

# Invasive alien plants in urban environment - case study in the city of Samobor (continental Croatia)

Diana Vlahović<sup>1</sup>, Dario Hruševar<sup>2</sup>, Božena Mitić<sup>2</sup>

<sup>1</sup> Primary School Bogumil Toni, Ivana Perkovca 90, 10430 Samobor, Croatia (dianavlahov@gmail.com)

<sup>2</sup> University of Zagreb, Faculty of Science, Department of Biology, Marulićev trg 9a, 10000 Zagreb, Croatia (dario.hrusevar@biol.pmf.hr; bozena.mitic@biol.pmf.hr)

## INTRODUCTION

The aim of our study was to determine whether urban areas, despite the implementation of measures for regular maintenance of public areas (e.g. mowing) and the existence of legal obligations to maintain private areas, can act as a pool for spreading invasive alien plants to surrounding areas. The small urban area of the Zagreb County - town of Samobor (Figs.1-2), where weed maintenance and removal measures are regularly carried out, was chosen for the case study of continental Croatia.



Figure 1 – Samobor from above (www.visitzagrebcounty.hr/mjesta/samobor)

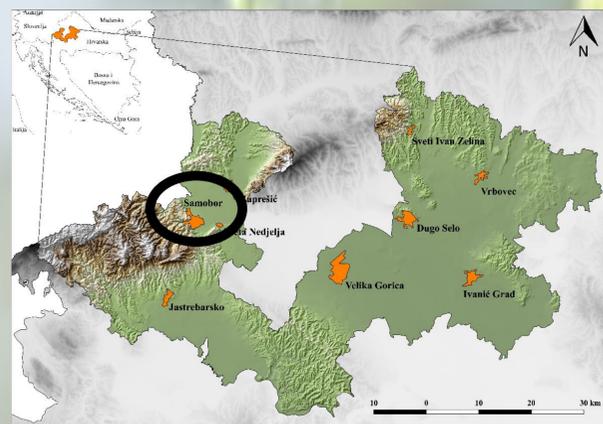


Figure 2 – The position of the study area (town of Samobor) in continental Croatia (Zagreb County)

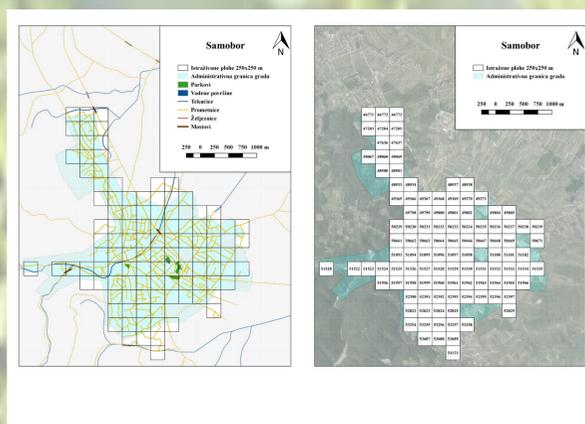


Figure 3 – Town of Samobor - the studied plots to which floristic and spatial data were related

## MATERIALS AND METHODS

The research of invasive alien plants was performed in the continental city of Samobor (area of 6.81 km<sup>2</sup>; Fig. 2) The field study was conducted in 2012 and reconducted in 2016 as to observe the potential spreading of some invasive species to new areas. Geographic locations of sites were geo-referenced with GPS receiver, and coordinates were stored in the Flora Croatia Database. The plots of 250 x 250 m<sup>2</sup> were investigated (Fig. 3) and standard analyzes of the detected flora and its habitats were performed. The habitats were classified according to the Croatian Habitat Classification.

## RESULTS

A total of 109 plots (250x250 m<sup>2</sup>) were explored, on which we recorded 34 (in 2012), and 36 (in 2016) invasive plants (Tab. 1), respectively. All recorded invasive plants belong to 18 families, of which the most represented are Asteraceae (13 taxa). The spectrum of life forms is dominated by therophytes (58.05%), and most invasive taxa originate from the Americas (62.90%). Majority of invasive plants (38.29%) apply a strategy of combining more propagation methods, and their life strategies show an equal share of CR (38.27%) and C (37.71%) life strategies, i.e. competitive - ruderal and competitive strategies. All this makes them even more competitive than native plants. During the repeated research in 2016, changes in the direction of horizontal spread of plants by surfaces were visible (Figs. 4 - 5). The largest increase in the number of findings belonged to the most frequent, unintentionally introduced taxa *Erigeron annuus*, *E. canadensis* and *Ambrosia artemisiifolia* (Tab.1) which is additionally worrying due to the great possibilities of these taxa to further spread. Most invasive plants have been recorded in the next habitat: residential houses in a row with back gardens, individual houses (29,33%).

Table 1 – The results of analysis of invasive alien plants of the town of Samobor (Zagreb County)

Town	Samobor	
	2012.	2016.
Population (2011.) centre/ broader area	37633	-
Studied area (km <sup>2</sup> )	6,81	6,81
No. IAS plants	34	36
No. IAS plants per km <sup>2</sup>	4,99	5,29
Life forms (%)		
G	4,75	7,26
H	18,14	16,10
H/G	1,55	1,18
Li	5,92	7,36
P	7,18	8,18
T	58,97	58,05
T/H	3,49	1,89
Origin (%)		
Af/As	5,53	2,86
Am	64,11	62,90
As	27,64	32,81
As/Am	2,72	1,43
CSR Strategies (%)		
C	35,01	37,71
C/SC	5,92	7,36
CR	38,99	38,27
CSR	2,13	3,83
R	13,97	9,86
R/CR	3,88	2,91
Unknown	0,10	0,05
Distribution strategies (%)		
Ae	35,31	31,78
At	8,83	8,58
Au	5,14	5,31
Hy	0,10	0,05
Zo	15,91	15,99
Combination (two or more s.)	34,71	38,29

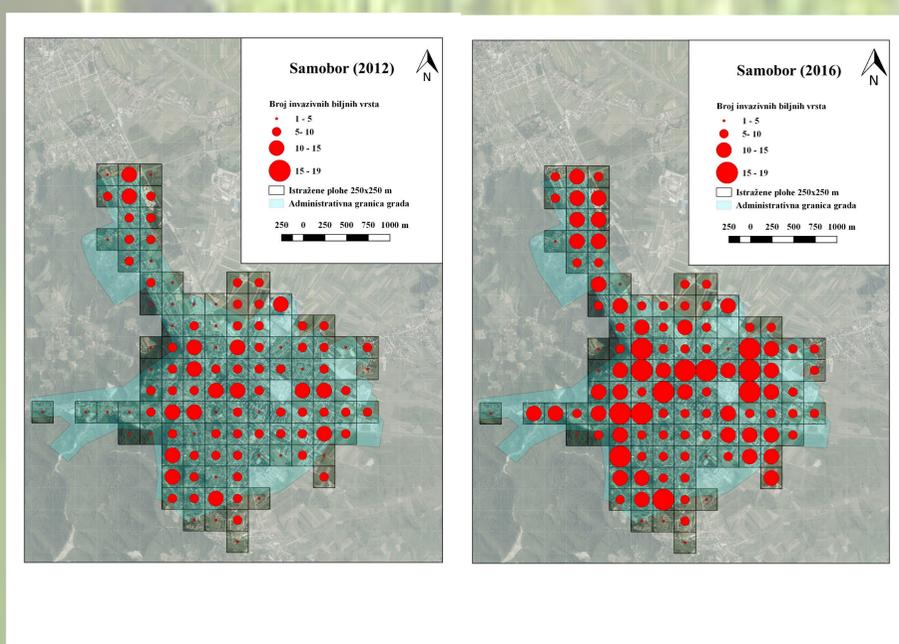


Figure 4 – Display of the increase in the number of plants during the repeated research (in 2012 and 2016) in Samobor.

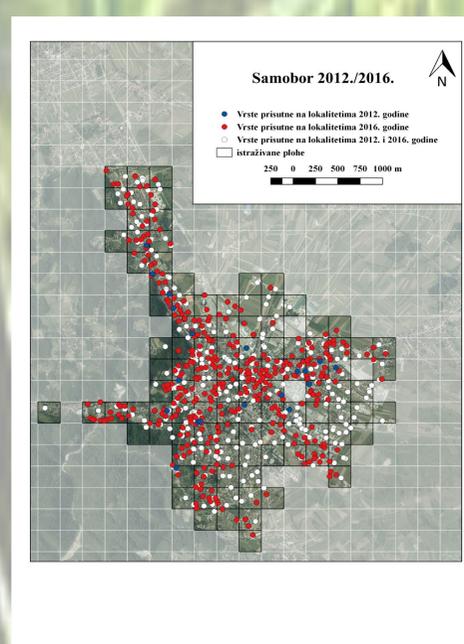


Figure 5 - Changes in the spatial distribution of invasive flora in the studied areas during the period 2012-2016 in Samobor.

## CONCLUSIONS

This research has for the first time systematically investigated and analyzed invasive flora of the town of Samobor (continental Croatia), and has pointed out the significant presence of invasive alien plants, particularly on the weakly and moderately fragmented surfaces. After a repeated four-year research period spatial distribution showed the rising number of sites of invasive alien plants, especially in urban outskirts. The increase in the number of taxa does not seem large, but it is worrying that a significant increase in the number of invasive plant findings was observed on all plots (increase from 1031 to 1959 findings - around 90%). Our study showed that regardless of the maintenance of the urban environment, the number of invasive plants is growing and that it is obviously necessary to take additional and more frequent measures to eradicate and continuously control them, all to prevent their spread in the natural environment.

Table 2 - Number of GPS findings of the most frequent invasive plants in Samobor in 2012 and 2016

