



**NEOPHYTES IN PROTECTED AREAS.  
CASE STUDY: THE DANUBE DELTA BIOSPHERE RESERVE**

ANASTASIU Paulina<sup>\*</sup>, NEGREAN Gavril<sup>\*</sup>, SMARANDACHE Daniela<sup>\*</sup>,  
LIȚESCU Sanda<sup>\*</sup>, BASNOU Corina<sup>\*\*</sup>

**Abstract:** The Danube Delta is a relatively young territory, formed about 14,000 years ago. It has quadruple status: Biosphere Reserve, Ramsar site, UNESCO World Heritage site, Natura 2000 site. Water and human activities are the most important factors influencing the flora of this area, including the penetration and spread of alien plants. The main goal of our research in this area was to inventory the alien plants and to identify those species which are invasive and potentially invasive in the natural and semi-natural ecosystems in order to propose measures for their prevention and mitigation. An inventory of these plants, conducted between 2009 and 2012 and based on bibliography and field research, comprises over 160 taxa. About half of them originated from America and less than a quarter of them from Asia. A relatively high number of species have unknown status in the Danube Delta; they were reported only from one or two localities and we did not record them during our extensive field work. In this category we also included some taxa of *Xanthium* without a very clear taxonomy. The taxa recorded as casual are usually ornamental plants escaped from cultivation; however among them there are some species which are known as invasive in other areas of Romania, as well as in Europe. There are 26 naturalised species, two of which established here over one hundred years ago. 37 invasive species were identified, many of them recorded in natural or semi-natural places. In order to prevent and mitigate the spread of plants recognised as invasive, we propose the implementation of some measures such as providing relevant information to local communities and raising awareness about the damages caused by the alien species, and promoting further research on alien plant species in this protected area.

**Key words:** Alien plants, Danube Delta, invasive, neophytes

*Received 13 August 2014*

*Revision accepted 28 October 2014*

**Introduction**

It is well known that invasive alien species have a negative impact on ecosystems as well as serious economic and social consequences (European Commission 2013). It has been estimated that 10-15% of alien species found in the European Environment causes environmental, economic and social damage (European Commission 2013). Their impact on biodiversity is significant, producing losses and species extinction (European Commission 2013). One of the priority actions of the EU Biodiversity Strategy to 2020 (European Commission 2012) is to tighten controls on invasive alien species all over Europe.

---

<sup>\*</sup> University of Bucharest, Faculty of Biology and Botanical Garden "D. Brandza", Intr. Portocalelor 1-3, 060101-București, Romania, e-mail: anastasiup@yahoo.com

<sup>\*\*</sup> CREAf, Edifici C, Universitat Autònoma de Barcelona, 08193 Bellaterra, Spain

The problematics of the invasive species is also highly important in the case of the protected areas (i.e. wetlands), where few data on plant invaders is available. Moreover, river corridors and the adjacent watersheds represent major conduits for invasion of alien species (Foxcroft et al. 2007). That is why, there is an urgent need of surveys that quantify the distribution and local abundance of alien plants within the natural ecosystems in protected areas (Hulme et al. 2013), in order to establish their impact and the consequent management priorities.

The Danube Delta is one of the most famous areas in Europe thanks to its rich biodiversity. It is a relatively young territory that started forming about 14,000 years ago (Gâștescu & Știucă 2006). Thus, Danube Delta has quadruple status: Biosphere Reserve, Ramsar site (wetland of international importance), UNESCO World Heritage site, Natura 2000 site. Water and human activities are the most important factors influencing the flora of this area, including the penetration and spread of alien plants.

According to recent data, the Danube Delta shelters 5,429 species in 30 types of ecosystems (Brînzan 2013). Flora of the Danube Delta is represented by over 1,000 species: 1,215 species according to Doroftei et al. (2011) and 1,007 species of vascular plants according to Brînzan 2013. Among them, 14 are endangered and 5 are species of community interest (*Centaurea jankae*, *Centaurea pontica*, *Marsilea quadrifolia*, *Aldrovanda vesiculosa* and *Echium russicum*). About 70% of Danube Delta's vegetation is dominated by *Phragmites australis* and *Typha* spp. These plants form a complex association that occupies about 235,000 ha (Brînzan 2013).

The oldest report regarding alien flora in the Danube Delta belongs to Kanitz (1879-1881) and it refers to *Calibrachoa parviflora* (syn. *Petunia parviflora*), *Heliotropium curassavicum* and *Diplotaxis erucooides*. Ciocârlan (1994) listed 73 alien plants, but Schneider & Tudor (2006) indicated that only 33 taxa "came from other continents". Other data on alien flora of the Danube Delta are available in some papers regarding flora and vegetation of this region (Dihoru & Negrean 1976, Roman 1992, Sârbu & Ștefan 1993, Hanganu et al. 2002, Dubyna et al. 2003). Doroftei (2009) listed in his PhD Thesis 128 alien plants, but Doroftei et al. (2011) indicated later a percent of 5.4% alien plants from a total of 1,215 vascular plants existing in the Danube Delta, this meaning only 66 species. In the Management Plan of the Danube Delta Biosphere Reserve, 58 alien vascular plants are mentioned and 56 of them are listed (Rezervația Biosferei Delta Dunării 2011). Anastasiu (2011b) reported 168 alien plants (including archaeophytes) for the Danube Delta, but new incomes are permanently reported (Anastasiu 2011a, Sîrbu & Oprea 2011). Some of these alien plants have already become characteristic or dominant species for some vegetal associations, but the majority are only present in ruderal vegetal communities (Doroftei & Anastasiu 2014).

The main goals of our work are: (1) to update the inventory of the neophytes in the Danube Delta Biosphere Reserve, recording current alien plants richness and (2) to highlight those species which are invasive and potentially invasive in the natural and semi-natural ecosystems. Our approach will allow the identification of the major plant invaders and the most invaded habitats in the study area, establishing the basis for the invasive species management in the Danube Delta.

### Material and methods

**Study area.** The research was not confined to the area of the Danube Delta Biosphere Reserve, but it was extended to the entire Natura 2000 Delta Dunării (Danube Delta) site (Fig. 1). Located West of the Black Sea, the Danube Delta Biosphere Reserve covers an area of 4,455 km<sup>2</sup> (Gâțescu & Baboianu 2011), while the Natura 2000 Delta Dunării site, which also includes the lake complex Razim-Sinoe, stretches over an area of 4,540.37 km<sup>2</sup> (Ministerul Mediului și Schimbărilor Climatice, 2011). The geographic coordinates of the site are: 44°20' - 45°26' N and 28°10'-29°43' E.

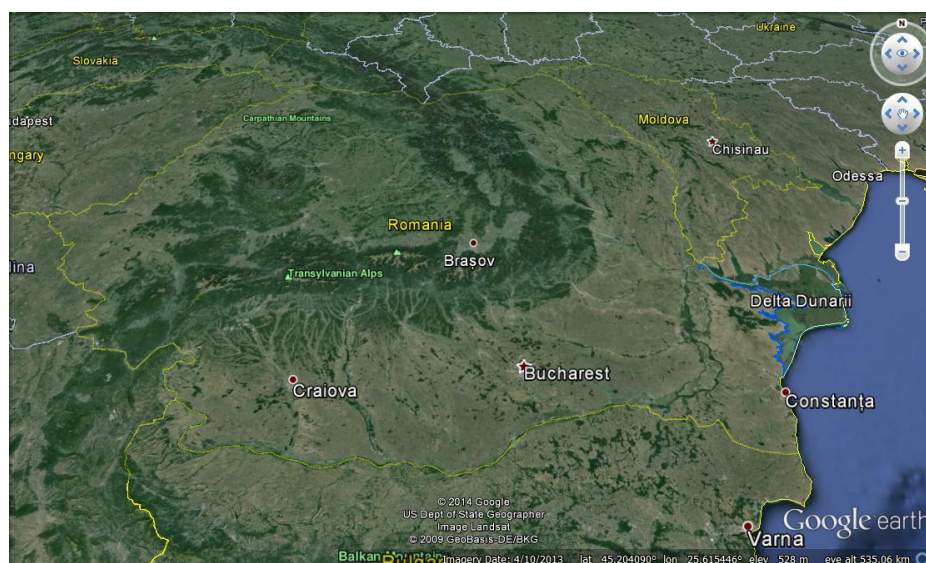


Fig. 1. Natura 2000 Delta Dunării (Danube Delta), marked with blue line, is located in the East part of Romania and West of Black Sea (source: Google earth)

The Danube Delta is a flat region (a developing alluvial plane), with an altitude between 0-1 m on most of its spread (Gâțescu & Baboianu 2011). There are higher altitudes of up to about 12 m in the following areas: Chilia field, Stipoc continental levee, Letea and Caraorman marine levees (Gâțescu & Baboianu 2011). The main morphohydrographic categories include the marine levees, the river levees, the continental fields, the swampy lands, the lakes, the arms, streams and main channels (Gâțescu & Baboianu 2011). The climate is continental temperate with sea influences.

The main types of ecosystems from Danube Delta are rivers, stagnant waters, swampy and flooded areas, levees (Gâțescu & Baboianu 2011), and the habitats are specific for steppic and Black Sea regions.

The Danube Delta Protected Area includes strictly protected areas, buffer areas and economic areas represented by rural and urban localities. The oldest localities are Chilia and Murighiol, dating from the Bronze Age (cca 3,000-500 b.C.) (Gâțescu & Baboianu 2011). In terms of size, the most important localities in the Danube Delta are the harbour cities of Tulcea and Sulina. The specific economic activities in the Danube

Delta are fishing, farming, agriculture, hunting, navigation and tourism (Gâștescu & Baboianu 2011).

**Neophytes inventory and data analyses.** The inventory list of neophytes is based on bibliographic sources, herbaria sheets and own field observation and records conducted between 2009 and 2012. Beside naturalised and invasive plants, we included in the final list all species of alien origin recorded as escaped from cultivation (casual). For each taxon we registered and analysed the family, life form, native distribution, Romanian distribution on historic region, invasive status and the presence in natural and semi-natural habitats.

The nomenclature of species and subspecies is according to The Plant List ([www.theplantlist.org](http://www.theplantlist.org)).

The terminology used for alien plants is according to Richardson et al. (2000) and Pyšek et al. (2004).

### Results and discussion

The inventory list of neophytes from the Danube Delta Biosphere Reserve comprises 163 taxa (see Annex 1). This list includes, beside the species with very clear status of neophytes, some species that are problematic due to either their unclear taxonomic status, or for their controversial native distribution: *Abutilon theophrasti*, *Artemisia annua*, *Bassia scoparia*, *Cladium mariscus* subsp. *martii*, *Heliotropium suaveolens*, *Hordeum marinum*, *Oenothera glazioviana*, *Salsola acutifolia*, *Salsola collina*, *Xanthium* spp.. For example, according to Erhardt et al. (2008), *Abutilon theophrasti* is an Asian species from India and China, naturalised in Europe, but according to other authors, this species is Eurasian and thus native in Romania (Ciocârlan 2009, Sârbu et al. 2013). The taxonomy of *Xanthium* is not fully elucidated. Thus, *Xanthium italicum* Moretti is considered either accepted name (Sârbu et al. 2013), or synonym for *Xanthium orientale* subsp. *italicum* (Moretti) Greuter (<http://www.theplantlist.org/>), *Xanthium strumarium* L. subsp. *italicum* (Moretti) D.Löve ([Royal Botanic Garden Edinburgh 1998](http://www.theplantlist.org/)).

The recorded neophytes from the Danube Delta Biosphere Reserve belong to 52 families, 31 only with one representative each, and other 21 with two up to 33 representatives (Fig. 2). The most taxa belong to the families Asteraceae (33 taxa), Amaranthaceae (20 taxa) and Poaceae (15 taxa). Asteraceae and Poaceae are families recognized for their significant contribution to the total number of alien species in areas with temperate climate, while Amaranthaceae is known as one of the families with the most invasive species (Pyšek 1998).

As regards the life forms of the neophytes from the Danube Delta Biosphere Reserve, therophytes are dominant with 91 taxa (55.8%). These are followed by hemicryptophytes with 29 taxa (17.8%) and phanerophytes with 21 taxa (12.9%) (Fig. 3). This situation is similar to the pattern of neophytes across Romania (Anastasiu & Negrean 2005, Anastasiu & Negrean 2009).

About half of the neophytes listed for the Danube Delta Biosphere Reserve are originated from America (84 taxa), 23.3% of neophytes have their native distribution in Asia (38 taxa) and 14.7% in the Mediterranean regions (Fig. 4). At national level, the distribution is quite different; neophytes with native distribution in the Mediterranean region come second, followed by neophytes originated in Asia (Anastasiu & Negrean

2009). This pattern could be explained by the geographical position of the Danube Delta, closer to Asia than other regions of Romania.

A remarkable percent of neophytes recorded for the Danube Delta (24.5% - 40 taxa) was not reported from other regions of the country. Among these neophytes we can mention *Ambrosia psilostachya*, *Calibrachoa parviflora*, *Dysphania pumilio*, *Cyperus odoratus*, *Heliotropium curassavicum*, *Lindernia dubia*, *Sagittaria trifolia*. Contrary, some neophytes (14 taxa - 8.5%) were recorded across the country (e.g. *Amaranthus retroflexus*, *Conyza canadensis*, *Cuscuta campestris*, *Galinsoga parviflora* etc.) (see Annex 1).

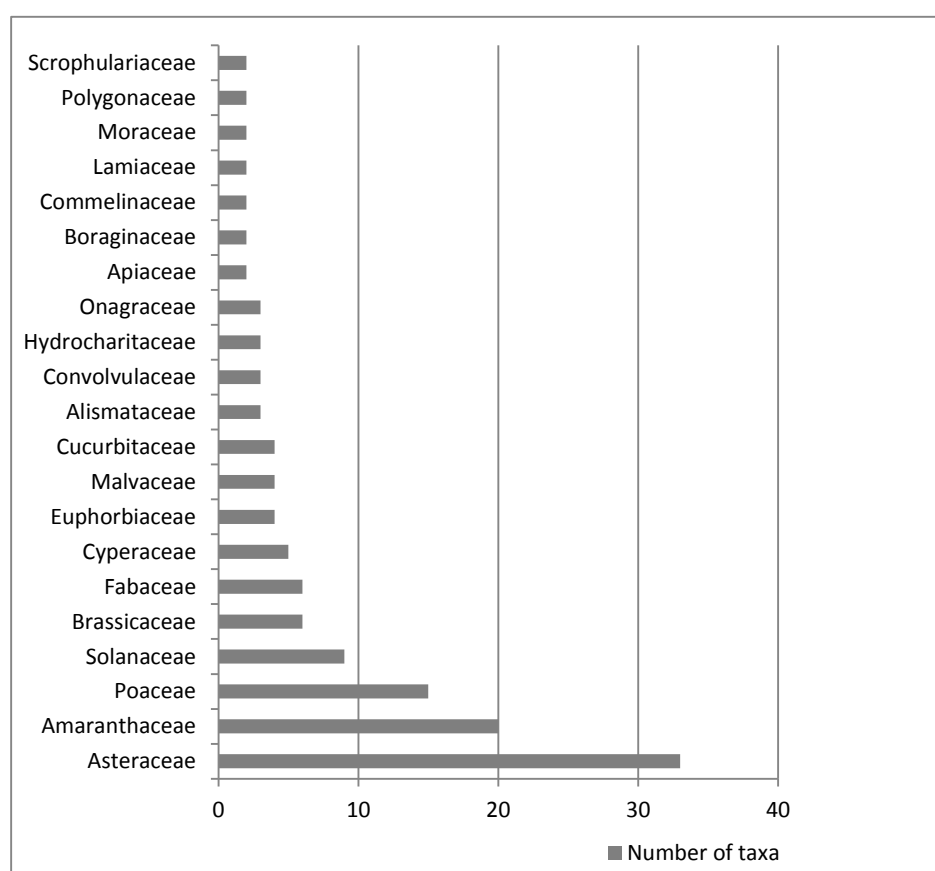


Fig. 2. The representative families for neophytes recorded in the Biosphere Reserve Danube Delta

Regarding the distribution of neophytes in the Danube Delta Biosphere Reserve, we cannot confirm the presence of many previously reported neophytes because we did not record them during our field work. In this situation there are 44 taxa (27%) and, except for two of them – *Hibiscus moscheutos* and *Paspalum distichum* – confirmed by

other sources (Doroftei et al. 2011, Sîrbu & Oprea 2011), these were appreciated having unknown status in the Danube Delta. In this category we also included some taxa of *Xanthium* without a very clear taxonomy. Other 59 taxa (35.54%) are casual, usually ornamental plants escaped from cultivation; however, among them there are some species which are known as invasive in other areas of Romania, as well as in Europe. We can mention here: *Asclepias syriaca*, *Helianthus tuberosus*, *Parthenocissus inserta*, *Rudbeckia laciniata* and *Solidago gigantea*. There are 26 naturalised species (15.66%), two of them are established here over one hundred years ago (*Calibrachoa parviflora*, *Heliotropium curassavicum*). 36 invasive species were identified (Annex 1, Fig. 5).

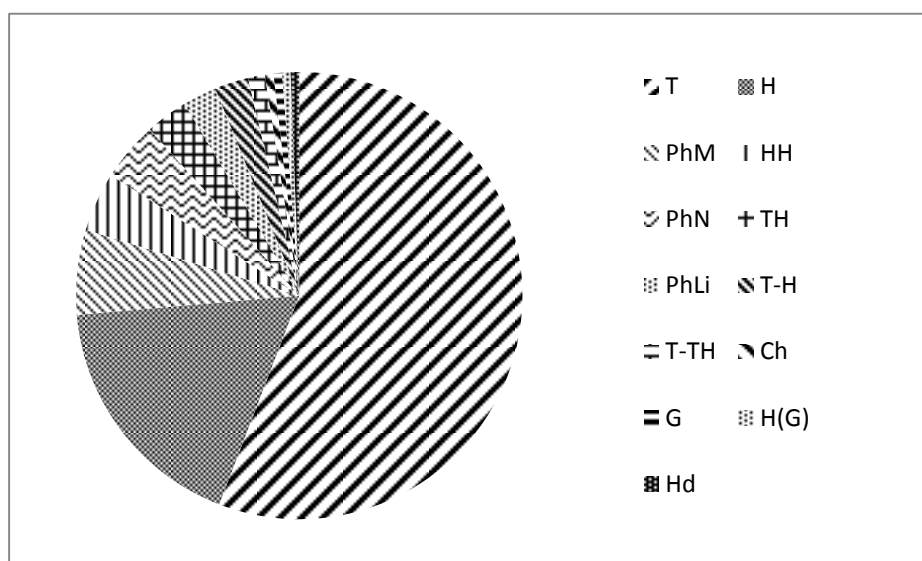


Fig. 3. Life forms of neophytes from the Danube Delta Biosphere Reserve

Many of the invasive plants were recorded in **natural or semi-natural habitats**: *Ailanthus altissima* and *Acer negundo* on dunes, *Amaranthus albus* and *Amaranthus blitoides* in salty habitats, *Amorpha fruticosa*, *Eclipta prostrata*, *Cyperus odoratus*, *Lindernia dubia* and *Dysphania ambrosioides* on alluvial sands, *Azolla filiculoides* and *Elodea nuttallii* in aquatic ecosystems, *Elaeagnus angustifolia* in salt marshes as well as on dunes, *Symphyotrichum ciliatum* on dunes and salty habitats as well, *Cuscuta campestris* on rare species such as *Eryngium maritimum*, *Argusia sibirica* and *Convolvulus persicus*.

However, The Management Plan of the Danube Delta Biosphere Reserve mentions only few alien species as competitors for native flora (*Azolla filiculoides*, *Amaranthus blitoides*, *Symphyotrichum ciliatum*, *Amorpha fruticosa*, *Phytolacca americana*), while other species are considered naturalized and not dangerous for local flora (*Acer negundo*, *Ailanthus altissima*, *Elaeagnus angustifolia*, *Fraxinus pennsylvanica*, *Lycium barbarum*, *Morus alba*, *Robinia pseudoacacia*) (Rezervația Biosferei Delta Dunării 2011).

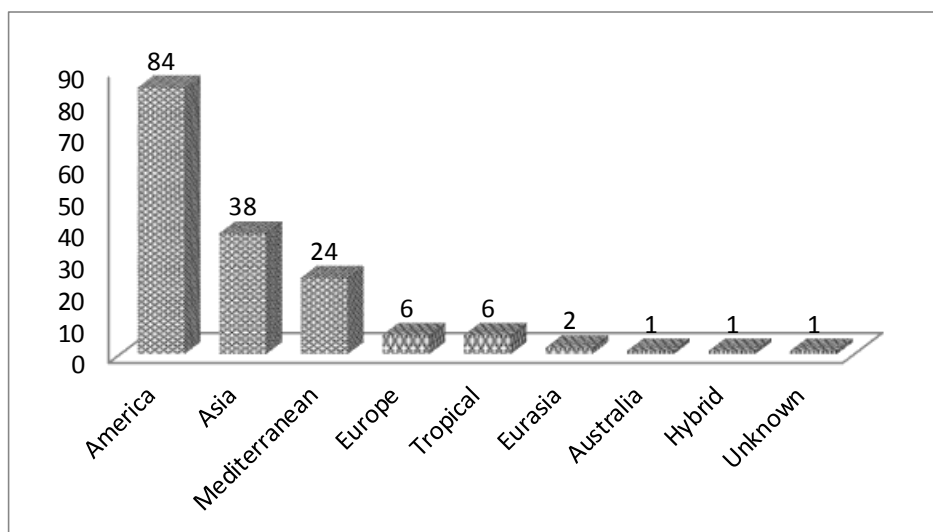


Fig. 4. Native distribution of neophytes recorded in the Danube Delta Biosphere Reserve

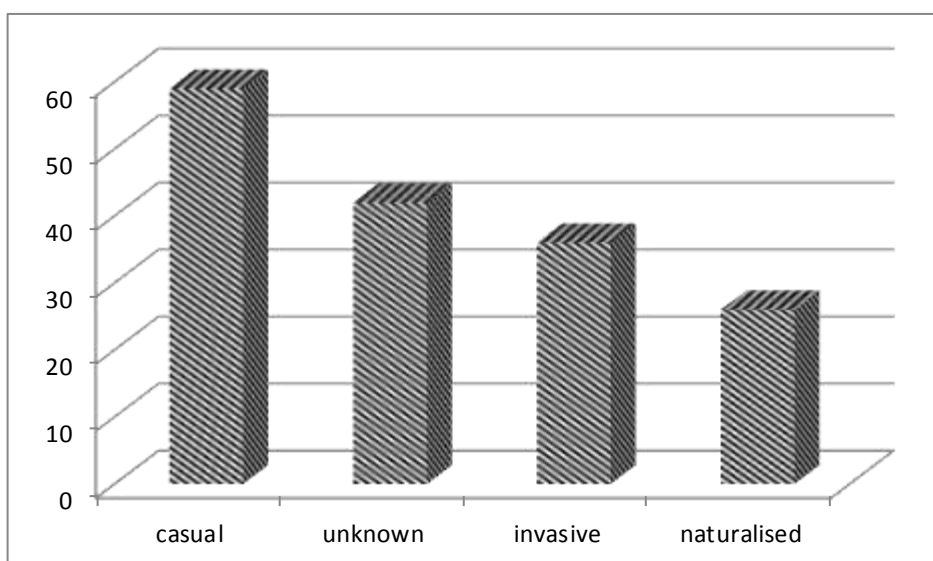


Fig. 5. The invasive status of neophytes from the Danube Delta Biosphere Reserve

One of the newest invasive plants in the Danube Delta is *Ambrosia artemisiifolia*, which was found in ruderal places from Sulina town (Anastasiu 2010), Chilia Veche, Dunavățul de Jos (Anastasiu 2011a) and also on the saltmarshes in Sacalin Island (Anastasiu 2011a), which is a strictly protected area.

The Action Plan for the Danube Delta Biosphere Reserve mentions, as activity A1.7, the inventory of invasive species and elaboration of precautionary measures for their management (Rezervația Biosferei Delta Dunării 2011). However, up to now there are not concrete actions regarding alien species. So, in order to prevent and mitigate the spread of plants recognised as invasive in the Danube Delta Biosphere Reserve, we propose the implementation of some measures such as providing relevant information to local communities and raising awareness about the damages caused by the alien species, ensuring permanent monitoring of the main entrances into the Danube Delta (e.g. harbours), the prohibition of deposits of vegetal waste, and promoting further research on alien plant species in this protected area. A special attention must be paid to those species recorded in the Danube Delta as escaped from cultivation, but known as invasive in other regions or countries: *Asclepias syriaca*, *Helianthus tuberosus*, *Parthenocissus inserta*, *Rudbeckia laciniata* and *Solidago gigantea*. The action of eradication must be prevalently focused on alien aquatic species as *Azolla filiculoides* and *Elodea* spp. Also, it is important to avoid the cultivation of some plants for biofuel like *Salix* spp. and *Populus* spp. that can escape and become invasive.

### Conclusions

The inventory of neophytes from the Danube Delta protected area comprises at this time 163 taxa. Even though 42 of them cannot be confirmed by our field work, there is a high number of invasive species (36 taxa) and other, recorded as naturalised or casual, that could become in short time invasive, given their status in Romania and in Europe too. Our findings could improve the evidence base and alien plant management of the Danube Delta Biosphere Reserve and provide a framework for developing an official black list with the major plant invaders. Further conservation strategies (i.e. Risk Assessment Analyses, delimitation and mapping of the areas and habitats with a high risk of invasion, watershed risk index etc.) will be later required to evaluate the impact and the control options of the invasive flora from the Danube Delta.

Because the Administration of the Danube Delta Biosphere Reserve did not implement any measures to control invasive alien species, it is imperatively necessary to take action as soon as possible in order to avoid the loss of important species and habitats from this important protected area.

**Acknowledgements:** The fieldwork in the Danube Delta was funded by CNCSIS PNII-IDEI 611/2008.

### References

- Anastasiu, P. & Negrean, G. (2005). Alien Plants in Romania. *Analele Șt. Univ. "A. I. Cuza" Iași*, 51, 85-96.
- Anastasiu, P. & Negrean, G. (2009). Neophytes in Romania. In L. Rakosy & L. Momeu (eds.), *Neobiota din Romania* (pp. 66-97). Cluj Napoca: Editura Presa universitară Clujană.
- Anastasiu, P. (2010). Contributions to chorological data on Romanian Flora. *Acta Horti Bot. Bucurest.*, 37, 45-50.
- Anastasiu, P. (2011a). New taxa and chorological data for Danube Delta Flora. *Acta Horti Bot. Bucurest.*, 38, 33-38.



- Anastasiu, P. (2011b). *Studiul complex asupra plantelor alohtone din Delta Dunării în vederea stabilirii impactului ecologic, evaluării riscului și elaborării măsurilor minime pentru managementul acestora*. Sinteza lucrării. București: Universitatea din București.
- Brînzan, T. (Red.) (2013). *Catalogul habitatelor, speciilor și siturilor Natura 2000 în România*. București: Exclus Prod.
- Ciocârlan, V. (1994). *Flora Deltei Dunării - Cormophyta*. București: Edit. Ceres.
- Ciocârlan, V. (1994). *Flora Deltei Dunării - Cormophyta*. București: Edit. Ceres.
- Ciocârlan, V. (2009). *Flora Ilustrată a României. Pteridophyta et Spermatophyta*. București: Edit. Ceres.
- Ciocârlan, V., Sârbu, I., Ștefan, N. & Marian, T. (1998). *Elodea nuttallii* (Planchon) St. John – specie nouă în flora României. *Bul. Grăd. Bot. Iași*, 6(1), 231-215.
- Dihoru, G. & Negrean, G. (1976). Flora of the Danube Delta. *Peuce (Bot.)*, 5, 217-251.
- Doroștei, M. & Anastasiu, P. (2014). Potential Impacts of Climate Change on Habitats and Their Effects on Invasive Plant Species on Danube Delta Biosphere Reserve, Romania. In S. Rannow & M. Neubert (eds.). *Managing Protected Areas in Central and Eastern Europe under Climate Change Advances in Global Change Research*, 58: 267-278.
- Doroștei, M. (2009). *Cercetări ecologice asupra unor specii de plante lemnoase alohtone din Delta Dunării*. PhD Thesis. Constanța: University Ovidius.
- Doroștei, M., Oprea, A., Ștefan, N. & Sârbu, I. (2011). Vascular flora of Danube Delta Biosphere Reserve. *Scientific Annals of DDI*, 17, 15-52.
- Dubyna, D.V., Shelyag-Sosonko, Y. R., Zhmud, O. I. et al. (2003). *Dunaisky Biosphere Reserve. Plant Kingdom*. Kyiv: Phytosociocentre.
- Erhardt, W., Götz, E., Bödeker, N. & Seybold, S. (2008). *Der grosse Zander. Enzyklopädie der Pflanzennamen*. Stuttgart: Ulmer.
- European Commission (2013). Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the prevention and management of the introduction and spread of invasive alien species /\* COM/2013/0620 final - 2013/0307 (COD) \*/. Retrieved December 13, 2013, from: <http://ec.europa.eu/environment/nature/invasivealien/>
- Foxcroft, L.C., Rouget, M. & Richardson, D.M. (2007). Risk assessment of riparian plan invasions into protected areas. *Conserv. Biol.*, 21 (2), 412-421.
- Gâștescu, P. & Baboianu, G. (2011). *Rezervația Biosferei Delta Dunării. Ghidul vizitatorului / Danube Delta Biosphere Reserve. Visitor's Guide*. Suceava: Manifest Suceava.
- Gâștescu, P. & Știucă, R. (2006). *Delta Dunării: rezervație a biosferei*. Constanța: Edit. Dobrogea.
- Ghișa, E. (1972). *Erianthus* L. C. Rich. In T. Săvulescu (red. princip.). *Flora Republicii Socialiste România*. Vol. 12 (pp. 62-65). București: Edit. Academiei Române.
- Hanganu, J., Dubyna, D., Zhmud, E., Grigoraș, I., Menke, U., Drost, H., Ștefan, N., & Sârbu, I. (2002). *Vegetation of the Biosphere Reserve "Danube Delta" with Transboundary Vegetation Map on a 1: 150000 scale*. Danube Delta National Institute, Romania; M.C. Kholodny – Institute of Botany & Danube Delta Biosphere Reserve, Ukraine and RIZA The Netherlands. RIZA Rapport 2002049, Lelystad.

- Hulme, P.E., Pyšek, P., Pergl, J., Jarošík, V., Schaffner, U. & Vilà, M. (2013). Greater focus needed on plant invasion impacts in protected areas. *Conservation Letters*. DOI: 10.1111/conl.12061
- Kanitz, A. (1879-1881). *Plantas Romaniae hucusque cognitae*. (Ephemeridi ad “Magyar Növövénytani Lapok” anni iii-v). i-xxiii, 1-268. Claudiopoli: E. Demjén; Londini: Dulau & Co.; Vindobonae: W. Braumüller et fil.
- Ministerul Mediului și Schimbărilor Climatice 2011. Formularul standard Natura 2000. Retrieved February 26, 2014, from: [http://www.mmediu.ro/protectia\\_naturii/biodiversitate/2011-10-20\\_protectia\\_naturii\\_RO\\_SCI\\_SDF\\_2011.pdf](http://www.mmediu.ro/protectia_naturii/biodiversitate/2011-10-20_protectia_naturii_RO_SCI_SDF_2011.pdf)
- Morariu, I. (1952). *Salsola* L. In T. Săvulescu (red. princip.). *Flora Republicii Populare Române*. Vol. 1 (pp. 577-581). București: Edit. Academiei Române.
- Nyárády, E. I. (1955). Fam. 36 Cruciferae B. Juss. In T. Săvulescu (red. princip.). *Flora Republicii Populare Române*. Vol. 3 (pp. 102-501). București: Edit. Academiei Române.
- Prodan, I. (1935-1938). Conspectul Florei Dobrogei. *Bul. Acad. Înalte Stud. Agron. Cluj*, 5(1), 175-342.
- Pyšek, P. (1998). Is there a taxonomic pattern to plant invasions? *Oikos*, 82, 282-294.
- Pyšek, P., Richardson, D.M., Rejmánek, M., Webster, G.L., Williamson, M. & Kirschner, J. (2004). Alien plants in checklists and floras: towards better communication between taxonomists and ecologists. *Taxon*, 51 (1), 131-143
- Rezervația Biosferei Delta Dunării (2011). *Planul de Management al Rezervației Biosferei Delta Dunării*. Retrieved 14 August, 2014, from: [http://www.ddbra.ro/media/Plan%20de%20Management%20RBDD\\_2011.pdf](http://www.ddbra.ro/media/Plan%20de%20Management%20RBDD_2011.pdf)
- Richardson, D.M., Pyšek, P., Rejmánek, M., Barbour, M.G., Panetta, F.D. & West, C.J. (2000). Naturalization and invasion of alien plants: concepts and definitions. *Diversity and Distribution*, 6, 93-107.
- Roman, N. (1992). Contribuții la cunoașterea florei Rezervației Biosferei Delta Dunării. *Analele Ști. Inst. Delta Dunării*, /1992/, 51-56.
- Royal Botanic Garden Edinburgh (1998). *Flora Europaea*. Retrieved 12 December, 2013, from: <http://rbg-web2.rbge.org.uk/>
- Sârbu, I. & Ștefan, N. (1993). Semina plantarum spontaneorum anno 1993 in Comuna Crișan, sat Caraorman, Grindul Hrușcova, Grindul Serec, Mila 23, Maliuc, Canal Șontea, Insula Popina, Sfântu-Gheorghe, Canal Buhaz, Câșla Vădanei, Gura Erenciuc, Grindul Crasnicol, Grindul Crețului, Grindul Ivancea, Grindul Sărăturile, Insula Sahalin lecta. *Delectus Seminum et Spororum, Hort. Bot. Iassiensis*, 70, 79-82.
- Sârbu, I., Ștefan, N. & Oprea, A. (2013). *Plante vasculare din România. Determinator de teren*. București: Edit. victorBvictor.
- Schneider, E. & Tudor, M. (2006). Flora. In P. Gâștescu & R. Știucă (eds), *Rezervația Biosferei Delta Dunării* (pp. 191-197). Constanța: Edit. Dobrogea.
- Sîrbu, C. & Oprea, A. (2011). *Flora adventivă din România*. Iași: Edit. Universității “Alexandru Ioan Cuza”.
- The Plant List (2010). *Version 1*. Retrieved October 25, 2013, from: <http://www.theplantlist.org/>

Annex 1 Inventory of alien plant from the Danube Delta Biosphere Reserve

Nr. crt.	Taxa	Family	Native distribution	Life form	Distribution in Romania (Anastasiu & Negrean 2009)	Distribution in Danube Delta (according to references)	References	Field records between 2009-2011	Status in Danube Delta
1	Abutilon theophrasti Medik.	Malvaceae	As / Eua	T	MM,Cr,T,B,O, Mu,D,DD,Mo	Chilia, Maliuc, Sulina, Tulcea	Doroftei et al. 2011 (as native)	Sulina, Chilia Veche, Periprava, Sf. Gheorghe	naturalised
2	Acer negundo L.	Sapindaceae	AmN	PhM	T,B,Cr,MM,O, Mu,Mo,DD,D	DD channels	Doroftei 2009	Sulina, Chilia Veche, Sf. Gheorghe	invasive
3	Acorus calamus L.	Acoraceae	As	H	T,B,O,Mu,Mo, DD	rare	Ciocârlan 1994	Sulina, Periprava, Sf. Gheorghe	naturalised
4	Aegilops crassa Boiss.	Poaceae	AsC	T	DD	Letea	Roman 1992, Ciocârlan 1994, Ciocârlan 2009	not recorded	unknown
5	Ailanthus altissima (Mill.) Swingle	Simaroubaceae	As	PhM	B,O,Mu,Mo,D, DD	cultivated and subsponaneous	Ciocârlan 1994, Doroftei 2009	Chilia Veche, Ostrov Tătaru, Periprava, C.A.Rosetti, Letea, Sfiștofca, Sulina, Sf. Gheorghe, Mahmudia, Saele Levee (to the fortress)	invasive
6	Albizia julibrissin Durazz.	Fabaceae	AsSW	PhM	DD	-	-	Chilia Veche	casual
7	Althaea rosea (L.) Cav.	Malvaceae	As(China)	H	B,O,Mu,Mo,D	Popina	Doroftei et al. 2011	not recorded	unknown
8	Amaranthus albus L.	Amaranthaceae	AmN	T	T,Cr,O,Mo,D, DD	rare	Ciocârlan 1994, Dubyna et al. 2003	Chilia Veche, Chilia's Field, Periprava, C.A. Rosetti, Sulina, Cășla Vădanei Levee	invasive
9	Amaranthus blitoides S.Watson	Amaranthaceae	AmN	T	Mu,Mo,D,DD	rare	Ciocârlan 1994, Dubyna et al. 2003	Chilia Veche, Sulina	invasive

<b>Nr. crt.</b>	<b>Taxa</b>	<b>Family</b>	<b>Native distribution</b>	<b>Life form</b>	<b>Distribution in Romania</b> (Anastasiu & Negrean 2009)	<b>Distribution in Danube Delta</b> (according to references)	<b>References</b>	<b>Field records between 2009-2011</b>	<b>Status in Danube Delta</b>
10	<i>Amaranthus blitum</i> subsp. <i>emarginatus</i> (Salzm. ex Uline & Bray) Carretero, Muñoz Garm. & Pedrol	Amaranthaceae	Trop	T	B,Mu,DD	rare on alluvial at Sacalin, Sf. Gheorghe, Chilia Veche	Ciocârlan 1994	Chilia Veche, Ostrov Babina, Sulina, Cășla Vădanei Levee, Sf. Gheorghe	invasive
11	<i>Amaranthus caudatus</i> L.	Amaranthaceae	AmS	T	Mu	Chilia Delta	Dubyna et al. 2003	Chilia Veche, Sulina, Mahmudia	casual
12	<i>Amaranthus crispus</i> (Lesp. & Thévenau) N.Terracc.	Amaranthaceae	AmS	T	T,Cr,MM,Mu, Mo,D,DD	rare	Ciocârlan 1994	C.A.Rosetti	naturalised
13	<i>Amaranthus cruentus</i> L.	Amaranthaceae	AmTrop	T	T,Cr,Mu,Mo	-	-	Chilia Veche, Periprava, Sf. Gheorghe	casual
14	<i>Amaranthus deflexus</i> L.	Amaranthaceae	AmS	T	T,B,Cr,MM,O, Mu,Mo,D,DD	rare	Ciocârlan 1994, Dubyna et al. 2003	not recorded	unknown
15	<i>Amaranthus hybridus</i> L. s.l.	Amaranthaceae	AmN	T	T,B,Cr,MM,O, Mu,Mo,D,DD	sporadic	Ciocârlan 1994	Chilia Veche	casual
16	<i>Amaranthus powellii</i> S.Watson s.l.	Amaranthaceae	AmN&S	T	Mu,Mo,DD	sporadic	Ciocârlan 1994	not recorded	unknown
17	<i>Amaranthus retroflexus</i> L.	Amaranthaceae	AmN	T	T,B,Cr,MM,O, Mu,Mo,D,DD	sporadic	Ciocârlan 1994, Dubyna et al. 2003	Chilia Veche, Ostrov Tătaru, Chilia's Field, Periprava, C.A. Rosetti, Sulina, Cășla Vădanei Levee, S. Gheorghe, Mahmudia, Murighiol, Saele Levee (to the fortress)	invasive

Nr. crt.	Taxa	Family	Native distribution	Life form	Distribution in Romania (Anastasiu & Negrean 2009)	Distribution in Danube Delta (according to references)	References	Field records between 2009-2011	Status in Danube Delta
18	<i>Ambrosia artemisiifolia</i> L.	Asteraceae	AmN	T	T,B,Cr,MM,O, Mu,Mo,D	Chilia Delta	Shelyag-Sosonko & Dubyna 1984 in Ciocârlan 1994	Sulina, Chilia Veche, Sacalin	invasive
19	<i>Ambrosia psilostachya</i> DC. [syn. <i>Ambrosia coronopifolia</i> Torr. & A. Gray]	Asteraceae	AmN	H	DD	rare on ruderal sands to Sfiștofca (Ciocârlan 1994), C.A. Rosetti (Ciocârlan 2009)	Ciocârlan 1994, Ciocârlan 2009	C.A.Rosetti	naturalised
20	<i>Ammophila arenaria</i> (L.) Link subsp. <i>arundinacea</i> H.Lindb.	Poaceae	Med	G	DD	Sulina	Prodan 1935-1938	not recorded	unknown
21	<i>Amorpha fruticosa</i> L.	Fabaceae	AmN	PhN	B,O,Mu,Mo,D, DD	cultivated and subsponaneous	Dubyna et al. 2003, Doroftei 2009	DD, frequent	invasive
22	<i>Anethum graveolens</i> L.	Apiaceae	AsSW	T	D	-	-	Periprava, CA.Rosetti, Sulina, Sf. Gheorghe	casual
23	<i>Antirrhinum majus</i> L.	Plantaginaceae	Med	T	T,B	-	-	Periprava, Sulina	casual
24	<i>Apium graveolens</i> L. s.l.	Apiaceae	EuW&S	TH	D,DD	frequent	Ciocârlan 1994	Chilia Veche, Periprava, Letea, Sulina, Câșla Vădanei Levee, Sf. Gheorghe, Sacalin	naturalised
25	<i>Armoracia rusticana</i> P. Gaertn., B. Mey. & Schreb.	Brassicaceae	EuSW&AsV	H(G)	MM,Cr,T,B,O, Mu,Do,DD,Mo	sporadic	Ciocârlan 1994	Chilia Veche, Chilia's Field, Antipa, Periprava, C.A. Rosetti, Sacalin	naturalised

Nr. crt.	Taxa	Family	Native distribution	Life form	Distribution in Romania (Anastasiu & Negrean 2009)	Distribution in Danube Delta (according to references)	References	Field records between 2009-2011	Status in Danube Delta
26	<i>Artemisia annua</i> L.	Asteraceae	AsC&SW	T	T,B,Cr,MM,O, Mu,Mo,D,DD	sporadic	Ciocârlan 1994	Chilia Veche, Chilia's Field, Antipa, Ostrov Cernovca, Ostrov Babina, Periprava, Letea, C.A. Rosetti, Sf. Gheorghe, Mahmudia, Saele Levee	invasive
27	<i>Asclepias syriaca</i> L.	Apocynaceae	AmN	H	B,Cr,Mu,Mo	-	-	Sulina	casual
28	<i>Atriplex hortensis</i> L.	Amaranthaceae	As	T	T, Cr, B, Mu, DD	-	-	Chilia's Field, Periprava, Sulina, Sf. Gheorghe	casual
29	<i>Azolla filiculoides</i> Lam. [syn. <i>Azolla caroliniana</i> Willd.]	Salviniaceae	AmN	HH	B,O,Mu,D,DD	sporadic	Ciocârlan 1994, Dubyna et al. 2003	Chilia Veche, Antipa, S. Gheorghe, Sacalin	invasive
30	<i>Bassia scoparia</i> (L.) A.J.Scott	Amaranthaceae	As&EuE	T	T,Cr,B,O,Mu, Mo,D,DD	subspontaneous	Ciocârlan 1994	Chilia Veche, Periprava, C.A. Rosetti, Sulina, Caraorman, Sf. Gheorghe, Mahmudia, Saele Levee	invasive
31	<i>Bassia sieversiana</i> (Pallas) A. Weber	Amaranthaceae	As	T	O,Mu,Mo,DD	rare,	Ciocârlan 1994	not recorded	unknown
32	<i>Bidens connata</i> Muhl. ex Willd.	Asteraceae	AmN	T	DD	very rare,	Ciocârlan 1994	not recorded	unknown
33	<i>Bidens frondosa</i> L.	Asteraceae	AmN	T	O,Mu,DD	frequent	Ciocârlan 1994, Dubyna et al. 2003	Chilia Veche, Tâtaru Channel, Ostrov Cernovca, Periprava, Sulina, Sf. Gheorghe	invasive

Nr. crt.	Taxa	Family	Native distribution	Life form	Distribution in Romania (Anastasiu & Negrean 2009)	Distribution in Danube Delta (according to references)	References	Field records between 2009-2011	Status in Danube Delta
34	<i>Bidens vulgata</i> Greene	Asteraceae	AmN	T	B,O,Mu,DD	„Reported from Delta Dunării, but probably confused with <i>B. frondosa</i> ” (Ciocârlan 1994); Delta Dunării (Ciocârlan 2009)	Ciocârlan 1994, Ciocârlan 2009	not recorded	unknown
35	<i>Calendula officinalis</i> L.	Asteraceae	Med	T-H	T,B,Cr,O,Mu, Mo	-	-	Chilia Veche, Periprava, Sulina, Sf. Gheorghe, Mahmudia	casual
36	<i>Calibrachoa parviflora</i> (Juss.) D'Arcy	Solanaceae	AmS	T-H	DD	rare, Sulina, Sf. Gheorghe	Ciocârlan 1994	Sulina, Sf. Gheorghe, Periprava, Sacalin	naturalised
37	<i>Campsis radicans</i> (L.) Seem.	Bignoniaceae	AmN	PhLi	DD	-	-	Periteașca Channel, Sulina	casual
38	<i>Carthamus tinctorius</i> L.	Asteraceae	AsW	T	DD	-	-	Chilia's Field	casual
39	<i>Celosia argentea</i> L.	Amaranthaceae	Trop	T	Mu	-	-	Chilia Veche, Sulina	casual
40	<i>Cenchrus incertus</i> M.A.Curtis	Poaceae	AmTrop	T	D	Doloșman	Doroftei et al. 2011	not recorded	unknown
41	<i>Cenchrus longispinus</i> (Hackel) Fernald	Poaceae	AmN	T	D,Mo	Chilia Delta	Dubyna et al. 2003	not recorded	unknown
42	<i>Dysphania pumilio</i> (R.Br.) Mosyakin & Clemants	Amaranthaceae	Australia	T	DD	Partizani, Chilia Delta	Ciocârlan 1994, Dubyna et al. 2003	Caraorman	naturalised

Nr. crt.	Taxa	Family	Native distribution	Life form	Distribution in Romania (Anastasiu & Negrean 2009)	Distribution in Danube Delta (according to references)	References	Field records between 2009-2011	Status in Danube Delta
43	<i>Citrullus lanatus</i> (Thunb.) Matsum. & Nakai	Cucurbitaceae	AfNW	T	B,D	-	-	Periprava, Ostrov Tătaru, Sulina, Caraorman, Sf. Gheorghe, Sinoe, Popina Island	casual
44	<i>Cladium mariscus</i> subsp. <i>martii</i> (Roem. & Schult.) T.V.Egorova	Cyperaceae	AsC,Med	H	Mu,DD	rare, Caraorman, Letea, Gârla Îmпуțită	Ciocârlan 1994	Sulina on Gârla Îmпуțită, Busurca Channel, Periprava	naturalised
45	<i>Cleome spinosa</i> Jacq.	Cleomaceae	Afr,As	T	DD	-	-	Sulina	casual
46	<i>Commelina communis</i> L.	Commelinaceae	As	H	T,B,MM,O,Mu,Mo,DD	-	-	Chilia Veche, Sulina, Sf. Gheorghe	casual
47	<i>Consolida ajacis</i> (L.) Schur	Ranunculaceae	Med	T	T,B,Cr,D	-	-	Sulina	casual
48	<i>Conyza canadensis</i> (L.) Cronquist	Asteraceae	AmN	T	T,B,Cr,MM,O,Mu,Mo,D,DD	frequent	Ciocârlan 1994	DD	invasive
49	<i>Coreopsis tinctoria</i> Nutt.	Asteraceae	AmN	T	T,Mu,Mo	-	-	Sulina	casual
50	<i>Cucumis sativus</i> L.	Cucurbitaceae	As	T	DD	-	-	Chilia Veche, Periprava, Sulina	casual
51	<i>Cucurbita pepo</i> L.	Cucurbitaceae	AmC	T	B,Mo	-	-	Chilia Veche, Chilia's Field, Periprava, C.A. Rosetti, Gârla Îmпуțită, Sulina	casual
52	<i>Cuscuta approximata</i> Bab.	Convolvulaceae	Med	T	DD	rare, Caraorman	Ciocârlan 1994	not recorded	unknown
53	<i>Cuscuta campestris</i> Yunck.	Convolvulaceae	AmN	T	T,B,Cr,MM,O,Mu,Mo,D,DD	frequent	Ciocârlan 1994	DD	invasive



Nr. crt.	Taxa	Family	Native distribution	Life form	Distribution in Romania (Anastasiu & Negrean 2009)	Distribution in Danube Delta (according to references)	References	Field records between 2009-2011	Status in Danube Delta
54	<i>Cydonia oblonga</i> Mill.	Rosaceae	AsSW	PhM	DD	-	-	Chilia Veche, Chilia's Field, Periprava, Ostrov Babina, Antipa, Ostrov Tătaru, Sulina, Sf. Gheorghe	naturalised
55	<i>Cymbalaria muralis</i> P. Gaertn., B. Mey. & Scherb. s. l.	Scrophulariaceae	Med	H	T,B,O,Mu,Mo	-	-	Sulina	casual
56	<i>Cyperus difformis</i> L.	Cyperaceae	EuS	T	O,Mu,Mo	-	-	Chilia Veche	naturalised
57	<i>Cyperus esculentus</i> L.	Cyperaceae	Trop	T-H	DD	DD	Dihoru & Negrean 1976	not recorded	unknown
58	<i>Cyperus odoratus</i> L.	Cyperaceae	Trop	T-H	DD	very rare, Letea, Sulina, Sf. Gheorghe, Chilia Delta	Roman 1992, Ciocârlan 1994, Dubyna et al. 2003	Chilia Veche, Sf. Gheorghe, Sacalin	invasive
59	<i>Datura innoxia</i> Mill.	Solanaceae	AmC	T	Mo	-	-	Chilia's Field, Periprava, C.A. Rosetti, Sulina, Caraorman, Sf. Gheorghe	casual
60	<i>Datura stramonium</i> L. [syn. <i>Datura tatula</i> L.; <i>Datura stramonium</i> var. <i>tatula</i> (L.) Torrey]	Solanaceae	Am	T	T,B,Cr,MM,O, Mu,Mo,D,DD	rare	Ciocârlan 1994	Chilia Veche, Chilia's Field, Antipa, Periprava, C.A. Rosetti, Letea, Sulina, Cășla Vădanei Levee, Sf. Gheorghe, Mahmudia	naturalised
61	<i>Dendranthema indicum</i> (L.) Des Moul.	Asteraceae	As	Ch	DD	-	-	Sulina	casual

<b>Nr. crt.</b>	<b>Taxa</b>	<b>Family</b>	<b>Native distribution</b>	<b>Life form</b>	<b>Distribution in Romania</b> (Anastasiu & Negrean 2009)	<b>Distribution in Danube Delta</b> (according to references)	<b>References</b>	<b>Field records between 2009-2011</b>	<b>Status in Danube Delta</b>
62	<i>Diplotaxis erucoides</i> (L.) DC.	Brassicaceae	Med	T	DD	Sulina	Kanitz 1879-1881	not recorded	unknown
63	<i>Dysphania ambrosioides</i> (L.) Mosyakin & Clemants	Amaranthaceae	AmTrop	T	B,Mo,D	sporadic	Ciocârlan 1994, Dubyna et al. 2003	Chilia Veche, Sulina, Sf. Gheorghe, Mahmudia, Murighiol, Dunavăț	invasive
64	<i>Echinocystis lobata</i> (Michx.) Torr. & A.Gray	Cucurbitaceae	AmN	T	T,B,Cr,O,Mo	Chilia Delta	Shelyag-Sosonko & Dubyna 1984 in Ciocârlan 1994	Sf. Gheorghe (abandoned fishery)	invasive
65	<i>Eclipta prostrata</i> (L.) L.	Asteraceae	AmTrop	T	D,DD	Sf. Gheorghe, Delta Dunării, Chilia Delta	Ciocârlan 1994, Ciocârlan 2009, Dubyna et al. 2003	Chilia Veche, Sf. Gheorghe, Sacalin, Mahmudia	invasive
66	<i>Elaeagnus angustifolia</i> L.	Elaeagnaceae	AsTemp	PhN	B,Mu,Mo,D,D D	frequent	Doroftei 2009	DD, frequent	invasive
67	<i>Elodea canadensis</i> Michx.	Hydrocharitaceae	AmN	HH	T,B,O,Mu,Mo, D,DD	sporadic	Ciocârlan 1994	not recorded	unknown
68	<i>Elodea nuttallii</i> (Planch.) H.St.John	Hydrocharitaceae	AmN	HH	B,O,Mu,D,DD	frequent	Ciocârlan et al. 1998	Ceamurlia enclosure on channels, Sulina, Sf. Gheorghe, Sacalin	invasive
69	<i>Erigeron annuus</i> (L.) Pers. subsp. <i>annuus</i>	Asteraceae	AmN	TH	T,B,Cr,MM,O, Mu,Mo,D	Chilia Delta	Shelyag-Sosonko & Dubyna 1984 in Ciocârlan 1994	Chilia Veche	naturalised

Nr. crt.	Taxa	Family	Native distribution	Life form	Distribution in Romania (Anastasiu & Negrean 2009)	Distribution in Danube Delta (according to references)	References	Field records between 2009-2011	Status in Danube Delta
70	<i>Eruca vesicaria</i> (L.) Cav. s.l.	Brassicaceae	Med	T	T,O,Mu,Mo,D,DD	Letea, C.A. Rosetti	Nyárády 1955	not recorded	unknown
71	<i>Euphorbia leptocaula</i> Boiss.	Euphorbiaceae	Eu(Pt)	H	DD	rare, Letea	Ciocârlan 1994	not recorded	unknown
72	<i>Euphorbia maculata</i> L.	Euphorbiaceae	AmN	T	T,B,O,Mu,Mo,DD	sporadic	Ciocârlan 1994, Dubyna et al. 2003	Periprava, Sulina, Cășla Vădanei Levee	invasive
73	<i>Euphorbia marginata</i> Pursh	Euphorbiaceae	AmN	T	O,Mu,Mo,DD	-	-	Chilia Veche	casual
74	<i>Fallopia aubertii</i> (L.Henry) Holub	Polygonaceae	As	PhLi	Mu,D,Mo	-	-	Chilia Veche, Sulina	casual
75	<i>Fimbristylis bisumbellata</i> (Forssk.) Bubani	Cyperaceae	Med	T	DD	very rare, Sulina, Caraorman	Dihoru & Negrean 1976, Ciocârlan 1994	not recorded	unknown
76	<i>Fraxinus pennsylvanica</i> Marshall	Oleaceae	Am	PhN	B,O,Mu	DD	Doroftei 2009	Chilia Veche, Tătaru Channel, Antipa, Ostrov Cernovca, Sulina, Caraorman, Sf. Gheorghe	invasive
77	<i>Gaillardia pulchella</i> Foug.	Asteraceae	AmN	T	DD	-	-	C.A.Rosetti, Sulina	casual
78	<i>Galinsoga parviflora</i> Cav.	Asteraceae	AmS	T	T,B,Cr,MM,O,Mu,Mo,D,DD	sporadic	Ciocârlan 1994, Dubyna et al. 2003	Chilia Veche, Sulina, Sf. Gheorghe, Mahmudia, Saele Levee	invasive
79	<i>Gleditsia triacanthos</i> L.	Fabaceae	AmN	PhM	B,Mo	cultivated and subsponaneous	Doroftei 2009	Sulina, Sf. Gheorghe	casual
80	<i>Glinus lotoides</i> L.	Mollugonaceae	Med	T	O,D,DD	very rare, on alluvial, wet sand, to Chilia Veche	Ciocârlan 1994	not recorded	unknown

Nr. crt.	Taxa	Family	Native distribution	Life form	Distribution in Romania (Anastasiu & Negrean 2009)	Distribution in Danube Delta (according to references)	References	Field records between 2009-2011	Status in Danube Delta
81	<i>Gomphrena globosa</i> L.	Amaranthaceae	AmS	T	DD	-	-	Sulina	casual
82	<i>Helianthus annuus</i> L.	Asteraceae	AmN	T	T,B,Cr,MM,O, Mu,Mo,D,DD	Sulina, Portița	Dihoru & Negrean 1976	Chilia Veche, Tătatu Forest, Sulina, Sf. Gheorghe, Sacalin, Saele Levee Sulina	casual
83	<i>Helianthus tuberosus</i> L.	Asteraceae	AmN	H	T,B,O,Mu,Mo	-	-	Sulina	casual
84	<i>Heliotropium curassavicum</i> L.	Boraginaceae	AmS	H	DD	rare, Caraorman, Letea, Sulina	Ciocârlan 1994	Sulina	naturalised
85	<i>Heliotropium suaveolens</i> M.Bieb.	Boraginaceae	Med	T	DD	Letea	Roman 1992	Popina Island	naturalised
86	<i>Hemerocallis fulva</i> (L.) L.	Xanthorrhoeaceae	As	H	T,Mu,Mo,D	-	-	Sulina	casual
87	<i>Hibiscus syriacus</i> L.	Malvaceae	AsS&W	PhN	DD	cultivated	Doroftei 2009	Sulina	casual
88	<i>Hibiscus moscheutos</i> L.	Malvaceae	AmN	H	DD	subspontaneous, Caraorman	Sîrbu & Oprea 2011	not recorded	casual
89	<i>Hordeum jubatum</i> L.	Poaceae	AmN,As	T	MM,Mu,DD	Stipoc Levee, Letea, Periprava	Dihoru & Negrean 1976	not recorded	unknown
90	<i>Hordeum marinum</i> Huds.	Poaceae	AfrN,EuW&S	T	DD	Letea, Sulina	Dihoru & Negrean 1976	not recorded	unknown
91	<i>Ipomoea purpurea</i> (L.) Roth	Convolvulaceae	AmTrop	T	T,B,O,Mu	-	-	Sulina, Sf. Gheorghe	casual

Nr. crt.	Taxa	Family	Native distribution	Life form	Distribution in Romania (Anastasiu & Negrean 2009)	Distribution in Danube Delta (according to references)	References	Field records between 2009-2011	Status in Danube Delta
92	<i>Iva xanthiifolia</i> Nutt.	Asteraceae	AmN	T	T, Mo, Mu, D	Chilia Delta	Shelyag-Sosonko & Dubyna 1984 in Ciocârlan 1994, Dubyna et al. 2003	Chilia Veche, Sulina, Mahmudia, Sf. Gheorghe	invasive
93	<i>Lathyrus sativus</i> L.	Fabaceae	Med	T	T,Mo,D,DD	-	Dihoru & Negrean 1976	not recorded	unknown
94	<i>Lemna minuta</i> Kunth	Araceae	Am	HH	D,DD	Chilia Delta, Nebunu Lake	Dubyna et al. 2003, Ciocârlan 2005 (com.pers.)	Periprava	naturalised
95	<i>Lepidium didymum</i> L.	Brassicaceae	AmS	T-TH	D,DD	rare, Sulina	Ciocârlan 1994	not recorded	unknown
96	<i>Leptochloa fusca</i> (L.) Kunth subsp. <i>fascicularis</i> (Lam.) N. Snow	Poaceae	AmN	T	DD	Chilia Delta	Dubyna et al. 2003	not recorded	unknown
97	<i>Lindernia dubia</i> (L.) Penell	Linderniaceae	AmN	T	DD	Sacalin, Sf. Gheorghe	Ciocârlan 1994	Chilia Veche, Sf. Gheorghe	invasive
98	<i>Lonicera japonica</i> Thunb.	Caprifoliaceae	AsE	PhLi	Mu	-	-	Sulina	casual
99	<i>Lycium barbarum</i> L.	Solanaceae	AsE	PhN	B,O,Mu,Mo,D	Letea	Doroftei 2009	Chilia Veche, Saele Levee (at the fortress)	invasive
100	<i>Lycopersicon esculentum</i> Mill.	Solanaceae	AmS	T	B,O,Mu,Mo,D	-	-	Chilia Veche, Ostrov Tătaru, Sulina, Sf. Gheorghe	casual

Nr. crt.	Taxa	Family	Native distribution	Life form	Distribution in Romania (Anastasiu & Negrean 2009)	Distribution in Danube Delta (according to references)	References	Field records between 2009-2011	Status in Danube Delta
101	<i>Matthiola longipetala</i> (Vent.) DC. s.l.	Brassicaceae	Med	T	DD	Letea, Sf. Gheorghe, probably escaped	Sârbu & Ștefan 1993	not recorded	unknown
102	<i>Medicago sativa</i> L. subsp. <i>sativa</i>	Fabaceae	Med	H	T,B,Cr,MM,O, Mu,Mo,D,DD	Maliuc	Dihoru & Negrean 1976	Chilia Veche, Ostrov Tătaru, Sulina, Sf. Gheorghe	naturalised
103	<i>Mentha spicata</i> L.	Lamiaceae	EuW&S	H	DD	-	-	Sf. Gheorghe	casual
104	<i>Mirabilis jalapa</i> L.	Nyctaginaceae	AmTrop	H	T,Mo	-	-	Chilia Veche, Sulina, Sf. Gheorghe	casual
105	<i>Monochoria korsakowii</i> Regel & Maack	Pontederiaceae	AsE	H	O,Mu	-	-	Chilia Veche	casual
106	<i>Morus alba</i> L.	Moraceae	As(China)	PhM	T,B,Cr,MM,O, Mu,Mo,D	DD, cultivated and subsponaneous	Doroftei 2009	Chilia Veche, Chilia's Field, Ostrov Tătaru, Ostrov Babina, Ostrov Cernovca, Periprava, Letea, C.A. Rosetti, Sulina, Caraorman, Câșla Vădanei Levee, Sf. Gheorghe, Saele Levee	invasive
107	<i>Morus nigra</i> L.	Moraceae	Med	PhM	Mu,Mo (?)	DD, cultivated	Doroftei 2009	not recorded	unknown
108	<i>Nicotiana glauca</i> Link & Otto	Solanaceae	AmS	T	B,Mu,Mo,D	-	-	Chilia Veche, Sulina	casual
109	<i>Oenothera biennis</i> L.	Onagraceae	AmN	TH	MM,Cr,T,B,O, Mu,Mo,D,DD	sporadic	Ciocârlan 1994	not recorded	unknown

Nr. crt.	Taxa	Family	Native distribution	Life form	Distribution in Romania (Anastasiu & Negrean 2009)	Distribution in Danube Delta (according to references)	References	Field records between 2009-2011	Status in Danube Delta
110	<i>Oenothera glazioviana</i> Micheli	Onagraceae	Eu	TH	MM,T,Mo,Do, DD	-	-	Chilia Veche, Sulina, Caraorman, Sf. Gheorghe	naturalised
111	<i>Oenothera parviflora</i> L.	Onagraceae	AmN	TH	Mo,DD	rare	Ciocârlan 1994	C.A. Rosetti, Sf. Gheorghe	unknown
112	<i>Oxalis corniculata</i> L.	Oxalidaceae	AmN&C	H	T,B,Cr,O,Mu, Mo,DD	Sulina	Dihoru & Negrean 1976	Chilia Veche, Periprava, Sulina, Sf. Gheorghe	invasive
113	<i>Panicum capillare</i> L.	Poaceae	AmN	T	T,B,Cr,MM,O, Mu,Mo,D,DD	Periprava	Dihoru & Negrean 1976	not recorded	unknown
114	<i>Panicum dichotomiflorum</i> Michx	Poaceae	AmN	T	Cr,O,Mu,Mo,D	-	-	Murighiol, on the right bank of Sf. Gheorghe Channel	casual
115	<i>Panicum miliaceum</i> L.	Poaceae	AsC&E	T	DD	-	-	Sf. Gheorghe	casual
116	<i>Papaver somniferum</i> L.	Papaveraceae	Med	T	DD	Caraorman, Periprava	Doroftei et al. 2011	Sulina	casual
117	<i>Parthenocissus inserta</i> (A.Kern.) Fritsch	Vitaceae	AmN	PhLi	B,Mu,D	-	-	Sulina, Saele Levee (at the fortress)	casual
118	<i>Paspalum distichum</i> L.	Poaceae	Trop	H	B,DD	Letea	Roman 1992	not recorded	invasive
119	<i>Perilla frutescens</i> (L.) Britton	Lamiaceae	As (Himalaya)	T	B,Mu	-	-	Chilia Veche, Sulina, Sf. Gheorghe	casual
120	<i>Persicaria orientalis</i> (L.) Spach	Polygonaceae	AsE&SE	T	B,O	-	-	Sulina	casual
121	<i>Petunia × hybrida</i> hort. ex Vilm.	Solanaceae	Cult	T	T,D,DD,Mo	-	-	Chilia Veche, Sulina, Sf. Gheorghe	casual
122	<i>Phytolacca americana</i> L.	Phytolaccaceae	AmN	H	T,B,O,Mu,Mo, DD	Chilia Veche, Sf. Gheorghe	Ciocârlan 1994	Chilia Veche, Periprava, Sulina, Sf. Gheorghe	invasive

Nr. crt.	Taxa	Family	Native distribution	Life form	Distribution in Romania (Anastasiu & Negrean 2009)	Distribution in Danube Delta (according to references)	References	Field records between 2009-2011	Status in Danube Delta
123	<i>Portulaca grandiflora</i> Hook.	Portulacaceae	AmS	T	B,Mu	-	-	Chilia Veche, C.A. Rosetti, Sulina, Sf. Gheorghe	casual
124	<i>Raphanus sativus</i> L.	Brassicaceae	unknown	T-TH	DD	-	-	Sulina, Sf. Gheorghe	casual
125	<i>Rhus typhina</i> L.	Anacardiaceae	AmN	PhM	DD	DD, subsponaneous	Doroftei 2009	not recorded	unknown
126	<i>Ribes aureum</i> Pursh	Grossulariaceae	AmN	PhN	T	cultivated	Doroftei 2009	C.A. Rosetti, Sulina, Sf. Gheorghe	naturalised
127	<i>Ricinus communis</i> L.	Euphorbiaceae	AfTrop	T	B,O,Mu	-	-	Sulina	casual
128	<i>Robinia pseudoacacia</i> L.	Fabaceae	AmN	PhM	B,O,Mu,Mo,D	DD, subsponaneous	Doroftei 2009	Chilia Veche, Antipa, Ostrov Tătaru, Periprava, Letea, C.A. Rosetti, Sulina, Cășla Vădanei Levee, Sf. Gheorghe, Saele Levee	naturalised
129	<i>Rudbeckia laciniata</i> L.	Asteraceae	AmN	H	Mu,Mo	-	-	Sulina	casual
130	<i>Saccharum ravennae</i> (L.) L.	Poaceae	Med	H	DD	DD	Ghișa 1972	not recorded	unknown
131	<i>Sagittaria lancifolia</i> L.	Alismataceae	As	HH	DD	Dunărea Veche	Dihoru & Negrean 1976	not recorded	unknown
132	<i>Sagittaria latifolia</i> Willd.	Alismataceae	AmN	HH	Mu,DD	Chilia Delta	Hanganu et al. 2002, Dubyna et al. 2003	not recorded	unknown
133	<i>Sagittaria trifolia</i> L.	Alismataceae	As	HH	DD	very rare, Sf. Gheorghe	Ciocârlan 1994, Hanganu et al. 2002	Sf. Gheorghe, Sacalin	naturalised
134	<i>Salsola acutifolia</i> (Bunge) Botsch.	Amaranthaceae	Eua	T	DD	DD	Roman 1992	not recorded	unknown



<b>Nr. crt.</b>	<b>Taxa</b>	<b>Family</b>	<b>Native distribution</b>	<b>Life form</b>	<b>Distribution in Romania</b> (Anastasiu & Negrean 2009)	<b>Distribution in Danube Delta</b> (according to references)	<b>References</b>	<b>Field records between 2009-2011</b>	<b>Status in Danube Delta</b>
135	<i>Salsola collina</i> Pall.	Amaranthaceae	Eua /Cont	T	DD	very rare, Pardina	Ciocârlan 1994	not recorded	unknown
136	<i>Sedum sarmentosum</i> Bunge	Crassulaceae	As	H	Mu,DD	-	-	Sulina	casual
137	<i>Silene chalconica</i> (L.) E.H.L.Krause	Caryophyllaceae	AsV&EuE	H	DD	very rare, Caraorman	Ciocârlan 1994	not recorded	unknown
138	<i>Solanum angustifolium</i> Mill.	Solanaceae	AmN	T	D,DD	Chilia Delta (Ostrov Ermakiv)	Dubyna et al. 2003	not recorded	unknown
139	<i>Solanum retroflexum</i> Dunal	Solanaceae	AmN	T	Mo,D,DD	C.A. Rosetti, Sulina, Sf. Gheorghe, Sulina, Caraorman	Ciocârlan 2009	C.A. Rosetti, Sulina, Caraorman, Cășla Vădanei Levee, Sf. Gheorghe	invasive
140	<i>Solidago gigantea</i> Aiton	Asteraceae	AmN	H	T,B,Cr	-	-	Sulina	casual
141	<i>Sorghum halepense</i> (L.) Pers.	Poaceae	AfN,AsSW	H	T,B,Cr,O,Mu, Mo,D,DD	sporadic	Ciocârlan 1994	Chilia Veche, Antipa, Ostrov Tătaru, Periprava, Sf. Gheorghe, Saele Levee	invasive
142	<i>Suaeda splendens</i> (Pourr.) Gren. & Godr.	Amaranthaceae	Med	T	DD	very rare, Chilia Veche, bank of Razim Lake	Morariu 1952, Ciocârlan 1994	not recorded	unknown
143	<i>Symphotrichum ciliatum</i> (Ledeb.) G.L.Nesom	Asteraceae	As	T	Mo,DD	rare, Sacalin, Sf. Gheorghe, Chilia Delta	Ciocârlan 1994, Dubyna et al. 2003	Periprava, Sulina, Sf. Gheorghe, Sacalin	invasive
144	<i>Symphotrichum lanceolatum</i> (Willd.) G.L.Nesom	Asteraceae	AmN	H	T	-	-	Chilia Veche	naturalised

<b>Nr. crt.</b>	<b>Taxa</b>	<b>Family</b>	<b>Native distribution</b>	<b>Life form</b>	<b>Distribution in Romania (Anastasiu &amp; Negrean 2009)</b>	<b>Distribution in Danube Delta (according to references)</b>	<b>References</b>	<b>Field records between 2009-2011</b>	<b>Status in Danube Delta</b>
145	Tanacetum balsamita L.	Asteraceae	AsSW	H	DD	-	-	Periprava	casual
146	Tanacetum parthenium (L.) Sch.Bip.	Asteraceae	Med	H	DD	-	-	Sulina, Murighiol	casual
147	Tradescantia virginiana L.	Commelinaceae	AmN	H	Mu,Mo	-	-	Sulina	casual
148	Triticum aestivum L.	Poaceae	As	T	B,Cr,O,Mu,Mo	-	-	Sulina	casual
149	Tropaeolus majus L.	Tropaeolaceae	AmS	T	DD	-	-	Sulina	casual
150	Ulmus pumila L.	Ulmaceae	As	PhM	Mu,Mo	-	-	Sulina	naturalised
151	Vallisneria spiralis L.	Hydrocharitaceae	Trop	Hd	Mu,DD	sporadic	Dihoru & Negrean 1976, Ciocârlan 1994	Madgearu Channel, Sulina, Sf. Gheorghe, Colina	naturalised
152	Veronica persica Poir.	Scrophulariaceae	As	T	B,Cr,Mu,Mo	rare	Ciocârlan 1994	Antipa	invasive
153	Xanthium albinum (Widd.) H. Scholz	Asteraceae	AmN	T	DD	Chilia Delta	Shelyag-Sosonko & Dubyna 1984 in Ciocârlan 1994	not recorded	unknown

Nr. crt.	Taxa	Family	Native distribution	Life form	Distribution in Romania (Anastasiu & Negrean 2009)	Distribution in Danube Delta (according to references)	References	Field records between 2009-2011	Status in Danube Delta
154	<i>Xanthium orientale</i> L. subsp. <i>italicum</i> (Moretti) Greuter [syn. <i>Xanthium italicum</i> Moretti, <i>Xanthium saccharatum</i> Wallr.]*	Asteraceae	AmN	T	T,B, Cr,O,Mu,Mo,D, DD	-	-	DD, frequent	invasive
155	<i>Xanthium orientale</i> L. subsp. <i>californicum</i> (Greene) Greuter [syn. <i>Xanthium californicum</i> Greene]*	Asteraceae	AmN	T	DD	Chilia Delta	Shelyag-Sosonko & Dubyna 1984 in Ciocârlan 1994	not recorded	unknown
156	<i>Xanthium orientale</i> L. subsp. <i>orientale</i> [syn. <i>Xanthium macrocarpum</i> DC.]*	Asteraceae	Am	T	DD	Chilia Veche, Pardina, Letea, Cardon, Caraorman	Dihoru & Negrean 1976, Ciocârlan 1994	not recorded	unknown
157	<i>Xanthium orientale</i> L. subsp. <i>riparium</i> (Čelak.) Greuter [syn. <i>Xanthium ripicola</i> Holub]*	Asteraceae	Am	T	DD	Chilia Delta	Shelyag-Sosonko & Dubyna 1984 in Ciocârlan 1994	not recorded	unknown
158	<i>Xanthium pungens</i> Wallr. [syn. <i>Xanthium pennsylvanicum</i> Wallr.]	Asteraceae	AmN	T	-	Chilia Delta	Shelyag-Sosonko & Dubyna 1984 in Ciocârlan 1994	not recorded	unknown

Nr. crt.	Taxa	Family	Native distribution	Life form	Distribution in Romania (Anastasiu & Negrean 2009)	Distribution in Danube Delta (according to references)	References	Field records between 2009-2011	Status in Danube Delta
159	<i>Xanthium spinosum</i> L. [syn. <i>Acanthoxanthium spinosum</i> (L.) Fourr.]	Asteraceae	AmS	T	T,B,Cr,O,Mu, Mo,D	sporadic	Ciocârlan 1994, Dubyna et al. 2003	Chilia's Field, Chilia Veche, Ostrov Babina, Antipa, Periprava, C.A. Rosetti, Sulina, Caraorman, Sf. Gheorghe, Mahmudia	invasive
160	<i>Xanthium strumarium</i> L.	Asteraceae	Am	T	T,B,Cr,O,Mu, Mo,D,DD	sporadic	Ciocârlan 1994	Chilia Veche, Sf. Gheorghe	naturalised
161	<i>Zea mays</i> L.	Poaceae	Am	T	B,O,Mu,D	-	-	Sulina	casual
162	<i>Zinnia elegans</i> Jacq.	Asteraceae	AmN	T	DD	-	-	Sulina, Sf. Gheorghe	casual
163	<i>Ziziphus jujuba</i> Mill.	Rhamnaceae	AsTemp	PhN	D	rare	Dubyna et al. 2003	not recorded	naturalised

\* synonym according to The Plant List, accessed to 24th of July, 2011

Abbreviations: **Native distribution:** Af – Africa; Am – America; As – Asia; Eu – Europe; Eua – Eurasia; Cauc – Caucasus; Anat – Anatolia; Cs – Cosmopolite; Cb – Circumboreal; Temp – Temperate; Trop – Tropical; Ct – Continental; Med – Mediterranean; Sm – Submediterranean; Pt – Pontic; N – North; E – East; S – South; W – West; C – Centre (central). **Life form:** Ch – Chamaephytae; G – Geophyte; H – Hemicryptophyte; HH – Helohydrophyte; PhEp – Epiphyte; PhLi – Liana; PhM – Macrophanerophyte; PhN – Nanophanerophyte; T – Therophyte; TH – Hemiterophyte. **Distribution in Romania** (historic regions): T – Transilvania; B – Banat; Cr – Crişana; MM – Maramureş; O – Oltenia; Mu – Muntenia; Mo – Moldova; D – Dobrogea; DD – Danube Delta.