ALIEN PLANT SPECIES IN THE AREA OF CONSTANŢA HARBOUR

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Abstract. The field studies carried out in the area of Constanta Harbour led to the identification of 430 vascular plant taxa, of which 107 taxa are non-native for the harbour area. Among the recorded alien plants, 45 taxa are invasive, 10 are naturalized and 52 taxa are casual. On the basis of field observations, a database with recorded alien plants has been accomplished. Some considerations regarding life forms, native range, invasive status and introduction ways of the alien plants in the harbour are also presented. Among recorded alien taxa, the majority were deliberately introduced as cultivated plants, ornamental or forest plants, as food and fodder plants, industrial and medicinal plants. Most of the alien plants within Constanta Harbour have North American and Asian origin. The dates concerning alien species of Constanta Harbour have been compared with that of bibliographical sources regarding alien plants from the flora of Romania and the flora of Dobrogea province. The percentage of alien plants within Constanta Harbour is significantly higher than that of alien species within the flora of Dobrogea and the flora of Romania and therefore Constanta Harbour can be considered a major gateway for the non-native species of southeastern zone of Romania.

Keywords: alien plants, invasive plants, Constanţa Harbour.

Rezumat. Specii de plante alohtone din zona portului Constanţa. Studiile realizate în zona portului Constanţa au dus la identificarea a 430 de taxoni vasculari, dintre care 107 sunt alohtoni (străini); dintre aceştia 45 sunt taxoni invazivi, 10 sunt naturalizaţi iar 52 sunt ocazionali. A fost realizată o bază de date cu speciile străine inventariate dar şi o serie de consideraţii pe seama acestora: din punct de vedere al bioformelor, al elementelor fitogeografice, al categoriilor de specii alohtone (invazive, naturalizate, ocazionale), a căilor şi a scopului introducerii acestora în zona portului. Dintre speciile străine identificate în zona portului, majoritatea au fost introduse intenţionat, ca plante cultivate, ornamentale, forestiere, alimentare, furajere, industriale sau medicinale. Cea mai mare parte a speciilor străine din portul Constanţa au origine nord-americană şi asiatică. Datele privind speciile alohtone din zona portului Constanţa au fost comparate cu cele din sursele bibliografice referitoare la speciile străine din flora României şi flora Dobrogei. Procentajul ridicat al speciilor străine din portul Constanţa, comparativ cu cel din flora Dobrogei şi flora României, este un indiciu al faptului că portul Constanţa este principala cale de pătrundere a speciilor alohtone în sud-estul României.

Cuvinte cheie: plante alohtone, plante invazive, Portul Constanţa.

INTRODUCTION

Situated in the province of Dobrogea, in the South-East of Romania, on the Western coast of the Black Sea, Constanţa Harbour is the main port of the Black Sea and one of the 10 most important ports of Europe. It is located at the crossroads of the trade routes linking the markets of the landlocked countries from Central and Eastern Europe with the Central Asia, Transcaucasia and the Far East. It covers 3926 ha (of which 1313 ha is land and 2613 ha is water) and have 6 gates (Fig. 1). Constanţa Port has a handling capacity of over 100 million tons per year and 156 berths, of which 140 berths are operational (Administration of Constanţa Port, 2013). Constanţa Harbour is both a maritime and a river port; the connection with the Danube River is made through the Danube-Black Sea Canal. Constanţa Harbour is bordered in the west side by a loess cliff about 30 meters high and also by green spaces, gardens, residential buildings or vacant lots (Fig. 1).

Constanţa Harbour is not only a huge gate for the entry and exit of goods but also a way for the entering in Romania of some alien plants, many of them invasive or potentially invasive. Subsequently, these species spread easily in the green spaces around the Harbour.

The spread of alien species poses a serious threat to the conservation of natural and semi-natural habitats and that such invaders can have a tremendous impact on the native floral communities (WEBER, 2005). In the harbour area, natural and semi-natural habitats miss but such type of habitats can be found not very far from the port area, on the Black Sea coast and in some Natural Reserve located around Constanţa town (Agigea marine sand dunes Natural Reserve, Fântâniţa-Murfatlar Natural Reserve, Techirghiol Lake area, etc.). Highly disturbed man-made habitats occur within Constanţa harbour and provide favourable conditions for the alien species naturalization.

Only a small fraction of the alien plants that lands in new territory actually becomes established, and even a smaller fraction becomes a serious problem (MOONEY et al., 2005). Most of the new entered alien plant species become naturalized and do not cause significant problems as they are confined to highly disturbed sites or do not expand their range (WEBER, 2005). According to PYŠEK et al. (2004), the naturalized plants are those alien plants which reproduce constantly and find populations persisting over several life cycles (at least 10 years) without direct human intervention (or in spite of it); frequently, they produce freely descendants, usually in proximity of adult plants, and do not necessarily invade natural, semi-natural or anthropogenic ecosystems.

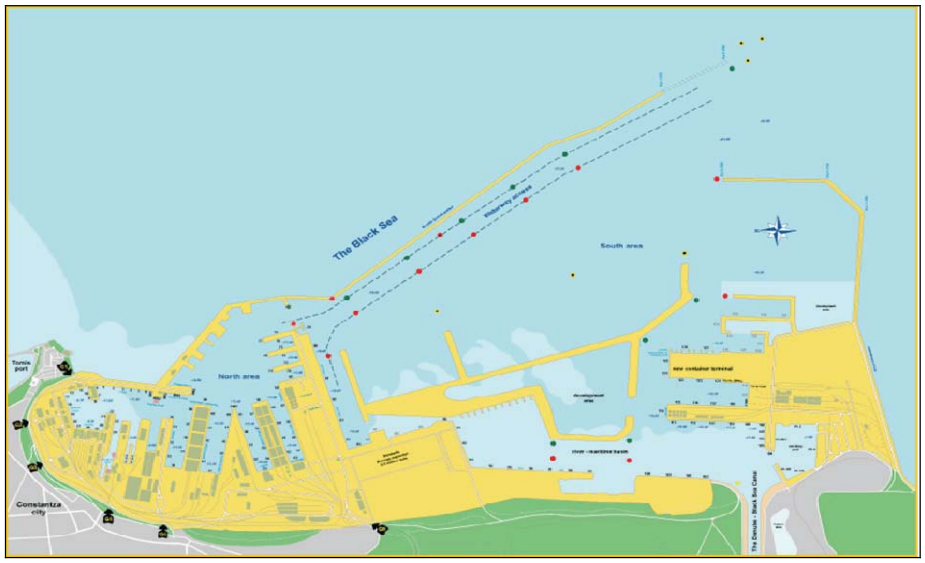

Fig. 1. Constanta Harbour with six gates and green spaces around the cliff and berths (source net).

Other alien species become invasive and threat the native vegetation of natural and semi-natural habitats. According to RICHARDSON et al. (2000), the alien invasive plants are naturalized plants, which produce descendants, sometimes in large amounts, at considerable distance from the parental plants and over large stretches. The invasive plants change the character, form or nature of ecosystem over a significant part of their extension. In the competition between the invader and its neighbouring native plants the invader having a superior competitive ability.

IUCN defines alien invasive species as (MCNEELY et al., 2001) "an alien species which becomes established in natural or semi-natural ecosystems or habitats, is an agent of change and threatens native biological diversity".

Not only alien plants can be invaders but also the indigenous plants which in some circumstances succeed to occupy considerable areas within disturbed ecosystems. These species are named "colonizing plants" (RICHARDSON et al., 2000; PYŠEK et al., 2004) or "expansive plants" (PYŠEK et al., 2004) but not invasive.

The occasional or casual alien plants are capable to develop and even reproduce in a given zone, but which do not form populations able for regeneration, relying on repetitive introductions for persistence (RICHARDSON et al., 2000).

The main objective of the study was to create a comprehensive database with the alien plant species within Constanţa Harbour. Such database represents an important tool for the better alien species knowledge and for prevention and control of alien plants spreading. Early detection and rapid assessment can limit the damage and allow for efficient control methods. Therefore, monitoring programs are required in areas of high risk or along transfer routes (LODGE et al., 2006).

MATERIAL AND METHODS

Field studies took place between years 2008 and 2011 in the area of Constanţa Harbour (berths, warehouses, administrative buildings, railways, roads inside the harbour, access gates area). On the basis of field observations, a database with the alien plants recorded in Constanţa Harbour area has been accomplished. According to RICHARDSON et al., 2000 definition, we have considered as alien those species which are not native and were introduced in the harbour area deliberately or accidentally.

The nomenclature of species is according to Flora Europaea (TUTIN et al., 1964-1980; 1993). The affiliation of alien plants to the botanical families is concordant with Angiosperms Phylogeny Group recommendations (APG III 2009). The life forms and native range of alien plants are generally given according to CIOCÂRLAN (2009) and Flora Europaea. The terminology and definitions recommended by RICHARDSON et al. (2000) and PYŠEK et al. (2004) were used to establish the status of the alien plants (invasive, naturalized or casual).

RESULTS AND DISCUSSION

Field studies carried out in the area of Constanta Harbour led to the identification of 430 vascular plant taxa, of which 107 taxa (24.88%) are non-native (alien or neophytes) for the harbour area (Table 1).

Previous studies in Constanţa Harbour (COSTEA, 1996) reported a lot of alien taxa as newly introduced in Romania: *Amaranthus palmeri*, *A. tamariscinus*, *Polygonum pensylvanicum*, *Solanum rostratum*, *Datura stramonium* var. *tatula*, *Setaria faberi*, *Ipomoea lacunosa*, *I. hederacea*, *Sesbania exaltata*, *Senna obtusifolia*, *Cardiospermum halicacabum*, *Biscutella auriculata*, *Sida spinosa*, *Salsola collina*, *Eleusine indica.* Other taxa such as *Ipomoea quamoclit* and *Ipomoea purpurea* were mentioned as escaped from cultivation in the harbour area (COSTEA 1996). Some species (*Amaranthus palmeri*, *Ipomoea lacunosa*, *I. hederacea*, *Solanum carolinense*) became naturalized in the

meantime (ANASTASIU et al., 2011). The majority of alien plant taxa reported by COSTEA (1996) have been probably casual and was not found by us in the harbour area in the study period.

Field observations have revealed that almost half of the alien plants become spontaneous only occasionally (52 taxa, respectively 48.59%) (Table 2). Casual species (*Bromus madritensis, B. wildenowii, Chloris barbata, Datura innoxia, Fallopia aubertii, Impatiens balsamea, Ipomaea lacunosa, I. purpurea, Phalaris canariensis, Setaria faberi, Viola x wittrockiana*, etc.) escaped from cultivations or accidentally introduced in the harbour area are unable to produce new stable populations for long term in the disturbed ecosystems of the harbour.

Only 10 taxa (9.34%) are naturalized (Table 2) being able to reproduce and to sustain populations over many years without direct human intervention.

Other 45 taxa (42.05%) are invasive (Table 2) and, by their high capacity of multiplication and propagation, they have a negative impact in the invaded ecosystems of the harbour.

The most aggressive invasive alien plants were observed in the ruderal places between the berths, on the edge of the railway and connection roads within the harbour: *Ambrosia artemisiifolia, Ambrosia trifida, Xanthium strumarium* subsp. *italicum, Xanthium spinosum, Artemisia annua, Bassia scoparia, Conyza canadensis, Amorpha fruticosa, Acer negundo, Ailanthus altissima, Fraxinus pennsylvanica, Fraxinus americana, Phytolacca americana, Ulmus pumila, Sorghum halepense, Amaranthus retroflexus, Cuscuta campestris* subsp. *campestris, Helianthus tuberosus, Iva xanthifolia,* etc. (Table 1).

Other invasive species have been identified around the administrative buildings: *Eleusine indica, Euphorbia maculata, Datura stramonium, Alcea rosea, Amaranthus hybridus, Erigeron annuus* subsp. *annuus, Alopecurus myosuroides, Chamomilla suaveolens, Oxalis corniculata, Oxalis stricta, Veronica persica, Parthenocissus inserta, Lycium barbarum, Morus alba, Robinia pseudacacia* (Table 1).

According to ANASTASIU & NEGREAN (2006) the flora of Dobrogea (approximately 2000 vascular taxa) includes 140 alien plants while the flora of Romania (3840 taxa, according to CIOCÂRLAN, 2009) contains 435 alien taxa (ANASTASIU & NEGREAN, 2005). The number of alien plants within Constanţa Harbour is very close both to that recorded in the Black Sea coastal area (ANASTASIU et al., 2009) and in Dobrogea province (Table 2).

Table 2. Number and percentages of alien taxa in Constanţa Harbour compared with that of western Black Sea coastline, flora of Dobrogea and flora of Romania.

No. of plant taxa and percentages	Total number of taxa	Alien taxa (no. of taxa and percentage)	Invasive (I)	Naturalized (N)	Casual (C)
Constanta Harbour	430	107 (24.88%)	45 (48.59%)	10 (9.34%)	52 (42.05%)
Black Sea coastline between Chituc and Cape Kaliakra	1001	115 (11.48%)	45 (39.13%)	13 (11.30%)	57 (49.56%)
Dobrogea province	2000	140 (7%)	30 (21.42%)	34 (24.28%)	76 (54.28%)
Romania	3840	435 (11.32%)	38 (8.73%)	93 (21.37)	304 (69.88)

The percentage of alien taxa is much higher in Constanţa Harbour (24.88%) than that of the Black Sea coast area (11.48%), Dobrogea province (7%) and Romanian flora (11.32%) (Fig. 2). The comparative data indicate the harbour of Constanţa as a major gateway for the non-native species. Subsequently, alien species spread around the harbour and further both in the coastal zones and inland continental areas from the southeastern part of Romania.

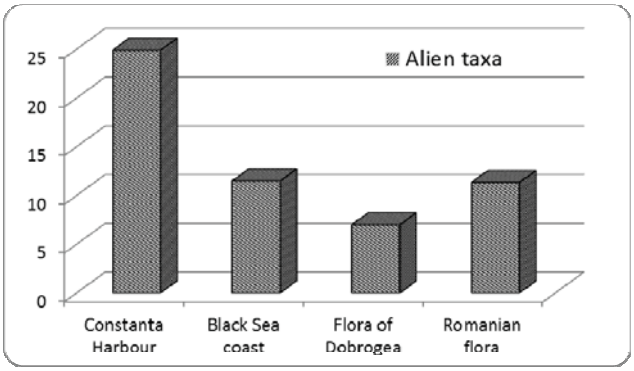

Figure 2. Percentage of alien plants in Constanţa Harbour, Black Sea coast, Dobrogea province and Romanian flora.

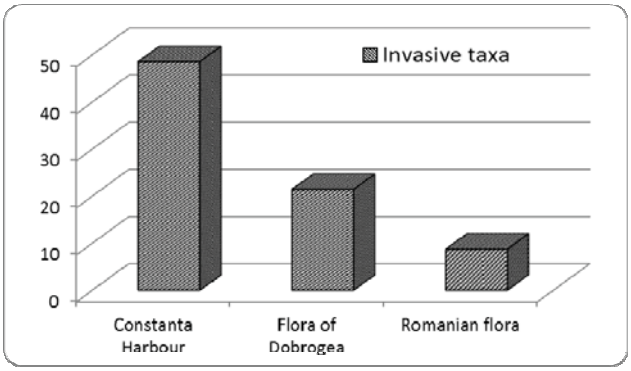

Figure 3. Percentage of invasive taxa in Constanţa Harbour, Black Sea coast, Dobrogea province and Romanian flora.

Among alien taxa, the invasive plants are the most dangerous because they threat the native flora of the natural and semi-natural habitats. The percentage of invasive alien plant taxa in the harbour area (48.59%) is much higher than that of the flora of Dobrogea (21.42%) and the Romanian flora (8.73%) (Fig. 3). The number of invasive plants

recorded in Romania and Dobrogea increased permanently and, therefore, the bibliographical information regarding the number of neophytes needs updating.

The naturalized plant taxa are already well integrated in the native plant communities and the casual species grow only occasionally in the new territories.

The high rate of neophytes in the harbour area can be correlated with the strongly human impact and the presence of disturbed habitats, especially around berths, access gates, administrative buildings, green areas, along the Danube-Black Sea Canal, but also near the roads, rail networks, building boundaries, landfill areas. Constanţa Harbour is both a major way for access of new invasive species in south-east Romania and a complex of anthropogenic habitats which facilitate the establishment, reproduction and dissemination of new invader plants.

The alien plants recorded in Constanţa Harbour belong to 31 botanical families, of which the following are better represented as number of taxa: Poaceae (18 taxa), Asteraceae (14 taxa), Amaranthaceae (9 taxa), Solanaceae (7 taxa), Rosaceae (6 taxa), Fabaceae (5 taxa). Other botanical families have smaller number of taxa: Brassicaceae, Convolvulaceae, Oxalidaceae, Apiaceae, Moraceae, Vitaceae, Sapindaceae, Lamiaceae.

The analysis of the life forms (Fig. 4) revealed the dominance of therophytes (54.80%) followed by macrophanerophytes (15.38%), hemicryptophytes (9.61%), nanophanerophytes (6.73%) and lianas (4.80%). The large number of therophytes can be correlated with the disturbed man-made habitats (WEBER, 2005) where annual plants are advantaged in colonization and reproduction process. Other categories (hemitherophytes, helo-hydrophytes) are poorly represented (fewer than 2%). The total percentage of phanerophytes (trees, shrubs and lianas) is also significant (26.91%) because seeds of many woody species arrive in the port with the timber trade.

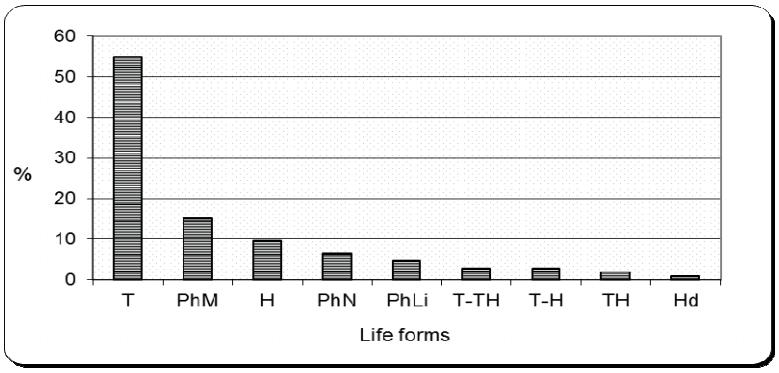

Figure 4. Life forms of alien taxa within Constanţa Harbour.

Legend: Th – Therophyte; TH – Hemitherophyte; H Hemicryptophyte; PhM – Macrophanerophyte; PhN – Nanophanerophyte; PhLi – Liana.

Analyses of alien species native range (Fig. 5) showed that the majority of the alien plants within Constanţa Harbour are native to America (49.03%), especially North America (27.88%) and South America (7.69%). The Asian species are also well-represented (22.11%). Species of North African (1.92%) and tropical (0.96%) origin are few. Other alien plant species are of Mediterranean origin (9.61%) and Sub-Mediterranean (0.96%). The European alien species (West, South, Central, South-West European, Canary Islands and South-East Russian) have a total percentage of 6.73%. Alien species obtained in cultivation, especially as a result of hybridisation (*Fragaria* × *ananassa, Viola* × *wittrockiana*, *Mentha* × *piperita, Petunia* × *atkinsiana*) have a rate of 4.80% and species with unknown native range 3.84%. Regarding the ways of introduction in the harbour area, 64 alien taxa (59.81%) were introduced deliberately, as ornamental or forest plants (34.82%), as food (21.15%) and fodder plants (3.84%), industrial and medicinal plants (4.80%). Other 43 alien taxa (40.18%) were probably accidentally introduced by shipping and navigation activities, especially by cereal and timber trade (Fig. 6, Table 1).

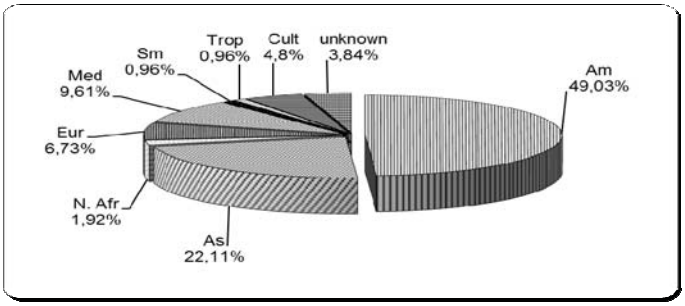

Figure 5. Phytogeographical origin of alien species within Constanţa Harbour.

Legend: Am - American; As - Asian; N. Afr - North African; Eur - European; Med - Mediterranean; Sm - Sub - Mediterranean; Trop - Tropical; Cult - cultivation.

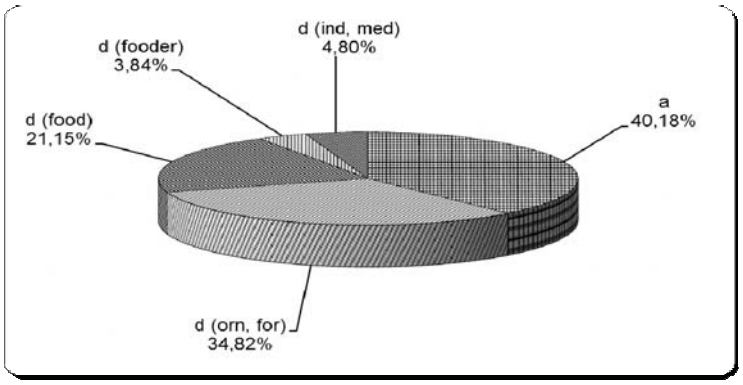

Figure 6. Percentage of alien species introduced accidentally or deliberately in Constanţa Harbour area.

Legend: a - accidentally; d - intentionally; d (orn, for) - ornamental or forest plants; d (food) - food plants; d (fodder) - fodder plants; d (ind, med) - industrial, medicinal plants.

Subsequently, the neophytes have quickly spread in the anthropogenic ecosystems of the harbour and further outside the port in some natural and semi-natural habitats.

Table 1. Alien taxa within Constanta Harbour area.

No.	Alien taxa	Botanical family	Life form	Native range	Entering way	Invasive status
1.	*Acer negundo*	Sapindaceae	PhM	Am	d (orn)	I
2.	*Aesculus hippocastanum*	Sapindaceae	PhM	Eur SE	d (orn)	C
3.	*Ailanthus altissima*	Simaroubaceae	PhM	As	d (orn)	I
4.	*Alcea rosea*	Malvaceae	H	Med	d (orn)	I
5.	*Alopecurus myosuroides*	Poaceae	Th	Eu W, S & C	a	I
6.	*Amaranthus albus*	Amaranthaceae	Th	Am.N	a	I
7.	*A. crispus*	Amaranthaceae	Th	Am.S	a	I
8.	*A. hybridus*	Amaranthaceae	Th	Am.N	a	I
9.	*A. palmeri*	Amaranthaceae	Th	Am.N	a	N
10.	*A. powellii*	Amaranthaceae	Th	Am.N & S	a	N
11.	*A. retroflexus*	Amaranthaceae	Th	Am.N	a	I
12.	*Ambrosia artemisiifolia*	Asteraceae	Th	Am.N	a	I
13.	*A. trifida*	Asteraceae	Th	Am.N	a	I
14.	*A. fruticosa*	Fabaceae	PhN	Am.N	d (orn, for)	I
15.	*Anethum graveolens*	Apiaceae	Th	As.SW, India	d (food)	C
16.	*Antirrhinum majus*	Plantaginaceae	Th	Med	d (orn)	C
17.	*Artemisia annua*	Asteraceae	Th	As.C & SW	a	I
18.	*Atriplex hortensis*	Amaranthaceae	Th	As	d (food)	C
19.	*Avena sativa s.l.*	Poaceae	Th	unknown	d (food)	C
20.	*Bassia scoparia*	Amaranthaceae	Th	Russia E & S	a	I
21.	*Bidens frondosa*	Asteraceae	Th	Am.N	a	I
22.	*Brassica rapa* subsp. *oleifera*	Brassicaceae	Th-TH	cult.	d (ind)	C
23.	*Bromus madritensis*	Poaceae	Th	Eur W& S, Afr.N	a	C
24.	*B. rigidus*	Poaceae	Th	Med	a	C
25.	*B. wildenowii*	Poaceae	Th	AmS	a	C
26.	*Calendula officinalis*	Asteraceae	TH-H	Med	d (orn, med)	C
27.	*Chamomilla suaveolens*	Asteraceae	Th	Am, As	a	I
28.	*Chenopodium ambrosioides*	Amaranthaceae	Th	Am.Trop	a	I
29.	*C. botrys*	Amaranthaceae	Th	Sm	a	C
30.	*Chloris barbata*	Poaceae	Th	Am.Trop	a	C
31.	*Citrullus lanatus*	Cucurbitaceae	Th	Afr.NW	d (food)	C
32.	*Conyza canadensis*	Asteraceae	Th	Am.N	a	I
33.	*Cucurbita pepo*	Cucurbitaceae	Th	Am.C	d (food)	C
34.	*Cuscuta campestris* subsp. *campestris*	Convolvulaceae	Th	Am.N	a	I
35.	*Datura innoxia*	Solanaceae	Th	Am.C	d (orn)	C
36.	*D. stramonium*	Solanaceae	Th	Am	a	I
37.	*Elaeagnus angustifolia*	Elaeagnaceae	PhN	As.Temp	d (orn, for)	I
38.	*Eleusine indica*	Poaceae	T	Trop	a	I
39.	*Erigeron annuus* subsp. *annuus*	Asteraceae	TH	Am.N	a	I
40.	*Euphorbia maculata*	Euphorbiaceae	Th	Am.N	a	I
41.	*Fallopia aubertii*	Polygonaceae	PhLi	As	d (orn)	C
42.	*Ficus carica*	Moraceae	PhN	Med	d (food)	C
43.	*Foeniculum vulgare*	Apiaceae	TH-H	Med	d (arom)	C
44.	*Fragaria x ananassa*	Rosaceae	H	cult.	d (food)	C
45.	*Fraxinus americana*	Oleaceae	PhM	Am.N	d (orn)	I
46.	*F. pennsylvanica*	Oleaceae	PhM	Am.N	d (orn)	I

47.	*Galinsoga parviflora*	Asteraceae	Th	Am.S	a	I
48.	*Gleditsia triacanthos*	Fabaceae	PhM	Am.N	d (orn, for)	I
49.	*Helianthus annuus*	Asteraceae	Th	Am	d (food)	C
50.	*H. tuberosus*	Asteraceae	H	Am.N	d (orn, food)	I
51.	*Hemerocallis fulva*	Hemerocallidaceae	H	As	d (orn)	C
52.	*Hibiscus syriacus*	Malvaceae	PhN	As. E & S	d (orn)	C
53.	*Hordeum distichon*	Poaceae	Th	unknown	d (food)	C
54.	*H. marinum*	Poaceae	Th	Eur W & S	a	C
55.	*H. vulgare*	Poaceae	Th	unknown	d (food)	C
56.	*Impatiens balsamina*	Balsaminaceae	Th	As (India E)	d (orn)	C
57.	*Ipomoea hederacea*	Convolvulaceae	Th	Am.Trop	a	N
58.	*I. lacunosa*	Convolvulaceae	Th	Am.N	a	N
59.	*I. purpurea*	Convolvulaceae	Th	Am.Trop	d (orn)	C
60.	*Iva xanthifolia*	Asteraceae	Th	Am.N	a	I
61.	*Juniperus virginiana*	Cupressaceae	PhN	Am.N	d (orn)	C
62.	*Koelreuteria paniculata*	Sapindaceae	PhM	As (China)	d (orn)	C
63.	*Lemna minuta*	Araceae	Hd	Am	a	I
64.	*Lepidium virginicum*	Brassicaceae	Th-TH	Am.N	a	I
65.	*Lycium barbarum*	Solanaceae	PhN	As	d (orn)	I
66.	*Lycopersicon esculentum*	Solanaceae	Th	Am.S	d (food)	C
67.	*Maclura pomifera*	Moraceae	PhM	Am.N	d (orn)	C
68.	*Malus domestica*	Rosaceae	PhM	As.C	d (food)	C
69.	*Medicago sativa* subsp. *sativa*	Fabaceae	Th	Med	d (fodder)	N
70.	*Mentha × piperita*	Lamiaceae	H	cult.	d (med, arom)	N
71.	*Mirabilis jalapa*	Nyctaginaceae	H	Am.Trop	d (orn)	C
72.	*Morus alba*	Moraceae	PhM	As (China)	d (ser)	I
73.	*Nicotiana alata*	Solanaceae	Th	Am.S	d (orn)	C
74.	*Oxalis corniculata*	Oxalidaceae	H	Am.N & C	a	I
75.	*O. europaea*	Oxalidaceae	H	Am.N, As.E	a	I
76.	*O. stricta* [syn. *O. dillenii*]	Oxalidaceae	TH-H	Am.N	a	I
77.	*Panicum capillare*	Poaceae	Th	Am.N	a	I
78.	*P. dichotomiflorum*	Poaceae	Th	Am.N	a	N
79.	*Parthenocissus inserta*	Vitaceae	PhLi	Am.N	d (orn)	I
80.	*P. tricuspidata*	Vitaceae	PhLi	Am.N	d (orn)	N
81.	*Petroselinum crispum*	Apiaceae	TH	Med	d (arom)	N
82.	*Petunia × atkinsiana*	Solanaceae	Th	cult.	d (orn)	C
83.	*Phalaris canariensis*	Poaceae	Th	Canare	d (fodder)	C
84.	*Phytolacca americana*	Phytolaccaceae	H	Am.N	d (tinct)	I
85.	*Prunus armeniaca*	Rosaceae	PhM	As.W	d (food)	C
86.	*P. cerasus*	Rosaceae	PhM	Eur.SE & As.W	d (food)	C
87.	*P. persica*	Rosaceae	PhM	As (China)	d (food)	C
88.	*Raphanus sativus*	Brassicaceae	Th-TH	unknown	d (food)	C
89.	*Robinia pseudacacia*	Fabaceae	PhM	Am.N	d (orn, for)	I
90.	*Salvia splendens*	Lamiaceae	Th	Am S	d (orn)	C
91.	*Satureja hortensis*	Lamiaceae	Th	Med	d (arom)	C
92.	*Setaria faberi*	Poaceae	Th	As.E	a	C
93.	*Solanum carolinense*	Solanaceae	H	Am.N	a	N
94.	*S. tuberosum*	Solanaceae	Th	Am.S	d (food)	C
95.	*Sophora japonica*	Fabaceae	PhM	As.E	d (orn)	C
96.	*S. sorbifolia*	Rosaceae	PhN	As	d (orn)	C
97.	*Sorghum dochna* var. *technicum*	Poaceae	Th	As.S	d (fodder)	C
98.	*S. halepense*	Poaceae	H	Afr.N, As.SW	a	I
99.	*Tecoma radicans*	Bignoniaceae	PhLi	Am.N	d (orn)	C
100.	*Triticum aestivum*	Poaceae	Th	As	d (food)	C
101.	*Ulmus pumila*	Ulmaceae	PhM	As	d (orn)	I
102.	*Veronica persica*	Plantaginaceae	Th	As	a	I
103.	*Viola × wittrockiana*	Violaceae	Th	cult.	d (orn)	C
104.	*Vitis vinifera*	Vitaceae	PhLi	As.SW, Med	d (drink)	N
105.	*Xanthium spinosum*	Asteraceae	Th	Am.S	a	I
106.	*X. strumarium* subsp. *italicum*	Asteraceae	Th	Med	a	I
107.	*Zea mays*	Poaceae	Th	Am	d (food, fodder)	C

Legend: I - invasive; N – naturalized; C – casual.

CONCLUSIONS

Field studies carried out in Constanţa Harbour led to the identification of 107 alien plants, of which 45 taxa are invasive, 10 are naturalized and 52 taxa are casual.

The percentage of the alien plants is much higher in the harbour area than that of neophytes from the Black Sea coast or within Dobrogea province and Romanian flora; the harbour of Constanţa is a major gateway for the non-native plant taxa in southeastern Romania. The number of the invasive alien taxa in Constanţa Harbour represents almost half

of the total number of recorded neophytes and can be correlated with the human impact and the presence of disturbed habitats which facilitate the invasion, reproduction and dissemination process of new invader plants.

Most of the neophytes within Constanţa Harbour have North American and Asian origin. The Mediterranean, European species and hybrid plants obtained in cultivation are also well represented.

Most of the alien plant taxa were deliberately introduced in the harbour area as useful plants. Other neophytes were probably accidentally introduced especially by cereal and timber trade.

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REFERENCES

ANASTASIU P. & NEGREAN G. 2005. *Alien plants in Romania*. Analele Ştiinţifice ale Universităţii „Al. I. Cuza", Seria II-a. Biologie vegetală. Iaşi. **51**: 87-96.

ANASTASIU P. & NEGREAN G. 2006. *Alien vascular plants in Dobrogea (Romania) and their impact on different types of habitats*. In: Ivanova D. (Ed). Plant, fungal and habitat diversity investigation and conservation. Proceedings of IV Balkan Botanical Congres. Sofia: 590-596.

ANASTASIU P., NEGREAN G., FĂGĂRAS M., SAMOILĂ C., COGĂLNICEANU D. 2009. *Constanta Harbour (Romania) as a major gateway and reservoir for alien plant species.* Acta Horti Botanici Bucurestiensis. Bucureşti. **36**: 41-60.

ANASTASIU P., NEGREAN G., SAMOILĂ C., MEMEDEMIN D., COGĂLNICEANU D. 2011. *A comparative analysis of alien plant species along the Romanian Black Sea coast area. The role of harbours.* Journal of Coastal Conservation. Planning and Management. Springer. **15**: 595-606.

APG III. 2009. *Classification of orders and families of flowering plants*. Botanical Journal of the Linnean Society. http://en.wikipedia.org/wiki/APG_III_system. (Accessed: March 22, 2013).

CIOCÂRLAN V. 2009. *Flora ilustrată a României. Pteridophyta et Spermatophyta.* Editura Ceres. Bucureşti. 1141 pp.

COSTEA M. 1996. *The reccording of some new adventive taxa for Romania in the harbour Constanta*. Revue Roumaine de Biologie. Serie de Biologie Vegetale. Bucharest. **41**(2): 91-96.

LODGE D. M., WILLIAMS S., MACISAAC H. J., HAYES K. R., LEUNG B., REICHARD S., MACK R. N., MOYLE P. B., SMITH M., ANDROW, D. A., CARLTON J. T., MCMICHAEL S. 2006. *Biological invasions: recommendations for U. S. policy and management*. Ecological Applications. **16**: 2035-2054.

MCNEELY J. A., MOONEY H. A., NEVILLE L. E., SCHEI P., WAAGE J. K. 2001. *Global Strategy on Invasive Alien Species*. IUCN on behalf of the Global Invasive Species Program. Gland. Switzerland. http://www.fws.gov/invasives/ (Accessed: March 22, 2013).

MOONEY H. A., MACK R. N., MCNEELY J. A., NEVILLE L. E., SCHEI P. J., WAAGE J. K. 2005. *Invasive Alien Species*. *A New Synthesis.* SCOPE Series. Island Press. Washington-Covelo-London. 368 pp.

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.

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*. Blackwell Science Ltd. Diversity and Distribution. **6**: 93-107.

TUTIN T. G., HEYWOOD V. H., BURGES N. A., MOORE D. M., VALENTINE D. H., WALTERS S. M., WEBB D. A. (Eds.). 1964-1980. *Flora Europaea*. Cambridge University Press. Cambridge. **1** (629 pp), **2** (469 pp), **3** (385 pp), **4** (505 pp), **5** (452 pp).

TUTIN T. G., BURGES N. A., CHATER A. O., EDMONDSON J. R., HEYWOOD V. H., MOORE D. M., VALENTINE D. H., WALTERS S. M., WEBB D. A. (Eds., Assist. by Akeroyd J. R., Newton M. E. (appendices ed by Mill R. R.). 1993. *Flora Europaea.* 2nd ed. Psilotaceae to Platanaceae. Cambridge University Press. Cambridge. **1**. 581pp.

WEBER E. 2005. *Invasive Plant Species of the World. A Reference Guide to Environmental Weeds.* CABI Publishing. Oxon. U. K. 548 pp.

*** Administration of Constantza Port. 2013 - http://www.portofconstantza.com (Accesed: March 22, 2013).

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