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Original Article

Contribution to the alien flora of Montenegro and Supplementum to the Preliminary list of plant invaders

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***Abstract*:**
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This contribution is based on the field observations from 2011 to 2013. Besides new data about distribution of some known plant invaders, one new alien species for the flora of Montenegro is reported- *Solidago gigantea.* This plant was recorded in 2011, on two distinct localities near the road side in peri-urban area of Nikšić and Mojkovac, in the vicinity of gardens, were it has been grown as ornamental. In 2012 survey, species was again reported for Mojkovac, but it disappeared from Nikšić, due to environmental changes caused by road construction. Remaining locality is placed near the Tara river bank, so considering ecological preferences (roadsides, disturbed river banks and moist soils), this species might become more frequent in the area. It is included into the EPPO list of invasive alien plants. In addition, alien plant *Tagetes minuta* is added to the preliminary list of plant invaders in Montenegro.

Key words: Alien flora, invasive flora, Montenegro, *Solidago gigantea*, *Tagetes minuta*

Introduction

Since our last publication from 2010 (Stešević & Petrović, 2010) situation with funding of the research and control of IAS (invasive alien species) didn't change much, but some progress in the legislative has been made. Pursuant to the requirements of the Convention on Biological Diversity, on 29 July 2010th, the first national biodiversity strategy and action plan for 2010 - 2015th was adopted (www.gov.me/.../FileDownload.aspx?rId=121033). This document defined the long-term goals and a number of measures for the protection of biodiversity and protected natural resources, as well as its implementation according to overall economic and social conditions in the country. The strategy has identified the main threats to biodiversity and ecosystems. Introduction of alien and invasive species was considered as so far poorly understood threat, with comment that its greater significance among the threats to biodiversity can be expected soon. In the meantime, on 14 March 2013th, the Government of Montenegro on the proposal Agency for Environmental Protection adopted a Regulation on the National list of indicators in environmental protection, by which alien and invasive species are an indicator (B05) of pressure on DPSIR (Driving forces - Pressures - State-Impact-Response) model. Therefore, in coming period they will be systematically monitored in annually dynamics, while summary data will be published each 10 years (Official Gazette No 29/2013).

According to recommendations of Lambdon et al. (2008), national check list of alien and invasive flora need to be further assessed within respect to the invasion status and residence time of the species included. For future in-depth analyses it is crucial that especially the naturalized/casual status is evaluated. Furthermore,

more rigorous approach is also needed at the national level in terms of recording of habitat (Chytrý et al., 2008) and abundance data, and according to recognized standards which are comparable across the continent.

This paper is a contribution to the alien and invasive flora of Montenegro and results given in it presents our field observation, gathered during different floristic and habitat investigations.

Material and methods

Data on invasive flora presented in this paper were gathered during different floristic and habitat investigations of central and coastal part of the country, undertaken in period late summer 2011 to spring 2013. Each location where alien plants were recorded were geo-coded by using a GPS device Garmin e-Trex Vista C. Field data about the habitats were also collected. Collected specimens were deposited in the Herbarium Collection of the Faculty of Natural Sciences in Podgorica (TGU!), while identification of materials was conducted according to McNeil (1976) and Pignatti (1982).

Results and discussion

Solidago gigantea Aiton, Giant goldenrod/Late goldenrod (Fam. Asteraceae)

During the floristic survey in August-September 2011,on two distinct localities near the road side in peri-urban area of Nikšić (N42º 47'21''E 18º 55'42") and Mojkovac (N42º 57'28''E 19º 34'23"), several individuals of ornamental plant *Solidago gigantea* Aiton, were recorded. The plant belongs to the *Solidago canadensis* L. complex within the subgenus *Triplinervae* (Weber & Jacobs, 2005). Plant is known as a Giant goldenrod/Late goldenrod. It is up to 280 cm tall, erect rhizomatous perennial with annual aboveground shoots 5-11mm in diameter. Shots are branched only in the inflorescence. They are mainly glabrous, or weakly hairy in the inflorescence. Leaves are alternate, oblong to lanceolate, often acuminate, with margins mostly serrate, occasionally entire, triple-nerved, glabrous or sometimes pubescent beneath. They are largest in the middle of shoots and become smaller towards the apex and within inflorescence. Inflorescences form broad pyramidal panicles with recurving branches and a central axis. Bracts of the involucre are linear, obtuse or somewhat acute, 3.5-5mm. Ray florets are golden yellow, female and fertile, disc florets are bisexual and fertile, capitula 3-5 mm long. Achenes are pubescent, 1-2 mm long, with a pappus of 1 mm long (McNeil, 1976; Weber & Jacobs, 2005).

Giant Goldenrod originates from North America (McNeil, 1976). It was introduced into Europe as an ornamental plant in the mid-1700s, with naturalized populations first observed in the mid-1800s (Wagenitz, 1979). Continuous spread was noted between 1850 and 1950, by which time most of the present range was occupied (Weber, 1998). According to (Euro+Med, 2006-), plant is naturalized in west, central and part of South Europe. It is included into the EPPO list of invasive alien plants (http://www.eppo.int/INVASIVE PLANTS/ias_lists.htm#A1A2Lists). It grows in a wide range of different soil conditions but is not shade tolerant (Ellenberg et al., 1992). Initially it occupied ruderal sites, such as roads, railway lines and rivers, it has also established in semi-natural and natural habitat since the late 19th Century (Guzikowa & Maycock 1986; Lohmeyer & Sukopp, 1992).

In the peri-urban area of Nikšić and Mojkovac, plant was reported near the roadside, in the vicinity of gardens, were it has been grown as ornamental. In 2012 survey, species was again

Fig. 1. *Solidago gigantea*, plant habitus and detail of glabrous shoot (photo A. Haines)

Fig. 2. *Solidago canadensis*, plant habitus (Photo D. Stešević) and detail of pubescent shoot (photo A. Haines)

reported for Mojkovac, but it disappeared from Nikšić, due to environmental changes caused by the road construction. The remaining locality in Mojkovac is placed near the Tara river bank, so considering habitat preferences: disturbed river banks and moist soils (Jacobs et al., 2004; Stančić, 2010; Koutika et al., 2011), this species might become more frequent in the area.

Besides Giant Goldenrod (*Solidago gigantea*), Canada Goldenrod (*S. canadensis* L.) is even more frequently planted in central and northern part of Montenegro. Both species are known as honey bee plants. According to (Walter, 1987) planting of Goldenrods as feeding plant for bees, may also have facilitated its invasion into new habitats. These closely related species are distinguished by following features: *S. gigantea* have glabrous and glaucous shoots, while shoots of *S. canadensis* are at least weakly pubescent (Fig. 1, 2). Involucre in *S. gigantea* is 3.5-5mm, while in *S.canadensis* is up to 3mm. Flowers of *S. gigantean* are bright yellow and the pappus is brownish-white, whereas the flowers of *S. canadensis* are somewhat lemon-yellow and the pappus silvery whitish (McNeil, 1976; Pignatti, 1982). Canada Goldenrod is also on the EPPO list of invasive alien plants (http://www.eppo.int/INVASIVE_PLANTS/ias_lists.htm#A1A2Lists). Considering bad habits of gardeners, who cut down the fruiting shoots or dump rhizome fragments on rubbish heaps outside the gardens, on riversides, brooks or waste places near the roadside, it is possible to generate subspontaneously growing individuals/populations of this species, too.

In the field survey at the Long Ulcinj Beach and Buljarice Bay, undertaken in late autumn 2012 to spring 2013, eleven NATURA 2000 habitats have been mapped: 1210 Annual vegetation of drift lines, 1410 Mediterranean salt meadows (*Juncetalia maritimi*), 2110 Embryonic shifting dune, 2120 Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes), 2190 Humid dune slack, 2220 Dunes with *Euphorbia terracina*, 2240 *Brachypodietalia* dune grasslands with annuals, 2270 * Wooded dunes with *Pinus pinea* and/or *Pinus pinaster*, 3170 * Mediterranean temporary ponds, 92A0 *Salix alba* and *Populus alba* galleries sand 91AA Eastern White-Oak wood. Almost each habitat type has an alien component of the flora (Tab. 1).

As it is shown in table 1, in the field survey of Long Ulcinj Beach and Buljarice Bay, 28 alien species were recorded. The richest alien flora has the Embryonic shifting dune and *Brachypodietalia* dune grasslands with annuals (10 species each), while the poorest with alien species are Mediterranean salty meadows (only one). Number of aliens would definitely be much higher if the survey included whole hinterland of both localities and all floristic aspects. Among them twenty are considered as invasive (Stešević & Petrović, 2010), while *Tagetes minuta* is proposed to be included in the list. Our own field investigation of the Long Ulcinj Beach dates from the beginning of 2000, when species was noticed sporadically. In the meantime it occupied larger area in the first line of the Beachs'hinterland, just near the sandy road that parallel goes with the sea-line, distant 250-600m from the sea. The most abundant population was recorded at Ada Bojana. As a new alien species for Montenegro this plant has been recorded at the beginning of 1970es in Boka Kotroska Bay: Dobrota, Kostanjica, Kamenjari, Igalo. Actually, it has been reported as a noxious weed of whole Mediterranean and Submediterranean part of former Yugoslavia, starting from SW Istria to S Macedonia (Šilić, 1973). The plant is worldwide known as invasive South-American species that establishes readily in disturbed sites in the coastal areas and can form dense populations. The large size and dense growth makes it highly competitive to native plant species (Weber 2003). Considering the fact that plant is recorded at 3 distant localities: Boka Kotorska Bay (Šilić, 1973; Obradović, 1980), Ulcinj area and Buljarice Bay, therefore, it would be interesting to

make a survey and see if it is established at some "in between" places.

General remarks of the survey are that the most aggressive and widespread aliens at surveyed sites at the Long Ulcinj Beach and its hinterland are *Xanthium strumarium* subsp. *italicum, Oenothera glazioviana, O. fallax, Conyza canadensis, C. albida, Aser squamatus, Sporobolus poirettii,* and *Tagetes minuta,* while in Buljarice Bay are: *Paspalum dilatatum, Sorghum halepense, Conyza canadansis, C.albida* and *Aster squamatus*. Alike other species, that can invade different kind of devastated habitats with small plant-cover value, Dallis Grass- *Paspalum dilatatum* prefere the grassy one, on which it soon begins to dominate. It is often accompanied by *Sporobolus poiretti*.

Conclusion

i) Alien flora of Montenegro is richer for one species: Giant Goldenrod- *Solidago gigantea.* Besides it, another Goldenrod species is frequently planted in central and northern part of Montenegro- Canada Goldenrod (*S. canadensis*). Considering bad habits of gardeners, who cut down the fruiting shoots or dump rhizome fragments on rubbish heaps outside the gardens, on riversides, brooks or waste places near the roadside, it is possible to generate subspontaneously growing individuals/populations of this species, too.

ii) The list of plant invaders in Montenegro is enlarged for one species: *Tagetes minuta.* The plant is recorded at 3 distant localities: Boka Kotorska Bay, Ulcinj area and Buljarice Bay, therefore it would be interesting to make a survey and see if it is established at some "in between" places.

iii) The most aggressive and widespread aliens at surveyed sites at the Long Ulcinj Beach and its hinterland are *Xanthium strumarium* subsp. *italicum, Oenothera glazioviana, O. fallax, Conyza canadensis, C. albida, Aser squamatus, Sporobolus poirettii,* and *Tagetes minuta*, while in Buljarice Bay are: *Paspalum dilatatum, Sorghum halepense, Conyza canadansis, C.albida* and *Aster squamatus*. Alike other species, that can invade different kind of devastated habitats with small plant-cover value, Dallis Grass- *Paspalum dilatatum* prefer the grassy one, on which it soon begins to dominate. It is often accompanied by *Sporobolus poiretti*.

Table 1. Alien and invasive species on different NATURA 2000 and anthropogenized habitats at the Long Ulcinj Beach and Buljarice Bay

Species	**Long Ulcinj Beach, Habitat type/cooridnates**	**Buljarice Bay, Habitat type/cooridnates**
Ailanthus altissima (Mill.) Swingle		Graveyard (N 42°11'18.1" E 18°59'25.7").
Agave americana L.	2110 Embryonic shifting dune (N 41°54'31.2" E 19°14'55.2").	
Amaranthus hybridus L.	Agricultural habitat (N 41°54'48.6" E 19°15'12.4", N 41°54'45.0" E 19°15'32.1").	
Amorpha fruticosa L.	92A0 *Salix alba* and *Populus alba* galleries (N 41°53'32.0" E 19°18'29.1"), 2270* Wooded dunes with *Pinus pinea* and/or *Pinus pinaster* (N 41°54'37" E 19°15'02.0"), 2190 Humide dune slack (N 41°54'19.4"E 19°16'00.8", N 41°54'09.8" E 19°16'42.3"), 2240 *Brachypodietalia* dune grasslands with annuals (N 41°51'51.6" E 19°20'27").	
Aster squamatus (Spreng.) Hieron	1410 Mediterranean salt meadows (*Juncetalia maritimi*) (N 41°52'52.9 E 19°19'48.5), 2190 Humide dune slack (N 41°54'19.4" E 19°16'00.8", N 41°53'19.0" E 19°18'42.6"), 2270* Wooded dunes with *Pinus pinea* and/or *Pinus pinaster* (N 41°54'15.18" E 19°15'58"), Ruderal habitat (N 41°53'14.9" E 19°18'29.2").	Graveyard (N 42°11'18.1" E 18°59'25.7").
Bidens subalternans DC.		Graveyard (N 42°11'18.1" E 18°59'25.7").

Species	**Long Ulcinj Beach, Habitat type/cooridnates**	**Buljarice Bay, Habitat type/cooridnates**
Conyza albida Willd.	2110 Embryonic shifting dune (N 41°54’39" E 19°14’34.7"), 2270* Wooded dunes with *Pinus pinea* and/or *Pinus pinaster* (N 41°54’15.18" E 19°15’58"). Agricultural habitat (N 41°54’45.0” E 19°15’32.1”), Ruderal habitat (N 41°54’31.7“ E 19°16’21.1“,N 41°53’52.2“ E 19°17’58.2“, N 41°53’14.9“ E 19°18’29.2“).	Mesophilic meadows (N 42°11’02.7” E 18°58’05.5”), Graveyard (N 42°11’18.1” E 18°59’25.7”).
Conyza canadensis (L.) Cronq.	2110 Embryonic shifting dune (N 41°54’ 31.2” E 19°14’ 55.2”), 2190 Humide dune slack (N 41°54’19.4” E 19°16’00.8”, N 41°53’19.0” E 19°18’42.6”), 2240 *Brachypodietalia* dune grasslands with annuals (N 41°54’08.1” E 19°16’59.8”, N 41°53’55.3” E 19°18’04.9”), 2270* Wooded dunes with *Pinus pinea* and/or *Pinus pinaster* (N 41°54’33.0” E 19°15’23.3”, N 41°54’15.18” E 19°15’58”), Agricultural habitat (N 41°54’48.6” E 19°15’12.4”), Ruderal habitat (N 41°54’31.7” E 19°16’21.1”, N 41°53’52.2” E 19°17’58.2”N 41°53’14.9” E 19°18’29.2”, N 41°53’27.9” E 19°18’26.8”), agricultural land (N 41°54’02.7” E 19°186’00.2”).	Mesophilic meadows (N 42°11’02.7” E 18°58’05.5”), Graveyard (N 42°11’18.1” E 18°59’25.7”).
Datura stramonium L.	2270* Wooded dunes with *Pinus pinea* and/or *Pinus pinaster* (N 41°54’15.18” E 19°15’58”), Agrucultural habitat (N 41°53’52.2” E 19°17’58.2”).	
Chenopodium multiflorum Moq.	Ruderal habitat (N 41°53’52.2“ E 19°17’58.2“).	
Cuscuta caesattiana Bertol.	2270* Wooded dunes with *Pinus pinea* and/or *Pinus pinaster* (N 41°54’15.18” E 19°15’58”).	
Datura stramonium L.	Agricultural habitat (N 41°54’45.0” E 19°15’32.1”), Ruderal habitat (N 41°53’52.2” E 19°17’58.2”).	
Eleusine indica (L.) Gaertn.	Ruderal habitat (N 41°54’37.0" E 19°14’27.7", N 41°53’14.9" E 19°18’29.2").	
Euphorbia maculata L.	Ruderal habitat (N 41°53’14.9" E 19°18’29.2").	
Lepidium virginiacum L.		Graveyard (N 42°11’18.1" E 18°59’25.7").
Melia azedarach L.	2110 Embryonic shifting dune (N 41°54’ 31.2" E 19°14’ 55.2")	Roadside vegetation (N 42°11’32.0" E 18°58’20.6").
Mentha × *piperita*	Ruderal habitat (N 41°53’52.2" E 19°17’58.2").	
Oenothera fallax Renner & *O. glazioviana* Micheli	2110 Embryonic shifting dune (N 41°54’31" E 19°14’55.2", N 41°54’39" E 19°14’34.7", N 41°54’28.0" E 19°15’19.7", N 41°54’19.2" E 19°15’50.3"), 2120 Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) (N 41°53’47.4" E 19°17’21.0", N 41°53’32.0" E 19°18’01.0") Ruderal habitat (N 41°53’27.9" E 19°18’26.8").	
Oenothera suaveolens Desf.	2110 Embryonic shifting dune (N 41°53’18.9" E 19°18’33.3").	

Species	**Long Ulcinj Beach, Habitat type/cooridnates**	**Buljarice Bay, Habitat type/cooridnates**
Robinia pseudoacacia L.	2110 Embryonic shifting dune (N 41°54' 31.2" E 19°14' 55.2"), 2270* Wooded dunes with *Pinus pinea* and/or *Pinus pinaster* (N 41°54'37" E 19°15'02.0", N 41°54'15.18" E 19°15'58") Ruderal habitat (N 41°54'40.2" E 19°14'10.4", N 41°54'40.2" E 19°14'10.4"), Agricultural habitat (N 41°54'48.6" E 19°15'12.4").	
Parthenocissus quinquefolia (L.) Planch.	Ruderal habitat (N 41°54'40.2" E 19°14'10.4").	
Paspalum dilatatum Poir.	92A0 *Salix alba* and *Populus alba* galleries (N 41°54'31.5" E 19°15'53.9").	Mesophilic meadows (N 42°11'42.2" E 18°58'10.3", N 42°11'36.1" E 18°58'17.1", N 42°11'02.7" E 18°58'05.5").
Paspalum paspaloides (Michx.) Schribn.	2270* Wooded dunes with *Pinus pinea* and/or *Pinus pinaster* (N 41°54'33.0" E 19°15'23.3") Ruderal habitat (N 41°54'31.7" E 19°16'21.1", N 41°53'27.9" E 19°18'26.8").	
Phytolacca americana L.	Agricultural habitat (N 41°54'48.6" E 19°15'12.4"), Ruderal habitat (N 41°54'40.2" E 19°14'10.4", N 41°54'31.7" E 19°16'21.1", N 41°53'52.2" E 19°17'58.2").	
Sorghum halepense (L.) Pers.	Agricultural habitat (N 41°54'48.6" E 19°15'12.4", N 41°54'45.0" E 19°15'32.1").	Mesophilic meadows (N 42°11'00.2" E 18°58'50.4", N 42°11'02.7" E 18°58'05.5").
Sporobolus poirettii (R.et S.) Hitche	2240 *Brachypodietalia* dune grasslands with annuals (N 41°54'08.1" E 19°16'59.8", N 41°53'55.3" E 19°18'04.9"), 2270* Wooded dunes with *Pinus pinea* and/or *Pinus pinaster* (N 41°54'15.18" E 19°15'58") 92A0 *Salix alba* and *Populus alba* galleries (N 41°54'31.5" E 19°15'53.9"9), Agricultural habitat (N 41°54'48.6" E 19°15'12.4", N 41°54'45.0" E 19°15'32.1"), Ruderal habitat (N 41°54'31.7" E 19°16'21.1", N 41°53'14.9" E 19°18'29.2", N 41°53'27.9" E 19°18'26.8").	Mesophilic meadows (N 42°11'42.2" E 18°58'10.3"), Graveyard (N 42°11'18.1" E 18°59'25.7").
Tagetes minuta L.	2240 *Brachypodietalia* dune grasslands with annuals, and ruderal habitat in line transect: (N 41°53'52.2" E 19°17'58.2" to N 41°51'51.6" E 19°20'27").	Graveyard (N 42°11'18.1" E 18°59'25.7").
Xanthium strumarium L. *italicum* (Moretti) D.Löve	2110 Embryonic shifting dune (N 41°54'31" E 19°14'55.2", N 41°54'39" E 19°14'34.7", N 41°54'19.2" E 19°15'50.3", N 41°53'22.6" E 19°18'22.7"), 2270* Wooded dunes with Pinus pinea and/or Pinus pinaster (N 41°54'15.18" E 19°15'58"), 2120 Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) (N 41°54'09.7" E 19°16'19.5", N 41°53'47.4" E 19°17'21.0", N 41°53'32.0" E 19°18'01.0", N 41°53'19.0" E 19°18'42.6"), Ruderal habitat (N 41°54'40.2" E 19°14'10.4", N 41°54'31.7" E 19°16'21.1", N 41°53'14.9" E 19°18'29.2"), Agricultural land (N 41°54'02.7" E 19°186'00.2", N 41°53'27.9" E 19°18'26.8").	1210Annual vegetation of drift lines (N 42°11'36.4" E 18°578'54.7").
Yucca gloriosa L.	2110 Embryonicshifting dune (N 41°54' 31.2" E 19°14' 55.2").	

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