



## MANAGING PLANT INVASIONS USING LEGISLATION TOOLS: AN ANALYSIS OF THE NATIONAL AND REGIONAL REGULATIONS FOR NON-NATIVE PLANTS IN ITALY

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**ABSTRACT** - The integration of international, national and local regulations is one of the fundamental steps for preventing, controlling and managing biological invasions. The aim of the present study is to present and analyse, for the first time, the list of all non-native plant species that are regulated in Italy by the European, Italian and regional legislation in force. To date, there are 147 regulated non-native plant taxa. This number includes the 36 invasive alien plants of European Union concern and additional 111 taxa (95 species and 16 collective taxa) that have been listed at the regional level alone. A total of 19 plants of European Union concern and 95 regulated plants are present in the wild in at least one administrative region. The majority of the 95 species that are listed at the regional level alone are woody species (23 trees, 9 shrubs, 6 woody vines), followed by 29 herbs (19 annual herbs, 10 perennial herbs) and 11 aquatic plants. By presenting the regulated species and by identifying the most relevant species, the present study will provide an important tool to support plant invasion research and management and for the application of Regulation (EU) no. 1143/2014 on invasive alien species.

**KEYWORDS:** BLACK LISTS; INVASIVE ALIEN SPECIES (IAS); EUROPEAN REGULATION ON IAS; ENVIRONMENTAL LEGISLATION; INTRODUCED FLORA

## INTRODUCTION

The introduction, establishment and spread of invasive alien species (IAS) have been identified as major threats to biodiversity both globally (e.g., Ricciardi et al., 2013; Bellard et al., 2016) and locally (Del Guacchio et al., 2018, Lazzaro et al., 2019).

Specifically, when alien plant species become invasive, they negatively impact the environment by threatening native species diversity, distribution and persistence. In addition, they can cause economic, societal, health and political issues

(Shine, 2007; Simberloff et al., 2013). The concern aroused by this global risk has been addressed by dedicated international and national legislation, policies and strategies, many of which were introduced after the Convention on Biological Diversity, whose aim is to mitigate these impacts around the world (Tollington et al., 2015; Ochoa-Ochoa et al., 2019).

At the European Union (EU) level, Regulation no. 1143/2014, which is a binding legal tool for all Member States, came into force in 2015 (European Union, 2014) and is commendably underpinned by a consensus amongst scientists and policy makers that prevention is better than cure (Beninde et al., 2015; Genovesi et al., 2015; Tollington et al., 2015). The Regulation introduces some novel elements, including the promotion of early-warning and surveillance systems, the development of action plans to address priority pathways, rapid eradications to prevent establishment and long-term mitigation as well as control mechanisms. In the implementation phase, the EU Member States agreed upon a first list of IAS of EU concern of 37 species in 2016, followed by an updated list to which 12 species were added in 2017 (European Commission, 2017) and a further 17 in 2019 (European Commission 2019a). To date, there are 66 invasive alien species of EU concern, 36 of which are plants (European Commission 2019b).

In addition, according to the Regulation, Member States may establish a national list of invasive alien species of Member State concern. For these invasive alien species, Member States may apply measures such as those listed above that they deem appropriate for their territory (Lazzaro et al., 2019).

The aim of the present study was to present and analyse, for the first time, the full list of all non-native plant species that are regulated by the Italian legislation in force.

## MATERIALS AND METHODS

Data on non-native regulated plants in Italy were collected by screening the national and regional legislation on non-native (alien, exotic, introduced) plants on Institutional websites (national and regional environmental authorities) and cross-checking the information collected on standard legislation databases (Dejure [<https://dejure.it/>], FAOLEX [<http://www.fao.org/faolex/en/>], Normattiva [<https://www.normattiva.it/>]). We excluded from the analysis agricultural and forest legislation that only contained generic references to non-native species (not listing plant names) and collected information solely from legal texts on legislation in which non-native plant species are clearly and explicitly declared invasive and in which the scientific and/or common names of such species are reported. In addition, we focused on legal texts that do refer to specific bans or restrictions on non-native plants, the reason being that non-native trees used in forestry or in agro-forestry

come under a completely different corpus of legislation (e.g. Dir. 1999/105/CE). Moreover, not only have plantations of non-native trees been funded under several European Union or national policies (e.g., Reg. (EEC) no. 2078/92 and Reg. (EEC) no. 2080/92), but a considerable number of forest or ornamental non-native trees are protected for reasons such as their inclusion in the list of national monumental trees and for other reasons (e.g., Law no. 113/1992).

As regards the marine environment, 64 non-native marine macro algae and one vascular plants were recorded by Servello (2019). Six of these species are invasive (*Acrothamnion preissii* (Sond.) E.M.Woll., *Asparagopsis armata* Harv., *Caulerpa cylindracea* Sond., *Caulerpa taxifolia* var. *distichophylla* (G.Sond.) M.Verlaque, Huisman & Procaccini, *Lophocladia lallemantii* (Mont.) F.Schmitz, and *Womersleyella setacea* (Hollenb.) R.E.Norris), while a further two are reported in the transitional water environments (*Sargassum muticum* (Yendo) Fensholt and *Undaria pinnatifida* (Harv.) Suringar (Occhipinti-Ambrogi et al., 2011)). An official list of marine species that may be considered legally binding is, however, still missing in Italy, whether it be at the national or regional level, in spite of the commitment being made by the MSFD (Marine Strategy Framework Directive) and related Italian legislation, by a considerable number of monitoring projects as well as by control actions (e.g. [www.marinealien.sinanet.isprambiente.it](http://www.marinealien.sinanet.isprambiente.it)).

## RESULTS AND DISCUSSION

Italy has ratified all the major conventions that provide for an overarching commitment to tackle biological invasions and mitigate their negative effects, such as the International Plant Protection Convention (FAO/IPPC, since 1955), the Bern Convention (since 1981) and the Convention on Biological Diversity (since 1994). Non-native plants are also addressed in a number of additional legal texts, such as the “Habitats Directive” on the conservation of natural habitats and of wild fauna and flora (European Community, 1992) and the Marine Strategy Framework Directive which, by setting non-indigenous species among its eleven qualitative descriptors (Descriptor 2), suggests practices to achieve a good environmental status in the EU marine waters by the year 2020 (Servello et al., 2019). Currently, there is no post-2020 extension of the EU MSFD. However, it is assessing how the directive must be carried out by individual member states and how this can contribute to the objectives of the 2030 Agenda for Sustainable Development. Importantly, in Italy the most stringent legislation on non-native plants, which is based on an explicit list of regulated invasive species, is, just as it is in the rest of the European

Union, Regulation (EU) no. 1143/2014. Italy has adjusted its internal legislation to the Regulation by means of a dedicated national decree (D.lgs no. 230/2017). Furthermore, a number of Italian regions had regulated single non-native

plant species or approved regional black lists even before the Regulation came into force.

On the basis of our analysis, we listed in Table 1 all non-native plant species that are regulated in Italy by the legislation in force.

**Table 1. The non-native plant species that are regulated by the Italian legislation in force.**

The 147 taxa that are regulated according to the European (EU), Italian and regional legislation are listed with information on the 10 regional laws and regulations of the regions: F = Friuli Venezia Giulia, L = Lombardy, P = Piedmont, T = Tuscany, and V = Aosta Valley. The numbers from 1 to 10 in the table indicate the reference legislation. The number is accompanied by a code on the prescribed management, use restrictions or the type of list, as follow: AL = Black List – Action List, ML = Black List - Management List, WL = Black List – Warning List, C = Control obligations, OLS = Obligation to limit the spread, BP = Ban of use in productive plantations, M = Commitment to monitor, MC = Commitment to monitor and control, MCE = Commitment to monitor, control and eradicate, ME = Commitment to monitor and eradicate. Plant families follow APG IV (2016). Growth forms (GF) are reported according to Pérez-Harguindeguy et al. (2016) and Garnier et al. (2017) and are coded as follows: A = aquatic (hydrophyte), B = bambusoid, Gr = graminoid, Ha = annual herb, Hp = perennial herb, M = mat forming moss, P = palmoid, Sh = shrub, Su = succulent, T = tree, and V = vine climber. NR stands for the number of Italian administrative regions where the species has been recorded in the wild.

Alien species	Family	GF	NR	EU and regional legislation
<i>Acacia saligna</i> (Labill.) H.L.Wendl.	Fabaceae	T	9	EU; L 2-ME
<i>Acer negundo</i> L.	Sapindaceae	T	19	L 2-MC; P 5-OLS, 6-ML, 7-BP
<i>Agave americana</i> L. subsp. <i>americana</i>	Asparagaceae	Su	18	L 2-M
<i>Agave salmiana</i> Otto ex Salm-Dyck subsp. <i>ferox</i> (K.Koch) Hochstätter	Asparagaceae	Su	5	L 2-M
<i>Ailanthus altissima</i> (Mill.) Swingle	Simaroubaceae	T	20	EU; F 1-MC; L 2-MC, 3-FB; P 5-OLS, 6-ML, 7-BP; T 8-BP; V 9-MCE
<i>Alternanthera philoxeroides</i> (Mart.) Griseb.	Amaranthaceae	A	2	EU; L 2-ME; P 6-WL
<i>Ambrosia</i> L. [all species]	Asteraceae	H		L 2-MC
<i>Ambrosia artemisiifolia</i> L.	Asteraceae	Ha	13	F 1-MC; L 4-C; P 6-ML; V 9-MCE
<i>Ambrosia trifida</i> L.	Asteraceae	Ha	10	P 6-AL
<i>Amelanchier lamarckii</i> F.G.Schroed.	Rosaceae	T	1	L 2-M
<i>Amorpha fruticosa</i> L.	Fabaceae	Sh	19	L 2-MC, 3-BP; P 6-ML; t 8-BP
<i>Amphicarpea comosa</i> (L.) G.Don ex Loudon	Fabaceae	Ha	2	L 2-M
<i>Andropogon virginicus</i> L.	Poaceae	Gr	0	EU; L 2-ME
<i>Artemisia annua</i> L.	Asteraceae	Ha	17	P 6-ML
<i>Artemisia verlotiorum</i> Lamotte	Asteraceae	Ha	20	L 2-MC; P 6-ML
<i>Arundo donax</i> L.	Poaceae	B	20	P 6-ML
<i>Asclepias syriaca</i> L.	Apocynaceae	Hp	7	EU; L 2-CE; P 6-AL
<i>Azolla</i> Lam. [all species]	Salviniaceae	A		L 2-MC; P 6-ML
<i>Baccharis halimifolia</i> L.	Asteraceae	Sh	3	EU; L 2-ME; P 6-WL
<i>Bambuseae</i> Kunth ex Dumort. [all species]	Poaceae	B		L 2-MC
<i>Bidens frondosa</i> L.	Asteraceae	Ha	19	P 6-ML
<i>Bidens frondosa</i> L., incl. <i>B. vulgata</i> Greene	Asteraceae	Ha	20	L 2-MC
<i>Broussonetia papyrifera</i> (L.) Vent.	Moraceae	T	19	L 2-MC, 3-FB; P 6-ML
<i>Buddleja davidii</i> Franch.	Scrophulariaceae	Sh	17	L 2-MC, 3-FB; P 6-ML; V 9-MCE
<i>Bunias orientalis</i> L.	Brassicaceae	Hp	7	P 6-AL
<i>Cabomba caroliniana</i> A.Gray	Cabombaceae	A	0	EU; L 2-ME; P 6-WL
<i>Campylopus introflexus</i> (Hedw.) Brid. [Bryopsida]	Dicranaceae	M	10	P 6-ML
<i>Cardiospermum grandiflorum</i> Sw.	Sapindaceae	V	2	EU; L 2-ME
<i>Carex vulpinoidea</i> Michx.	Cyperaceae	Gr	5	P 6-AL
<i>Camphora glandulifera</i> (Wall.) Nees	Lauraceae	T	3	L 2-MC
<i>Carpobrotus</i> N.E.Br. [all species]	Aizoaceae	Su		T 8-BP
<i>Catalpa</i> Scop. [all species]	Bignoniaceae	T		L 2-MC
<i>Catalpa ovata</i> G.Don	Bignoniaceae	T	3	P 6-WL

Alien species	Family	GF	NR	EU and regional legislation
<i>Catalpa speciosa</i> Teas	Bignoniaceae	T	2	P 6-WL
<i>Cenchrus setaceus</i> (Forssk.) Morrone	Poaceae	Gr	6	EU; L 2-ME; P 6-WL
<i>Clematis tangutica</i> (Maxim.) Korsh.	Ranunculaceae	V	3	L 2-M
<i>Commelina communis</i> L.	Commelinaceae	Hp	16	P 6-ML
<i>Cortaderia jubata</i> (Lemoine) Stapf	Poaceae	Gr	0	EU; L 2-ME
<i>Crataegus</i> sect. <i>Coccineae</i> Loudon [all species]	Rosaceae	T		L 2-M
<i>Cycloloma atriplicifolium</i> (Spreng.) J.M.Coult.	Chenopodiaceae	Ha	8	L 2-MC
<i>Cyperus</i> L. [all non-native species]	Cyperaceae	Gr		P 6-ML
<i>Dichanthelium acuminatum</i> (Sw.) Gould & C.A.Clark subsp. <i>implicatum</i> (Scribn.) Freckmann & Lelong	Poaceae	Gr	3	P 6-AL
<i>Diplachne fusca</i> (L.) P.Beauv. ex Roem. & Schult. subsp. <i>fascicularis</i> (Lam.) P.M.Peterson & N.Snow	Poaceae	Gr	3	P 6-ML
<i>Egeria densa</i> Planch.	Hydrocharitaceae	A	6	L 2-MC
<i>Ehrharta calycina</i> Sm.	Poaceae	Gr	0	EU; L 2-ME
<i>Elaeagnus pungens</i> Thunb.	Elaeagnaceae	T	10	L 2-MC; P 6-WL
<i>Elaeagnus umbellata</i> Thunb.	Elaeagnaceae	T	2	L 2-MC
<i>Eleocharis obtusa</i> (Willd.) Schult.	Cyperaceae	Gr	5	P 6-ML
<i>Elodea</i> Michx. [all species]	Hydrocharitaceae	A		L 2-MC
<i>Elodea canadensis</i> Michx.	Hydrocharitaceae	A	15	P 6-ML
<i>Elodea nuttallii</i> (Planch.) H.St.John	Hydrocharitaceae	A	6	EU; P 6-ML
<i>Eragrostis curvula</i> (Schrud.) Nees	Poaceae	Gr	7	P 6-AL
<i>Erigeron annuus</i> (L.) Desf.	Asteraceae	Ha	17	P 6-ML
<i>Erigeron canadensis</i> L.	Asteraceae	Ha	20	P 6-ML
<i>Erigeron sumatrensis</i> Retz.	Asteraceae	Ha	20	P 6-ML
<i>Eucalyptus</i> L'Hér. [all species]	Myrtaceae	T		T 8-BP
<i>Euonymus fortunei</i> (Turcz.) Hand.-Mazz.	Celastraceae	T	2	L 2-M
<i>Gunnera tinctoria</i> (Molina) Mirb.	Gunneraceae	Hp	0	EU; L 2-ME; P 6-WL
<i>Gymnocoronis spilanthoides</i> (D.Don ex Hook. & Arn.) DC.	Asteraceae	A	1	EU; L 2-ME
<i>Helianthus tuberosus</i> L.	Asteraceae	Hp	20	L 2-MC; P 6-ML
<i>Heracleum mantegazzianum</i> Sommier & Levier	Apiaceae	Hp	5	EU; L 2-ME; P 6-AL; V 10-MCE
<i>Heracleum persicum</i> Desf. ex Fisch., C.A.Mey. & Avé-Lall.	Apiaceae	Hp	0	EU; L 2-ME; P 6-WL
<i>Heracleum sosnowskyi</i> Manden.	Apiaceae	Hp	0	EU; L 2-ME; P 6-WL
<i>Heteranthera reniformis</i> Ruiz & Pav.	Pontederiaceae	A	6	L 2-MC; P 6-ML
<i>Humulus japonicus</i> Siebold & Zucc.	Cannabaceae	V	6	EU; L 2-MC; P 6-ML
<i>Hydrocotyle ranunculoides</i> L.f.	Araliaceae	A	6	EU; L 2-ME; P 6-WL
<i>Impatiens</i> L. [all non-native species]	Balsaminaceae	Ha		V 9-MCE
<i>Impatiens balfourii</i> Hook.f.	Balsaminaceae	Ha	17	L 2-MC; P 6-ML
<i>Impatiens glandulifera</i> Royle	Balsaminaceae	Ha	9	EU; L 2-MC; P 6-ML
<i>Impatiens parviflora</i> DC.	Balsaminaceae	Ha	10	L 2-MC; P 6-ML
<i>Impatiens cristata</i> Wall. ( <i>Impatiens scabrida</i> auct., non DC.)	Balsaminaceae	Ha	1	P 6-AL
<i>Bassia scoparia</i> (L.) Voss	Chenopodiaceae	Ha	17	P 6-WL
<i>Koenigia polystachya</i> (Wall. ex Meisn.) T.M.Schust. & Reveal	Polygonaceae	Hp	3	L 2-M; P 6-WL
<i>Lagarosiphon major</i> (Ridl.) Moss	Hydrocharitaceae	A	4	EU; L 2-MC; P 6-AL
<i>Lemna minuta</i> Kunth	Araceae	A	16	L 2-MC; P 6-AL
<i>Lespedeza cuneata</i> (hort. angl. ex Dum.Cours.) G.Don	Fabaceae	Hp	0	EU; L 2-ME
<i>Ligustrum lucidum</i> W.T.Aiton	Oleaceae	T	17	L 2-MC; P 6-WL
<i>Ligustrum ovalifolium</i> Hassk.	Oleaceae	T	8	L 2-M; P 6-WL

Alien species	Family	GF	NR	EU and regional legislation
<i>Ligustrum sinense</i> Lour.	Oleaceae	T	14	L 2-MC; P 6-ML
<i>Lonicera japonica</i> Thunb.	Caprifoliaceae	V	18	L 2-MC; P 6-ML; V 9-MCE
<i>Ludwigia grandiflora</i> (Michx.) Greuter & Burdet	Onagraceae	A	0	EU; L 2-ME; P 6-WL
<i>Ludwigia hexapetala</i> (Hook. & Arn.) Zardini, H.Y.Gu & P.H.Raven	Onagraceae	A	3	EU; L 2-MC
<i>Ludwigia peploides</i> (Kunth) P.H.Raven subsp. <i>montevidensis</i> (Spreng.) P.H.Raven	Onagraceae	A	6	EU; L 2-MC; P 6-AL
<i>Lupinus polyphyllus</i> Lindl.	Fabaceae	Hp	5	L 2-M
<i>Lygodium japonicum</i> (Thunb.) Sw.	Lygodiaceae	V	0	EU; L 2-ME
<i>Lysichiton americanus</i> Hult�n & H.St.John	Araceae	Hp	0	EU; L 2-ME; P 6-WL
<i>Mahonia bealei</i> (Fortune) Carri�re	Berberidaceae	Sh	2	L 2-M
<i>Microstegium vimineum</i> (Trin.) A.Camus	Poaceae	Gr	0	EU; L 2-ME; P 6-WL
<i>Miscanthus sinensis</i> Andersson	Poaceae	Gr	3	P 6-AL
<i>Murdannia keisak</i> (Hassk.) Hand.-Mazz.	Commelinaceae	Hp	2	P 6-ML
<i>Myriophyllum aquaticum</i> (Vell.) Verdc.	Haloragaceae	A	9	EU; L 2-ME; P 6-AL
<i>Myriophyllum heterophyllum</i> Michx.	Haloragaceae	A	0	EU; L 2-ME; P 6-WL
<i>Najas gracillima</i> (A.Braun ex Engelm.) Magnus	Hydrocharitaceae	A	4	P 6-AL
<i>Nelumbo nucifera</i> Gaertn.	Nelumbonaceae	A	6	L 2-MC; P 6-AL
<i>Nymphaea mexicana</i> Zucc.	Nymphaeaceae	A	3	P 6-AL
<i>Nymphaea xmarliacea</i> Lat.-Marl.	Nymphaeaceae	A	2	L 2-M
<i>Oenothera</i> L. [all species]	Onagraceae	H		P 6-ML
<i>Opuntia</i> Mill. [all species]	Cactaceae	Su		P 6-AL
<i>Opuntia ficus-indica</i> (L.) Mill.	Cactaceae	Su	16	T 8-BP
<i>Parthenium hysterophorus</i> L.	Asteraceae	Ha	0	EU; L 2-ME; P 6-WL
<i>Parthenocissus quinquefolia</i> (L.) Planch.	Vitaceae	V	19	P 6-ML
<i>Parthenocissus quinquefolia</i> (L.) Planch., incl. <i>P. inserta</i> (A.Kern.) Fritsch	Vitaceae	V	19	L 2-MC
<i>Paspalum dilatatum</i> Poir.	Poaceae	Gr	19	P 6-AL
<i>Paulownia tomentosa</i> (Thunb.) Steud.	Paulowniaceae	T	15	L 2-MC; P 5-OLS, 6-ML, 7-BP
<i>Persicaria filiformis</i> (Thunb.) Nakai	Polygonaceae	Ha	2	L 2-MC; P 6-WL
<i>Persicaria pensylvanica</i> (L.) M.G�mez	Polygonaceae	Ha	7	P 6-WL
<i>Persicaria perfoliata</i> (L.) H.Gross	Polygonaceae	V	0	EU; L 2-ME
<i>Persicaria virginiana</i> (L.) Gaertn.	Polygonaceae	Ha	1	L 2-MC; P 6-WL
<i>Phyllostachys</i> Siebold & Zucc. [all species]	Poaceae	B		V 9-MCE
<i>Phyllostachys aurea</i> Carri�re ex Riviere & C.Riviere	Poaceae	B	11	P 6-ML
<i>Phytolacca americana</i> L.	Phytolaccaceae	Ha	20	P 6-ML
<i>Pinus nigra</i> J.F.Arnold	Pinaceae	T	10	L 2-MC
<i>Pinus rigida</i> Mill.	Pinaceae	T	1	L 2-MC
<i>Pinus strobus</i> L.	Pinaceae	T	7	L 2-MC
<i>Pontederia cordata</i> L.	Pontederiaceae	A	4	L 2-MC
<i>Pontederia crassipes</i> Mart.	Pontederiaceae	A	9	EU; L 2-ME; P 6-WL
<i>Prosopis juliflora</i> (Sw.) DC.	Fabaceae	T	0	EU; L 2-ME
<i>Prunus laurocerasus</i> L.	Rosaceae	T	14	P 6-ML; V 9-MCE
<i>Prunus serotina</i> Ehrh.	Rosaceae	T	7	L 2-MC, 3-BP; P 5-OLS, 6-ML, 7-BP
<i>Pseudosasa japonica</i> (Siebold & Zucc. ex Steud.) Makino ex Nakai	Poaceae	B	6	P 6-ML
<i>Pueraria lobata</i> (Willd.) Ohwi	Fabaceae	V	6	EU; L 2-MC; P 6-AL
<i>Quercus rubra</i> L.	Fagaceae	T	10	L 2-MC, 3-BP; P 5-OLS, 6-ML, 7-BP
<i>Reynoutria</i> Houtt. [all species]	Polygonaceae	Sh		L 2-MC; P 6-ML; V 9-MCE
<i>Reynoutria bohemica</i> Chrt�k & Chrt�kov�	Polygonaceae	Sh	9	V 10-MCE
<i>Rhus typhina</i> L.	Anacardiaceae	T	12	P 6-AL

Alien species	Family	GF	NR	EU and regional legislation
<i>Robinia</i> L. [all species]	Fabaceae	T		L 2-MC
<i>Robinia pseudoacacia</i> L.	Fabaceae	T	20	P 6-ML; T 8-BP
<i>Rosa multiflora</i> Thunb.	Rosaceae	Sh	12	L 2-MC
<i>Rubus phoenicolasius</i> Maxim.	Rosaceae	Sh	5	L 2-MC; P 6-WL
<i>Sagittaria latifolia</i> Willd.	Alismataceae	A	5	L 2-MC; P 6-AL
<i>Salvinia molesta</i> D.S.Mitch.	Salviniaceae	A	0	EU; L 2-ME
<i>Saururus cernuus</i> L.	Saururaceae	A	1	L 2-ME
<i>Senecio inaequidens</i> DC.	Asteraceae	Hp	20	F 1-MC; L 2-MC; P 6-ML; V 10-MCE
<i>Sicyos angulatus</i> L.	Cucurbitaceae	V	14	L 2-MC; P 6-ML
<i>Solanum carolinense</i> L.	Solanaceae	Hp	7	P 6-AL
<i>Solidago canadensis</i> L.	Asteraceae	Hp	12	L 2-MC
<i>Solidago gigantea</i> Aiton	Asteraceae	Hp	15	L 2-MC; P 6-ML; V 9-MCE
<i>Sorbaria tomentosa</i> (Lindl.) Rehder	Rosaceae	Sh	4	L 2-MC
<i>Sorghum halepense</i> (L.) Pers.	Poaceae	Gr	20	P 6-ML; V 9-MCE
<i>Spiraea japonica</i> L.f.	Rosaceae	Sh	7	L 2-MC; P 6-ML
<i>Sporobolus</i> R.Br. [all non-native species]	Poaceae	Gr		P 6-AL
<i>Taxodium distichum</i> (L.) Rich.	Cupressaceae	T	5	L 2-M
<i>Trachycarpus fortunei</i> (Hook.) H.Wendl.	Arecaceae	P	12	L 2-MC; P 6-AL
<i>Triadica sebifera</i> (L.) Small	Euphorbiaceae	T	0	EU; L 2-ME
<i>Ulmus pumila</i> L.	Ulmaceae	T	19	P 5-OLS, 6-ML, 7-BP
<i>Vitis riparia</i> Michx.	Vitaceae	V	8	P 6-ML
<i>Zanthoxylum armatum</i> DC.	Rutaceae	Sh	2	L 2-M

#### Legend for the numbers in the table, and the related reference legislation:

- (1) Friuli Venezia Giulia - Legge regionale Friuli Venezia Giulia 23 aprile 2007, n. 9 “Norme in materia di risorse forestali.” - Allegato A (Bollettino Ufficiale della Regione Autonoma Friuli Venezia Giulia, 2 maggio 2007, n. 18, pp. 11-55);
- (2) Lombardy - Deliberazione della Giunta Regionale 16 dicembre 2019, n. XI/2658 (Bollettino Ufficiale Regione Lombardia, 20 dicembre 2019, Serie Ordinaria n. 51, pp. 91-96);
- (3) Lombardy - Regolamento regionale 20 luglio 2007, n. 5 - Allegato B, “Norme forestali regionali, in attuazione dell’articolo 50, comma 4, della legge regionale 5 dicembre 2008, n. 31 (testo unico delle leggi regionali in materia di agricoltura, foreste, pesca e sviluppo rurale)” (Bollettino Ufficiale Regione Lombardia, 24 Luglio 2007, n. 30, 1° Supplemento Ordinario);
- (4) Lombardy - Ordinanza 29 marzo 1999, n. 25522 del Presidente della Regione Lombardia “Ordinanza contingibile e urgente ai sensi dell’art. 32 della l. 23 dicembre 1978, n. 833 – Disposizioni contro la diffusione della pianta “Ambrosia” nella regione Lombardia al fine di prevenire la patologia allergica ad essa correlata” (Bollettino Ufficiale Regione Lombardia, 12 aprile 1999, Serie Ordinaria n. 15, p. 764);
- (5) Piedmont - Decreto del Presidente della Giunta regionale Piemonte 20 settembre 2011, n. 8/R - Allegato E “Regolamento regionale recante: Regolamento forestale di attuazione dell’articolo 13 della legge regionale 10 febbraio 2009, n. 4 (Gestione e promozione economica delle foreste). Abrogazione dei regolamenti regionali 15 febbraio 2010, n. 4/R, 4 novembre 2010, n. 17/R, 3 agosto 2011, n. 5/R.” (Bollettino Ufficiale della Regione Piemonte, 22 settembre 2011, n. 38);
- (6) Piedmont - Deliberazione della Giunta regionale 27 maggio 2019, n. 24-9076 “Aggiornamento elenchi (Black List) delle specie vegetali esotiche invasive del Piemonte approvati con DGR 33-5174/17 “Aggiornamento elenchi delle specie vegetali esotiche invasive del Piemonte approvati con DGR 23-2975/16 e approvazione del documento “Linee guida per la gestione e controllo delle specie esotiche vegetali nell’ambito di cantieri con movimenti terra e interventi di recupero e ripristino ambientale” (Bollettino Ufficiale della Regione Piemonte, 27 giugno 2019, n. 26);
- (7) Piedmont - Decreto del Presidente della Giunta Regionale 20 settembre 2011, n. 8/R “Regolamento forestale di attuazione dell’articolo 13 della legge regionale 10 febbraio 2009, n. 4 (Gestione e promozione economica delle foreste)” – Allegato E (Bollettino Ufficiale della Regione Piemonte, 22 settembre 2011, n. 38).
- (8) Tuscany - Legge regionale Toscana 19 marzo 2015, n. 30 “Norme per la conservazione e la valorizzazione del patrimonio naturalistico-ambientale regionale. Modifiche alla l.r. 24/1994, alla l.r. 65/1997, alla l.r. 24/2000 ed alla l.r. 10/2010” (Bollettino Ufficiale della Regione Toscana, 25 marzo 2015, n. 14, parte prima, pp. 4-73);
- (9) Valle d’Aosta - Deliberazione 2 dicembre 2016, n. 1670 “Approvazione dell’aggiornamento degli elenchi delle specie di flora di cui agli allegati A, B e F della legge regionale 7 dicembre 2009, n. 45 e dei primi interventi in materia di specie vegetali esotiche invasive e istituzione di un Gruppo di lavoro permanente per la gestione delle specie vegetali esotiche” (Bollettino Ufficiale della Regione Valle d’Aosta, 3 gennaio 2017, n. 1, pp. 75-99);
- (10) Valle d’Aosta - Legge regionale 7 dicembre 2009, n. 45 “Disposizioni per la tutela e la conservazione della flora alpina. Abrogazione della legge regionale 31 marzo 1977, n. 17.” - Allegato F (Bollettino Ufficiale della Regione Autonoma Valle d’Aosta 5 gennaio 2010, n. 1, pp. 15-46).

Table 2 lists invasive alien plants of EU concern including both species that are currently present and those that are not found in Italy. Names in Tables 1 and 2 are reported as they are found in the legal source, with the accepted name in the

check list of the alien vascular flora of Italy (Galasso et al., 2018), which has been continually updated in the Portal to the Flora of Italy (2020).

**Table 2. Invasive alien species of European Union concern and their status in Italy.** Species are shown with the names as they appear in the EU legislation (including the listed synonyms), the accepted names for Italy (Galasso et al., 2018) and information on the invasive status in Italy: Abs = Absent; Cult = Introduced, Cultivated; Nat = Naturalised; I = Invasive; N & I = Naturalised in some regions and invasive in other regions. The distribution in the wild takes into account the Italian Ecoregional Divisions (Blasi et al., 2018), where TM = Temperate Division, MD = Mediterranean Division. In the same column: Abs = Absent, Abs\* MD = Absent, Recorded in the past in the MD; R = Rare; COM = Common, LOC COM = Locally Common; WID = Widespread. The distribution in the wild and the major pathways of introduction in Italy: ACC Co, St = Accidental Introduction - Contaminant, Stowaway; FG = Forage; FOR = Forestry, MP = Multi-Purpose, ORN = Ornamental, ORN Aq = Aquatic Ornamental Plants.

Species name in the Union List	Accepted name Italy	Status	Distribution in the wild	Major pathways
<i>Acacia saligna</i> H.L.Wendl. ( <i>Acacia cyanophylla</i> Lindl)	<i>Acacia saligna</i> (Labill.) H.L.Wendl.	I	WID MD	ORN, FOR, MP
<i>Ailanthus altissima</i> (Mill.) Swingle	<i>Ailanthus altissima</i> (Mill.) Swingle	I	WID TD, MD	ORN, FOR, MP
<i>Alternanthera philoxeroides</i> (Mart.) Griseb.	<i>Alternanthera philoxeroides</i> (Mart.) Griseb.	I	LOC COM MD	ORN Aq ACC
<i>Andropogon virginicus</i> L.	<i>Andropogon virginicus</i> L.	Abs	Abs	ACC Co, St
<i>Asclepias syriaca</i> L.	<i>Asclepias syriaca</i> L.	Nat	COM TD	ORN, ACC Co, MP
<i>Baccharis halimifolia</i> L.	<i>Baccharis halimifolia</i> L.	N & I	LOC COM TD	ORN
<i>Cabomba caroliniana</i> Gray	<i>Cabomba caroliniana</i> A.Gray	Cult	Abs	ORN Aq
<i>Cardiospermum grandiflorum</i> Sw.	<i>Cardiospermum grandiflorum</i> Sw.	Nat	R MD	ORN
<i>Cortaderia jubata</i> (Lemoine ex Carrière) Stapf	<i>Cortaderia jubata</i> (Lemoine) Stapf	Cult	Abs	ORN
<i>Eichhornia crassipes</i> (Martius) Solms	<i>Pontederia crassipes</i> Mart.	N & I	LOC COM MD	ORN, MP
<i>Elodea nuttallii</i> (Planch.) St. John	<i>Elodea nuttallii</i> (Planch.) H.St.John	N & I	COM TD	ORN Aq
<i>Ehrharta calycina</i> Sm.	<i>Ehrharta calycina</i> Sm.	Abs	Abs	FG, ACC Co, St
<i>Gunnera tinctoria</i> (Molina) Mirbel	<i>Gunnera tinctoria</i> (Molina) Mirb.	Cult	Abs	ORN
<i>Gymnocoronis spilanthoides</i> (D.Don ex Hook. & Arn.) DC.	<i>Gymnocoronis spilanthoides</i> (D.Don ex Hook. & Arn.) DC.	Nat	R TD	ORN Aq
<i>Heracleum mantegazzianum</i> Sommier & Levier	<i>Heracleum mantegazzianum</i> Sommier & Levier	N & I	LOC COM TD	ORN
<i>Heracleum persicum</i> Fischer	<i>Heracleum persicum</i> Desf. ex Fisch., C.A.Mey. & Avé-Lall.	Abs	Abs	ORN
<i>Heracleum sosnowskyi</i> Mandenova	<i>Heracleum sosnowskyi</i> Manden.	Abs	Abs	ORN
<i>Humulus scandens</i> (Lour.) Merr.	<i>Humulus japonicus</i> Siebold & Zucc.	N & I	COM TD	ORN
<i>Hydrocotyle ranunculoides</i> L. f.	<i>Hydrocotyle ranunculoides</i> L.f.	N & I	LOC COM MD	ORN Aq
<i>Impatiens glandulifera</i> Royle	<i>Impatiens glandulifera</i> Royle	N & I	COM TD	ORN
<i>Lagarosiphon major</i> (Ridley) Moss	<i>Lagarosiphon major</i> (Ridl.) Moss	N & I	LOC COM TD	ORN Aq
<i>Lespedeza cuneata</i> (Dum.Cours.) G.Don ( <i>Lespedeza juncea</i> var. <i>sericea</i> (Thunb.) Lace & Hauech)	<i>Lespedeza cuneata</i> (hort. angl. ex Dum.Cours.) G.Don	Cult	Abs	FG, ACC Co, St
<i>Ludwigia grandiflora</i> (Michx.) Greuter & Burdet	<i>Ludwigia grandiflora</i> (Michx.) Greuter & Burdet	Abs	Abs	ORN Aq
<i>Ludwigia grandiflora</i> (Michx.) Greuter & Burdet	<i>Ludwigia hexapetala</i> (Hook. & Arn.) Zardini, H.Y.Gu & P.H.Raven	N & I	LOC COM TD	ORN Aq
<i>Ludwigia peploides</i> (Kunth) P.H. Raven	<i>Ludwigia peploides</i> (Kunth) P.H.Raven subsp. <i>montevicensis</i> (Spreng.) P.H.Raven	N & I	LOC COM TD, MD	ORN Aq
<i>Lygodium japonicum</i> (Thunb.) Sw.	<i>Lygodium japonicum</i> (Thunb.) Sw.	Cult	Abs	ORN
<i>Lysichiton americanus</i> Hultén & St. John	<i>Lysichiton americanus</i> Hultén & H.St.John	Cult	Abs	ORN
<i>Microstegium vimineum</i> (Trin.) A. Camus	<i>Microstegium vimineum</i> (Trin.) A.Camus	Abs	Abs	ACC Co, St
<i>Myriophyllum aquaticum</i> (Vell.) Verdc.	<i>Myriophyllum aquaticum</i> (Vell.) Verdc.	N & I	LOC COM TD, MD	ORN Aq
<i>Myriophyllum heterophyllum</i> Michaux	<i>Myriophyllum heterophyllum</i> Michx.	Cult	Abs	ORN Aq, ACC
<i>Parthenium hysterophorus</i> L.	<i>Parthenium hysterophorus</i> L.	Abs	Abs	ACC Co, St
<i>Pennisetum setaceum</i> (Forssk.) Chiov.	<i>Cenchrus setaceus</i> (Forssk.) Morrone	N & I	LOC COM MD	ORN

Species name in the Union List	Accepted name Italy	Status	Distribution in the wild	Major pathways
<i>Persicaria perfoliata</i> (L.) H. Gross ( <i>Polygonum perfoliatum</i> L.)	<i>Persicaria perfoliata</i> (L.) H.Gross	Abs	Abs	ACC Co, St
<i>Prosopis juliflora</i> (Sw.) DC.	<i>Prosopis juliflora</i> (Sw.) DC.	Cult	Abs	ORN, FOR, MP
<i>Pueraria montana</i> (Lour.) Merr. var. <i>lobata</i> (Willd.) ( <i>Pueraria lobata</i> (Willd.) Ohwi)	<i>Pueraria lobata</i> (Willd.) Ohwi	N & I	LOC COM TD	ORN
<i>Salvinia molesta</i> D.S. Mitch. ( <i>Salvinia adnata</i> Desv.)	<i>Salvinia molesta</i> D.S.Mitch.	Cult	Abs* MD	ORN Aq
<i>Triadica sebifera</i> (L.) Small ( <i>Sapium sebiferum</i> (L.) Roxb.)	<i>Triadica sebifera</i> (L.) Small	Cult	Abs	ORN, MP

The Commission Implementing Regulation (EU) no. 2016/1141 of 13 July 2016 lists two *Ludwigia* species i.e. *Ludwigia grandiflora* (Michx.) Greuter & Burdet, and *Ludwigia peploides* (Kunth) P.H. Raven. However, according to Galasso et al. (2018) we exclude the presence in Italy in the wild of *Ludwigia grandiflora* (Michx.) Greuter & Burdet s.s. All records for Italy have to be referred to *Ludwigia hexapetala* (Hook. & Arn.) Zardini, H.Y.Gu & P.H.Raven (SYN  $\equiv$  *Ludwigia grandiflora* (Michx.) Greuter & Burdet subsp. *hexapetala* (Hook. & Arn.) G.L.Nesom & Kartesz). This taxon has been recorded in three regions (Table 2). In our opinion, the subspecies of a listed non-native species is expected to be included in the European Union list even when elevated to the rank of a species.

To date, 19 invasive alien plant of EU concern have been recorded in the wild in Italy, at least as casual in one administrative region (i.e. observed in the wild but not yet naturalised, as in Galasso et al., 2018) (Table 2), while the other 17 invasive alien plant of EU concern are considered absent in the wild. *Salvinia molesta* D.S.Mitch. which was recorded in Italy in the past, has been eradicated in one location (Buccomino et al., 2011) and is no longer present in other historical sites. A few EU species of ornamental interest were probably being traded and cultivated before the ban came into force despite never being recorded in the wild. For example, according to Maniero (2000) *Gunnera tinctoria* (Molina) Mirb. was first introduced in Italy in around 1846 at the Royal Gardens in Monza.

As for the regional regulations, in 2010, the Friuli Venezia Giulia region updated a regional law introduced in 2007 and declared the following three non-native species ‘weedy species that have negative impacts on human health and the environment’: *Ailanthus altissima* (Mill.) Swingle, *Ambrosia artemisiifolia* L., and *Senecio inaequidens* DC. The Friuli Venezia Giulia region made a commitment to control these species, even by collaborating with other public bodies and private owners, and to raise public awareness of the negative impacts they exert and the control methods available (Table 1). The Lombardy region has, since 2008, pledged to adopt a blacklist of alien species subject to monitoring, containment or eradication. The first blacklist endorsed in 2008 included 21 alien plant species and one alien section, i.e. *Fallopia* sect. *Reynoutria* (Houtt.) Ronse Decr. In 2019, the blacklist was updated to include all the invasive alien plants of EU concern and a significant number of non-native plants and whole genera or tribes (e.g., *Ambrosia* L., *Azolla* Lam., *Bambuseae* Kunth ex Dumort., *Elodea* Michx.). The Lombardy region has, since 1999, established control obligations against *Ambrosia artemisiifolia*.

Since 2012, the Piedmont region has established a regional working group on invasive alien plant species. The working group has prepared and frequently updated a regional blacklist of invasive species, with the latest updated list, which takes into account Reg. (EU) no. 1143/2014, being released in 2019. The non-native plants are classified according to 3 different blacklists, i.e. Management List, Action List (eradication list) and Warning List. These blacklists for the Piedmont region, like those for the Lombardy region, also include a number of whole genera (or sections), such as *Fallopia* (*Reynoutria*) sp.pl., *Opuntia* sp.pl., and *Azolla* sp.pl. It should be borne in mind that although *Robinia pseudoacacia* L. is included in the Management List, specific management guidelines do not ban the cultivation of this species in view of the benefits it provides in confined agro-forestry systems (Sádlo et al., 2017).

In the Tuscany region, four woody species and two genera, *Carpobrotus* N.E.Br. and *Eucalyptus* L’Hér., have been banned in reforestation, greening and soil stabilisation since 2015 according to the regional law on environmental protection.

Finally, in the Aosta Valley region, three non-native species have been banned since 2009 by means of a regional law on the conservation of the flora. Following the addition of other non-native species to the list in 2016, the list now contains 13 non-native species.

In total, the analysis of the legislation currently in force shows that 131 non-native species and 16 collective taxa are regulated in Italy. The latter group includes 11 genera and all the species that belong to them, 3 genera with only their non-native species, one section and one tribe.

The 94 non-native species that have been listed at the regional level alone (i.e. not included in the EU list) are predominately woody species (23 trees, 9 shrubs and 6 woody vines), followed by 29 herbs (19 annual herbs and 10 perennial herbs) and 11 aquatic plants. The 36 non-native species of European Union concern that are listed also at regional level



are in the majority aquatic plants (13), followed by perennial herbs (7), woody vines (5), graminoids (5), and trees (4). The number of aquatic species is therefore relatively high in both groups, if we bear in mind that aquatic taxa are among the most prominent plant invaders in Europe (Brundu et al., 2012; Brundu 2015).

Importantly, table 1 includes some species of major concern which are not in the EU list, such as *Amorpha fruticosa* L., *Carpobrotus* sp.pl., *Reynoutria* sp.pl., *Prunus serotina* Ehrh. (Celesti-Grapow et al., 2017; Forte et al., 2019), to cite but a few, are those that feature prominently on many other regional, national and global lists of important or potentially invasive non-native plants (e.g., Carboneras et al., 2018). According to Regulation (EU) no. 1143/2014, invasive alien species are defined as those species that, based on available scientific evidence, [are] likely to have a significant adverse impact on biodiversity or the related ecosystem services. The regulation primary focus is on biodiversity. Therefore, the presence of adverse negative impact on human health or the economy is considered only as an aggravation criteria, but it is not enough to include a species in the list of European Union concern (Genovesi et al., 2015). As shown in Table 1, five Italian regions have applied their legislative power to regulate even non-native species whose impact is exerted mostly on agriculture and/or human health. One such species is *Ambrosia artemisiifolia*, which is a weedy species whose chances of being included in the European Union list or in a list of national concern would otherwise be low.

In addition, important controversial forestry species such as *Robinia pseudoacacia* or *Eucalyptus* sp.pl. are clearly addressed more effectively by regional and local legislation, best forestry practices and guidelines, site selection and site-specific management (Sádlo et al., 2017), than they would be if they were included in the EU list. Similarly, for other species, such as *Pinus nigra* J.F.Arnold subsp. *nigra* which are alien only to some regions in Italy (i.e., it is native to a number of regions but has spread or has been translocated to other regions), national or sub-national legislation is the undoubtedly most effective tool.

## CONCLUSIONS

As prevention is the best strategic approach to controlling invasive alien species, acting at a regulatory level is fundamental for the effective management of biological invasions in all stages of the invasion process. By identifying the regulated species and by highlighting the most noteworthy species, the lists presented in this paper will serve as an important tool to support Regulation no. 1143/2014, which affords EU Member states the possibility to establish

a national lists of invasive alien species of Member state concern. It will also help those administrative regions that have yet to introduce specific legislation to adopt dedicated legislation tools that are in accordance with those of their neighbouring regions. Since the movement of non-native invasive species takes place regardless of administrative borders, it is mandatory that national and global concerted actions have to be adopted for both terrestrial and marine environments.

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