstitialis* L. – Mediteran. | NT |
| 38 | *Chenopodium botrys* L. – Asia and Southern Europe, Cosmopol. | NT+ SV* |
| 39 | *Chenopodium foliosum* (Moench) Aschers. (*Blitus virgatus* L.) - (subspont.) - T., Mediteran. | NT |
| 40 | *Chenopodium schraderanum* Schult. – Est. Africa | NT*+ SV |
| 41 | *Conyza canadensis* (L.) Cronq. (*Erigeron canadensis* L.) - T, North America | NT+SV |
| 42 | *Coreopsis tinctoria* Nutt. – T, N.-America, 2n=26, (subspont.) | NT |
| 43 | *Cosmos bipennatus* L. – T, Adv. Mexico | NT+SV |
| 44 | *Cucurbita pepo* L. – T, Adv. (North and Central America | NT |
| 45 | *Cuscuta campestris* Yunck. - North America | NT+ SV* |
| | D | |
| 46 | *Datura stramonium* L. - T, North America | NT + SV* |
| 47 | *Dianthus barbatus* L. – Meridional Europe | NT* + SV |
| 48 | *Dipsacus strigosus* Willd. – Ht, Pontic. – Central Asia | NT+SV* |
| 49 | *Echinochloa crus-gali (L.) P. Beauv. (E. colona (L.) Link – Cosmopolite.* | NT |

| No. | Species and origins | County |
|---|---|---|
| | E | |
| 50 | *Echinocystis lobata* (Michx.) Torr. et A. Gray - T, N.-America | NT + SV |
| 51 | *Elaeagnus angustifolia* L. – Ph, Asia Temp. | NT+ SV* |
| 52 | *Elodea canadensis* Michx. – HH, North America | NT |
| 53 | *Elsholtzia ciliata* (Thunb.) Hyl. - T, Asia | NT + SV |
| 54 | *Epilobium ciliatum* Rafin. – North America | SV |
| 55 | *Erigeron annuus* (L.) Pers. (*Stenactis annua* (L.) Less.) - T, Ht, H, North America | NT + SV |
| 56 | *Erectites hieraciifolius* (L.) Raf. Ex DC., America | NT* + SV |
| 57 | *Erucastrum nasturtiifolium (Poir.) O.E. Schulz,* S.-Weatern Europe, Atlantic and Mediteranean | NT+ SV* |
| | F | |
| 58 | *Fallopia aubertii* (L. Henry) Holub – Ph, West China, Tibet | NT |
| | G | |
| 59 | *Galinsoga parviflora* Cav. - T, South America, now Cosmopol. | NT + SV |
| 60 | *Geranium sibiricum* L. – West Siberia | NT |
| 61 | *Galinsoga quadriradiata* Ruiz. et Pav. (syn. *Galinsoga ciliata* (Rafin.) Blake)) - T, South America | NT+ SV |
| | H | |
| 62 | *Helianthus annuus* L. - T, North America | NT + SV* |
| 63 | *Helianthus tuberosus* L. - G, North America | NT + SV |
| 64 | *Hemerocallis lilioasphodelus* L. – Eurasia, Mediteran. | NT |
| 65 | *Hyssopus officinalis* L. - Medit. | NT |
| | I | |
| 66 | *Impatiens balsamina* L. – T, Est. India | NT |
| 67 | *Impatiens balsamina* L. – T, Est. India | NT |
| 68 | *Impatiens balsamina* L. – T, Est. India | NT |
| 69 | *Impatiens glandulifera* Royle (*I. roylei* Walp.) – T, Himalaya | NT+SV |
| 70 | *Impatiens noli-tangere* L. - T, Eurasia | NT+SV |
| 71 | *Impatiens parviflora DC.* - T, Central Asia | NT |
| 72 | *Ipomoea purpurea* Roth – T, Trop. America | NT |
| 73 | *Iris X lurida* Aiton | SV |
| 74 | *Iva xanthiifolia* Nutt. (*Cyclachaena xanthifolia* (Nutt.) Fresen) - T, North America, Sporadic. | NT + SV* |
| | J | |
| 75 | *Juncus tenuis* Willd. (*J. macer* S.F. Gray) - G, North America | NT + SV |
| 76 | *Juglans regia* L. – Asia and Souhern Europe | NT + SV* |
| | L | |
| 77 | *Lactuca sativa* L. – Eurasia. | NT |
| 78 | *Lavandula angustifolia* Mill., Mediteran., NT - CCB "Stejarul" | NT |
| 79 | *Lepidium densiflorum* Schrad. – T, North America | NT+ SV* |
| 80 | *Lepidium viginicum L.* – T-Ht, North America | NT+ SV* |
| 81 | *Lilium bulbiferum* L. – cultivated, Europe. | NT+ SV* |
| 82 | *Lonicera caprifolium* L. – cultivated, Sub-Mediteran. | NT |
| 83 | *Lycium barbatum* L. – China, Subspont. | NT + SV |
| 84 | *Lycopersicon aesculentum* Miller – South America | NT+SV |
| | M | |
| 85 | *Malva verticillata* L – East Asia | NT+SV* |
| 86 | *Malus pumila* Mill. - Asia | NT+SV |
| 87 | *Matricaria suaveolens (Pursh) Rydb. (Chamomilla suaveolens (Pursh) Rydb., M. matricarioides (Less.) Porter p.p.) - Th, (N.-E. Asia, North America?* | NT+SV |
| 88 | *Medicago sativa L. & Medicago media Pers. - Asia* | NT+SV |
| 89 | *Melissa officinalis L. – Ht, Mediteran.* | NT + SV* |

| *No.* | *Species and origins* | *County* |
|---|---|---|
| | M | |
| 90 | *Morus alba* L. – Ph, China, subspont. + *Morus nigra* L - Asia | NT+ SV* |
| 91 | *Mentha X piperita* – Mediteran. | NT + SV |
| 92 | *Mentha spicata* L. (syn. *M. viridis*), Mediteran., Subspont. | NT + SV |
| | N | |
| 93 | *Nicotiana alata* Link & Otto, South America | NT (P. Nt.) |
| | O | |
| 94 | *Oenothera biennis L.* - Ht, North America | NT+ SV |
| 95 | *Oenothera erythrosepala* Borb. (*O. glazioviana* Micheli) – H, North America (subspont.) | NT+ SV* |
| 96 | *Oxalis dillenii* Jacq. (*O. corniculata* Jacq. *var. dillenii* (Jacq.) Trelease) – T, North America | NT+ SV* |
| 97 | *Oxalis stricta* L. – T, North America | NT+ SV |
| 98 | *Oxalis corniculata* L. – Southern Europe | Nt + SV* |
| | P | |
| 99 | *Panicum miliaceum* L. – NT, Central Asia - China, Subspont. | NT |
| 100 | *Papaver somniferum* L. – West Mediteran. | NT |
| 101 | *Phytolocca americana* L. – H, North America | NT |
| 102 | *Physalis alkekengi* L. – North America | NT + SV* |
| 103 | *Parthenocissus inserta* (A. Kern) Fritsch – Ph, North America | NT+ SV* |
| 104 | *Parthenocissus quinquefolia* (L.) Planch. – Ph., North America | NT |
| 105 | *Prunus armeniac* L. – Central Asia | NT |
| 106 | *Prunus cerasifera Ehrh.* – Southern Europe and Asia | NT+ SV |
| | R | |
| 107 | *Raphanus sativus* L. – Central Asia – Medititeran., and *Raphanus raphanistrum* L. – Mediteranean (NT) | NT+ SV* |
| 108 | *Reynoutria x bohemica* Chrtek et Chrtkoá (*Fallopia x bohemica* (Chrtek et Chrtkoá) J.P. Bailey) – G, E. Asia. (Centr. Europe?) | NT |
| 109 | *Reynoutria japonica* Houtt. (*Fallopia japonica* (Houtt.) Ronse Decr., *Polygonum cuspidatum* Sieb. et Zucc.) – E. Asia | NT |
| 110 | *Ribes rubrum* L. – West Europe | NT+ SV |
| 111 | *Robinia pseudoacacia* L. - Ph., North America | NT |
| 112 | *Robinia viscosia* Vent - Ph., North America | NT |
| 113 | *Rubia tinctoria* L. – Mediteran. | NT |
| 114 | *Ruta graveolens* L. – H-Ph, Mediteran. | NT |
| 115 | *Rudbeckia laciniata* L. - H, North America | NT + SV |
| 116 | *Rudbeckia hirta* L. – H, North America | NT |
| 117 | *Rumex longifolius* DC. in Lam. et DC. - Northern Europe and Russia | SV |
| 118 | *Rhus sp.* – R. tyohina L. NT- North America | NT+SV |
| | S | |
| 119 | *Salix babylonica* L. (cult.) – Ph, E. Asia | NT |
| 110 | *Salvia officinalis* L. – H, Mediteran | NT |
| 111 | *Satureja hortensis* L. - T, Mediteran. | NT |
| 112 | *Senecio vulgaris* L. - T, Eurasia, Cosmopolit. | NT |
| 113 | *Setaria italica* (L.) P. Beauv. – T, West Asia | NT |
| 114 | *Sinapis alba* L. – Mediteran. | SV |
| 115 | *Silybum marianum* (L.) Gaertn. - Mediteran. | NT |
| 116 | *Sisymbrium irio* L. – T-Ht, Mediteran. | NT |
| 117 | *Sisyrinchium montanum* Greene - North America | NT + SV |
| 118 | *Solidago canadensis* L. – H, North America | NT + SV |
| 119 | *Sorghum halepense* (L.) Pers., Mediteran. | NT + SV* |
| | T | |
| 120 | *Tanacetum parthenicum* (L.) Sch. Bip. (*Chrysanthemum parthenicum* (L.) Bernh. non (Lam.) Gaterau) – H, E. Mediteran. | NT + SV |
| 121 | *Tagetes patula* L. – T, Mexico | NT |

| No. | *Species and origins* | County |
|---|---|---|
| | T | |
| 122 | *Thladianta dubia* Bunge - North of China | NT + SV |
| 123 | *Thymus vulgaris* L. – Mediteran. | NT |
| 124 | *Triticum aestivum* L. - almost cosmopolite, cultivated | NT |
| 125 | *Trifolium hybridum L.* – Atlantic and Mediteranean | NT + SV* |
| | V | |
| 126 | *Vallisneria spiralis* L. - Hd, Tropical America | NT |
| 127 | *Veronica persica* Poir. - T, S. West Asia | NT+ SV |
| 128 | *Vicia sativa* L. - Mediteranean | NT+ SV |
| | X | |
| 129 | *Xanthium orientale* L. *subsp. italicum* (Moretti) Greuter (*X. italicum* Moretti) – T, North and South America (Adv. in Europe) | NT |
| 130 | *Xanthium spinosum* L. - T, South America, Cosmopol. | NT |
| 131 | *Xanthium strumarium* L. - T, Eurasia, Cosmopol. | NT + SV |
| | Z | |
| 132 | *Zinnia elegans* Jacq. – Mexico, cultivated and subsp. in Europe | NT |

*Species noted with "*" are recorded only at county level (NT = Neamt; SV = Suceava).

This 132 adventive plant species (Table 1) are representing about 5% from all the plant species (over 2000 vascular plant species are recorded from Bistrita River Basin (Neamt and Suceava Counties)). These adventive species, the largest part, more than 50% have an American origin.

Beside these 132-adventive species from the list above, there are a few adventive species that are present in this region but are not recorded from Bistrita River Basin as sub-spontaneous or spontaneous species: *Alopecurus myosuroides* Huds. – NT; *Linaria cymbalaria* (L.) Mill. - NT; *Mentha suaveolens* Ehrh. - NT; *Lolium multiflorum* Lam. - NT + SV; *Dracocephalum moldavica* L. – NT + SV; *Apium graveolens* L. (commonly cultivated in this region - NT + SV); *Euphorbia marginata* – SV but not in Bistrita River Basin; *Polygonum orientale* – NT; *Asclepias syriaca* L. cultivated in Piatra Neamt (NT); *Nicandra physalodes* (L.) Gaertn. – Roman (NT); *Oenothera parviflora* L. - SV.; *Linum usitatissimus* L. SV + NT (Tasca - cultivated in the recent past); *Tuja orientalis* L. and *T. occidentalis* L. – species cultivated in NT and SV; *Pinus banksiana* Lamb. - SV; *Pinus strobus* L. – cultivated in NT; *Pseudotsuga menziesii* (Mirb.) Franco - SV; *Mahonia aquifolium* (Pursh) Nutt. – cultivated in Piatra Neamt (NT); *Eschscholzia californica* Cham. – cultivated in Neamt; *Platanus X acerifolia* (Aiton) Willd. – cultivated in NT; *Celtis spp.* – cultivated in this region; *Oxybaphus nyctagineus* (Michx.) Sweet – mentioned from this region; *Dianthus barbatus* L. cultivated for the ornamental value - NT and SV; *Amaranthus graecizans* L. – SV; *Spiraea spp.* - NT and SV; *Cerasus vulgaris* Mill.; *Gleditsia triacanthos* L. - NT; *Cytisus scilarius* (L.) Link. - NT; *Lupinus spp.* - NT and SV; *Caragana arborescens* Lam. - SV; *Pisum sativum* L. - NT and SV; *Trifolium incarnatum* L. – recorded from this region; *Hibiscus syriacus* L. – cultivated in NT*; Malva moschata L.* - SV; *Camelina sativa* (L.) Crantz - NT; *Populus x canadensis* Moench - NT; *Sicyos angulatus* L. – SV; *Cyclamen purpurascens* Mill - SV.

The species of *Rhus* spp. are cultivated but until the present time we did not observe any naturalization of this species, the impact is considered to be low.

*Rumex alpinus* L. - a local invader, is spreading and affects the pastures of the mountain area - Tasca, Neagra, Bicazul Ardelean, Buhalnita - Hangu, Borca, Farcasa, Rarau; this species is present in the area of the sheepfolds and sheepfold fields in the entire Carpathian area. In the studied areas it occupies large ha's in areas where they are or have been sheepfolds and sheepfold fields. This species has a pronounced nitrofilous character. It is thus found in overburdened areas or high nitrogen values due to manure accumulated over time. These factors make this species radically alter the pastures it installs on, growing to over 1 m high and shading, eliminating the species that originally constituted the phytocoenosis of the pasture. We will treat this species extensively in a future material because the damage and the surfaces it is widespread in the Carpathian Mountains are particularly high. *Mentha spicata* L. (= *M. viridis*) – is spreading in

Tarancuta-Piatra Neamt, in ruderal sunny areas. *Xanthium italicum* and *X. strumarium,* both species are present in this region of NT and SV.

*Oenothera glazioviana* Micheli (= *O. erythrosepala*) it is present on the mountain streams banks, ex. on the banks of the river Bicaz (Tasca) and in Chiril (Rarau), but also Piatra Neamt (Tarancuta area and near Bistrita River); the individuals are rare, dispersed from place to place; they do not form compact communities.

*Bidens spp.* in the Borzogheanu stream area and near the Bistrita River, in humid areas, competes with the other ruderal species.

**Distribution and notes with regards to the most invasive plant species of Bistrita river basin, with new/or recent records:**

**I. Fam. Polygonaceae**
**Reynoutria Houtt.**

**I.1. *Reynoutria japonica* Houtt. -** Figure 2 (syn. *Fallopia japonica* (Houtt.) Ronse Decr., *Polygonum cuspidatum* Sieb. et Zucc.) - G, Origin - East Asia, 2n=44, 88, P, (subspont.); Distribution in Neamt county: Lunca Bistricioarei (Zanoschi 1971; Zanoschi 1977), Piatra Neamt (Mititelu et al 1968), Bicaz Chei (Stefan & Mititelu 1980), Ceahlau Mountain (Mititelu, 1989), near the main road in Cheile Bicazului (Mititelu & Nechita 1992; Nechita 2003); Galu, Lungeni, Sabasa (Sirbu & Oprea 2008a, 2008b); Petru Voda, Sabasa (Sirbu & Oprea 2008b; Oprea & Sirbu 2009); distrib. in SV county: Brosteni, Cotargasi, Holda (Sirbu & Oprea 2008a), Vatra Dornei (Sirbu & Oprea 2011).

**Recent records**: Piatra Neamt – in the center of the city, Precista and near Bistrita river bank, Hamzoaia-Tasca, Agarcia-Alexandru cel Bun (Neamt county); Dorna Arini – Ortoaia river bank, Chiril, Crucea (Suceava county).

*R. japonica* is one of the species that is doing a lot of damage to the natural environemnet, the riveran ecosystems of this area are threatened, populations of this species are continuously extending from the main rivers to the smaller streams, reproducing mainly vegetatively. In present, the species populations are growing out of control and are occupying the main river banks and the lower beds of some streams. This species has the tendancy to spread not only on the main river banks but also on the tributaries.

According to our observations, *R. japonica* - once installed, gradually substitutes the ruderal plant species of native plants (like *Artemisia* spp*.*, *Carduus* spp*.*, *Cirsium* spp*.*), The only species that putt resistance and effectively resist in the area studied by us were *Salix* spp*.*: *Salix fragilis*, *Salix alba*, *Salix capraea* and *Alnus incana, Alnus glutinosa*.

Regarding the hybrid species *Reynoutria x bohemica* Chrtek et Chrtkoá (*Fallopia x bohemica* (Chrtek et Chrtkoá) J.P. Bailey) – G, East Asia (hibrid C Eur.?), 2n=66: recorded earlier from Galu, Potoci, Bicaz, Piatra Neamt (Oprea & Sirbu 2009), we mention that we did find this hybrid species in our area of study but seems to be rare in Neamt and Suceava counties (the only localities are the ones from Tasca - Neamt County and the Red Lake area – Harghita county). As regarding our main material, in the case of *R. japonica* the leaves are relatively small and without a cordated base (the leaf-base is trucated) and without hair on the lower face of leaf-vains, characters that are typical for *R. japonica*.

We have observed the invasion of *R. japonica* in Bicaz river valley, this species was mentioned at first from Bicaz Chei (Stefan & Mititelu 1980) and from Cheile Bicazului (Mititelu & Nechita 1992; Nechita 2003), so for Hamzoaia-Tasca locality we presume that this invader migrated here from north-west, but also this species was cultivated for ornamental purposes. In Tasca the invasion started with the year 2010 and continues to spread on small streams and rivers as Bicaz River and on the side of the roads. As for the installation and proliferation factors of *R. japonica* in Hamzoaia (Tasca), we considered the main factor - the soil disturbance produced in the period 2009-2014, the perioud of the road construction in Hamzoaia (Tasca), the antropic disturbance practically favored this invader.

Sirbu & Oprea (2008a) mentioned and recorded *Reynoutria x bohemica* Chrtek & Chrtková from Romania, but it seems to be not so common.



*Reynoutria japonica* populations from Hamzoaia (Tasca) – invaded extended areas from Bicaz River bank, from 2013 up to 2015 because of soil disturbance produced as a consequence of a road construction

*R. japonica* near Crucea locality – upper Bistrita River area

Typical leaves of *R. japonica*

*R. x bohemica* near the Red Lake - Harghita

Figure 2. The infamous species *Reynoutria japonica*, an invader from Japon, observed by us in different areas of Neamt and Suceava Counties*, R. japonica* and *R. x bohemica* colonizes rapidly newer areas, eliminating its competitors, only *Salix sp*. and *Alnus sp*. resist to this impact (original).

**II. Fam. Fabaceae**
***Amorpha* L.**

**II.1. *Amorpha fruticosa* L.** - in Figsure 3, Ph, Adv. (North America), 2n=40, $U_3T_4R_0$: Piatra Neamt (Grecescu 1898), Pangarati (Nechita 1995; Oprea & Sirbu 2009), Vaduri, Bistrita, Cuejdi (Sirbu & Oprea 2008b; Oprea & Sirbu 2009); Bicaz – train station (Sirbu & Oprea (2011).

**Recent records**: Bistrita river Valey, Sarata - Piatra Neamt, Agarcia, Alexandru cel Bun, Dumbrava, Savinesti and Roznov, Poiana Largului si Poiana Teiului (initially planted in the Izvoru Muntelui lake area, to prevent soil erosions and land slides).

This species is present near lakes, railways and some roads from Piatra Neamt to Bicaz. *A. fruticosa* is very adaptable but depends on wather (it roots can grow up to 3 m-reaching the acviferous). It grows on the concrete craks from Batca Doamnei dam, producing the dislocation of the concrete slabs. Despite the effort to cut and wipe this species off, the plants are still proliferating (due to the root system); this plants are resistant (plants are viable) up to a few weeks after are pulled out of the ground with roots and all. In the proper conditions, being dependent on wather, this species is colonizing large areas. After being cut, new shots are groing from the roots, (new stalks grow rapidly in the same year were cut and bloom much later than uncut plants). There are species that resist and are associated with *A. fruticosa*, here we mention *Aristolochia clematitis, Lythrum salicaria, Matricaria recutita, Artemisia absinthium* and other plant species as *Hordeum murinum*.

***Robinia* L.**

**II.2. *Robinia pseudoacacia* L.** - in Figure 3, Ph., Adv., 2n=20, 22, $U_{2,5}T_4R_0$: Viisoara (Bistrita), Piatra Neamt (Doamna), Dumbrava Rosie (Cut) (Mititelu et al 1987), Vaile – Bagda stream, Frasinel (Mititelu & Mancas 1987), Buhalnita (Zamfirescu 2007), Buhalnita hill (Daraban 2007); Galu, Garcina, Holdita, Horaita (Sirbu & Oprea 2008b); Piatra Neamt (Mititelu et al 1986; Oprea & Sirbu 2009), Ticos, Neagra, Tasca, Bicaz (Oprea & Sirbu 2009); Piatra Neamt (Precista, Carlomanu and Cozla) (Pricop 2009); Ticos, Tasca, Bicazu Ardelean, Bicaz Chei, Bornis, Garcina, Neagra, Pluton, Tetcani, Ticos-Floarea.

**Recent records**: Doamna-Piatra Neamt, Agarcia – Alexandru Cel Bun, Hamzoaia (Tasca), Bicaz, Tarcau-Cazaci, Secu-Vaduri, Girov, Dumbrava Rosie, Savinesti, Roznov, Balanu, Zanesti, Traian, Podoleni but also Ceahlau, Galu, Borca, Farcasa, Poiana Largului and Poiana Teiului, Brosteni, Crucea, Dorna - Arini. In SV – *R. pseudoacacia* is frequent (Chifu et al 2006), e.g. – Vatra Dornei – cultivated and subspont.

*Robinia 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.

Nowadays *R. pseudoacacia* populations are being cut and cleaned out from some areas of the urban environment from Piatra Neamt (city area) and from the areas near the railways (areas administred by the CFR) and a few areas near lakes and rivers of Neamt County.

Althow the populations of this species are overspreading 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), but still the species is predominant in some specific urban and rural areas. *R. pseudacacia* was cultivated in part also because of the meliferous proprieties and also for the root system - mainly to prevent the soil erosion and land slides, but also to prevent the formation of sand dunes.

In the communist era the species was extensevly cultivated on some deforested areas from lower altitudes (200-700 m elevation).

**III. Fam. Simaroubaceae**

***Ailanthus* Desf.**

**III.1. *Ailanthus altissima* (Miller) Swingle** – in Figure 3, MM, Adv., $U_0T_0R_0$: Hasmas (Mititelu & Nechita 1992; Nechita 2003), Telecu Mare (Nechita 2003), Piatra Neamt (Sirbu & Oprea 2008b; Oprea & Sirbu 2009).

**Recent records**: 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. The species prefers the sunny and dry areas of Piatra Neamt - at the foot of the Cozla hill, but also the areas from lower elevation, from 200 up to 400 m altitude. This species is predominant and growing in sunny areas, in arid areas at lower altitudes from Neamt county – urban and rural environment with high antropic impact. The aridisation of this areas, and the climate change (the global warming) are linked factors that influence the spread and propagation of *A. altissima*; these factors are also linked with the higher temperatures and a higher insolation observed at lower altitudes in Neamt County (270 – 350 m elev., in the sowth–east part of Neamt County).

**IV. Fam. Aceraceae**

***Acer* L.**

**IV.1. *Acer negundo* L.** - in Figure 3, Ph, Adv., North America, 2n=26 - Dealul Frasinului, Potoci, Ruginesti, Buhalnita (Zamfirescu, 2007), Bicaz, Piatra Neamt (incl. on Cozla hill), Buhalnita (Daraban 2007), Garcina (Sirbu & Oprea 2008b; Oprea & Sirbu 2009), Piatra Neamt, Horaita (Sirbu & Oprea 2008b), Piatra Neamt (Carlomanu hill area) (Pricop 2009), Ticos, Tasca, Neagra, Pluton, Ticos-Floarea; SV – Vatra Dornei and Brosteni.

**Recent records**: below 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.

*Amorpha fruticosa* from different areas of Piatra Neamt and Alexandru cel Bun, colonizing the habitats with high humidity near Batca-Doamnei and Vaduri lakes

*Acer negundo* and *Amorpha* near the railway from Sarata-NT

*Acer negundo* on Cuiejdi river bank

*Amorpha fruticosa* between the concrete slabs - Batca D-nei. dam

*Robinia pseudoacacia* - very common in Neamt county

*Ailanthus altissima* dispersed in Piatra Neamt – near the center of the city and in Roznov – central park area

Figure 3. Different invasive shrubs and trees (woody plants) which are very common in some areas of Bistrita River Basin, near roads, including railways, cities and near lakes (original).

*A. negundo* it 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. *Acer negundo* populations on Cuiejdi river bank are extending. This species is present also in the lower and middle basin of Bistrita River, from Brosteni and Borca – downstream Bistrita River.

**V. Fam. Balsaminaceae**

***Impatiens* L.**

**V.1. *Impatiens glandulifera* Royle** (*I. roylei* Walp.) – Figure 4, Th, Himalaya, 2n=18, 20, $U_4T_4R_4$: From NT: Roznov (Mititelu et al 1987); Bicaz (Oprea 2005); Fagului-Lungeni river area, Bistrita, Pingarati river valley (Sirbu & Oprea 2008b), Bicaz (Oprea 2005; Oprea & Sirbu 2009), Tasca, Bistrita, Manastirea Bistrita, Pangarati (Sirbu & Oprea 2008b; Oprea & Sirbu 2009); Savinesti, Pintec, Piatra Neamt, Madei, Garcina, Manastirea Bistrita, Bicaz Chei.

**Recent records**: From NT: Bicaz; from SV: Bistrita river valley - Dorna Arini, Rusca, Sunatori, Calinesti, Chiril, Satu Mare, Cojoci, Satu Mare, Crucea, Holda, Brosteni, Sabasa, Farcasa.

Rapid installation and development of a Himalayan balsam population on some disturbed soil from Calinesti and Dorna-Arini

Flower frequented by pollinators

Populations of *I. glandulifera* installed near Crucea and Chiril, upper Bistrita River Basin – Suceava county

*Impatiens noli-tangere* from Dorna-Arini

Figure 4. *Impatiens glandulifera* near Bistritei river bank, newly recorded populations from Dorna Arini and Crucea, Chiril that are rapidly extending and colonizing new areas; this Himalayan balsam most probably migrated to this region from North, from Maramures County (original).

Beside *I. glandulifera* we observed the presence also of *Impatiens noli-tangere* L. - T, Euras., 2n=20, 40, DP, $U_4T_3R_4$: From NT: Doamna, Gosman Mountains-Tarcau, Agarcia – Alexandru cel Bun, Valeni-Piatra Neamt; From SV: Dorna Arini, Vatra-Dornei, Iacobeni, Ciocanesti, Cirlibaba.

*I. glandulifera* is one of the most dangerous invaders along with *R. japonica* modifying native-riparian communities of plants; the main impact is near rivers.

*Impatiens noli-tangere* is present in the partially deforested areas (clearing of forests) or at the edge of the forest roads of Agarcia-Alexandru cel Bun, Doamna, Valeni (Piatra Neamt) and Dorna Arini. The species has been installed in some forest habitats and at the edges of roads also due to anthropogenic impact, it eliminates valuable native plant communities with plant species as *Mycelis muralis. I. glandulifera* is frequented and preferred by many species of pollinators, we mention here the species of *Bombus spp.*: *Bombus lapidarius, B. hypnorum, B. lucorum, B. pratorum* and *B. mastrucatus*, species that are collecting the polen of this plant (observations from the upper Bistrita River Basin – Vatra Dornei area, Dorna Arini, Ortoaia, Chiril-Rarau area, up to Crucea - SV).

**VI. Fam. Asteraceae**
***Ambrosia* L.**

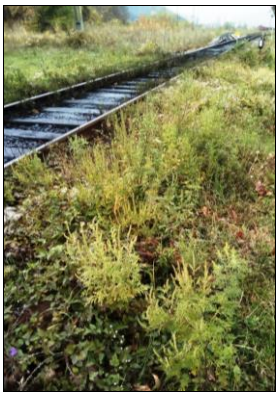
**VI.1. *Ambrosia artemisiifolia* L.** (*A. elatior* L.) – Figure 5, T, Adv. (Amer. N), 2n=36, $U_2T_0R_0$: From NT: Piatra Neamt, Vaduri, Bicaz, Pangarati, Bistrita, Garcina (Sirbu & Oprea 2008b; Oprea & Sirbu 2009); Ticos Floarea; From SV: Vatra Dornei.

**Recent Records**: Bicazu Ardelean,Ticos-Neagra, Tasca, Tarcau, Straja, Stejaru, Alexandru cel Bun, Piatra Neamt (the train station areas and the railways), Dumbrava Rosie, Savinesti, Roznov, Zanesti, Podoleni and near Buhusi-Bacau. Ambrosia is distributed in the study area along the railways. It appears rarely on the road-sides.

Topa & Boscaiu (1965) regarded *A. artemisiifolia* as a dangerous adventive plant species.

As observed by us, in the area of Moldova, the main way of propagating the species *A. artemisiifolia* was the railways, and we found her frecvently in ruderal areas of the large railway stations. We have not encountered frecvently this species on the side of the roads, but only in very rare cases. This species is not able to grow well in these new locations from the Bistrita River Basin (it can reach only 50-60 cm in height), while in cities such as Iasi and Bucharest (much warmer in the summer time), the plants of *Ambrosia* can reach over a meter in height. So, we can conlude that the species has a termophilous character and has reached a climathical barrier in her expansion. Different weeds resist the presence of *A. artemisiifolia*, here we mention *Tanacetum vulgare* (*Chrysanthemum tanacetifolium*), *Xanthium italicum*, *Melilotus flavus*, *Lycopus exaltatus, Arctium lapa, Artemisia absinthium, Erygeron canadense*, *Daucus carota* etc.

*A. artemisiifolia* in Tasca - Neamt County



*A. artemisiifolia* in october near the train station of Piatra Neamt and on the railway of Zanesti-Neamt County

Figure 5. The infamous invader *Ambrosia artemisiifolia* observed in different localities, form Tasca up to Zanesti and Buhusi; this species is distributed mainly across the railways, near and abundantly in the train stations (original).

Observations on the morphology: in lower (lowland) and hotter areas of Romania, as we observed in Bucharest, the plants of *A. artemisiifolia* are well developed reaching up to 1.3-1.4 m in hight (that is in September), but in our area of stuy the plants are reaching only 60 to 70 cm in hight (at full maturation of seeds - in October), in fact this is caused

by the vegetation perioud that is shorter and because of the mean temperatures that are lower, in contrast with the area of origin of this species - North America. It is rather curious that *A. artemisiifolia* in our area of study (Bistrita River Basin) is rather distributed along the railways in contrast with other areas at low altitudes where it has a rather ruderal presence, along the sides of the roads.

**VII. Fam. Hydrocharitaceae**
***Elodea* Michx.**

**VII.1. *Elodea canadensis* Michx**. – Figure 6, HH, Adv. (Amer. de N), 2n=24, 48, $U_6T_{3,5}R_0$: Piatra Neamt - in the lake near Batca Doamnei, Pangaracior river (Sirbu & Oprea 2008b); Pangarati and Vaduri lakes (Pricop 2009); Recent records: Reconstructia lake from Piatra Neamt, Alexandru cel Bun – Agarcia canal, Doamna - Batca Doamnei lake, Valeni, Savinesti-Zanesti. It is a species with a high impact on the aquatic ecosystems, and is progresivley increasing its areal, colonizing lakes and sometimes ponds (stagnand bodies of wather in general) but also canals.

Caraus (2013) mentioned the presence of *Elodea nuttallii* in the artificial lakes from Bistrita River valley, but we did not find this species in our area of study.

*Elodea canadensis* is present in this region, mostly on the lakes of Bistrita River (Pangarati, Vaduri, Batca Doamnei, Reconstructia dam) - basically downstream of the Izvorul Muntelui - Bicaz lake. The species has greatly multiplied occupy large areas. On Batca Doamnei-Piatra Neamt lake it occupies almost 60 to 70% of the surface of the stagnant water. Due to this "blooming" we have noticed the negative phenomena of fish mortality. This is caused by the increased temperature and the low concentration in oxygen during the summer months (from May until September). The remaining oxygen low as it is, is consumed by this species in the respiratory processes. The species was not so present in the 70s and 80s, or at least it not occupied an area as extensive as it is today.

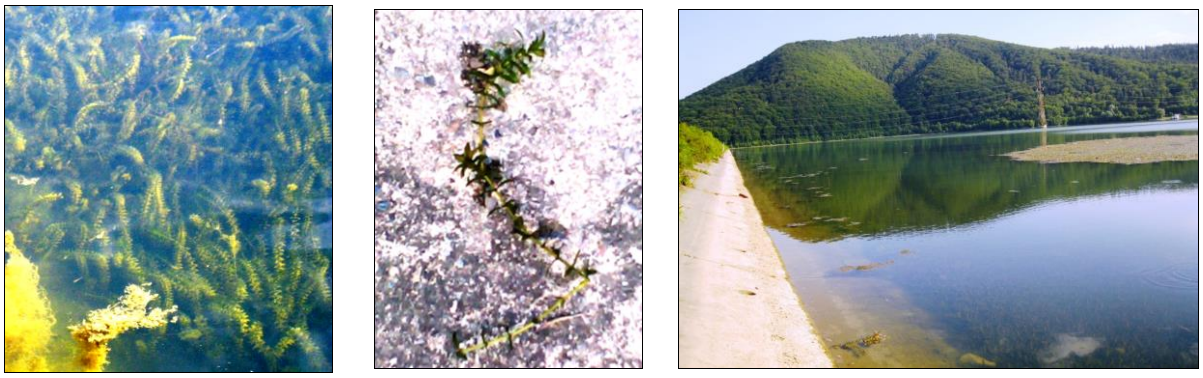


Figure 6. *Elodea canadensis* an aquatic invader and its habitat in Batca-Doamnei lake representing a profunndelly altered semi-natural ecosystem; *E. canadensis* is present and distributed across Bistrita River, beginning from Bacau and up to Pingarati lake (including), but not in Izvoru Muntelui Lake (original).

There are also species of aquatic plants such as *Myriophyllum spicatum* L., *Potamogeton* spp. (*P. pectinatus*, *P. crispus, P. lucens* and *P. natans*), *Ceratophyllum demersum*, *Ranunculus* spp., *Alisma plantago-aquatica* and *A. lanceolata*. Species which resist in these invaded areas and also the algae of different genera (*Spirogyra*, *Cladophora* and *Zygnema*).

**Conclusions**. In the present time, there are about 132 subspontanous alien, known as adventive plant species that are spreading across Bistrita Riber Basin, from the most problematic ones, we mention: *A. fruticosa, R. japonica*, *I. glandulifera*, *A. artemisiifolia, A. negundo*, *R. pseudoacacia* and *E. canadensis*; in spite of the fact that some measures have been taken to prevent the invasion as in the case of *A. fruticosa* and *R. pseudoacacia* populations (cutting and cleaning the affected areas), the invasion of the

most harmfull species: *R. japonica* and *I. glandulifera* are neglected because do not damage the infrastructure (roads, railways systems or dams) and the urban areas.

*A. artemisiifolia* is present in the urban environment and affects the human health, active measures have not been taken, with the exceptions of some mowing practices, measures supported by the legislation. We observed that the invasion phenomen is directly linked to the anthropic impact and the abundance of human activities. There seems to be a link between the overpopulated areas and cities with a high overdeveloped density of infrastructure (roads and railways) and the invaders. These factors (the anthropic impact factors) influence directlly the spread of the invasive species, correlated with the biodiversity loss (observable facts). Because of the land use, intensive agriculture and chaotic rural development, deforestation and land overexploitation (intensive human activities) - the lower areas of Bistrita River Basin are the most affected areas by these factors.

In the region of Bistrita River Basin (and some extralimital areas) we mention that, almost all of these 132 adventive plant species mentioned were recorded in Neamt County (with the exception of one species of *Rumex* found only in Suceava County). Only 80 of these species were recorded also from Suceava County (Table 1).

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