Invasive Species and their Naturalization and Distribution

Tanja Radić Lakoš

Polytechnic of Šibenik, Trg Andrije Hebranga 11, 22000 Šibenik, Hrvatska / Croatia
T: +385 (22) 311 072; M: +385 (98) 1667 477
E-mail id: *tanja@vus.hr*

Abstract: Invasive species are one of the main causes of the decline of biodiversity, but also the cause of significant economic losses and damages. The research on invasive species are nowadays more numerous at the local (Croatian) as well at global scale. Recent researches on Croatian invasive flora are engaged in research of distribution and further expansion of these species in relation to abiotic and biotic factors. Furthermore, it is necessary to investigate the reasons why some alien species show a greater invasion potential than other alien species and to analyse which species show invasion potential into neighbouring countries, but not yet in Croatia.

The expected results will contribute to a better understanding of the process of naturalization and distribution of alien species, determining potential of their invasiveness and may provide guidance for successful environmental management with the aim of timely observations of invasive species and their successful suppression.

Keywords: Invasive species, Dissemination, Suppression, Invasive potential

1 INTRODUCTION

Composition of plant species in a certain area is subject to changes. These changes in the composition of flora in a habitat can be the result of changes within abiotic and biotic actors, anthropogenic activities, loss of present and advent of new species. However, the main cause in swift changes of flora composition in an area has recently been ascribed to human activities. When discussing the alterations we primarily focus on the loss of a habitat and species that inhabit that habitat due to intensifying industry and agriculture and spreading of agricultural areas. Other activities and especially increasing home and international traffic are responsible for introduction of new species into habitats where they have not been present (Lambdon et al, 2008). Certain allochthonous species have gone through the process of naturalization and have achieved the ability to breed and have established self-sustained populations (Kiraly et al 2008). These species that have domesticated themselves outside of their natural areas and are capable of self-sustainability in nature which provides them with great power to successfully spread and occupy new spaces while endangering autochthonous species and groups are called invasive species (Mitić et al 2008). These phenomena nowadays have been the focus of researches from numerous scientists. Allochthonous species of biomes in moderate areas in Europe have been studied in-depth and lists of invasive herbal species created for Austria (Essl and Rabitsch 2004), Czech Republic (Pyšek et al 2002), Hungary (Mihaly and Botta-Dukat, 2004), Germany (Klotz et al 2002), Switzerland (Wittenberg 2005) and the United Kingdom (Preston et al 2002). After national researches on the continent there was a survey on assessment of the real situation with invasion of alien species (project DAISIE) (Lambdon et al 2008). The list of invasive species for Croatia was created in 2008 (Boršić et al, 2008; Mitić et al, 2008), and included in the Croatian flora data base (FCD, Nikolić 2012) as the separate module „Allochthonous plants".

Invasive behaviour of certain alien species in areas outside of their natural habitat has been recognized as one of the crucial ecological problems of today with potentially negative effects on biodiversity, economy and human health (Hejda et al 2009, Hierro and Callaway 2003). Despite the significant improvement with process of cataloguing invasive species there are still uncertainties as to why some areas tend to be „receptive" for introduction and dissemination of invasive species when compared to some other regions and to differences in level of invasion. It is widely considered that that invasion process depends on three factors: a) invasion intensity of alien species, b) biological characteristics of species, c) features of a new habitat (Keane and Crawley 2002). Some species are more successful than others and we rightly ask about the reasons for that. Richardson and Pyšek (2006) in the overview of their previous researches state several factors for difference in invasion between species. Invasive species show greater affinity for specific types of habitat and less occurrence for some other (e.g. fragmented habitats are sensitive to invasion). Furthermore, lack of natural enemies, greater competitiveness in relation to autochthonous species, big phenotypical plasticity, quicker evolution, efficient dissemination, allelopathic effect are all the reasons for successfulness of invasive species. However, not all the species, genera and families are subject evenly to processes of naturalization and invasion and hence the difference between specific taxons (Williams et al 2002). There are really few invasive species within Orchidaceae and Rubiaceae (Pyšek 1998), whereas successful "invadors" can be found in Amaranthaceae, Brassicaceae, Convolvulaceae, Fabaceae, Malvaceae, Poaceae, Papaveraceae i Polygonaceae (Pyšek 1998, Wu et al 2004) which provides space for further research in this field with the aim of obtaining answers as to why some invasive species are so prosperous and what are the factors in a habitat which limit species in being invasive in an area (they are potentially invasive) while being invasive already in some other habitat.

2. AIM AND HYPOTHESIS OF RESEARCH

The fundamental hypothesis is that all naturalized alien species do not become invasive ones. The expression of their invasiveness depends on a number of abiotic and biotic factors. In order to recognize and prevent spreading of invasive species it is essential to know combinations of factors responsible for expression of invasiveness.

The basic aim of this research it to determine whether there is a significant difference between observed invasive and potentially invasive herbal species which will hopefully help in better understanding while assessing invasive potential of alien herbal species. It is therefore necessary to:

- define if there is a factor of successfulness in spreading invasive species related to existence of seeds bank and germination

- define the level of Allelopathic activities of observed species (leaf and root extract and soil with dense population)

- conduct an analysis of linkage between observed species and type of habitat and its topographic and climatic features

- define if there is significant difference between observed species regarding ways of pollination and dissemination

3. MATERIAL, RESPONDENTS, METHODOLOGY AND RESEARCH PLAN

In order to obtain set goals the author will compare a group of invasive plants with a group of alien, mostly naturalized and potentially invasive species that have realized their invasive potential in some other countries but not yet in Croatia. The list is subject to changes according to the real situation but the author plans to include the following species in this research:

a) Invasive :

Arboreal: *Ailanthus altissima* (Mill.) Swingle; *Broussonetia papyrifera* (L.) Vent; *Robinia pseudoacacia* L.

Herbaceous: *Xanthium italicum* Moretti; *Paspalum paspalodes* (Michx.) Scribn.; *Carpobrotus edulis* (L.) N.E.Br. in Phillips; *Opuntia ficus-indica* (L.) Mill.

b) Alien (allochthonous) potentially invasive:

Arboreal: *Acacia dealbata* Link. *Koelreuteria paniculata* Laxm; *Maclura pomifera* (Rafin.) C.K. Schneider, *Rhus typhina* L.

Herbaceous: *Agave americana* L.; *Lycium europaeum* L.; *Opuntia vulgaris* Miller

The author plans to take samples of soil on localities with selected species. All samples will be dried before further analysis. A part of the samples will serve to determine seed banks in soil. The banks are one of the factors of successful invasion with different species (Dean et al, 1986). A research on germination of seeds will be conducted in Petri dishes (on filter paper and silicic sand). The seeds will be treated with 20% solution of ethanol during 1' (for disinfection) and their seed shell will be pierced in order to break dormancy. After this the samples will be stored in air chamber until the moment of germination. The second part of soil sample will serve to determine physical and chemical parameters (conductivity, pH, H2O, pH KCl, quantity of organic substance, quantity of humus, percentage of nitrogen, soil texture, and air and water capacity). According to the geographical location further topographic and climatic data will be added.

One part of the soil will be sampled immediately with plants (in the zone of rhysosphere) in order to determine Allelopathic potential. Parts of plants (leaves and roots) will be collected, dried and stored until the analysis in bags with Silica gel. The experiment will be conducted in a manner of first making leaves and roots extracts (in three different concentrations, 1, 3 and 5%) and then testing Allelopathic activities of tested species on germination of seeds of wheat and heartburn.

Furthermore, an analysis of attachment between observed herbal species and type of habitat will be conducted. With the aim of determining relation between habitat conditions and successfulness of invasive flora the occurrence of invasive species in the Šibenik-Knin county will be analysed. Taking into consideration prevalence of invasive flora and map of the habitat the author will analyze several parameters of habitat heterogeneity (McGarigal and Marks 1994).

Finally, the author will analyze if there is significant difference between observed invasive and alien, potentially invasive herbal species regarding the ways of pollination and dissemination and ultimately social and economic aspects (if the species is commercially usable, in horticulture, weeds and similar).

Based on the obtained results the author will propose tools for determining potential of invasiveness of alien species in the form of multi-criteria questionnaire which will categorize species in some of the categories of potential invasiveness.

Data source:

Prevalence of invasive flora – CroFlora data source (FCD, http://hirc.botanic.hr/fcd)

Map of biogeographic regions, map of habitats according to NKS-u (M=1:100000, resolution 9 ha) – Sate Institute for Nature Protection (http://www.dzzp.hr)

Dissemination type – CroFlora data source (FCD, http://hirc.botanic.hr/fcd) and Landolt et al (2010)

4. EXPECTED SCIENTIFIC CONTRIBUTION

Expected results of this research will contribute to better understanding of processes that lead to expression and invasiveness of alien species. These insights are essential in the development of efficient and timely identification of invasive species which is one of the prerequisites of successfully controlling and suppression. This will increase probability of their suppressing and it will certainly reduce direct and indirect expenses that invasive species cause which will therefore enable practical application of acquired knowledge.

5. REFERENCES

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