Plant Composition and Diversity in Selected Urban Green Spaces of Athens, Greece: A Significant Management Suggestion

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Abstract

Urban green spaces are of vital importance in terms of urban biodiversity conservation. The main aim of this study was to estimate urban plant composition and diversity of main green space types in Maroussi Municipality. Results showed that the highest herbaceous plant species richness was found in park-OAKA B, followed by pedestrian-Gramou and mild traffic road-M. Alexandrou, while the lowest herbaceous species richness was in street island-Vasilisis Sofias. Also, the highest woody plant species richness was found in park-OAKA B and mild traffic road-M. Alexandrou, followed by street island-Vasilisis Sofias and pedestrian-Gramou. Herbaceous and woody plant species richness were observed satisfactory in urban parks of Maroussi Municipality. These findings could provide insights for plant biodiversity conservation in urban green spaces. However, the underlying mechanisms of the urbanization degree and plant diversity need further study. Finally, promoting the use of native species in landscape design projects, especially in parks, pedestrian and mild traffic roads may contribute to creating sustainable urban spaces in the region in the future, under the concept of climatic changes.

Keywords

Biodiversity, urban green spaces, native, alien, city, urbanization level, Greece

1. Introduction

It is a fact that urban regions can support more species than a nearby surrounding landscape, hosting large numbers of native and alien species. A significant contribution can be offered to biodiversity due to the different habitat types, which range from low to high land transformation levels [1]. That is the reason why urban green spaces contribute to the ecosystem services, becoming a progressively important refuge for native biodiversity [2].

Urban green areas present a certain habitat transformation by promoting original combinations of native/alien species well adapted to these new site conditions-sometimes even better than expected, in comparison to their original habitat. Having this knowledge, it is important to evaluate the benefits linked to alien species [3,1]. However, many authors have presented and underlined the risks of further invasions of alien species, which can displace the native ones if uncontrollably spread into their natural areas [4,6,7]. However not all introduced species have invasive character [8].

The fact is that urban stresses such as soil compaction, salinity and air-pollution result in limited number of species suitable for urban areas and this in turn, causes the introduction of alien species

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[9,10]. Other factors, i.e. landscaping-gardening practices, usage and maintenance of exotic species contribute to plant species diversity in cities [2]. Apart from that, urban fauna can be influenced by vegetation structures (complexity, size, connectivity, vertical structure) [2,11]. Due to these facts, special studies are needed so that the potential of various urban green spaces and their biodiversity conservation should be revealed and managed accordingly. For this reason, the potential of different green spaces in terms of biodiversity conservation along an urban-rural settlement gradient needs to be revealed for appropriate management practices [9]. In this study we aimed to analyze the main green space categories of Maroussi Municipality in terms of plant composition and diversity (herbaceous and woody plant species richness), which were shaped by species selection approach, management and ecological conditions.

2. Study Area and Sampling

The Municipality of Maroussi is located 12 km northeast of the centre of Athens and belongs administratively to the Eastern Regional Sector of the Attica Region. The administrative boundaries of the municipality occupy an area of 1,309.3 ha and extend north up to the lowest foothills of Penteli, up to its hills Magoufanas (Pefki), Kifissia and today's Melissia, while to east, south and southwest the demarcation follows basically their network small and large streams in the area: the Polydrosos stream, which is connected to the largest stream of Podoniftis. From a geomorphological point of view, Maroussi is located at its southeastern end basin formed between Parnitha, Penteli and Turkovounia. The water systems of the area are formed mainly by three streams named Kokkinaras, Sappho and Polydrosos.

Based on available longterm data of the most recent climatic period (1960-1997), obtained from the nearest meteorological station of Tatoi (38.10oN, 23.78oE, alt. 236 m a.s.l.), the climate of the region is semi-arid [12,13] according to UNEP's [14] aridity classification system which is based on Thornthwaite's [15] water balance approach. The annual precipitation of the broader area is low (460mm) with however increased potential evapotranspiration rate (891 mm/y) resulting in a rather decreased aridity index of 0.48. During the dry period of the year, the water deficit for the development of vegetation is about 460m, whereas in the wet period the water surplus is zero.

Four public green spaces (street island-Vasilisis Sofias, park-OAKA B, pedestrian-Gramou and mild traffic road-M. Alexandrou) were selected for the current study. More specifically, the sampling of herbaceous plant communities was done in each type of urban green space in spring 2019. The samplings of herbaceous plants were carried out in plots 0.25 m^2 (0.5 m × 0.5 m), in order to record herbaceous plant composition and diversity (species richness). Also, representative sampling surfaces measuring 100 m^2 (10x10m) [16,17] were used for woody plant species composition and diversity [18]. Species identification was mainly based on Mountain Flora of Greece I, II [19,20], Flora Hellenica I & II [21,2] and Flora Europaea [23,24,25,26,27]. Plant nomenclature and distribution follow Dimopoulos et al. [28,29].

3. Results and Discussion

A total of 29 herbaceous plant and 14 woody plant species were determined in the selected urban green spaces. Among these, 28 herbaceous plant and 9 woody plant species are native species while one herbaceous plant (Figure 1) and five woody plant species are alien species (Figure 2-6). The highest herbaceous plant species richness was found in park-OAKA B, followed by pedestrian-Gramou and mild traffic road-M. Alexandrou while the lowest herbaceous species richness was in street island-Vasilisis Sofias (Figure 7, Table 1). Also, the highest woody plants species richness was found in park-OAKA B and mild traffic road-M. Alexandrou, followed by street island-Vasilisis Sofias and pedestrian-Gramou (Figure 8, Table 2). Herbaceous and woody plant species richness were observed satisfactory in urban parks. It is a well-known fact that by understanding the various roles of vegetation as far as our environment is concerned, we become fully aware of its importance. We have to safeguard vegetation because it is a natural protection-a kind of barrier-as it directly influences the energy balance on the earth's surface saving us not only from extreme weather conditions but also from pollution or erosion. Moreover, it helps to maintain and even enrich ecology, resulting in better living conditions.

However, selecting and applying vegetation species in particular areas is a demanding task which requires in-depth knowledge of the physical characteristics and relative needs of the specific/selected vegetation [30].
Another very interesting and crucial issue is that of invasive plants-when alien species spread into landscapes through trade, traffic and horticulture (the most common dispersal pathways) [31,32]. Invasive plants can affect bioregions causing serious ecological/environmental damage and measures should be taken targeting the human-facilitated introductions. Studies have shown that the composition of the invasive plants is higher in parks containing highway greenings and public gardens. The alien species of the present study cover large areas because of their extensive quality. According to Kowarik [1], although the presence of alien plant harbours risks, these risks are mostly related to particular species and do not apply to the whole group of alien ones. This very fact explains the need for programs targeting species management and their implementation by many municipalities advising against planting alien species.

Figure 1: *Oxalis pes-caprae* L.

Figure 2: *Eriobotrya japonica* (Thunb.) Lindl.

Figure 3: *Eucalyptus robusta* Sm.

Figure 4: *Ailanthus altissima* (Mill.) Swingle

Figure 5: *Phoenix canariensis* Chabaud

Figure 6: *Thuja occidentalis* L.

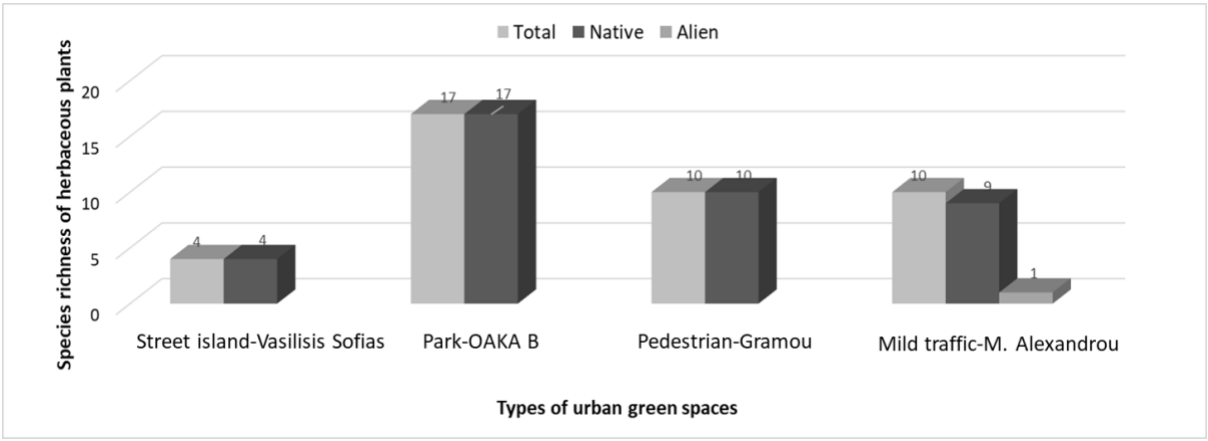

Figure 7: Herbaceous plant species richness of urban green spaces.

Table 1
Herbaceous plant species in urban green spaces of Maroussi Municipality.

Urban green space	Family	Plant species	Status
Street island -Vasilisis Sofias	Malvaceae	*Malva sylvestris* L.	Native
	Poaceae	*Cynodon dactylon* (L.) Pers.	Native
	Poaceae	*Hordeum murinum* L.	Native
	Resedaceae	*Rezeda alba* L.	Native
Park-OAKA B	Asteraceae	*Anthemis chia* L.	Native
	Asteraceae	*Glebionis coronaria* (L.) Spach	Native
	Asteraceae	*Hypochaeris achyrophorus* L	Native
	Asteraceae	*Matricaria recutita* L.	Native
	Asteraceae	*Sonchus oleraceus L.*	Native
	Euphorbiaceae	*Euphorbia peplus* L.	Native
	Fabaceae	*Medicago polymorpha L.*	Native
	Fabaceae	*Trifolium tomentosum L.*	Native
	Malvaceae	*Malva sylvestris* L.	Native
	Plantaginaceae	*Plantago lagopus L.*	Native
	Plantaginaceae	*Plantago lanceolata L.*	Native
	Poaceae	*Bromus rubens* L.	Native
	Poaceae	*Catopodium rugidum* (L.) C.E. Hubb.	Native
	Poaceae	*Cynodon dactylon* (L.) Pers.	Native
	Poaceae	*Rostraria cristata (L.) Tzvelev*	Native
	Primulaceae	*Anagallis arvensis* L.	Native
	Solanaceae	*Solanum elaeagnifolium Cav.*	Native
Pedestrian-Gramou	Asteraceae	*Sonchus oleraceus L.*	Native
	Brassicaceae	*Arabidopsis thaliana (L.) Heynh.*	Native
	Brassicaceae	*Sinapis arvensis L.*	Native
	Caryophyllaceae	*Stellaria media (L.) Vill.*	Native
	Geraniaceae	*Geranium robertianum L.*	Native
	Poaceae	*Cynodon dactylon (L.) Pers.*	Native
	Poaceae	*Hordeum murinum L.*	Native
	Rubiaceae	*Galium aparine L.*	Native
	Urticaceae	*Urtica dioica L.*	Native
	Veronicaceae	*Veronica arvensis L.*	Native
Mild traffic-M. Alexandrou	Asteraceae	*Matricaria recutita L.*	Native
	Asteraceae	*Sonchus oleraceus L.*	Native
	Brassicaceae	*Capsella bursa-pastoris (L.) Medik.*	Native
	Brassicaceae	*Sisymbrium irio L.*	Native
	Geraniaceae	*Geranium molle L.*	Native
	Malvaceae	*Malva sylvestris L.*	Native
	Oxalidaceae	*Oxalis pes-caprae L.*	Alien
	Poaceae	*Cynodon dactylon (L.) Pers.*	Native
	Poaceae	*Hordeum murinum L.*	Native
	Veronicaceae	*Urtica dioica L.*	Native

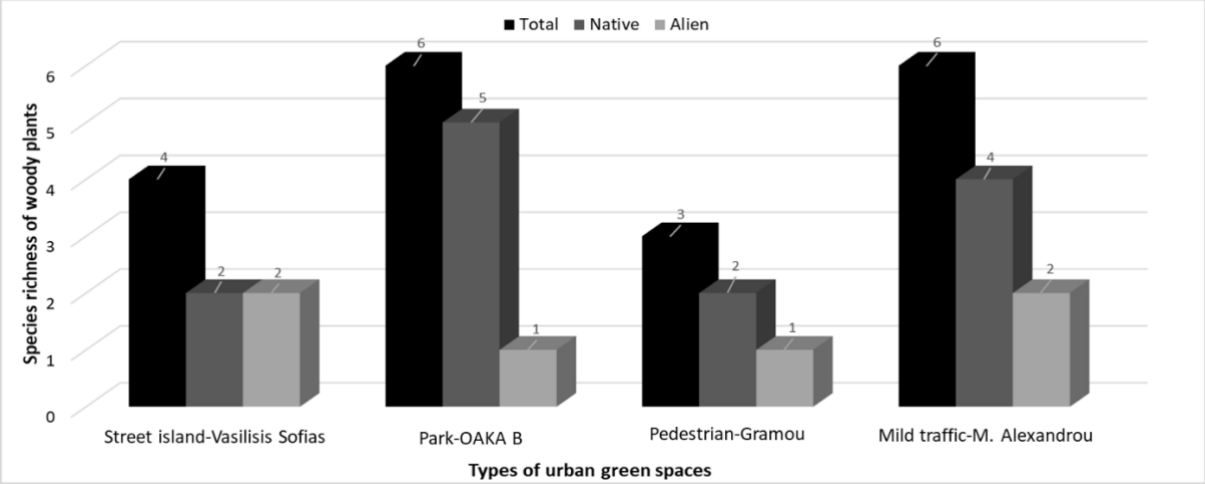

Figure 8: Woody plant species richness of urban green spaces.

Table 2
Woody plant species in urban green spaces of Maroussi Municipality.

Urban green space	Family	Plant species	Status
Street island-Vasilisis Sofias	Apocynaceae	*Nerium oleander* L.	Native
	Moraceae	*Morus alba* L.	Native
	Rosaceae	*Eriobotrya japonica* (Thunb.) Lindl.	Alien
	Simaroubaceae	*Ailanthus altissima* (Mill.) Swingle	Alien
Park-OAKA B	Arecaceae	*Phoenix canariensis* Chabaud	Alien
	Moraceae	*Morus alba* L.	Native
	Pinaceae	*Pinus pinea* L.	Native
	Platanaceae	*Platanus orientalis* L.	Native
	Platanaceae	*Platanus orientalis L.*	Native
	Sapindaceae	*Acer negundo* L.	Native
Pedestrian-Gramou	Cupressaceae	*Thuja occidentalis L*	Alien
	Fabaceae	*Cercis siliquastrum L.*	Native
	Sapindaceae	*Acer negundo L.*	Native
Mild traffic-M. Alexandrou	Arecaceae	*Phoenix canariensis Chabaud*	Alien
	Cupressaceae	*Cupressus sempervirens L.*	Native
	Myrtaceae	*Eucalyptus robusta* Sm.	Alien
	Oleaceae	*Olea europaea L.*	Native
	Pinaceae	*Pinus brutia* Tenore	Native
	Pinaceae	*Pinus pinea* L.	Native

This study demonstrates that parks in Maroussi are among the most species rich types of urban greenspaces for herbaceous and woody plants. It is also remarkable to note that the species richness found in urban green spaces is to a great extent determined by certain factors, such as: a) the environmental heterogeneity in urban areas [1], b) the species selection made by the person in charge [33], c)the status of the neighborhood both cultural and socioeconomic [34,35,1], d) the selective force of random natural disasters [36] and e) the plant availability of local garden produce.

4. Conclusions

In this study, the tree register of urban forests gives a certain baseline for the settings of the urban tree canopy and its management. These registers are very useful for the establishment of safe species without any risk of invasion and those with high invasion risk which -naturally- must be avoided and excluded. Our main conclusion is that a recent checklist of Greece invasive alien flora (i.e. https//www.alienplants.gr/taxa-checklist) can form a basis concerning the national management strategies towards nature conservation, not to mention that by promoting the use of native species in landscape design projects, mainly in parks and pedestrian/traffic roads we contribute to the future creation of sustainable urban green spaces in a region, under the concept of climate change.

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