Proceeding Book of ISESER 2023

O 38. INVASIVE PLANT SPECIES IN THE URBAN ECOSYSTEM: BOSTANLI STREAM EXAMPLE; KARSIYAKA, IZMIR

Gülşah KAÇMAZ AKKURT[1]*, Seda ŞEMSIYECI[2]

[1]Department of City and Regional Planning, Faculty of Architecture, Dokuz Eylül University, Izmir, Turkey, ORCID: 0000-0002-1984-5324
[2]ORCID: 0000-0002-5930-7774

E-mail*: [1]gul.sah.k@hotmail.com, [2]Sedasemsiyeci@gmail.com*

ABSTRACT: Human beings have tended to change the physical environment in which they live since the day they came into existence. One of the results of these changes is the change of flora and fauna. These conscious or unconscious changes cause invasive species to settle in natural habitats. These habitat changes especially threaten the existence of local plant species and may even cause their extinction.

It is important to identify and control these plant species that prevent the provision of ecosystem services by reducing biodiversity in urban landscapes. In addition, when choosing plants in landscape projects, local plant species should be preferred instead of aesthetic concerns or periodic popular choices. In this direction, the aim of this study was to determine the invasive plant species used in the green areas along Bostanlı Stream in Izmir, where exotic plant species are abundant.

Keywords: Izmir, Bostanlı Stream, Invasive Plant Species, Urban Ecosystem

1. INTRODUCTION

The increase of invasive species (plant or animal) on Earth is in fact closely related to the history or rise of humankind on Earth. Therefore, to understand the increase of invasive alien species, it is useful to look at recent human history. Some scientists consider the beginning of the period when mankind began to influence the earth as the beginning of agriculture. However, evaluations based on atmospheric data suggest that humans lived in partial harmony with nature until the end of the 18th century, and with the industrial revolution, a new era emerged in which mankind began to use natural resources unbalanced and irresponsibly (Önen, 2015). Today, when population density and urbanisation have reached incredible dimensions, especially with the effect of the development in transportation and communication technology. The earth has become a world of gigantic cities connected to each other by complex networks (communication, energy, transportation, etc.) Urban settlements, which were generally concentrated in regions rich in natural resources before, are now spread almost all over the earth. This situation has eliminated the natural barriers (sea, ocean, mountain ranges, deserts, etc.) between biogeographical (biodiversity) regions of the earth and shortened the distances. Therefore, invasive organisms have become easily transportable to new countries/regions (Önen, 2015).

The International Union for Conservation of Nature and Natural Resources (IUCN) defines alien invasive species (plant or animal) as agents that establish themselves as alien species in natural or semi-natural ecosystems and habitats, threatening and altering natural biodiversity. These plants, which have extremely high resistance, provide superiority to other plant species in the new area they enter due to their genetic diversity, strong growth ability, lack of natural enemies and environmental pressure in the area where they settle. The invasion processes of invasive alien plant species generally include settlement, spread and invasion stages. Invasive plant species increase their populations in the areas they spread in a short time and become dominant. In the past, these species were mostly used to cover problematic areas (such as dam edges, mining areas, marsh drying areas, erosion control areas, etc.) with plants as soon as possible. However, as time passed, they spread from the area where they were planted to natural areas and destroyed the natural vegetation and local plant compositions (Sarı, 2019).

Invasion of natural ecosystems by invasive species is a major threat to biodiversity globally. Many researchers have argued that invasive plants negatively affect ecosystem structure and functioning in all habitats by reducing native species richness, altering water and fire regimes, soil nutrient status and geomorphological processes (Lake and Leishman 2003). Furthermore, the Millennium Ecosystem

Assessment (2005) recognized biological invasions as one of the five main causes of biodiversity decline, which translates into a reduction in ecosystem services worldwide.

Strategies and approaches have been developed in many parts of the world to restore ecosystems following degradation caused by invasive species. From interventions that aim to reduce the presence, abundance or impacts of invasive species and favor native species, to low-impact practices that involve only the removal or reduction of invasive species (Holmes et al., 2000). Among these methods, mitigation efforts based on the elimination of invasive species have created dilemmas in some cases. The most well-known example is the use of invasive Tamarix species in the USA as habitat for endangered flycatchers (Empidonax traillii subsp. extimus). These birds, which are known to be extremely rare throughout the country, have not been seen in the area dominated by Tamarix until now, but are known to be present there. This has created a dilemma as to whether the coastal ecosystem, which is more conducive to the sustainability of essential ecosystem services, or flycatchers should be prioritized (Pysek and Richardson, 2010).

As in many parts of the world, many ornamental plants with invasive characteristics are intensively used in green areas designed for urban development in Turkey. The number of studies on the identification and control of these plants, which are likely to damage natural ecosystems by spreading from urban landscapes to natural landscapes, should be increased.

Within the scope of this study; invasive plant species used in the green areas along the Bostanlı Stream in Karşıyaka district of İzmir province in the Aegean Region of Turkey were examined. In addition, the environmental and economic damages caused by these plants in İzmir province were also mentioned.

2. MATERIAL AND METHOD

This study was conducted in the vicinity of Bostanlı Stream in Bostanlı neighborhood of Karşıyaka district of İzmir Province (Figure 1).

Figure 1. Research Area Boundary

In the city of İzmir, there are often streams through the residential landscape. The immediate surroundings of these concreted streams are mostly built up. Some of them are surrounded by green

areas, such as the stream subject to our research (Figure 2). The area subject to the research is the 1,1 km section of Bostanlı stream extending from Demirköprü Underpass to Hasan Ali Yücel Boulevard.

In the first stage of the research, the natural vegetation and characteristics of İzmir province were investigated. In the second stage, the plant species used in the landscape design of Bostanlı Stream were identified. In the last stage of the study, invasive plant species used in the research area were identified.

Figure 2. General View of the Study Area (Original, 2023)

3. RESEARCH FINDINGS

In the research findings, the presence of invasive plant species in the green areas around Bostanlı Stream in Bostanlı neighborhood of Karşıyaka district of İzmir province was evaluated. Approximately 70 different plant species were identified in the area and these species were grouped as deciduous/palm trees and shrubs, deciduous shrubs, evergreen trees, evergreen shrubs, ivy and ground cover species. As a result of the evaluations, it was determined that approximately 35% of these species consist of invasive and high-invasive plant species (Figure 3).

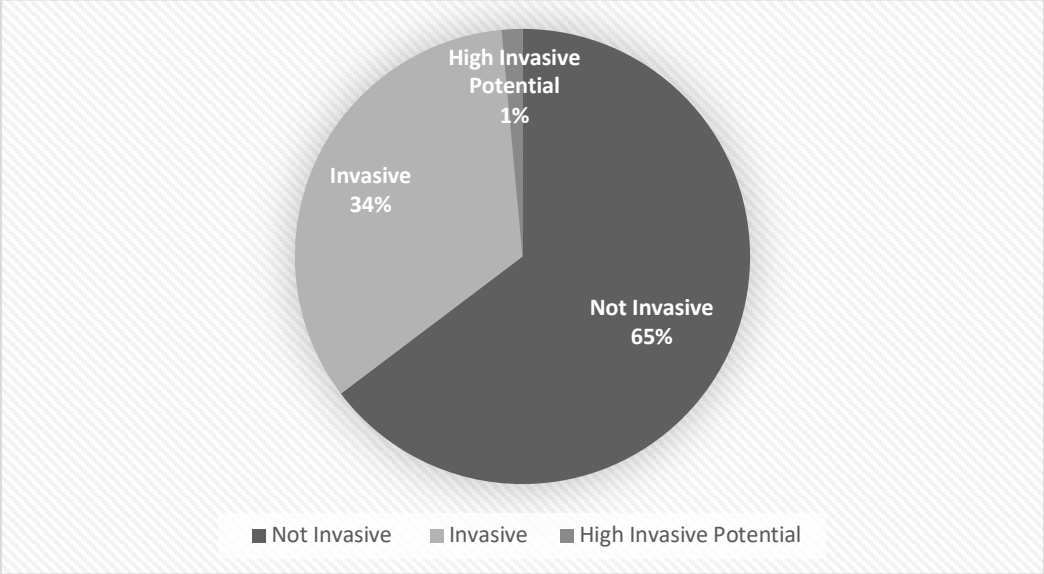

Figure 3. Rate of invasive plant species in the research area

Approximately 35 different deciduous and evergreen tree species were identified in the area (Table 1). According to the data obtained, *Robinia pseudoacacia, Acer negundo, Albizzia julibrissin, Paulownia tomentosa, Olea europea, Nerium oleander, Laurus nobilis, Hibiscus syriacus, Eucalyptus camaldulensis, Morus alba, Prunus persica, Populus nigra, Phoenix canariensis, Chamaerops excelsa* were identified as invasive species and *Robinia pseudoacacia "Umbracifera"* was identified as potentially invasive species. The proportion of these species in the area in relation to all evergreen tree and shrub species is quite high at 43%. These species can encircle the area very quickly and cause undesirable designs. In addition, the proportion of exotic plant species in the area is also quite high (Table 1).

Table 1. Invasiveness assessment of deciduous/palm trees and shrubs species in the study area

No	Latin Name	Family	Homeland	Invasive	High Invasive Potential	Not Invasive
1	*Robinia pseudoacacia "Umbraculifera"*	Leguminosae	North America		**X**	
2	*Robinia pseudoacacia*	Leguminosae	Southeast America	**X**		
3	*Fraxinus angustifolia*	Oleaceae	Middle and Southern Europe and North Africa and Southwest Asia			**X**
4	*Platanus orientalis*	Platanaceae	Eurasia, Balkans			**X**
5	*Robinia hispida*	Leguminosae	Southeast America			**X**
6	*Acer negundo*	Aceraceae	North America	**X**		
7	*Schinus molle*	Anacardiaceae	Middle and South America			**X**
8	*Jacaranda mimosifolia*	Bignoniaceae	Brazil			**X**
9	*Tilia cordata*	Malvaceae	Europe			**X**
10	*Liquidambar orientalis*	Altingiaceae	Anadolu			**X**
11	*Paulownia tomentosa*	Paulowniaceae	China	**X**		
12	*Hibiscus syriacus*	Malvaceae	Asia	**X**		
13	*Catalpa bignonioides*	Bignoniaceae	North America			**X**
14	*Bauhinia variegata*	Leguminosae	China			**X**
15	*Punica granatum*	Lythraceae	Near East Asia			**X**
16	*Eucalyptus camaldulensis*	Myrtaceae	Australia	**X**		
17	*Chamaerops excelsa*	Arecaceae	China and Japan	**X**		
18	*Prunus cerasifera "Atropurpurea"*	Rosaceae	North America			**X**
19	*Morus nigra*	Moraceae	China Japan, Thailand Malaysia			**X**
20	*Morus alba*	Moraceae	Turkey, Iran, Arabia, Caucasus	**X**		

21	*Prunus armeniaca*	Rosaceae	Central Asia			**X**
22	*Prunus persica*	Rosaceae	East Asia and China	**X**		
23	*Olea europaea*	Oleaceae	From the Mediterranean and Africa, Central Asia and Australia	**X**		
24	*Populus nigra*	Salicaceae	Europe, Southwest and Central Asia, Turkey	**X**		
25	*Ficus nitida 'Retusa'*	Moraceae				**X**
26	*Ceratonia siliqua*	Leguminosae	Eastern Mediterranean and its coasts			**X**
27	*Washingtonia filifera*	Arecaceae	Southwestern America and Northwestern Mexico			**X**
28	*Prunus serrulata*	Rosaceae	Japan			
29	*Gleditsia triacanthos*	Leguminosae	North America			**X**
30	*Albizia julibrissin*	Leguminosae	The tropics of Asia	**X**		
31	*Nerium oleander*	Apocynaceae	Mediterranean Region	**X**		
32	*Laurus nobilis*	Lauraceae	Anatolia and the Balkans	**X**		
33	*Cydonia oblonga*	Rosaceae	North - Western Iran, North Caucasus, the shores of the Caspian Sea and Northern Anatolia			**X**
34	*Phoenix canariensis*	Palmae	Tropical and Subtropical Africa-Canary Islands	**X**		
35	*Magnolia grandiflora*	Magnoliaceae	North America			**X**

In the area, 24 different deciduous shrub species were identified (Table 2). Among these species, *Nandina domestica, Ligustrum japonicum, Agave americana, Pyracantha coccinea, Lantana camara, Berberis thunbergii "Atropurpurea*" were identified as invasive species. Although these species constitute 25% of all deciduous shrub species in the area, they cover a large area due to their invasive characteristics.

Table 2. Invasiveness assessment of deciduous shrub species in the study area

No	**Latin Name**	**Family**	**Homeland**	**Invasive**	**High Invasive Potential**	**Not Invasive**
1	*Nandina domestica*	Berberidaceae	India, China and Japan	**X**		

2	*Solanum laciniatum*	Solanaceae	America			**X**
3	*Euryops pectinatus*	Asteraceae	South Africa			
4	*Viburnum lucidum*	Caprifoliaceae	Southeast Europe, Mediterranean coast			**X**
5	*Pittosporum tobira*	Pittosporaceae	Southeast Asia and Australia.			**X**
6	*Euonymus japonica 'Aurea'*	Celastraceae	Japan, Korea and China			**X**
7	*Seneraria cineraria*	Asteraceae	Mediterranean Region Southern and Central Europe			**X**
8	*Ligustrum japonicum*	Oleaceae	Japan and Korea	**X**		
9	*Agave americana*	Agavaceae	America	**X**		
11	*Westringia fruticosa*	Lamiaceae	Australia			**X**
12	*Yucca filamentosa*	Agavaceae				**X**
13	*Campsıs radıcans*	Bignoniaceae	South America			**X**
14	*Abelia grandiflora*	Caprifoliaceae	China			**X**
15	*Pyracantha coccinea*	Rosaceae	Southern Europe and Anatolia	**X**		
16	*Euonymus japonicus*	Celastraceae	Japan, China, Korea			**X**
17	*Lantana camara*	Verbenaceae	America	**X**		
18	*Santolina chamaecyparissus*	Asteraceae	Western Mediterranean, Turkey			**X**
19	*Cotoneaster microphyllus*	Rosaceae	Asia, Europe and Africa			**X**
20	*Viburnum tinus*	Caprifoliaceae	Ukraine, Russia, Southeast Asia, South Africa			**X**
21	*Berberis thunbergii "Atropurpurea"*	Berberidaceae	Southern Japan	**X**		
22	*Callistemon leavis*	Myrtaceae	South East Australia			**X**
23	*Ligustrum ovalifolium*	Oleaceae	Europe, North Africa, Asia Australia, China and Japan			**X**
24	*Hibiscus mutabilis*	Malvaceae	Güney Çin			**X**

Four different evergreen tree species were identified in the area (Table 3). As a result of the evaluations, there are no invasive species or species with invasive potential among the evergreen species.

Table 3. Assessment of evergreen tree species in the study area in terms of invasiveness

No	Latin Name	Family	Homeland	Invasive	High Invasive Potential	Not Invasive
1	*Thuja orientalis*	Cupressaceae	East Asia			**X**
2	*Cupressus arizonica*	Cupressaceae	Mexico, Arizona.			**X**
3	*Cupressus macrocarpa*	Cupressaceae	Western America			**X**
4	*Pinus brutia*	Pinaceae	Eastern Mediterranean Basin			**X**

As a result of the surveys, 2 different evergreen shrub species were identified in the area (Table 4). As a result of the assessments, there are no invasive species or species with invasive potential among the evergreen species.

Table 4. Invasiveness assessment of evergreen shrub species in the study area

No	Latin Name	Family	Homeland	Invasive	High Invasive Potential	Not Invasive
1	*Juniperus horizontalis*	Cupressaceae	Alaska, Canada, North America			**X**
2	*Juniperus sabina*	Cupressaceae	Central and Southern Europe, Alps, Carpathians, Pyrenees, Turkey, Caucasus and Siberia			**X**

Finally, as a result of the observations, 6 different ground cover and ivy species were identified in the study area (Table 5). Among these species, *Parthenocissus quinquefolia, Carpobrotus acinaciformis* and *Hedera helix* were identified as invasive species. Since 50% of all ground cover and ivy species in the area are invasive, these species occupy more space in landscape design than other species.

Table 5. Invasiveness assessment of ground cover and ivy species in the study area

No	Latin Name	Family	Homeland	Invasive	High Invasive Potential	Not Invasive
1	*Parthenocissus quinquefolia*	Vitaceae	North America	**X**		
2	*Mesembryanthemum nodiflorum*	Aizoaceae	South Africa			**X**
3	*Carpobrotus acinaciformis*	Aizoaceae	South Africa'	**X**		
4	*Bougainvillea alexandra*	Bougainvillea	South America			**X**
5	*Tecomaria capensis*	Bignoniaceae	South Africa			**X**
6	*Hedera helix*	Araliaceae	Europe and Southwest Asia, Turkey	**X**		

4. CONCLUSIONS

Invasive species are an important driver of global change, causing biodiversity loss, ecosystem degradation and reduced ecosystem services worldwide.

The detrimental effects of invasive plant species are now widely recognized and multi-scale programs are being implemented in many parts of the world to mitigate their current and future impacts. Among the activities that have received the most attention and hold the most promise for reducing problems are new approaches to early detection and remediation.

For this purpose, it is an important criterion to pay attention to whether they are invasive and natural or not, as well as their aesthetic functions when selecting plants to be used in urban landscapes. These species, which threaten the sustainability of natural ecosystems by encompassing the area they are found very quickly, should be carefully considered in their areas of use. For this reason, the use of natural plant species should be encouraged in landscape designs, especially in urban landscapes.

As can be seen as a result of the field studies carried out in the green areas around Bostanlı Stream, invasive plant species such as *Robinia pseudoacacia, Acer negundo, Albizzia julibrissin, Paulownia tomentosa* are widely used in urban landscapes in İzmir province. When using these species in landscape designs, their invasive character should be taken into consideration and their use should be limited. In addition, a comprehensive database of invasive plant species and diversity should be established throughout the country and the population of these species should be controlled.

REFERENCES

Holmes, PM., Richardson, DM., Van Wilgen, BW., Gelderblom, C., 2000, Recovery of South African fynbos vegetation following alien woody plant clearing and fire: implications for restoration. Austral Ecol. 25:631–39

Lake, JC. and Leishman, MR., 2003, Invasion success of exotic plants in natural ecosystems: the role of disturbance, plant attributes and freedom from herbivores. Biol Conserv 117: 215–226

Millenn. Ecosyst. Assess., 2005, Millennium Ecosystem Assessment Synthesis Report.Washington, DC: Island

Önen, H., 2015, İstilacı Yabancı Türler ve İstila Süreçleri (Invasive Alien species and invasion process), Türkiye İstilaci Bitkiler Kataloğu (Invasive Plants Catalogue Of Turkey), Publisher: T.C. Gida, Tarim ve Hayvancilik Bakanliği Tarımsal Araştırmalar ve Politikalar Genel Müdürlüğü Bitki Sağlığı Araştırmaları Daire Başkanlığı.

Pysek, P.and Richardson, DM., 2010, Invasive Species, Environmental Change and Management, and Health

The Annual Review of Environment and Resources, 35:25–55, 10.1146/annurev-environ-033009-095548

Richardson, D. M., Cowling, R. M. and Le Maitre, D. C., 1990, Assessing the risk of invasive success in Pinus and Banksia in South African mountain fynbos. J. Veg. Sci. 1, 629–42.

Sarı, D., 2019, Kentsel Peyzajda Kullanılan Bazı İstilacı Süs Bitkileri; Türkiye'den Örnekler, Scientific Developments - Chapter 12, ISBN: 978-605-78521-20

Wiser, S. K., Allen, R. B., Clinton, P. W. and Platt, K. H., 1998, Community structure and forest invasion by an exotic herb over 23 years. Ecol. 79, 2071–81.