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UPDATED LIST OF NON-NATIVE ORNAMENTAL PLANTS IN ROMANIA

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Abstract: The first list of non-native ornamental plants (nNOP) reported as escaped, naturalised or invasive in Romania was published 15 years ago. Since then, new additions to the non-native ornamental flora of Romania have been reported, while others plants have changed their status. As ornamental horticulture is one of the most important pathways for non-native plant introduction worldwide, we evaluated nNOP at the national level and updated the previous list in order to contribute to the development of tools for preventing, detecting, monitoring and managing the spread of nNOP. The updated list includes 264 taxa. Most of these are casual (199 taxa), 37 taxa are naturalised, and 28 taxa are invasive. In addition, the following characteristics were analysed: family, native range, life form, abundance in the country reported as number of localities and temporal trends. Non-native ornamental flora of Romania is dominated by American and Asian taxa, phanerophytes, hemicryptophytes and therophytes. The most widespread species is *Robinia pseudoacacia*, used not only for ornamental purposes, but also for its economic value. Many taxa (108 taxa) occur only in two to ten localities. 78 nNOP have been reported in the last 20 years. Six taxa are species of European Union concern (*Ailanthus altissima*, *Asclepias syriaca*, *Cabomba caroliniana*, *Humulopsis scandens*, *Impatiens glandulifera*, *Myriophyllum aquaticum*) and require special measures to control and mitigate their populations.

Keywords: alien, casual, decorative plants, geographical origin, invasive plants, life form, naturalized, residence time, Romania.

Introduction

There is strong evidence that ornamental horticulture is a major contributor to plant invasions worldwide [12, 52, 25, 21]. Studies conducted in other countries estimate that half of alien naturalized plant species were introduced intentionally, especially being grown for ornamental purposes [11, 29, 39]. There are easy ways to introduce new plants, especially the e-commerce that allows anyone to order plants from various parts of the world [28, 26]. But once introduced, some of them escape from botanical gardens, public areas or private gardens, become naturalized and compete with native plants [43, 14, 25, 52, 22].

It is well known that many characteristics of ornamental plants are responsible for their successful invasiveness [9], and some studies show the most prominent: native range, ease of propagation, a long flowering period, winter hardiness, adaptability to different habitat types, etc. [41, 53, 30, 52]. The taxonomic classification of ornamental plants can also be an indicator of their invasivenes [24].

Despite these characteristics, many people buy and cultivate ornamental plants without

knowing their invasive potential and which species should be avoided for cultivation in different regions [43].

The knowledge of the specific richness and diversity of ornamental alien plants from different regions is a precursor to making predictions about their likely impact [52]. Marking alien ornamental plants in lists is a well-known method for the buying public or stakeholders to be aware of the danger of introducing them into non-native areas and also for any risk assessment [43]. In particular, horticulture professionals and gardeners need to be better informed about the harmfulness of some ornamental plants through available and quality scientific data [23]. Also, using a list of alien ornamental plants together with their characteristics, allows stakeholders to draw up the best monitoring and regulatory measures to reduce their invasion [22]. The discovery that an ornamental plant initially introduced has become invasive over time, also leads to the need to update legislation in order to regulate the import or cultivation conditions [25].

In Romania, Anastasiu et al. [1] published a list of 93 ornamental alien taxa and some of their characteristics, recommending to be careful when alien plants are introduced for ornamental purposes due to the potential of some of them to expand and compete with native species. Fifteen years after the elaboration of this list, the situation in Romania has changed and other new ornamental plants have been listed or reported either in botanical gardens [34, 49, 35], or in urban spaces and private courtyards [47, 4, 48, 33, 8].

Some plants introduced for ornamental and horticultural purposes have caused serious problems in recent years. The best examples are *Reynoutria japonica*, *Echinocystis lobata* and *Helianthus tuberosus*, which escape from cultivation and become abundant, causing severe damage to native vegetation [15, 16]. None of these were included in the list of Anastasiu et al. [1].

This paper is intended to be an update to the list of alien ornamental plants present in Romanian flora given by Anastasiu et al. [1] and to analyse some characteristics that may play an important role in their invasion. In particular, attributes such as the botanical family, the native range, the life form, the invasive status in Romania, the frequency in Romanian localities and preferred habitat type are presented and discussed.

Because most of these plants are still planted in private gardens and public areas in our country, this list can contribute to the evaluation and development of tools for preventing, detecting, monitoring and managing the spread of non-native ornamental plants, and also for adoption of legal regulations for the horticultural industry with a low risk of plant invasion. Also, this list can be used to raise public awareness and build partnerships with stakeholders.

Material and Methods

The analyses performed for this paper considered a total of 362 non-native plant species introduced and used for their horticultural or other ornamental value (nNOP) [5, 6, 8, 20, 32, 33, 34, 35, 46, 47, 48, 49]. Taxa not reported in the last 50 years were evaluated as vanished and they were excluded from the updated list. The list was completed with taxa reported in the most recent scientific papers dedicated to the flora of botanical gardens [34, 49, 35], as well as for alien species in general, reported from the national territory [4, 33, 32].

Both, archaeophytes (aliens introduced before 1500 AD) and neophytes [40] were considered in the analyses.

The nomenclature and systematic classification in this study is according to GBIF (Global

Biodiversity Information Facility, accessed in October and November 2020) [19]. The terminology regarding the invasive status of taxa followed the classification rules recommended by Richardson et al. [44] and Pyšek et al. [40]. The classification for the life forms categories is according to Raunkiær [42].

To reveal the structure of non-native ornamental flora from Romania, the following attributes were analysed: family name, native range, life form, invasive status, number of localities from where taxa were reported, type of habitat, the presence in the previous list of naturalized and invasive ornamental plants [1], the year of the first report of the species on Romanian territory.

To establish from where the reported non-native species came, we considered both continents and geographical regions. This analysis is all the more important as it highlights the most important contributers of non-native species.

Expressing users' preferences for ornamental species, the spectrum of life forms was analysed. In addition, the invasiveness status was highlighted by identifying the species belonging to three categories, depending on the escape capacities, penetration into new territories, reproduction, installation, naturalisation, and invasion of new habitats.

To give an overview on the occurrence of the species at national level and to highlight the most widespread of them, we analysed the distribution of each taxon by the number of localities from where it was mentioned. Comparing the available data, we set a scale starting with species reported from a single locality and ending with the species mentioned in most localities. Moreover, a detailed analysis was performed and thus resulted a scale with seven classes: **1** – one locality, **2** – two to ten localities, **3** – 11 to 50 localities, **4** – 51 to 100 localities, **5** – 101 to 500 localities, **6** – 501 to 1000 localities, **7** – over 1000 localities.

The classification according to the habitats in which the species are present is completed in accordance with the synthesis work of Sîrbu & Oprea [46].

To illustrate the temporal trend of non-native species over time, we used a time scale based on the years in which each taxon was reported, the starting point being the first reporting in the literature, respectively the year 1779 [46].

Data regarding the status in European Union and the level of impact are according to EASIN Catalogue [18].

Results

The update list of the non-native plants introduced or used as ornamentals in Romania includes 264 species and subspecies (Table 1). These belong to 80 families. The most important are Asteraceae (33 taxa – 12.5%), Fabaceae (18 taxa – 6.81%), Rosaceae (15 taxa – 5.68%), Solanaceae (10 taxa – 3.78%), and Lamiaceae (8 taxa – 3.03%) (Fig. 1). A total of 34 families are represented by only one taxon (12.87%).

Table 1: List of non-native ornamental plants in Romania, escaped from cultivation, naturalised and invasive.

No.	Taxon	Family	Native range	Life form	Invasive status	Classes of occurrence	Type of habitat	First report	Status EU	Is high impact?
1	Abies nordmanniana Spach	Pinaceae	As (Caucasus)	Ph	c	1	a	1972	Alien	no
2	Acer negundo L.	Sapindaceae	Am N	Ph	i	5	n, sn, a	1946	Alien	yes
3	Achillea × roseoalba Ehrend.	Asteraceae	Hybrid	H	c	2	sn, a	1987	Cryptogenic	no
4	Achillea filipendulina Lam.	Asteraceae	As	H	c	1	a	2017	Alien	no
5	Aesculus × carnea Hayne	Sapindaceae	Hybrid	Ph	c	1	a	2018	Questionable	no
6	Aesculus hippocastanum L.	Sapindaceae	Md	Ph	c	3	n, a	1866	Alien	no
7	Ailanthus altissima (Mill.) Swingle	Simaroubaceae	As (China)	Ph	i	5	n, sn, a	1842	Alien	yes
8	Alangium platanifolium (Siebold & Zucc.) Harms	Cornaceae	As (China C, Japan)	Ph	n	1	a	2014	-	-
9	Albizia julibrissin Durazz.	Fabaceae	As (China)	Ph	n	2	a	1980	Alien	yes
10	Alcea rosea L.	Malvaceae	As	H	c	4	n, a	1816	Alien	no
11	Allium subhirsutum L.	Amaryllidaceae	Md	G	c	1	a	2015	Alien	no
12	Allium tuberosum Rottl. ex Spreng.	Amaryllidaceae	As (China, Himalaya)	G	c	1	a	2015	Alien	no
13	Amaranthus caudatus L.	Amaranthaceae	Am S	T	n	3	a	1866	Alien	no
14	Amaranthus cruentus L.	Amaranthaceae	Am trop	T	n	3	a	1866	Alien	no
15	Amaranthus hypochondriacus L.	Amaranthaceae	Am N	T	i	4	a	1866	Alien	no
16	Amorpha fruticosa L.	Fabaceae	Am N	Ph	i	5	n, sn, a	1898	Alien	yes
17	Anaphalis margaritacea (L.) Benth. & Hook.f.	Asteraceae	Am N	H	c	2	n, a	1866	Alien	no
18	Antirrhinum majus L.	Plantaginaceae	Md	T	c	3	n, a	1816	Alien	no
19	Aquilegia formosa Fisch.	Ranunculaceae	Am N	H	c	1	a	2015	-	-
20	Aquilegia vulgaris L.	Ranunculaceae	Eur W,C,S	H	c	4	a	1816	Alien	no
21	Aristolochia macrophylla Lam.	Aristolochiaceae	Am N	Ph	c	2	a	1955	Alien	no

22	Asclepias syriaca L.	Apocynaceae	Am N	H	i	4	n, sn, a	1866	Alien	yes
23	Aubrieta parviflora Boiss.	Brassicaceae	As (Turkey, Iran)	H	c	1	a	2015	-	-
24	Bassia scoparia (L.) A.J.Scott	Amaranthaceae	As	T	i	6	a	1816	Alien	no
25	Berberis aquifolium Pursh	Berberidaceae	Am N	Ph	c	2	a	1994	Alien	yes
26	Berberis julianae C.K. Schneid.	Berberidaceae	As (China)	Ph	c	1	a	2015	Alien	no
27	Berberis thunbergii DC.	Berberidaceae	As (Japan)	Ph	c	1	a	2017	Alien	yes
28	Borago officinalis L.	Boraginaceae	Md	T	c	3	a	1858	Alien	no
29	Bothriochloa bladhii (Retz.) S.T.Blake	Poaceae	Trop	H	n	2	a	1944	Alien	no
30	Brugmansia arborea Steud.	Solanaceae	Am S	Ph	c	1	a	2012	Alien	no
31	Brunnera macrophylla I.M.Johnst.	Boraginaceae	As (Caucasus)	H	c	2	a	1947	Alien	no
32	Buddleja davidii Franch.	Scrophulariaceae	As E	Ph	c	2	sn, a	1961	Alien	yes
33	Bulbine semibarbata (R.Br.) Haw.	Asphodelaceae	Austr	G	c	1	a	2015	-	-
34	Buxus sempervirens L.	Buxaceae	Md	Ph	n	2	a	1958	Alien	no
35	Cabomba caroliniana A. Gray	Cabombaceae	Am N, S	HH	n	2	n, sn	1955	Alien	yes
36	Calendula arvensis L.	Asteraceae	Md-Eur C	T	c	3	a	1816	Alien	no
37	Calendula officinalis L.	Asteraceae	Md	T	c	5	n, a	1779	Alien	no
38	Callistephus chinensis Nees	Asteraceae	As E	T	c	3	n, a	1866	Alien	no
39	Campanula medium L.	Campanulaceae	Md V	T	c	2	a	1816	Alien	no
40	Campsis radicans (L.) Seem.	Bignoniaceae	Am N	Ph	c	2	n, a	2009	Alien	no
41	Caragana arborescens Lam.	Fabaceae	As N	Ph	c	2	sn, a	1936	Alien	no
42	Carya ovata K.Koch	Juglandaceae	Am N	Ph	c	2	a	1960	Alien	no
43	Catalpa bignonioides Walter	Bignoniaceae	Am N	Ph	n	2	a	1961	Alien	no
44	Catalpa fargesii Bur.	Bignoniaceae	As (China)	Ph	c	1	a	2017	-	-
45	Catalpa ovata G.Don	Bignoniaceae	As E	Ph	c	1	a	2017	Alien	no
46	Catalpa speciosa Warder ex Engelm.	Bignoniaceae	Am N	Ph	c	1	a	2017	-	-
47	Celastrus orbiculatus C.P.Thunberg ex A.Murray	Celastraceae	As (China, Japan)	Ph	c	1	a	2014	Alien	yes
48	Celosia argentea L.	Amaranthaceae	Trop	T	c	2	a	1952	Alien	no
49	Celtis occidentalis L.	Cannabaceae	Am N	Ph	c	3	n, sn, a	1943	Alien	no

50	Cenchrus alopecuroides Thunb.	Poaceae	As E -Austr W	H	c	1	a	2017	-	-
51	Cephalotaxus harringtonii (Knight ex J.Forbes) K.Koch var. harringtonii	Cephalotaxaceae	As E	Ph	c	1	a	1958	Alien	no
52	Cerastium tomentosum L.	Caryophyllaceae	Eur S	Ch	c	1	a	2015	Alien	no
53	Ceratopteris thalictroides (L.) Brongn.	Pteridaceae	Trop	HH	n	1	n, a	1974	Alien	no
54	Cercis canadensis L.	Fabaceae	Am N	Ph	c	1	a	2014	-	-
55	Cercis griffithii Boiss.	Fabaceae	As (Afganistan)	Ph	c	1	a	2014	-	-
56	Cercis siliquastrum L.	Fabaceae	Md	Ph	c	2	a	1934	Alien	no
57	Chaenomeles japonica (Thunb.) Lindl. ex Spach	Rosaceae	As E	Ph	c	2	a	1974	Alien	no
58	Chaenomeles speciosa Nakai	Rosaceae	As (China)	Ph	c	2	a	2015	Alien	no
59	Cheiranthus cheiri L.	Brassicaceae	Md	T	c	2	n, a	1954	Questionable	no
60	Chrysanthemum indicum L.	Asteraceae	As (China)	H	c	1	a	2011	Alien	no
61	Citrus trifoliata L.	Rutaceae	As	Ph	c	1	a	2014	Alien	no
62	Cladrastis kentukea Rudd	Fabaceae	Am N	Ph	c	1	a	2014	-	-
63	Claytonia perfoliata Donn.	Montiaceae	Am N	T	c	1	a	2017	Alien	no
64	Clematis viticella L.	Ranunculaceae	Eur S, As W	Ph	c	2	a	1880	Alien	no
65	Commelina communis L.	Commelinaceae	As temp	H	n	3	n, sn, a	1947	Alien	no
66	Consolida ajacis (L.) Schur	Ranunculaceae	Md	T	n	3	a	1866	Alien	no
67	Coreopsis lanceolata L.	Asteraceae	Am N	H	c	2	n, a	1969	Alien	no
68	Coreopsis tinctoria Nutt.	Asteraceae	Am N	T	c	3	n, a	1866	Alien	no
69	Cosmos bipinnatus Cav.	Asteraceae	Am N	T	c	4	n, a	1937	Alien	no
70	Cotoneaster horizontalis Decne.	Rosaceae	As (China V)	Ph	c	1	a	2015	Alien	no
71	Cyclamen coum Mill.	Primulaceae	As (Caucasus)	G	c	1	a	2015	Alien	no
72	Cyclamen purpurascens Mill.	Primulaceae	Eur C	G	c	3	n, sn, a	1816	Alien	no
73	Cymbalaria muralis P.Gaertner, B.Meyer & Scherb.	Plantaginaceae	Eur S	H	n	3	n, sn, a	1816	Alien	no
74	Cynara scolymus L.	Asteraceae	Md	H	c	2	a	2000	Alien	no
75	Cytisus scoparius (L.) Link	Fabaceae	Eur W,S&C	Ph	n	4	n, sn, a	1816	-	-
76	Datura innoxia Mill.	Solanaceae	Am S,C	T	c	3	n, sn, a	1992	Alien	no
77	Datura wrightii Regel	Solanaceae	Am N	T	c	2	a	2011	Alien	no

78	Desmodium stenophyllum Pamp.	Fabaceae	As (Himalaya, China)	Ph	n	1	a	2014	-	-
79	Digitalis lutea L.	Plantaginaceae	Eur	H	c	1	a	2015	Alien	no
80	Echinocystis lobata Torr. & A.Gray	Cucurbitaceae	Am N	T	i	6	n, sn, a	1904	Alien	yes
81	Elaeagnus angustifolia L.	Elaeagnaceae	As	Ph	i	5	n, sn, a	1816	Alien	yes
82	Eranthis hyemalis Salisb.	Ranunculaceae	Md	H	n	2	n, sn, a	1780	Alien	no
83	Erythranthe guttata (DC.) G.L.Nesom	Phrymaceae	Am N	H	c	2	a	1898	Alien	yes
84	Erythranthe moschata (Douglas ex Lindl.) G.L.Nesom	Phrymaceae	Am N	H	c	2	a	1871	Alien	no
85	Eschscholzia californica Cham.	Papaveraceae	Am N	T-H	c	2	a	1961	Alien	no
86	Euonymus fortunei (Turcz.) Hand.-Mazz.	Celastraceae	As (China)	Ph	c	1	a	2015	Alien	no
87	Euphorbia lathyris L.	Euphorbiaceae	Md	TH	c	3	a	1816	Alien	no
88	Euphorbia marginata Pursh	Euphorbiaceae	Am N	T	n	3	n, a	1947	Alien	no
89	Euthamia graminifolia (L.) Nutt.	Asteraceae	Am N	H	n	2	n, a	1968	Alien	no
90	Fallopia baldschuanica (Regel) Holub	Polygonaceae	As E	Ph	c	3	n, a	1958	Alien	no
91	Forsythia suspensa Vahl	Oleaceae	AS (China)	Ph	c	1	a	2015	Alien	no
92	Fraxinus americana L.	Oleaceae	Am N	Ph	c	3	n, sn, a	2008	Alien	no
93	Fraxinus pennsylvanica Marshall	Oleaceae	Am N	Ph	i	5	n, sn, a	1947	Alien	no
94	Gaillardia pulchella Foug.	Asteraceae	Am N	T	c	2	a	2009	Alien	no
95	Gazania rigens (L.) Gaertner	Asteraceae	Afr S	H	c	1	a	2015	-	-
96	Ginkgo biloba L.	Ginkgoaceae	As E	Ph	c	2	a	1947	Alien	no
97	Gleditsia triacanthos L.	Fabaceae	Am N	Ph	n	5	n, sn, a	1898	Alien	yes
98	Gomphrena globosa L.	Amaranthaceae	Am C,S	T	c	2	a	2014	Alien	no
99	Gypsophila altissima L.	Caryophyllaceae	As, Eur cont	H	c	1	a	2015	Alien	no
100	Helianthus decapetalus L.	Asteraceae	Am N	H	n	4	n, sn, a	1948	Alien	no
101	Helianthus tuberosus L.	Asteraceae	Am N	H	i	5	n, sn, a	1858	Alien	yes
102	Hemerocallis fulva L.	Asphodelaceae	As E	H	c	4	n, sn, a	1816	Alien	no
103	Hemerocallis lilioasphodelus L.	Asphodelaceae	As	H	c	3	n, sn, a	1816	Alien	no
104	Hibiscus moscheutos L.	Malvaceae	Am N	H	c	1	a	2011	Alien	no
105	Hibiscus syriacus L.	Malvaceae	As E,S	Ph	c	2	a	2004	Alien	no
106	Hosta plantaginea Asch.	Asparagaceae	As (China)	G	c	1	a	2017	Alien	no

107	Humulopsis scandens (Lour.) Grudz.	Cannabaceae	As E	T	i	2	n, sn, a	1937	Alien	yes
108	Hylotelephium spectabile (Boreau) H.Ohba	Crassulaceae	As E	H	c	2	a	2008	Alien	no
109	Iberis amara L.	Brassicaceae	Eur W&S	T	c	2	n, a	1866	Alien	no
110	Iberis umbellata L.	Brassicaceae	Md	T-TH	c	2	n, a	1866	Alien	no
111	Ilex aquifolium L.	Aquifoliaceae	Eur W&S	Ph	n	2	n, a	1890	Alien	no
112	Impatiens balfourii Hook.f.	Balsaminaceae	As	H	c	3	a	2006	Alien	no
113	Impatiens balsamina L.	Balsaminaceae	As SE	T	c	2	a	2005	Alien	no
114	Impatiens glandulifera Royle	Balsaminaceae	As (Himalaya)	T	i	5	n, sn, a	1892	Alien	yes
115	Ipomoea hederacea Jacq.	Convolvulaceae	Am trop	T	c	2	a	1987	-	-
116	Ipomoea purpurea (L.) Roth	Convolvulaceae	Am trop	T	c	4	a	1937	Alien	no
117	Ipomoea quamoclit L.	Convolvulaceae	Am trop	T	c	1	a	1996	-	-
118	Ipomoea tricolor Cav.	Convolvulaceae	Am trop	T	c	1	a	1997	Alien	no
119	Iris albicans Lange	Iridaceae	Md	G	c	1	a	2005	Alien	no
120	Iris germanica L.	Iridaceae	Md	G	c	3	n, a	1816	-	-
121	Iris pallida Lam.	Iridaceae	Eur S	G	c	2	n, a	1866	Alien	no
122	Juniperus virginiana L.	Cupressaceae	Am N	Ph	c	2	n, a	2009	Alien	no
123	Koelreuteria paniculata Laxm.	Sapindaceae	As E	Ph	c	3	n, a	1964	Alien	no
124	Lagenaria siceraria (Molina) Standl.	Cucurbitaceae	Afr trop	T	c	1	sn	2011	Alien	no
125	Lilium bulbiferum L.	Liliaceae	Eur C	G	c	3	n, a	1816	Alien	no
126	Limnophila heterophylla Benth.	Plantaginaceae	As E	H	c	1	a	1959	-	-
127	Lobularia maritima (L.) Desv.	Brassicaceae	Md	H	c	2	a	1971	Alien	no
128	Lolium multiflorum Lam.	Poaceae	Md	T-H	n	4	n, sn, a	1866	Alien	yes
129	Lonicera japonica Thunb.	Caprifoliaceae	As E	Ph	c	2	n, sn, a	2010	Alien	yes
130	Lonicera periclymenum L.	Caprifoliaceae	Md	Ph	c	3	a	1816	Alien	no
131	Lonicera tatarica L.	Caprifoliaceae	As, Eur E	Ph	c	2	a	2005	Alien	no
132	Lupinus albus L.	Fabaceae	As W, Eur SW	T	c	2	a	1947	Alien	no
133	Lupinus polyphyllus Lindl.	Fabaceae	Am N	H	c	2	n, a	1947	Alien	yes
134	Lycium barbarum L.	Solanaceae	As E	Ph	i	6	sn, a	1842	Alien	no
135	Macleaya cordata R.Br.	Papaveraceae	As E	H	c	2	a	1947	Alien	no
136	Maclura pomifera (Raf.)C.K.Schneid.	Moraceae	Am N	Ph	c	2	n, a	1947	Alien	no

137	Malva moschata L.	Malvaceae	Md	H	c	3	n, sn	1863	Alien	no
138	Malva trimestris Salisb.	Malvaceae	Md	T	c	2	a	1866	Alien	no
139	Malva verticillata L.	Malvaceae	As E	T	c	3	a	1903	Alien	no
140	Matthiola longipetala (Vent.) DC. subsp. longipetala	Brassicaceae	Md E	T	c	2	a	1992	Alien	no
141	Mirabilis jalapa L.	Nyctagynaceae	Am S	H	c	3	a	1937	Alien	no
142	Mirabilis nyctaginea (Michx.) Mac Mill.	Nyctagynaceae	Am N	H	n	3	a	1947	Alien	no
143	Monochoria korsakowii Regel & Maack	Pontederiaceae	As temp	HH	c	2	n, sn, a	1989	Alien	no
144	Morus alba L.	Moraceae	As E	Ph	i	5	n, sn, a	1842	Alien	yes
145	Morus nigra L.	Moraceae	As SV	Ph	n	3	n, sn, a	1842	Alien	no
146	Myriophyllum aquaticum (Vell.) Verdc.	Haloragaceae	Am S	HH	c	1	n, a	1959	Alien	yes
147	Narcissus poeticus L. subsp. poeticus	Amaryllidaceae	Md	G	n	3	sn, a	1816	Alien	no
148	Narcissus pseudonarcissus L.	Amaryllidaceae	Atl-Md	G	c	3	a	1866	Alien	no
149	Nelumbo nucifera Gaertn.	Nelumbonaceae	Eur E, As subtrop	HH	n	2	n, a	1955	Alien	no
150	Nicandra physalodes (L.) Gaertn.	Solanaceae	Am S	T	c	2	a	1858	Alien	no
151	Nicotiana alata Link & Otto	Solanaceae	Am S	T	c	3	a	1943	Alien	no
152	Nigella damascena L.	Ranunculaceae	Eur S	T	c	2	a	1816	Alien	no
153	Nymphaea × marliacea Hort. Latour-Marliac	Nymphaeaceae	Hybrid	HH	c	1	n, a	2012	Questionable	no
154	Nymphaea lotus L.	Nymphaeaceae	Afr	HH	n	1	n, a	1798	Alien	no
155	Ocimum basilicum L.	Lamiaceae	As	T	c	2	a	1841	Alien	no
156	Oenothera biennis L.	Onagraceae	Am N	TH	i	5	n, sn, a	1816	Alien	no
157	Oenothera gaura W.L.Wagner & Hoch	Onagraceae	Am N	H	c	2	a	1957	Alien	no
158	Oenothera glazioviana Micheli	Onagraceae	Am N	TH	i	3	n, sn, a	1957	Alien	no
159	Oenothera odorata Jacq.	Onagraceae	Am S	H	c	1	a	1979	-	-
160	Oenothera parviflora L.	Onagraceae	Am N	TH	c	3	n, sn, a	1976	Alien	no
161	Oenothera rosea Aiton	Onagraceae	Am N	H	c	1	a	2017	Alien	no
162	Oxalis rosea Jacq.	Oxalidaceae	Am S	G	c	2	a	2015	Alien	no

163	Papaver atlanticum (Ball) Cosson	Papaveraceae	Afr	T, H	c	1	a	2015	Alien	no
164	Papaver orientale L.	Papaveraceae	As	H	c	1	a	2015	Alien	no
165	Papaver somniferum L.	Papaveraceae	As	T	c	3	a	1816	Alien	no
166	Parthenocissus inserta (A.Kerner) Fritsch	Vitaceae	Am N	Ph	i	5	n, sn, a	1898	-	-
167	Parthenocissus quinquefolia (L.) Planch.	Vitaceae	Am N	Ph	c	3	n, sn, a	1866	Alien	no
168	Parthenocissus tricuspidata Planch.	Vitaceae	As E	Ph	c	2	a	2008	Alien	no
169	Paulownia tomentosa Steud.	Paulowniaceae	As E	Ph	c	2	a	1970	Alien	yes
170	Perilla frutescens Britton.	Lamiaceae	As SE	T	c	3	n, sn, a	2005	Alien	no
171	Persicaria orientalis (L.) Spach	Polygonaceae	As E	T	c	3	a	1866	Alien	no
172	Petrosedum ochroleucum subsp. ochroleucum	Crassulaceae	Md	Ch	c	1	a	1959	Alien	no
173	Petunia × atkinsiana D.Don ex Loud	Solanaceae	Hybrid	T	c	3	a	1959	Alien	no
174	Petunia axillaris (Lam.) Britton, Sterns & Poggenb.	Solanaceae	Am S	T	c	1	a	2017	Alien	no
175	Petunia integrifolia Schinz & Thell.	Solanaceae	Am S	T	c	2	a	1939	Alien	no
176	Phedimus spurius (M.Bieb.) 't Hart	Crassulaceae	As W	H	c	3	a	1871	Alien	no
177	Philadelphus pubescens Loisel.	Hydrangeaceae	Am N	Ph	c	2	a	2010	Cryptogenic	no
178	Physocarpus opulifolius (L.) Maxim.	Rosaceae	Am N	Ph	c	2	a	1844	Alien	no
179	Platanus hybrida Brot.	Platanaceae	Hybrid	Ph	c	2	n, a	1968	Questionable	no
180	Platycladus orientalis (L.) Franco	Cupressaceae	As E	Ph	c	2	a	1960	-	-
181	Populus canadensis Moench	Salicaceae	Hybrid	Ph	c	3	sn, a	2006	Alien	no
182	Portulaca grandiflora Hook.	Portulacaceae	Am S	T	c	3	a	1937	Alien	no
183	Potentilla indica (Andrews) T.Wolf	Rosaceae	As S&E	H	n	2	a	1949	Alien	no

184	Prunus laurocerasus L.	Rosaceae	As	Ph	c	2	a	1987	Alien	no
185	Prunus serotina Ehrh.	Rosaceae	Am N	Ph	i	4	n, sn, a	1995	Alien	yes
186	Pseudofumaria lutea (L.) Borkh.	Papaveraceae	Eur C	H	c	1	a	1999	Alien	no
187	Pseudotsuga menziesii (Mirb.) Franco	Pinaceae	Am N	Ph	c	3	a	1900	Alien	no
188	Ptelea trifoliata L.	Rutaceae	Am N	Ph	c	2	a	1961	Alien	no
189	Pteris multifida Poir.	Pteridaceae	As E	H	n	2	a	1974	Alien	no
190	Quercus rubra L.	Fagaceae	Am N	Ph	n	3	sn, a	1962	Alien	no
191	Reseda odorata L.	Resedaceae	Md	T	c	2	a	1866	Alien	no
192	Reynoutria × bohemica Chrtek & Chrtková	Polygonaceae	Hybrid	H	i	5	n, sn, a	2004	Alien	no
193	Reynoutria japonica Houtt.	Polygonaceae	As E	G-H	i	5	n, sn, a	1940	Alien	yes
194	Reynoutria sachalinensis Nakai	Polygonaceae	As E	H	n	3	n, sn, a	1947	Questionable	yes
195	Rhus typhina L.	Anacardiaceae	Am N	Ph	n	4	n, a	1866	Alien	yes
196	Ribes aureum Pursh	Grossulariaceae	Am N	Ph	c	2	a	1842	Alien	no
197	Ricinus communis L.	Euphorbiaceae	Afr trop	T	c	3	sn, a	1947	Alien	yes
198	Robinia pseudoacacia L.	Fabaceae	Am N	Ph	i	7	n, sn, a	1816	Alien	yes
199	Robinia viscosa Vent.	Fabaceae	Am N	Ph	n	2	a	2005	Alien	no
200	Rosa × alba L.	Rosaceae	Hybrid	Ph	c	2	a	1836	Alien	no
201	Rosa foetida Herrm.	Rosaceae	As SW	Ph	c	2	a	1866	Alien	no
202	Rosa rugosa Thunb.	Rosaceae	As E	Ph	c	2	a	1995	Alien	yes
203	Rubus phoenicolasius Maxim.	Rosaceae	As E	Ph	c	2	sn, a	1956	Alien	no
204	Rudbeckia fulgida Ait.	Asteraceae	Am N	H	c	1	a	2015	Alien	no
205	Rudbeckia hirta L.	Asteraceae	Am N	H	c	2	n, a	2008	Alien	no
206	Rudbeckia laciniata L.	Asteraceae	Am N	H	i	5	n, sn, a	1855	Alien	no
207	Rudbeckia triloba L.	Asteraceae	Am N	H	c	2	sn, a	2004	Alien	no
208	Ruta graveolens L.	Rutaceae	Md	Ch	c	2	sn, a	1925	Alien	no
209	Sagittaria latifolia Willd.	Alismataceae	Am N	HH	n	2	n, sn, a	1966	Alien	yes
210	Salix babylonica L.	Salicaceae	As E	Ph	c	2	a	1842	Alien	no
211	Salvia desoleana Atzei & V.Picci	Lamiaceae	Md (Sardinia)	Ch	c	1	a	2015	-	-
212	Salvia sclarea L.	Lamiaceae	Md	H	c	3	a	1816	Alien	no
213	Salvia splendens Sellow ex Nees	Lamiaceae	Am S	T	c	1	a	2005	Alien	no
214	Salvia tiliifolia Vahl	Lamiaceae	Am C	T	c	1	a	2015	-	-
215	Salvia verbenaca L.	Lamiaceae	Atl-Md	H	c	2	n, sn, a	1969	Alien	no

216	Sassafras albidum (Nutt.) Nees	Lauraceae	Am N	Ph	c	1	a	2014	-	-
217	Scilla siberica Andrews	Asparagaceae	As W, Eur E (Russia)	G	c	2	sn, a	1939	Alien	no
218	Securigera cretica (L.) Lassen	Fabaceae	Md	T	c	2	a	1842	-	-
219	Sedum dasyphyllum L.	Crassulaceae	Md	H	c	2	n, a	1816	Alien	no
220	Sedum sarmentosum Bunge	Crassulaceae	As E	H	c	3	a	2011	Alien	no
221	Sempervivum tectorum L.	Crassulaceae	Eur C,W,S	H	c	3	n, a	1816	Alien	no
222	Sicyos angulatus L.	Cucurbitaceae	Am N	T	i	3	n, sn, a	1816	Alien	yes
223	Silene chalcedonica E.H.L.Krause	Caryophyllaceae	As W, Eur E	H	c	2	a	1866	Alien	no
224	Silene pendula L.	Caryophyllaceae	Md	T	c	2	a	1877	Alien	no
225	Silene sibirica Pers.	Caryophyllaceae	As (Siberia)	H	c	2	a	1960	Alien	no
226	Silphium perfoliatum L.	Asteraceae	Am N	H	c	1	a	1994	Alien	no
227	Sisyrinchium montanum Greene	Iridaceae	Am N	H	i	4	n, sn, a	1934	Alien	no
228	Smilax excelsa L.	Smilacaceae	As (Caucasus)	H	n	1	a	2014	Alien	no
229	Solanum citrullifolium A.Braun	Solanaceae	Am C	T	c	2	a	1941	Alien	no
230	Solidago canadensis L.	Asteraceae	Am N	H	i	5	n, sn, a	1866	Alien	yes
231	Solidago gigantea Aiton	Asteraceae	Am N	H	i	5	n, sn, a	1886	Alien	yes
232	Sorbaria sorbifolia (L.) A.Braun	Rosaceae	As N	Ph	c	2	a	2009	Alien	no
233	Sorghum bicolor (L.) Moench	Poaceae	Afr	T	c	3	n, a	1842	Alien	no
234	Spartium junceum L.	Fabaceae	Md	Ph	c	2	a	1866	Alien	no
235	Spiraea × billardii Hérincq	Rosaceae	Hybrid	Ph	c	1	a	2002	Alien	no
236	Spiraea × vanhouttei (Briot) Zabel	Rosaceae	Hybrid	Ph	c	2	n, a	1971	Alien	no
237	Spiraea japonica L.f.	Rosaceae	As E	Ph	c	2	n, a	1969	Alien	no
238	Stachys byzantina K.Koch	Lamiaceae	As SW	H	c	3	n, sn, a	1939	Alien	no
239	Styphnolobium japonicum (L.) Schott	Fabaceae	As E	Ph	c	2	a	1961	Alien	no
240	Symphoricarpos albus (L.) C.Koch	Caprifoliaceae	Am N	Ph	c	3	a	1947	Alien	no
241	Symphyotrichum lanceolatum (Willd.) G.L.Nesom	Asteraceae	Am N	H	i	5	n, sn, a	1940	Alien	no
242	Symphyotrichum novae-angliae (L.) G.L.Nesom	Asteraceae	Am N	H	c	2	n, a	1939	Alien	no

243	Symphyotrichum novi-belgii (L.) G.L.Nesom	Asteraceae	Am N	H	c	4	n, a	1945	Alien	yes
244	Symphyotrichum salignum (Willd.) G. L. Nesom	Asteraceae	Hybrid	H	i	3	n, sn, a	1780	Alien	no
245	Symphyotrichum tradescantii (L.) G. L. Nesom	Asteraceae	Am N	H	c	2	n, a	1939	Alien	no
246	Symphyotrichum versicolor (Willd.) G. L. Nesom	Asteraceae	Hybrid	H	c	3	n, a	1959	Alien	no
247	Tagetes erecta L.	Asteraceae	Am C	T	c	2	a	1961	Alien	no
248	Tamarix tetrandra Pall. ex M.Bieb.	Tamaricaceae	Eur SE, Asia SW	Ph	c	2	a	1947	Alien	yes
249	Tanacetum balsamita L.	Asteraceae	As SW	H	c	3	a	1841	Alien	no
250	Tanacetum parthenium Sch.Bip.	Asteraceae	Eur SE	H	c	5	n, sn, a	1816	Alien	no
251	Tarenaya spinosa Raf.	Cleomaceae	Am S	T	c	1	a	2014	Alien	no
252	Taxodium distichum Rich.	Cupressaceae	Am C (Mexic)	Ph	n	2	n, sn, a	1958	Alien	no
253	Thladiantha dubia Bunge	Cucurbitaceae	As E	G	n	5	n, a	1925	Alien	no
254	Tradescantia fluminensis Vell.	Commelinaceae	Am S	H	c	2	a	1999	Alien	yes
255	Tradescantia virginiana L.	Commelinaceae	Am N	H	c	2	a	1909	Alien	no
256	Tropaeolum majus L.	Tropaeolaceae	Am S	T	c	2	a	2003	Alien	no
257	Tulipa gesneriana L.	Liliaceae	As W, Md E	G	c	2	a	1866	Alien	no
258	Ulmus pumila L.	Ulmaceae	As C, E	Ph	n	3	n, a	1968	Alien	no
259	Viburnum rhytidophyllum Hemsl. ex Forb. & Hemsl.	Adoxaceae	As E	Ph	c	1	a	2004	Alien	no
260	Vinca major L.	Apocynaceae	Md	H	c	2	a	1863	Alien	no
261	Viola × wittrockiana Gams ex Nauenb. & Buttler	Violaceae	Hybrid	H	c	2	a	2009	Questionable	no
262	Wisteria sinensis Sweet	Fabaceae	As E	Ph	c	2	a	2005	Alien	no
263	Yucca filamentosa L.	Asparagaceae	Am	Ph	c	2	a	2011	Alien	no
264	Zinnia elegans Jacq.	Asteraceae	Am C	T	c	2	a	2005	Alien	no

Abbreviations: *Native range*: Afr – Africa, Am – America, As – Asia, Austr – Australia, Eur – Europe, Euras – Eurasia, Anat – Anatolia, Atl – Atlantic, Temp – Temperate, Trop – Tropical, Md – Mediterranean, N – North, E – East, S – South, W – West, C – Central. *Life form*: Ch – Chamaephyte, G – Geophyte, H – Hemicryptophyte, HH – Helohydatophyte, Ph – Phanerophyte, T – Therophyte, TH – Hemitherophytes. *Status of invasiveness in Romania*: c – casual, n – naturalized, i – invasive. *Type of habitat*: n – natural, sn – semi-natural, a – artificial. Others: EU – European Union.

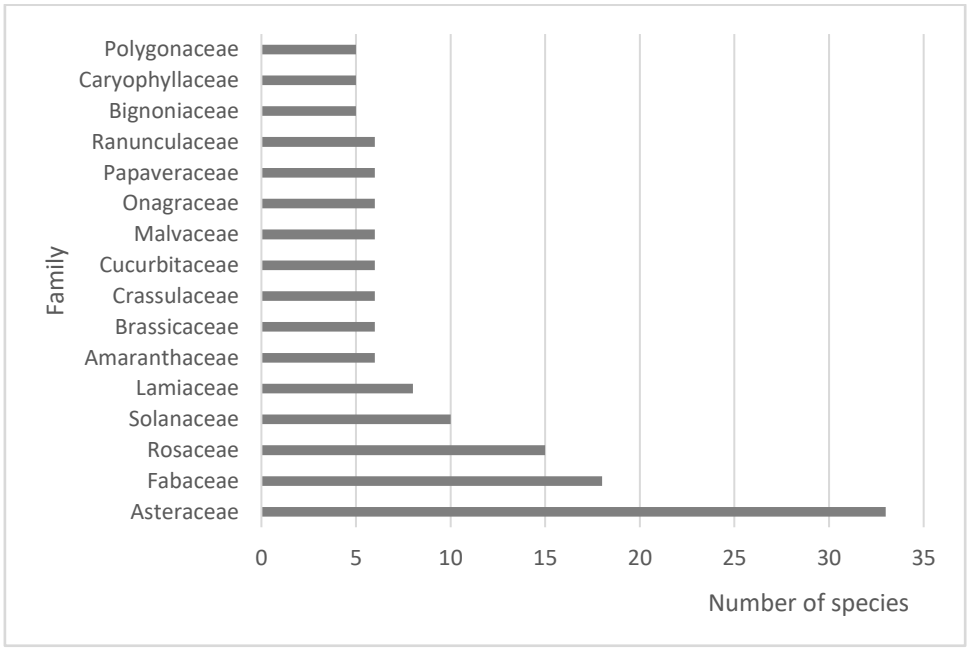

Fig. 1: The main families of the nNOP in Romania.

For Romania, the main contributers of non-native plants with ornamental value are America (100 taxa – 37.87%), Asia (82 taxa – 31.06%) and Mediterranean region (33 taxa – 12.5%) (Fig. 2, Table 1). The contribution of other regions such as Africa or Australia is very reduced (12 taxa – 4.54 taxa). Of hybrid origin there are 13 taxa (4.92%) (Fig. 2).

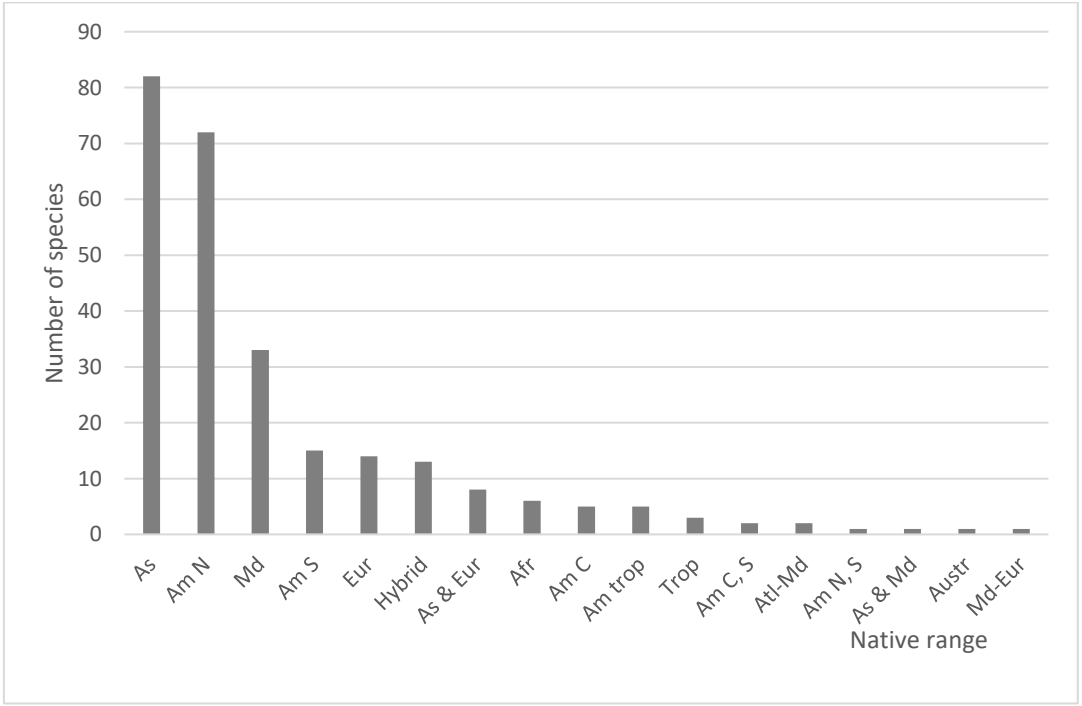

Fig. 2: Distribution of the nNOP in Romania according to the native range. Legend: Afr – Africa, Am N– North America, Am S – South America, Am C – Central America, As – Asia, Atl – Atlantic, Austr – Australia, Eur – Europe, Trop – Tropical, Md – Mediterranean.

Regarding their life forms, the most nNOP are phanerophytes with 92 species (34.84%) (Fig. 3, Table 1). They are followed by hemicryptophytes with 76 taxa (28.78%), therophytes with 59 taxa (22.34%), geophytes with 16 taxa (6.06%), helohydrophytes with 8 taxa (3.03%), chamaephytes and hemitherophytes with 4 taxa each (1.51%), and others (5 taxa – about 2%) (Fig. 3).

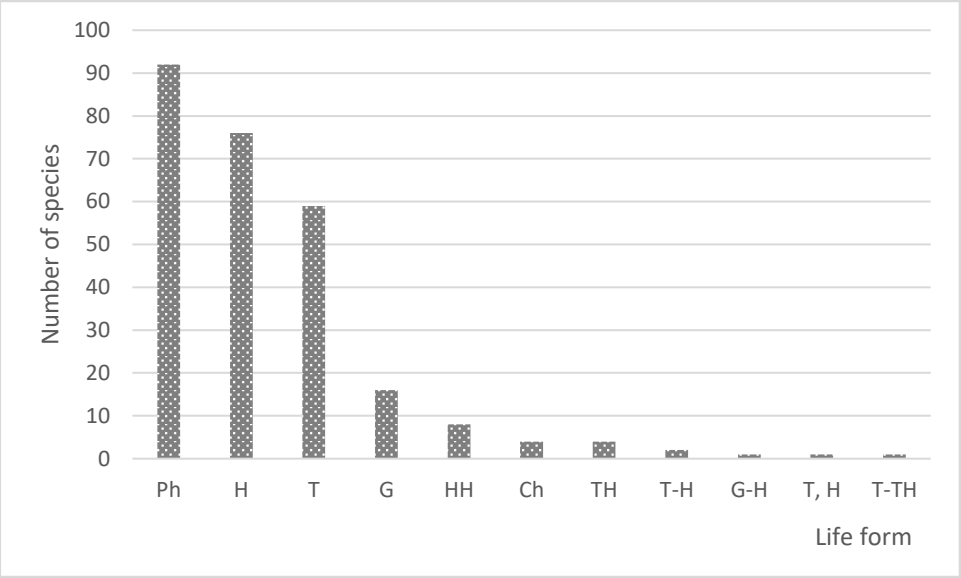

Fig. 3: Spectrum of life forms of the nNOP in Romania. Legend: Ch – Chamaephyte, G – Geophyte, H – Hemicryptophyte, HH – Helohydatophyte; Ph – Phanerophyte, T – Therophyte, TH – Hemitherophyte.

A significant percent is represented by casual nNOP – 199 taxa (75.38%) (Fig. 4, Table 1). Naturalised and invasive species together are less than a quarter (37 taxa – 14.02% naturalised and 28 taxa – 10.60% invasive) (Fig. 4). The ornamental species classified as invasive are: *Acer negundo*, *Ailanthus altissima*, *Amaranthus hypochondriacus*, *Amorpha fruticosa*, *Asclepias syriaca*, *Bassia scoparia*, *Echinocystis lobata*, *Elaeagnus angustifolia*, *Fraxinus pennsylvanica*, *Helianthus tuberosus*, *Humulopsis scandens*, *Impatiens glandulifera*, *Lycium barbarum*, *Morus alba*, *Oenothera biennis*, *Oenothera glazioviana*, *Parthenocissus inserta*, *Prunus serotina*, *Reynoutria × bohemica*, *R. japonica*, *Robinia pseudoacacia*, *Rudbeckia laciniata*, *Sicyos angulatus*, *Sisyrinchium montanum*, *Solidago canadensis*, *S. gigantea*, *Symphiotrichum lanceolatum* and *S. salignum*.

The most widespread species is *Robinia pseudoacacia*, already reported at national level from over 1000 localities. This is followed by a group of three species, all of them invasive, reported from 501–1000 localities: *Bassia scoparia*, *Echinocystis lobata*, *Lycium barbarum*. From 101 to 500 localities there are 20 non-native ornamental plant species, among these 16 being classified as invasive. Another group of 14 species is reported from 51 to 100 localities. This group includes four invasive species: *Amaranthus hypochondriacus*, *Asclepias syriaca*, *Prunus serotina* and *Sisyrinchium montanum*. 57 taxa are reported from a reduced number of localities, 11 to 50, three of them classified as invasive: *Oenothera glazioviana*, *Sicyos angulatus*, *Symphiotrichum salignum*. The largest group, with 108 taxa, includes species reported from two to ten localities. With only one single report there are 61 taxa (Fig. 5, Table 1).

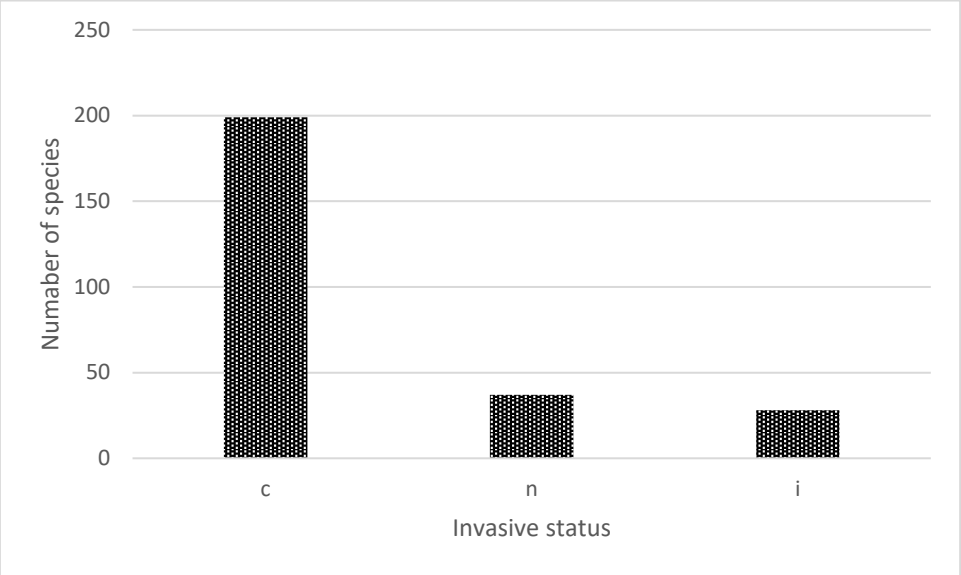

Fig. 4: Spectrum of invasiveness status of the nNOP in Romania. Legend: c – casual, n – naturalized, i – invasive.

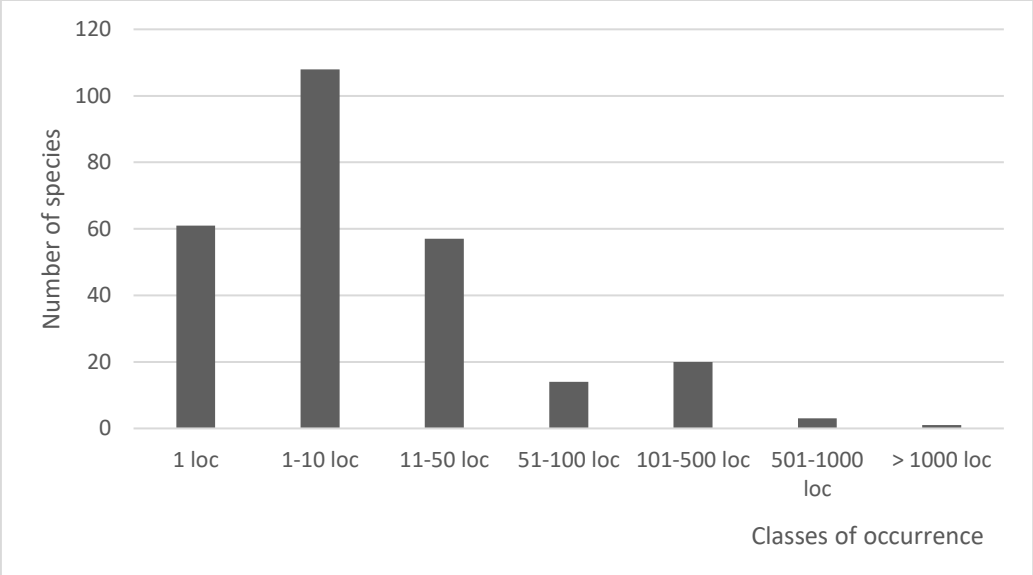

Fig. 5: Classes of occurrence of the nNOP in Romania.

More than half of the nNOP is reported only from artificial habitats (156 taxa – 59.09%), while a percent of 18.93% is represented by taxa reported from all types of habitats (Table 1).

First records of nNOP as sub-spontaneous date back to before 1800 (*Calendula officinalis*, *Eranthis hyemalis*, *Nymphaea lotus* and *Symphiotrichum salignum*). Before 1900 there have been reported 84 escapes among the nNOP (31.8%), while in the 20th century there have been reported 102 escapes (38.63%). In the last twenty years 78 (29.54%) nNOP species have been reported as escaped from cultivation (Fig. 6).

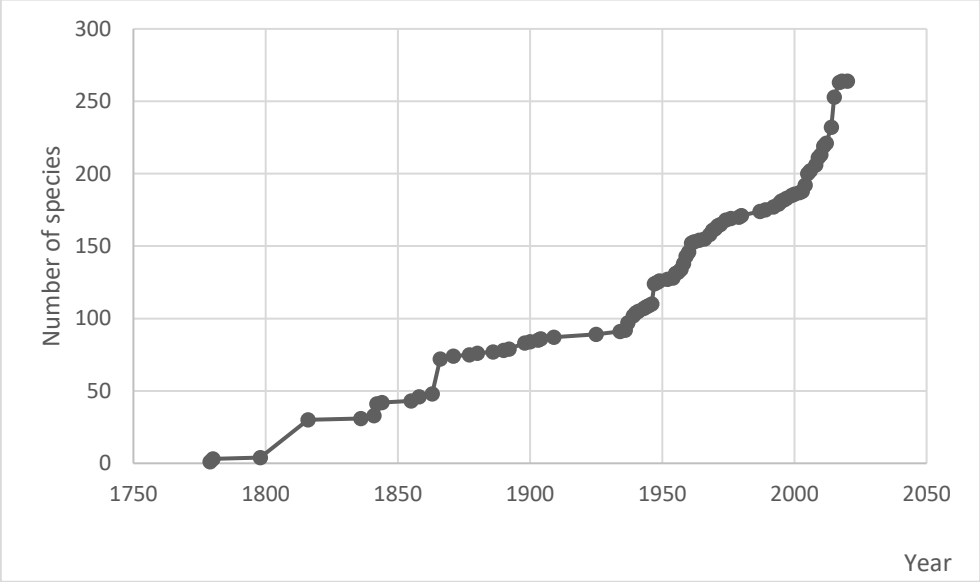

Fig. 6: Temporal trend of the nNOP in Romania in the last 240 years based on the year of first report of species as escaped from cultivation.

Discussion

The current list of nNOP in Romania includes about three times more taxa than the previous list published by Anastasiu et al. [1], fewer taxa than are indicated as ornamental by Sîrbu & Oprea [46], and about a quarter of naturalised aliens in Europe reported as escapes of species cultivated for ornament and horticulture [37]. The previous list comprises 93 taxa [1], while Sîrbu & Oprea [46] includes in their book 362 non-native plants with ornamental value. In Europe, escapes of species cultivated for ornament and horticulture account 58% of the total of 1983 naturalised aliens [37]. We did not include in the current list about 100 taxa not reported in the last 50 years, considering them to have vanished. Many have been reported as escaped from cultivation in botanical gardens, but did not survive over the time. We can mention some examples: *Aquilegia* × *cultorum*, *Aquilegia chrysantha*, *A. coerulea*, *A. olimpica*, *A. skinneri* reported in Bucharest Botanic Garden [13], or *Kitaibelia vitifolia*, *Smilacina stellata*, *Solanum nodiflorum* reported in Cluj-Napoca Botanic Garden [51]. On the other side, we included in the current list 78 species reported in the last 20 years. Among them are species reported as sub-spontaneous or naturalised in Bucharest Botanic Garden [34, 33] and in Jibou Botanic Garden as well [49, 35]. Two other species are missing from the current list due to taxonomic reasons. According to GBIF [19], *Bassia sierversiana* is a synonym of *B. scoparia*, and *Fallopia aubertii* is a synonym of *F. baldshuanica*. 23 taxa identified as nNOP for Romania are not included in EASIN Catalogue (accessed on 21-22 of November 2020). Mostly they are species recently reported as escaped (e.g. *Alangium platanifolium*, *Aquilegia formosa*, *Aubrieta parviflora*, *Bulbine semibarbata*, *Catalpa fargesii*, *C. speciosa*, *Cenchrus alopecuroides*, *Cercis canadensis*, *C. griffithii*, *Cladrastis kentukea*, *Desmodium stenophyllum*, *Gazania rigens*, *Salvia desoleana*, *S. tiliifolia*, *Sassafras albidum*).

Compared with the previous list [1], the number of families in the updated list is higher (47 families vs 80 families). The pattern of richness at the level of the most represented families is slightly changed, especially because of the higher number of taxa included in the current list, but also due to the different classification system used here [19]. In the current list, the top five families

are Asteraceae, Fabaceae, Rosaceae, Solanaceae and Lamiaceae. In the previous list the richest families were Asteraceae, Liliaceae, Fabaceae, Malvaceae, Ranunculaceae and Solanaceae with four taxa each [1]. Asteraceae and Fabaceae are also in the top five among the neophytes from Romania [3], as well as among the largest families of vascular plants of the world [10]. In fact, at global level, many species from Asteraceae family became popular as "garden ornamentals" due to the "diversity of plants, hardiness and reliability of flowering" [10]. The pattern of the families is similar to that of other countries such as Czech Republic [36] and Germany [31].

Regarding the pattern of the native range, the updated list is comparable with the previous one [1], and slightly different to the neophyte list for Romania, where American taxa are followed by Mediterranean and then Asian [3], and of the aliens list for Europe, where aliens of Asian origin comprise about 31%, and those of American origin about 19% [37].

The representation of life forms is slightly different to the previous list where the first rank belongs to hemicryptophytes with a percentage of 34.40%, followed by phanerophytes with 25.80% [1], and totally opposite to the structure of life forms of neophytes from Romania, where therophytes represent the dominant category, followed by hemicryptophytes and phanerophytes [3]. Species reported as subspontaneous from botanic gardens contribute to the high number of phanerophytes included in this updated list. Thus, from Bucharest Botanic Garden the following woody species were reported as subspontaneous during the most recent period: *Alangium platanifolium*, *Celastrus orbiculatus*, *Cercis canadensis*, *C. griffithii*, *Citrus trifoliata*, *Cladrastis kentukea*, *Desmodium stenophyllum* and *Sassafras albidum* [34]. Other phanerophytes are identified as subspontaneous in Jibou Botanical Garden: *Berberis julianae*, *Chaenomeles speciosa*, *Cotoneaster horizontalis*, *Euonymus fortune* and *Forsythia suspensa* [49], while species of *Catalpa* were identified as subspontaneous in Văcăreşti Natural Park, Bucharest (*Catalpa fargesii*, *C. ovata*, *C. speciosa*) [8].

When we look to the group of invasive nNOP, with only one exception, all of them are included as aliens in the EASIN Catalogue (accessed on November 20-22, 2020) [18]. The missing species is *Parthenocissus inserta*, much more widespread in Romania than *Parthenocissus quinquefolia* (101 reports as opposed to 40 reports, according to Sîrbu & Oprea [46]). Among the invasive nNOP, in the EASIN Catalogue 16 species are classified as being of high impact*: Acer negundo*, *Ailanthus altissima*, *Asclepias syriaca*, *Amorpha fruticosa*, *Echinocystis lobata*, *Elaeagnus angustifolia*, *Helianthus tuberosus*, *Humulopsis scandens*, *Impatiens glandulifera*, *Morus alba*, *Prunus serotina*, *Robinia pseudoacacia*, *Reynoutria japonica*, *Sicyos angulatus*, *Solidago canadensis* and *S. gigantea*. *Reynoutria japonica* has also been scored as of high socio-economic impact in Europe [45]. In the category of naturalised nNOP there are also few species classified as of high impact in Europe, according to the EASIN Catalogue [18]. These are: *Albizia julibrissin*, *Cabomba caroliniana*, *Gleditsia triacanthos*, *Lolium multiflorum*, *Reynoutria sachalinensis*, *Rhus typhina* and *Sagittaria latifolia*. In fact, except *Gleditsia triacanthos*, none of these species is widely distributed in Romania. For example, *Cambomba caroliniana*, a species of EU concern, has been reported in two restricted sites in the north-west of the country [50], but its presence is not confirmed by recent data [7]. On the contrary, *Gleditsia triacanthos* is reported from about 180 localities [46], but according to our field observations the presence of juveniles is strictly correlated with the presence of cultivated adults. Moreover, this species is still much cultivated for afforestation in many parts of the country. nNOP reported as casual is the richest category when we discuss their invasiveness. Even when for some of them there are many reports

(e.g. *Calendula officinalis*, *Ipomoea purpurea* and *Tanacetum parthenium*), they cannot establish persistent populations. According to EASIN Catalogue [18], 14 of the species identified as casual nNOP in Romania, are classified as species with high impact in Europe: *Berberis aquifolium*, *B. thunbergii*, *Buddleja davidii*, *Celastrus orbiculatus*, *Erythranthe guttata*, *Lonicera japonica*, *Lupinus polyphyllus*, *Myriophyllum aquaticum*, *Paulownia tomentosa*, *Ricinus communis*, *Rosa rugosa*, *Symphyotrichum novi-belgii*, *Tamarix tetrandra* and *Tradescantia fluminensis*. However, in Romania these species have a low occurrence (Table 1) and there have been no reports as yet of any negative impact correlated with their presence, even for those identified in natural habitats (*Lonicera japonica*, *Symphiotrichum novii-belgii*). For *Buddleja davidii*, a species scored as of high environmental impact in Europe [45], there are only four reports in Romania, from artificial and semi-natural habitats (Table 1).

While in Europe the most widely distributed alien taxa are *Robinia pseudoacacia*, *Ailanthus altissima*, *Impatiens glandulifera*, *Reynoutria japonica* and *Rosa rugosa* [37], in Romania the top five nNOP is occupied by *Robinia pseudoacacia*, *Lycium barbarum*, *Echinocystis lobata*, *Bassia scoparia* and *Oenothera biennis* (Table 1). This result is based on available data from literature, especially Sîrbu & Oprea [46], but it could alter very soon, after the inventories obtained through the national project „POIM/178/4/1/120008 - Adequate management of invasive species in Romania, in accordance with EU Regulation 1143/2014 on the prevention and management of the introduction and spread of invasive alien species", implemented between 2018-2022, are published. The success of *Robinia pseudoacacia* could be explained by the multiple pathways of introduction (release in nature for erosion control, dune stabilization, afforestation or as a melliferous plant; escape for confinement: forestry, ornamental, melliferous [46], the long period of residence time (see Table 1), and the intensity of planting. According to Pyšek et al. [38], the probability of escapes of trees depends exclusively on planting intensity.

Data about the presence of nNOP in different types of habitat are very few and not satisfactory, thus this type of analysis require further investigation. However, a study on neophytes of wetlands in Romania indicates 29 non-native ornamental species from different types of habitats such as inland surface water habitats, riparian woodlands, riverine and lakeshore scrubs [2], which are known as vulnerable to invasion [27]. Non-native ornamental species such as *Amorpha fruticosa*, *Acer negundo*, *Elaeagnus angustifolia* and *Robinia pseudoacacia* are mentioned for their capacity to change the lakeshore habitats of Snagov lake [5]. *Amorpha fruticosa* and *Robinia pseudoacacia* have been scored as being of very high impact on the habitats in the "Iron Gates" Natural Park [20]. In habitats from Danube Delta Biosphere Reserve, Anastasiu et al. [6] reported as invasive some nNOP (*Ailanthus altissima*, *Echinocystis lobata*, *Elaeagnus angustifolia*, *Fraxinus pennsylvanica*, *Lycium barbarum*, *Morus alba* and *Phytolacca americana*), but pointed out that some species recorded as escaped from cultivation are known as invasive in other regions or countries: *Asclepias syriaca*, *Helianthus tuberosus*, *Parthenocissus inserta*, *Rudbeckia laciniata* and *Solidago gigantea*.

Analysis of temporal trends of nNOP escapes reveals that over the years, the reports about this category of plants increase constantly, except for the last twenty years, when we have noted an accelerated increase of reports regarding escaped nNOP (Fig. 6). Thus, in only 20 years the reports almost equal in number those for 100 years of recording.

In the current list of nNOP in Romania, six species are included in the updated list of invasive alien species of EU concern (17): *Ailanthus altissima*, *Asclepias syriaca*, *Cabomba*

caroliniana, *Humulopsis scandens*, *Impatiens glandulifera* and *Myriophyllum aquaticum*. No management measures are implemented for their control and mitigation. Moreover, some species are still available for purchase from online stores (*Humulopsis scandens*, *Cabomba caroliniana*, and *Asclepias syriaca*).

Conclusions

As ornamental plants can be a significant source of introductions and spread into natural and semi-natural habitats, especially wetlands and sensitive zones such as natural protected areas, more attention should be given to this subject. Unequivocally, the problems posed by alien ornamental plants in Romania are similar to those faced in many other countries in Europe.

Thus, with regard to the benefits of ornamental plants, awareness of the most important stakeholders such as horticultural specialists, botanists, conservationists, and not least the general public, when importing, buying and using these plants needs to be as high as possible.

This paper is for the benefit of not only specialists but all categories of participants, adding the decisional factors that can play an important role in public awareness and improving legislation. The data have been compiled and analysed so as to offer supporting contributions of sustaining the need for development of proper tools for preventing, detecting, monitoring and managing the spread of nNOP.

When managing nNOP it is mandatory to take into consideration the obligations derived from European, international and national legislation regarding these taxa. Consequently, the collaboration between all stakeholders is also essential.

In the light of the above, several nNOP require special measures to control and mitigate their populations, as being species of European Union concern (*Ailanthus altissima, Asclepias syriaca, Cabomba caroliniana, Humulopsis scandens, Impatiens glandulifera, Myriophyllum aquaticum*). In addition, prevention of spread is without a doubt the preferred procedure rather than controlling the spread; therefore any nNOP reported as a casual deserves great attention.

The ornamental horticulture industry (including plant nurseries), along with botanic gardens, plays an important role in alien plant introductions, but also as a cause of their transport, propagation and spread. In order to mitigate the role of the ornamental plant industry in dispersing nNOP, we strongly recommend that the stakeholders involved adopt and implement the regulations of international and European codes of conduct and codes of practice regarding horticulture, ornamental and invasive alien plants, to implement voluntary and non-voluntary regulations for controlling the potentially invasive and invasive ornamental species (for example to label plants with information about the risk of escape and becoming invasive and proper care recommendations, to adopt good production practices and not dispose of plant waste outside places specially designed for the destruction of plant debris, ensure phytosanitary safety for products, etc.), to work with and invest in the scientific community that addresses nNOP, to use only science-based information, to work with volunteers and implement control initiative undertaken to remove ornamental alien plants that extend into natural habitats, to invest in continuously training and strengthening the personnel responsible, the gardening public and the buying public about the risk that nNOP may pose in order to prevent them become invasive, thus including stopping and avoiding the selling, buying and planting of the known IAS and make substitutes for invasives available, etc.

These recommendations cannot be fulfilled without sustained actions of education and increased awareness among stakeholders, and a better knowledge of the characteristics of alien ornamental plants and the historical environmental changes that they have generated all over the world.

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LISTA ACTUALIZATĂ A PLANTELOR ORNAMENTALE EXOTICE DIN ROMÂNIA

(Rezumat)

Prima listă a plantelor ornamentale exotice scăpate din cultură, naturalizate sau invasive a fost publicată în urmă cu 15 ani. De atunci, s-au înregistrat noi raportări de specii ornamentale pentru România, în timp ce altele şi-au schimbat statutul. Cum horticultura ornamentală este în întreaga lume una dintre cele mai importante căi de pătrundere pentru plantele exotice, am evaluat situaţia acestora la nivel naţional şi am actualizat lista publicată anterior cu scopul de a contribui la dezvoltarea instrumentelor de prevenire, detectare, monitorizare şi cartare a distribuţiei plantelor ornamentale exotice. Lista actualizată include 264 taxoni. Cei mai mulţi sunt doar ocazional întâlniţi ca subspontani (199 taxoni), 37 sunt naturalizaţi şi 28 sunt invazivi. Au fost analizate următoarele caracteristici: familia, distribuţia nativă, forma biologică, prezenţa în ţară (număr de localităţi) şi tendinţele în timp. Flora ornamentală exotică din România este dominată de specii americane şi asiatice, fanerofite, hemicriptofite şi terofite. Cea mai răspândită este *Robinia pseudoacacia*, folosită nu doar în scopuri ornamentale ci şi pentru valoarea sa economică. Cel mai mulţi taxoni (108) sunt răspândiţi în două până la 10 localităţi. În ultimii 20 de ani au fost raportate 78 de specii exotice ornamentale noi pentru România. Şase taxoni sunt îngrijorători pentru Uniunea Europeană (*Ailanthus altissima*, *Asclepias syriaca*, *Cabomba caroliniana*, *Humulopsis scandens*, *Impatiens glandulifera*, *Myriophyllum aquaticum*) şi necesită măsuri de control şi reducere a populaţiilor lor.

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