

INVASIVE AND POTENTIALLY INVASIVE PLANT SPECIES IN THE AREA OF CONSTANTA HARBOUR (ROMANIA)

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INTRODUCTION

Located in the province of Dobrogea, in the South-East of Romania, on the Western coast of the Black Sea (Figure 1), Constanta 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.

Constanta Harbour is both a maritime and a river port; the connection with the Danube River is made through the Danube-Black Sea Canal. It is bordered in the west side by a loess cliff and also by green spaces, gardens, residential buildings or ruderal places.

Constanta Harbour is not only a huge gate for the entry and exit of goods to and from our country but also a way for the entering in Romania of some alien plants, many of them invasive, which subsequently are easily spread in the anthropogenic and semi-natural habitats around Constanta port and city.



Figure 1 - The map of Constanta Harbour

MATERIAL AND METHOD

Our field observations have been carried out between years 2004 and 2009, in the area of berths, warehouses, administrative buildings, railways, roads inside the port and in the neighbouring of the harbour (access gates area, cliff and green areas in the vicinity of the port). On the basis of the field researches, a database with the alien plants recorded in Constanta Harbour area has been achieved.

According to Richardson's et al. (2000) definition we have considered as alien those species which are not native in the Dobrogea province and are introduced here deliberately or accidentally by humans.

The nomenclature of species is according to Flora Europaea (Tutin et al., 1964-1980, 1993). The alien species belonging to the botanical families have been made in accordance with Angiosperms Phylogeny Group recommendations (APG II, 2003). The life forms and phylogeographical origin of alien taxa are generally given after Ciocărlan (2000).

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 and casual).

RESULTS AND DISCUSSION

The field researches took place in the zone of Constanta Harbour and neighbouring area led to the identification of 429 vascular taxa, among which 104 taxa (24.24%) are considered to be alien for Dobrogea area.

Our observations have revealed that the most of the alien plants (52 taxa - 50%) become spontaneous only casually (Table 1). These plants escaped from the culture or introduced accidentally in the harbour area are unable to produce new stable populations on long term. We consider that only 7 taxa (6.73%) are naturalized, being able to reproduce and to sustain populations over many years without direct human intervention. Other 45 taxa (43.26%) are invasive or potentially invasive.

While some alien plant species have stable populations in the harbour area (*Ipomaea lacunosa*, *Panicum dichotomiflorum*, *Amaranthus powellii*, *Partenocissus tricuspidata* etc), others have become invasive in the area of Constanta city (*Eleusine indica* - Fig. 2, *Euphorbia maculata* - Fig. 3, *Veronica persica*, *Oxalis stricta* etc). Some species cited in the botanical references (Costea, 1996) were not found in the last four years of study (*Solanum carolinense*, *Datura stramonium* var. *talula*, *Cardospermum halicacabum*, *Biscutella laevigata*, *Sida spinosa*, *Salsola collina*).

Among the invasive and potentially invasive plants widespread in the harbour area, we mention: *Ambrosia artemisiifolia* - Fig. 5, *Ambrosia trifida* - Fig. 6, *Ailanthus altissima*, *Artemisia annua*, *Bassia scoparia*, *Coryza canadensis*, *Xanthium strumarium* subsp. *italicum*, *Xanthium spinosum*, *Amorpha fruticosa*, *Fraxinus pennsylvanica*, *Fraxinus americana*, *Ulmus pumila*, *Sorghum halepense*, *Amaranthus retroflexus*, *Amaranthus albus*, *Alopecurus myosuroides*, *Chamomilla suaveolens*, *Oxalis corniculata*, *Oxalis stricta* - Fig. 7, *Erigeron annuus* subsp. *annuus*, *Phytolacca americana*, *Iva xanthiifolia*, *Helianthus tuberosus*, *Partenocissus inserta* etc.



Figure 2 - *Eleusine indica*



Figure 3 - *Euphorbia maculata*

RESULTS AND DISCUSSION



Figure 4 - The Harbour neighbouring



Figure 5 - *Ambrosia artemisiifolia*



Figure 6 - *Ambrosia trifida*



Figure 7 - *Oxalis stricta*

Table 1 - The number, rate and categories of the alien taxa in Constanta Harbour, Romanian flora and flora of Dobrogea

No. of taxa and percentage	Total taxa	Alien taxa	Invasive (I)	Naturalized (N)	Casuals (C)
Constanta Harbour	429	104 (24.24%)	45 (43.26%)	7 (6.73%)	52 (50%)
Constanta Harbour neighbourhood	147	53 (36.05%)	30 (8.73%)	5 (21.37%)	18 (69.88%)
Flora of Dobrogea	2000	140 (7%)	30 (21.42%)	34 (24.28%)	76 (54.28%)
Flora of Romania	3795	435 (11.46%)	38 (8.73%)	93 (21.37%)	304 (69.88%)

Among alien inventoried plants, 53 taxa, more than half (50.96%) were found in the outside area of Constanta Harbour, on the cliff from the harbour neighbouring (Fig. 4), in the access zone of the port, or in the green areas around it. Of these, 30 taxa are invasive or potentially invasive, 5 are naturalized and 18 taxa are casual (Table 1).

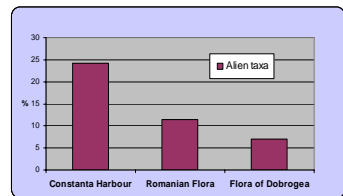


Figure 8 - The rates of alien taxa within Constanta Harbour, Romanian flora and Dobrogea region flora

The percentage of the alien taxa within Constanta Harbour (24.24%) is significantly higher than that of the alien taxa within Romanian flora (11.46%) and flora of Dobrogea (7%) (Figure 8).

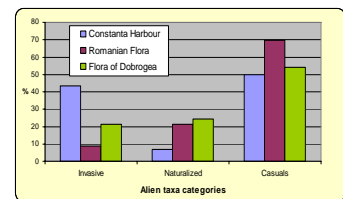


Figure 9 - The percentages of the alien taxa categories within Constanta Harbour, Romanian flora and flora of Dobrogea

Figure 9 shows that the percentage of invasive species in the harbour area is much higher than in Romanian flora and Dobrogea region flora. Constanta Harbour is both a way for the entering in the country of invasive species and a complex of natural and anthropogenic habitats (road networks, rail networks, hard-surfaced areas of port, constructed boundaries etc) which facilitate the installation, reproduction and spread of invasive plants.

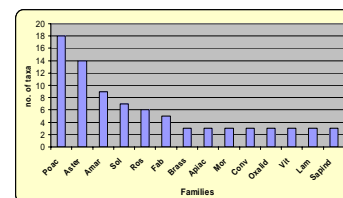


Figure 10 - The most important families of the alien taxa within Constanta Harbour

RESULTS AND DISCUSSION

The alien taxa inventoried during our researches belong to 31 families, of which the best represented are the following (Figure 10): *Poaceae* (18 taxa), *Asteraceae* (14 taxa), *Amaranthaceae* (9 taxa), *Solanaceae* (7 taxa), *Rosaceae* (6 taxa), *Fabaceae* (5 taxa).

The analysis of the life forms (Figure 11) revealed the dominance of therophytes (54.80%), followed by macrophanerophytes (15.38%), hemicryptophytes (9.61%), nanophanerophytes (6.73%) and lianas (4.80%).

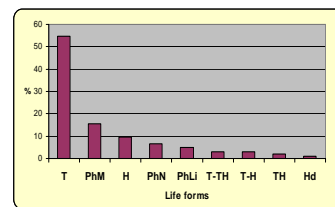


Figure 11 - The life forms of the alien taxa in the area of Constanta Harbour

Most of the alien plants within Constanta Harbour came from America (49.03%), especially North America (27.88%) and South America (7.69%). The Asian origin species are also well represented (22.11%). Other alien plant species are of Mediterranean origin (9.61%). The European alien species have a total percentage of 6.73%. Alien species obtained in cultivation, especially as a result of hybridisation, have a rate of 4.80% and those with unknown origin, 3.84% (Figure 12).

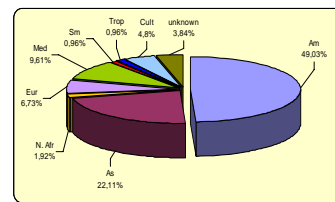


Figure 12 - The phylogeographical origin of the alien species within Constanta Harbour

Regarding the ways of introduction of the alien plants in Constanta Harbour, 64 taxa (61.53%) were introduced deliberately, as the cultivation plants. Subsequently they have spread in the anthropogenic ecosystems of the harbour and in the neighbourhood of the port. Other 40 taxa (38.46%) were probably accidentally introduced, most of them at the same time with the imported goods.

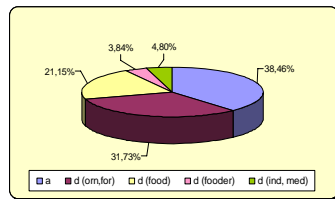


Figure 13 - The percentage of the alien species introduced accidentally or deliberately in Harbour area

Figure 13 shows the rate of alien species introduced into Constanta Harbour accidentally (a) or intentionally (d) as ornamental or forest plants, food or fodder plants, industrial, medical plants etc.

CONCLUSIONS

Our field researches carried out in Constanta Harbour area and its surroundings led to the identification of 104 alien plants, among which 45 taxa (43.26%) are invasive or potentially invasive.

More than half (66.66%) of the alien plants identified in Constanta Harbour, were found in the outside area of the port. Among the 53 alien taxa reported in the green areas from the port vicinity, 30 taxa (56.60%) are invasive.

The percentage of invasive species in the zone of Constanta Harbour (43.26%) is significantly higher than that of the flora of Romania (8.73%) and flora of Dobrogea province (21.42%). Constanta harbour is a gate for the entrance and spreading of the alien plants in Dobrogea and Romania.

The therophytes and phanerophytes are the most well represented life forms. Most of them are escaped from the cultivation.

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

Among the 104 alien plants identified in Constanta Harbour area, 40 taxa have been introduced accidentally, while 64 taxa were deliberately introduced as cultivated plants.

ACKNOWLEDGEMENTS

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