

THE CURRENT SPREAD OF SOME INVASIVE NEOPHYTES ALONG THE LOWER COURSE OF THE SIRET RIVER

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Abstract

In this paper, we present new data on eight species of neophytes of North American origin (*i.e.*, *Bidens frondosa*, *Euphorbia glyptosperma*, *Fraxinus pennsylvanica*, *Lepidium densiflorum*, *Oenothera depressa*, *O. suaveolens*, *Oxalis dillenii*, and *Parthenocissus inserta*), whose spread in the lower course of the Siret river proved to be much wider than was previously known in the literature. All of these species are invasive in natural and anthropogenic habitats, on both banks of the river. Two of them were introduced deliberately in Romania, as ornamental plants (*Fraxinus pennsylvanica* and *Parthenocissus inserta*), while the other 6 species were introduced accidentally. *Euphorbia glyptosperma* and *Oenothera suaveolens* are reported here for the first time in the historical province of Muntenia, and other species are floristic novelties for counties of Vrancea (*Bidens frondosa*, *Fraxinus pennsylvanica*, *Oenothera depressa*) and Brăila (*Fraxinus pennsylvanica* and *Oxalis dillenii*). In addition to current spread of these species along the lower course of the Siret River, the paper provides data on the types of habitats invaded by each of them.

Key words: alien flora, Romania, EUNIS habitat types

Invasive alien (non-native) species have been identified worldwide as the second cause affecting the biological diversity, after habitat deterioration or loss (Genovesi P., Shine C., 2004; Wittenberg R., Cock M.J.W., 2001).

As a result of their high degree of disturbance induced by various natural and anthropogenic factors, riverine ecosystems are particularly vulnerable to invasion (Anđelković A.A. *et al.* 2016; Castro-Díez P., Alonso Á., 2017; Miyawaki Sh., Washitani I., 2004; Nobis A. *et al.* 2018; Planty-Tabacchi A.M. *et al.* 1996; Pyšek P., Prach K., 1993; Rejmánek M. *et al.* 2013; Zedler J.B., Kercher S., 2004).

Due to their aggressive expansion abilities and rapid growth, many invasive alien plants may develop dense, mono-dominant stands, which substitute the primary plant communities in riparian or aquatic habitats. This may drive radical alterations on natural biodiversity and the structure and functions of river ecosystems (Richardson D.M. *et al.* 2007; Stohlgren T.J. *et al.* 1998; Zedler J.B., Kercher S., 2004). On their turn, riparian habitats invaded by alien plants function as important centers for subsequent invasions in adjacent areas (Nobis A. *et al.* 2018).

The interest in assessing neophyte invasion in riverine habitats is increasing in Romania, and

some general assessments of neophyte invasions and their ecological impact on this types of habitats has been published in recent time (*e.g.* Anastasiu P. *et al.* 2008; Goia I. *et al.* 2008; Sîrbu C. *et al.* 2012; Kucsicsa G. *et al.* 2018 etc.).

Our study was conducted along the lower course of the Siret River, which is of particular interest for the study of alien plants invasion, given that along it two large sites of Community interest have been designated, namely ROSCI0162 and ROSPA0071 (both with the same name - "Lunca Siretului inferior"), these including other five smaller sites of European or national interest (*e.g.* ROSCI0072 - "Dunele de Nisip de la Hanul Conachi", to mention only the best known one of them).

MATERIAL AND METHOD

Species and habitats were recorded as a result of our field works (2018-2020), along the lower course of the Siret river. Voucher specimens were deposited in the Herbarium of the University of Agricultural Sciences and Veterinary Medicine Iași (IASI). For species identification and nomenclature, we used the following standard floras: Ciocârlan V., 2000; Sârbu I. *et al.* 2013; Tutin T.G. *et al.* (eds), 1964-1980.

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Names and abbreviations of natural and anthropogenic habitats follow the EUNIS classification (Janssen J.A.M. *et al*, 2016; Schaminee J.H.J. *et al*, 2012).

For neophytes (i.e. alien plant species introduced after the year 1500) and their invasive status we followed the terminology and definitions recommended by Richardson D.M. *et al*, (2000) and Pyšek P. *et al* (2004).

RESULTS AND DISCUSSIONS

Of the alien plants identified by us along the lower course of the Siret river between the years 2018 and 2020, we have selected a number of 8 species to be presented here. All of these species are invasive neophytes, native to North America, whose spread in this territory proved to be much wider than was previously known in the literature. Two of them were introduced deliberately in Romania, as ornamental plants (*Fraxinus pennsylvanica* Marshall and *Parthenocissus inserta* (A. Kerner) Fritsch), while the other 6 species were introduced accidentally (*Bidens frondosa* L., *Euphorbia glyptosperma* Engelm., *Lepidium densiflorum* Schrad., *Oenothera depressa* E. Greene, *Oenothera suaveolens* Person, and *Oxalis dillenii* Jacq.).

Two species are reported here for the first time in the historical province of Muntenia (*Euphorbia glyptosperma* and *Oenothera suaveolens*), and others are floristic novelties for counties of Vrancea (*Bidens frondosa*, *Fraxinus pennsylvanica*, *Oenothera depressa*) and Brăila (*Fraxinus pennsylvanica* and *Oxalis dillenii*).

Bidens frondosa L. The first report of this species in Romania has been made by Vicol (1970), who identified it in the Danube Delta. In a short time, the species proved to be quite widespread both in the Danube Delta and along the entire river valley (Todor I. *et al*, 1971; Țopa E., 1976), and subsequently it has been also reported along several inland rivers from the southern regions of the country (Negrean G., Constantin N., 1998; Sanda V., Popescu A., 1997-1998; Ciocârlan V., 2000 etc.), as well as in Transylvania (Schneider-Binder E., 1979; Drăgulescu C., 2003), Maramureș (Oprea A., Sîrbu C., 2006), Crișana (Negrean G., 2012) and Moldova (Sîrbu C., 2006). According to data published by Sîrbu C. & Oprea A. (2011), *B. frondosa* has been reported in over 125 localities throughout the country, thus having a pronounced invasive character.

In the lower course of the Siret river, this species has been known so far from only 4 localities (Galați, Barboși, Movileni-Șendreni and Șerbeștii Vechi) (Sîrbu C., Oprea A. 2011). We have identified it in other 11 localities in this

territory, as follows: Biliștei, Suraia, Călienii Vechi, Nănești, Pufești (Vrancea county), Bucești, Condrea, Cosmești, Ionăsești, Movileni and Braniștea at Balta Potcoava (Galați county).

The habitats invaded by *B. frondosa* in the studied territory are the following ones (names and abbreviations according to the EUNIS classification): Dried fluvial deposits with sparse vegetation [C3.55, C3.6], Wet fluvial deposits with pioneer vegetation [C3.5], Tall-helophyte beds [C5.1a] and Small-helophyte beds [C5.1b].

Euphorbia glyptosperma Engelm. This species has been recently reported for the first time in Romania by the last and first author of this paper (Sîrbu C., Șușnia I., 2018), from three localities situated along the lower course of the Siret river (Galați, Movileni-Șendreni and Șerbeștii Vechi). During our recent field works we also identified it in other 13 localities, from the counties of Brăila (Vameșu, and between Cantemir and Cotul Mihalea), Vrancea (Biliștei, Doaga, Suraia and Șendreni) and Galați (Bucești, Condrea, Cosmești, Ionăsești, Lungoci, Movileni, and downstream of Lungoci). In addition, we also found this species outside the study area, in the city of Focșani. In these localities, *E. glyptosperma* invades a quite wide range of habitats, such as: Dried fluvial deposits with sparse vegetation [C3.55, C3.6], Trampled habitats [E1.E, H5.6], Anthropogenic herb stands (ruderal habitats) [E5.1], Inland cliffs and outcrops [H3], Extractive industrial sites [J3] and Transport networks [J4].

Fraxinus pennsylvanica Marshall. Introduced into the country probably at the beginning of last century (Sîrbu C., Oprea A. 2011), being widely planted in scientific collections, parks, forest plantations and along roads, after a few decades this North American tree became naturalized in Romania, being reported as sub-spontaneous first by Borza Al. (1947), in Transylvania. Meanwhile, the number of localities across the whole country in which it has been identified in the wild state has steadily increased, thus being included in the list of invasive plants of the country (Anastasiu P., Negrean G., 2007; Sîrbu C., Oprea A., 2011).

In the lower course of the Siret river, it has been previously reported only from 3 localities of the Galați county, namely (Sîrbu C., Oprea A. 2011): Galați Movileni-Șendreni and Șerbeștii Vechi. Between 2018-2020, we identified it in other 11 localities, on both banks of the Siret river, in the counties of Brăila (Cantemir, between Cantemir and Cotul Mihalea, Cotu Mihalea), Galați (Hanu Conachi, Braniștea at Balta Potcoava), and Vrancea (Adjud, Călimănești, Haret, Mărășești, Nănești, Pufești).

In the study area it invades some natural habitats such as Pontic sandy steppe [E1.1a] (in the nature reserve Hanu Conachi), but especially the anthropogenic habitats on sandy soils: Anthropogenic herb stands (ruderal habitats) [E5.1], Broad-leaved forestry plantations [G1.C], Extractive industrial sites [J3] and Transport networks [J4].

Lepidium densiflorum Schrad. Collected in Romania towards the end of the 19th century (1893), but identified erroneously as *L. virginicum*, this species has been reported for the first time in our flora by Negrean G. (1980), at approx. 100 years since the first collection. According to the literature (see Sîrbu C., Oprea A., 2011; Sîrbu C. *et al.*, 2014), *L. densiflorum* is nowadays widespread throughout the country, but especially in the eastern regions.

At the 8 localities from which it has been previously reported in the lower course of the Siret River (Sîrbu C., Oprea A. 2011), we now add another 13 presence points from the counties of Brăila (between Cantemir and Cotul Mihalea, Vameșu), Vrancea (Adjud, Mărășești, Biliești, Suraia, Doaga) and Galați (Bucești, Cosmești Vale, Ionășești, Mălureni, Movileni and downstream of Lungoci).

In the study area, *L. densiflorum* copiously grows on sandy soils, both in natural and anthropogenic habitats, as follows: Dried fluvial deposits with sparse vegetation [C3.55 & C3.6], Pontic sandy steppe [E1.1a], Inland cliffs and outcrops [H3], Trampled habitats [E1.E & H5.6], Anthropogenic herb stands (ruderal habitats) [E5.1], Extractive industrial sites [J3], Transport networks [J4].

Oenothera depressa E. Greene has been recently reported for the first time in Romania, by Sîrbu C., Oprea A. (2017), from three localities situated in the lower course of the Siret river, Galați county (Șerbeștii Vechi, Bucești and Movileni), on the fluvial sands. During our field works (2018-2020), we found that this species is in fact much more spread on the both banks of the river, another 7 points of presence being added to those previously reported ones: Biliești, Suraia (Vrancea county), Condrea, Cosmești, Lungoci, Mălureni, and downstream of Lungoci (Galați county).

On both banks of the river, *O. depressa* invades especially sandy grounds of both natural and anthropogenic habitats such as (respectively): Dried fluvial deposits with sparse vegetation [C3.55 & C3.6], Riparian scrubs [F9.1b], Inland cliffs and outcrops [H3]; Extractive industrial sites [J3], Broad-leaved forestry plantations [G1.C], Trampled habitats [E1.E & H5.6].

Oenothera suaveolens Person. Like the previous congeneric species, *O. suaveolens* has been reported for the first time in Romania, by Sîrbu C., Oprea A. (2017). In the lower course of the Siret river, the cited authors reported this species on the fluvial sands from two localities on the left bank of the river, Galați county (Șerbeștii Vechi and Bucești). Other 3 presence points are added now, as a result of our field works, namely: between Cantemir and Cotu Mihalea, Vameșu (Brăila county), and downstream of Lungoci (Galați county). Although the current data shows that *O. suaveolens* is less widespread in the study area than *O. depressa*, however, its local populations are denser and extensive.

Similar to *O. depressa*, this species invades fluvial sands or other sandy grounds in both natural and anthropogenic habitats, such as: Dried fluvial deposits with sparse vegetation [C3.55 & C3.6]; Anthropogenic herb stands (ruderal habitats) [E5.1], Broad-leaved forestry plantations [G1.C].

Oxalis dillenii Jacq. Although known in Romania only since the second half of the last century (Dihoru Gh., 1968), this species (often confused in the literature with other congeneric species) is currently widespread in all provinces of the country, cumulating over 60 presence points (Sîrbu C., Oprea A., 2011).

In the lower course of the Siret river, *O. dillenii* was first collected in 1993, being reported so far from 9 localities bordering the river, as follows: Doaga (Coroi M., 2001), Cosmești - at the bridge (Coroi M., 2001), Cosmești - village, Hanu Conachi, Salcia (Sîrbu C., 2006), Barboși, Galați, Movileni-Șendreni, Șerbeștii Vechi (Sîrbu C., Oprea A., 2011). To these we now add another 13 points of presence, located on both banks of the river, namely: between Cantemir and Cotu Mihalea, Cotu Mihalea, Vameșu (Brăila county), Biliești, Nănești, Suraia (Vrancea county), Bucești, Condrea, Cosmești-Vale, Ionășești, Mălureni, Movileni, and downstream of Lungoci (Galați county).

According to our data, *O. dillenii* invades a wide range of habitats in the lower course of the Siret river, both natural and anthropogenic, such as (respectively): Dried fluvial deposits with sparse vegetation [C3.55 & C3.6], Riparian scrubs [F9.1b], Inland cliffs and outcrops [H3]; Trampled habitats [E1.E & H5.6], Anthropogenic herb stands (ruderal habitats) [E5.1], Broad-leaved forestry plantations [G1.C], Arable land and market gardens [I1]; Extractive industrial sites [J3], Transport networks [J4].

Parthenocissus inserta (A. Kerner) Fritsch. This neophyte, highly appreciated as ornamental in gardens and parks, has been noticed in a sub-

spontaneous state on the Romanian territory since the middle of the 19th century (Drăgulescu C., 2003), and it is currently registered as an invasive species throughout the country (Șîrbu C., Oprea A., 2011).

In the lower course of the Siret river, it has been recently identified (Șîrbu C., Oprea A., 2011), being reported so far from 3 localities of the Galați county (Galați, Barboși, and Movileni-Șendreni). Between 2018-2020 we also identified it in Braniștea, Bucești, Șerbeștii Vechi and Vameș (Galați county), in various habitats such as: natural habitats: Broad-leaved forestry plantations [G1.C], Inland cliffs and outcrops [H3], Wet tall-herb fringes [E5.4], Temperate thickets [F3.1e], Riparian *Salix* woodlands [G1.1], Riparian *Alnus* and mixed woodlands [G1.2a & G1.2b], Thermophilous deciduous woodlands [G1.7a]; anthropogenic habitats: Anthropogenic herb stands (ruderal habitats) [E5.1], Trampled habitats [E1.E & H5.6], Extractive industrial sites [J3], Transport networks [J4].

CONCLUSIONS

In this paper, we present new data on eight species of neophytes, of North American origin (*Bidens frondosa*, *Euphorbia glyptosperma*, *Fraxinus pennsylvanica*, *Lepidium densiflorum*, *Oenothera depressa*, *O. suaveolens*, *Oxalis dillenii*, and *Parthenocissus inserta*), which invade natural and anthropogenic habitats along the lower course of the Siret river;

Two of these species (*Fraxinus pennsylvanica* and *Parthenocissus inserta*) were introduced deliberately in Romania, as ornamental plants, and the other 6 species were introduced accidentally;

Euphorbia glyptosperma and *Oenothera suaveolens* are reported here for the first time in the historical province of Muntenia; other species are floristic novelties for counties of Vrancea (*Bidens frondosa*, *Fraxinus pennsylvanica*, *Oenothera depressa*) and Brăila (*Fraxinus pennsylvanica* and *Oxalis dillenii*).

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