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Short communication

Five new alien species in the flora of Montenegro: *Coreopsis tinctoria* Nutt., *Ipomoea indica* (Burm.) Merr., *Lupinus* × *regalis* Bergmans, *Physalis angulata* L., and *Solidago canadensis* L. and new possible threats to the biodiversity

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Abstract – The alien flora of Montenegro is enlarged by 5 new species: *Coreopsis tinctoria, Ipomoea indica*, *Lupinus* × *regalis*, *Physalis angulata,* and *Solidago canadensis*. All species are grown as ornamentals, and thus horticulture is considered the most possible pathway for their introduction. Nevertheless, in the case of *Physalis angulata,* the occurrence might have originated in the remains of picnic meals. In order to define the alien status of these species, monitoring is needed, and thus we propose including the species on the National List of Indicators in environmental protection. Special attention should be paid to the species with invasive potentials: *Solidago canadensis, Ipomoea indica* and *Physalis angulata.*

Keywords: alien plants, *Coreopsis*, *Ipomoea*, *Lupinus*, Montenegro, *Physalis, Solidago.*

Introduction

The interest in alien flora in Montenegro has grown rapidly in the last decade, with many new alien species having been reported. Still, information on alien plants is incomplete and frequently updated with new records. According to recent research, 51 alien species are considered invasive in Montenegro (Stešević and Petrović 2010, Stešević and Caković 2013). Taking into account the rather small size of the country (13,812 km^2), this number can be considered as troublesome, while in Croatia, with a state area of 57,000 km^2, the number of invasive alien species (IAS) is 74 (Nikolić 2015), in Serbia with a state area of 88 361 km^2 the number of IAS is 68 (Lazarević et al. 2012), in Vojvodina with an area of 21, 506 km^2 the number of IAS is 152 (Anačkov et al. 2013), in Slovenia with a state area of 20,151 km^2 the number of IAS is 32+71 naturalized and potentially invasive (Jogan et al. 2012) etc. Nevertheless, those numbers are not fully comparable because the lists of IAS in different countries have been assembled in different ways. Out of 51 invasive species in Montenegro, only one, *Ambrosia artemisiifolia* is monitored and partly managed (Stešević et al. 2014). Nevertheless, improvements in this field are expected soon, due to the recently adopted Regulation on the National List of Indicators in environmental protection. According to this document, alien (A) and invasive species (IS) are considered an indicator (B05) of pressure in the driving forces – pressures – state – impact – response (DPSIR) model and they will be monitored with a 10 year dynamic (Official Gazette No 29/2013).

This paper presents a supplement to the national list of alien plant species in Montenegro as well as to the general distribution of the mentioned aliens in SE Europe.

Material and methods

Plant material of five new alien species for the flora of Montenegro was collected during field investigations of the coastal and central part of the country, in the period from August 2013 to October 2014. Site geocoding was done with a GPS device, Garmin e-Trex Vista C, while the specimens were identified with following keys: *Ipomoea indica* with Backer and Bakhuizen van den Brink (1965), *Physalis angulata* (Hawkes 1972), *Coreopsis tinctoria*, *Solidago canadensis* (Pignatti 1982), *Lupinus* × *regalis* (Webb 1988). Voucher specimens were deposited in the herbarium collection at the University of Montenegro (TGU), voucher num-

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bers 560413-56016 and in the Herbarium Collection of the Natural History Museum of Montenegro, voucher numbers 5591-5592. Species are presented in alphabetical order.

Results and discussion

***Coreopsis tinctoria* Nutt.**

During the floristic survey conducted in June 2014 in the hinterland of Long Beach in Ulcinj (N41°53'51", E19°17'52") we recorded a population of *Coreopsis tinctoria* (Fig 1a). There were ca. 20 individuals scattered over an area of 16 m^2. Besides the typical form with yellow ligules tinged reddish brown towards the center of the flower heads, also the form *Coreopsis atropurpurea* coexisted (2 individuals). It is characterized by completely reddish brown heads (Fig 1b) (Smith and Parker 1971). The population had grown on trampled vegetation along the road, accompanied by *Plantago major* L., *Plantago lanceolata* L., *Cichorium intybus* L., *Crepis sancta* (L.) Bornm., *Knautia integrifolia* (L.) Bertol, *Poa annua* L., *Lolium perenne* L., *Vicia villosa* Roth. subsp. *varia* (Host) Corb, *Erigeron annuus* (L.) Desf. etc. Since both forms of *C. tinctoria* are grown as ornamentals in the Štoj area, we suppose that horticulture is the pathway of introduction.

Up to the date the only *Coreopsis* species reported in the flora of Montenegro was the alien North American species *C. lanceolata* L. (Stešević et al. 2008). *C. tinctoria* is also a North American species introduced to Europe in 1835, when it has become a common garden plant (Gajić 1975). In the native range it inhabits low wet areas along the coast (Smith and Parker 1971), while in non-native areas it grows on disturbed places up to 1000m (Strother 2006). Nowadays it is spread over almost all of Europe as largely cultivated in Spain, Portugal, Poland, Serbia; as casual, in Austria, Belgium (Euro+Med 2006), the British Isles (Stace 1997), Bulgaria (V. Vladimirov 2014, personal communication), the Czech Republic (Pyšek et al. 2002), Croatia (Nikolić 2015), Denmark (Alanen et al. 2004), France, Germany, Hungary, Italy, Norway (Euro+Med 2006), Romania (Anastasiu et al. 2011), Ukraine (Volutsa 2010); or with a unclear status: in Belarus, Finland and Sweden (Euro+Med 2006). The oldest record of this species in Europe dates from 1883 (Czech Republic, Pyšek et al. 2002).

Voucher specimen: Montenegro, Long Beach in Ulcinj, N41°53'51", E19°17'52", 1 m.a.s.l., roadside vegetation, (N. Bubanja, 19.07.2014., No. 5591).

***Ipomoea indica* (Burm.) Merr.**,syn. *Convolvulus indicus* Burm., *Ipomoea congesta* R. Br., *I. acuminata* (Vahl) Roemer &Schultes, *I. learii* Paxton

The coastal part of the country hosted another alien species: *I. indica*. A wild population was recorded at several sites between the settlements of Meljine and Igalo in the Bay of Boka Kotorska (N42°26'59", E18°32'59"). The plant mainly formed very dense stands on the walls of abandoned buildings, or on trees in abandoned yards, or spreading over the ground. At the locality presented in the Fig. 1c, it covered an area of ca. 300 m^2. In two sites, a few individuals were growing sparsely on boulders close to the sea (Fig. 1d).

Up to this research the only *Ipomoea* species reported in the flora of Montenegro was the tropical American *Ipomoea purpurea* (L.) Roth (Stešević et al. 2008). The origin of *I. indica* is unclear. According to one opinion it originates probably from South America (Weber 2003), and to another from tropical Asia (Swarbrick and Skarratt 1994). It was introduced to Europe (Maltese Islands) in the last 500 years (Mufsud 2002–2013), while the oldest record of escaped and established individuals dates from the beginning of the 1900s in Spain. The minimum residence time is estimated as being 104 years (Gassó et al. 2012). In Spain (Gassó et al. 2012), Portugal (Invasoras 2012), Macronesia (Silva et al. 2008), and Italy (Acta Plantarum 2007) the species is considered invasive, and in Greece, Kriti (Yannitsaros 1998), France (Fried 2012) and Maltese Islands (Mufsud 2002–2013) is held to be naturalized. It usually inhabits coastal sites, moist forests and it is also known as an opportunistic colonizer of open, disturbed habitats. Under favorable conditions it can grow very rapidly, smothering all other vege-

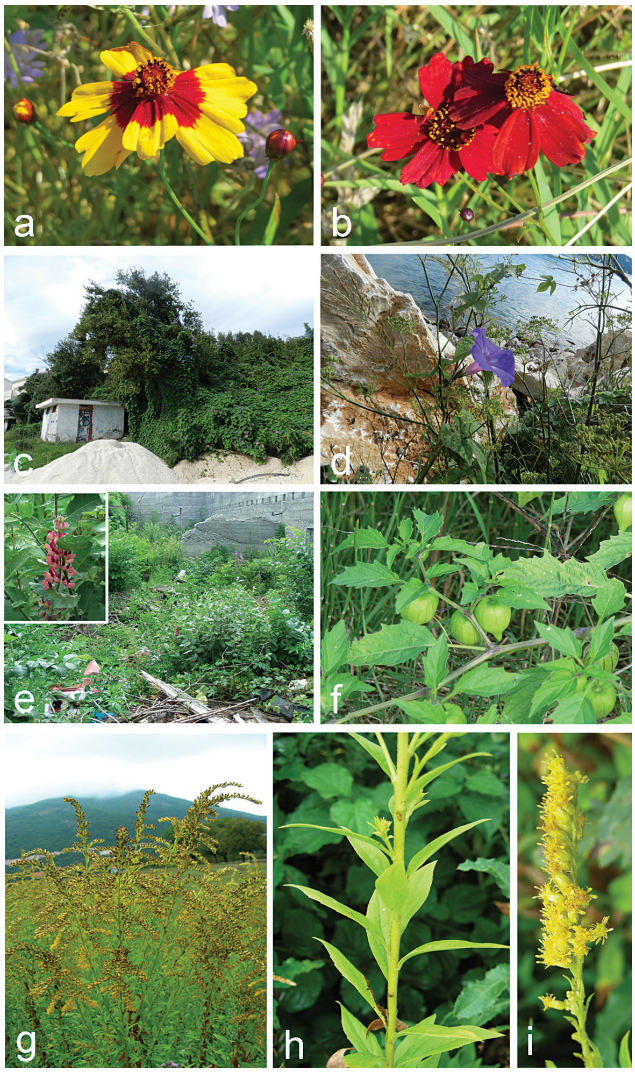

Fig. 1. a) *Coreopsis tinctoria*, b) *Coreopsis tinctoria* f. *atropurpurea*, c) stand of *Ipomoea indica* in Meljine, d) single individual of *I. indica* in Meljine, along the sea shore, e) *Lupinus* × *regalis* in the old ruin in Kolašin, f) *Physalis angulata*, g) *Solidago canadensis* habitus, h) *S. canadensis* stem, i) *S. canadensis* inflorescence (photo D. Stešević).

tation. Its climbing habit makes it as a very successful competitor (Muyt 2001). It reproduces primarily from broken fragments, hence, the most common mode of dispersal is believed to be unwanted vegetative material dumped by gardeners (Csurhes 2008). We suppose that the same scenario occurred in Montenegro.

Voucher specimen: Montenegro, Boka Kotorska, Meljine N42°26'59", E18°32'59", 1 m.a.s.l., wall of the abandoned yard (D. Stešević, 19.10.2013., TGU-560413).

Lupinus* × *regalis Bergmans = *L. arboreus* Sims × *L. polyphyllus* Lind I.

Several individuals of *Lupinus* × *regalis* (Fig. 1e) were recorded in the urban area of Kolašin, in one old ruin frequently used for dumping unwanted vegetative material and waste (N42°49'24", E19°31'40"). On the same site several ornamental plants grown in the city emerged: *Cosmos bipinnatus* Cav., *Reynoutria* × *bohemica* Chrtek & Chrtková and *Symphoricarpos albus* (L.) S. F. Blake. Thus, we consider horticulture the pathway of introduction. *Lupinus* × *regalis* is a garden hybrid (or hybrid complex) with the parents being *L. polyphyllus* Lindl. and *L. arboreus* Sims. (both native to North America), and possibly involving some annual species (Huxley 1999). It was introduced to the European market in 1935 as an ornamental (Fremstad 2010) and is frequently cultivated in Central and North Europe; it often occurs as a casual and may be locally naturalized (Franco and Silva 1968). In the UK it has gradually started to replace *L. polyphyllus* (Fremstad 2010). Due to the similarity of these species it is probable that many modern records refer to *Lupinus* × *regalis*, or backcrosses with *L. arboreus* (Clement and Foster 1994). The study conducted in Norway (Lid and Lid 2005) showed that *L.* × *regalis* seems to be less hardy than *L. polyphyllus* and has not established itself outside gardens so far. In France the species is sporadically established in some northern and central part of the country, but still not in Corsica (Julve 2014). With respect to ecology, the species grows on rough ground, motorway verges, riverside shingle (Preston et al. 2002), along railway lines (Preston et al. 2002), meadows (Groom 2007), forest edges (Rich et al. 1996), urban habitats (Lawley 2010).

Voucher specimen: Montenegro, Kolašin N42°49'24", E19°31'40", 960 m.a.s.l., old ruin (D. Stešević, 08.07.2014., TGU-560414).

Physalis angulata L., syn. *P. pendula* Rydb.

The autumn floristic survey in the hinterland of Long Beach in Ulcinj resulted in another new record for the alien flora of Montenegro: *Physalis angulate* (Fig. 1f). It inhabited moist waysides in an open coastal *Pinus halepensis* Mill. forest on sandy dunes in the hinterland of Long Beach (N41°54'33", E19°15'12"). Population counted ca. 15 plants, surrounded by numerous individuals of *Ephedra campylopoda* C. A. Mey., *Digitaria ischaemum* (Scherb) Muhl., *Solanum nigrum* L., *Vicia villosa* subsp. *varia*. In the area of Štoj the plant is grown as an ornamental, and thus horticulture is considered to have been one introduction pathway. The species is not used as an edible plant in Montenegro, but due to the fact that the Long Beach in Ulcinj is a very attractive touristic destination for foreign visitors, there is possibility that its occurrence also originates in the remains of picnic meals, as is the case in Greece (Travlos 2012).

Up to this record *Physalis alkekengi* L. was the only species out of the genus reported for our flora (Rohlena 1942). It is native in Europe, unlike *P. angulata,* which is considered to be native in tropical America (Hawkes 1972). Nowadays the species has a pantropical distribution as a weed of crops, gardens and plantations (Mairura 2008). It was introduced into warm areas of the world in post-Columbian times, with the voyages of exploration, discovery and commercial exploitation that began in the 16th century (Sturtevant 1919). In many regions of the world it is naturalized, while in Europe is cultivated locally for edible fruits (Hawkes 1972). It has the status of casual species in Austria (Essl and Rabitsch 2002), Belgium (Valdés 2012), the Czech Republic (Pyšek et al. 2002), Great Britain (Clement and Foster, 1994), and Slovenia (Lešnik 2009); and of naturalized species in Croatia (Milović et al. 2010), while it is considered invasive in Greece (Travlos 2012). The species is also present in Albania (Tan and Mullaj 2000) and Denmark (Nobanis 2005), but the status of naturalization is unclear. The means of introduction differs from country to country: escape from cultivation (Albania, Austria, Slovenia), soya bean importation (Belgium, Verloove 2011, Croatia, Milović et al. 2010, Slovenia, Lešnik 2014, personal communication), cereals (Croatia, Milović et al. 2010), oil seed and wool (Britain, Clement and Foster 1994), remains of picnic meals (Greece, Bőhling 2001). The oldest record of this species in Europe dates from 1961 (Belgium, Verloove 2011).With respect to ecology the species grows best in moist, fertile soils, it is tolerant to partial shade and occurs widely as a weed of crops and pastures, and in waste areas. It can be found up to 3000 m altitude. It can tolerate light frost (Mairura 2008).

Voucher specimen: Montenegro, Long Beach in Ulcinj N41°54'33", E19°15'12", 2 m.a.s.l., moist wayside in open *Pinus halepensis* forest (D. Stešević 06.10.2014., TGU-560416; N. Bubanja, No. 5591).

***Solidago canadensis* L.**, syn. *S. altissima* L., *S. canadensis* ssp. *altissima* (L.) Bolos & Vigo, *S. canadensis* var. *scabra* Torr. & A. Gray.

Along the roadside in the village Vir, near the city of Nikšić a population of *Solidago canadensis* was recorded (N42°50'11", E18°55'41"). It formed a dense patch that covered approximately 10 m^2. Due to strong anthropogenic pressure there were several alien and invasive species in the vicinity of the patch: *Artemisia verlotiorum* Lamotte and *Erigeron annuus*, as well as typical ruderal species common in the vegetation along the roadsides: *Salvia verticillata* L., *Cirsium arvense* (L.) Scop., *Clematis vitalba* L., *Daucus carota* L., *Diplotaxis tenuifolia* (L.) DC., *Geum urbanum* L., *Picris hieracioides* L., *Arrhenatherum elatius* (L.) P. Beauv. ex J. Presl & C. Presl etc. Since it is planted sporadically in the area of Nikšić, we suppose that horticulture is the introduction pathway.

The species (Figs. 1g–i) usually forms extensive colonies with high shoot density covering large areas, eliminating almost all other species. Individual clones expand rapidly by vegetative lateral growth. The annual stem (Fig. 1h) dies in autumn and new shoots arise from the rhizome in spring. Once established the plant remains dominant for a long period of time. Seeds are abundantly produced and dispersed by wind (Weber 2003). It is native to North America and was introduced to Europe as an ornamental plant (Weber 1998). Its earliest record dates from 1645 in England (Kowarik 2003). Because the species is attractive and easy to grow, it was widely used by gardeners. The first observations of wild populations in Europe dates to around 1850 (Wagenitz, 1964), and the plant spread rapidly until 1950 (Weber 1998). The species soon extended its range in Europe (Weber 2000). Nowadays it is present over most of Europe with the status of invasive alien plant (Parker 2008). In its native range the species is often a weedy component of vegetation in abandoned pastures and roadsides, in abandoned fields, grasslands, forest edges and human disturbed habitats in urban areas and settlements (Walck et al. 1999). In its alien range it inhabits grasslands, forest edges, riparian habitats, disturbed sites (Weber 2003).

Voucher specimen: Montenegro, village Vir, Nikšić municipality N42°50'11", E18°55'41", 645 m a.s.l., roadside vegetation (D. Stešević, 04.09.2014., TGU-560415).

In order to define the status of these five new alien species in Montenegro, monitoring is needed, land thus we propose the inclusion of the species on the National List of Indicators in environmental protection (B05). Particular attention should be paid to species with an invasive potential: *Solidago canadensis, Ipomoea indica* and *Physalis angulata.*

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