VISITORS' AWARENESS OF DIVERSITY AND ABUNDANCE OF TREES IN URBAN GREEN SPACES AND THEIR ABILITY OF ACCURATE SPECIES IDENTIFICATION

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Abstract. Istanbul's historical groves are important green areas consisting of large tree communities that have been protected and developed in a historical process and they meet the recreational needs of city residents. The purpose of this study, after revealing the richness and composition of woody plant species in a historical city grove, is to understand whether or not the visitors notice the plant richness of the grove and to test visitors' ability to identify tree species using photographs of the most common tree species in the grove. Results showed that 9388 woody plants belonging to 211 species, 111 genera and 55 families were found in Emirgan Grove. Perceived plant species richness within the grove was often well below the actual richness recorded in woody plant inventory. Frequency of visits had a significant relationship with the visitor awareness of tree species but it did not contribute meaningfully to the knowledge of species identification. Moreover, there was no indication that more abundant trees were better identified by visitors. Trees that have distinctive looks, fragrant or conspicuous flowers and typical fruits were better identified rather than the most abundant trees. These results can help to develop education programs to improve citizens' awareness and knowledge of plant species in urban areas.
Keywords: *species richness, tree knowledge, İstanbul, biodiversity awareness, historical grove*

Introduction

Trees, as the most important components of the urban green spaces, perform many ecosystem functions that contribute significantly to the quality of life of the people living in the region. Planting, caring for, and protecting trees in a city and thus ensuring its sustainable management is one of the most effective strategies that contribute directly and indirectly to the goal of improving the quality of life of the city residents (Turner-Skoff and Cavender, 2019; Jones, 2021).

High species and genus diversity is recommended in urban areas as one of the most important solutions to have a healthy and sustainable urban tree population, where the damage due to epidemic plant diseases and invasive pests (Guo et al., 2019), and possible effects of global climate change is minimal (Raupp et al., 2006; Tubby and Webber, 2010; Sjömann et al., 2012). Strategic recommendations that a tree species, genus, and family should not exceed a certain percentage of the total tree population in urban green areas (Barker, 1975; Grey and Deneke, 1986; Moll, 1989; Santamour, 1990; Miller and Miller, 1991) are important guidelines for the selection of tree species, increasing tree species

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diversity, and sustainable management of tree populations in such areas. In order to develop robust strategies to improve species diversity and age structure in an urban green space, first tree composition must be revealed (Miller, 1997; Pauleit, 2003; Ningal et al., 2010; Keller and Konijnendijk, 2012; Nielsen et al., 2014; Sjöman et al., 2016; Thomsen et al., 2016). Tree inventory provides baseline data for understanding current woody plant diversity and composition, age and size diversity, the number of native and non-native species in an urban green area, and an important tool in decision-making for sustainable management of the tree population (Morgenroth and Östberg, 2017).

Public biodiversity awareness and broad-based support in society are important to the success of urban biodiversity conservation attempts. In this sense, species identification skills are considered the first step to increasing the awareness of biodiversity in society and providing community support for conservation efforts (Elder et al., 1998; Greene 2005; Leather and Quicke, 2009; Hooykaas et al., 2019). The ability to identify and name plant species is essential to raise people's awareness of plant diversity, plant conservation, and early detection of species invasion (Dallimer et al., 2012; Robinson and Gaston, 2016; Hoykaas et al., 2019; Jubase et al., 2021; Mäder et al., 2021). Because correctly identifying a tree species means having some knowledge about it as well (Hooykaas et al., 2022).

'Grove' is defined as a small piece of forest or a large tree community or afforested area near the city (Uzun et al., 2000), parks or gardens with planted tress (Stark, 2014), tree communities whose woody understory vegetation has been cleared to a large extent (Phibbs, 1991). Istanbul's historical groves are important green areas consisting of large tree communities that have been protected and developed in a historical process and they meet the recreational needs of city residents. The Emirgan grove is one of the most popular historical green areas of İstanbul from the 17th century. In 1960, the tulip festival was held for the first time in the Emirgan grove (Yaltırık et al., 1997). Since 2005, tulip festival has been held in April every year, and a large number of people visit the grove during this period. Many native and exotic woody plant species were planted here, and at present the area has a rich woody plant diversity. Studies on the plant diversity awareness level and tree identify knowledge of people using green spaces in Istanbul, which is located on the border of the European continent and the most populated city in Europe, are extremely limited. There are not any studies present quantifying the tree species identification of the visitors of urban green areas in İstanbul.

In this study, our aim is (1) to determine the woody plant inventory of the Emirgan grove, which is one of the oldest historical groves of İstanbul and to reveal the woody plant composition and diversity, and (2) to evaluate species identification skills of the visitors of this historical grove by finding answers to the following questions:

Do species identification skills of the visitors differ between gender, age, education level, activities, and frequency of visits?

Is there a relationship between the abundance of the trees in the grove and visitors' species identification skills?

Materials and methods

Study area

The study was conducted in Emirgan Grove that covers a total area of 43 ha, located on a hill in the north of Istanbul, overlooking the Bosphorus (*Figure 1*). There are 3 mansions built in the 19th century in the Emirgan Grove which dates back to the 17th

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century when it was known as "Feridun bey gardens" at that time. The privately owned area was purchased by the Istanbul Municipality and opened to the public in 1943 (Evyapan, 1972) and today it is one of the most popular recreation areas in the city.

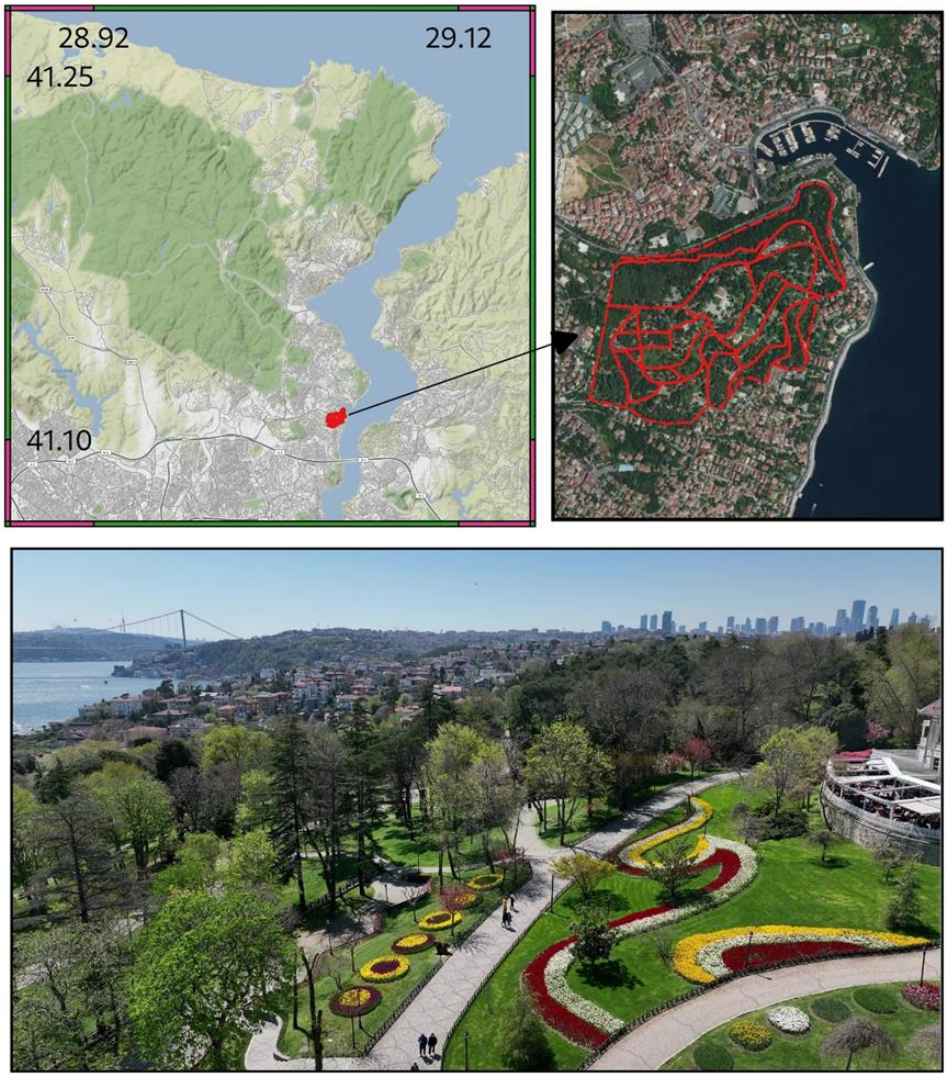

Figure 1. *Study area (Photograph İBB archive)*

Emirgan Grove is a reconstructed space composed of lawns, shrubs, monumental trees, 7 km of paths, a grotto, ornamental ponds, a small lake with a magnificent view of the Bosphorus. While the surroundings of the mansions are rich and well-maintained areas in terms of species diversity, the other large part of the grove has the appearance of a natural designed park with plenty of trees (Buğdaycıoğlu, 2004) and a small sloping part also has the appearance of a forest dominated by natural vegetation.

In 1960, the tulip festival was held for the first time in the Emirgan grove (Yaltırık et al., 1997). Since 2005, tulip festival has been held in April every year, and a large number of people visit the grove during this period.

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Plant data

Between July - November 2020, a full inventory of shrubs and trees was done in Emirgan Grove. The grove was divided into 23 parcels in total considering the road network on the map. Each woody plant species was identified using Krüssmann (1985, 1984-1986) and Akkemik (2020), and trees were classified in three diameter categories at the breast height (as 8-20 cm, 20-40 cm and more than 40 cm). The plants were classified as native versus exotic.

Questionnaire data

In July – September 2021, we conducted face-to-face semi-structured interviews (n = 80) in the grove. We briefly explained the purpose of the study to the visitors, asked them to participate, and conducted the survey with those who voluntarily accepted. The questionnaire consisted of 10 questions in Turkish (see *Appendix A*) and lasted 25 min on average. The age, gender, education level, visiting frequency and activity types of the visitors were asked and recorded. Afterwards, following Muratet et al. (2015), the visitors' perception of plant species richness in the grove, estimated number of plant species and opinion about the importance of species richness in the grove were taken. In the second part of the interview the visitors were shown photographs of the general appearance, bark, leaf, flower, fruit, or cone of 12 species, 10 of which were the most common species and 2 of which were not in the grove at all (Appendix B). The visitors were asked whether they had seen the trees shown in the photos in order to understand whether they noticed the plants during their visit to the grove. Then they were asked to common name the trees if they knew. Finally, we received the recommendations of visitors about the grove.

We preferred to conduct our surveys during the weekdays since the visitor profile vary considerably between weekends and weekdays. In this period, weekend visitors are mostly people who visit the grove for a picnic.

Data analysis

Basic descriptive statistics were derived to understand visitors' typology. Because the data failed the normality test, the non-parametric Kruskal-Wallis one-way analysis of variance on ranks was chosen to compare visitors' differences in recognition and identification of plants between gender, age, education level, and visiting frequency. A biplot comparisons were applied whether identification score and detection score were associated with the number of species in the grove. All of the statistical analyses were performed using the statistical software R 4.1.2 (R Core Team, 2021). Data manipulation and descriptive statistics were conducted using the R package "dplyr" (Wickham et al., 2023) and plots were generated with the R packages "ggplot2" (Wickham, 2016), "ggsci" (Xiao, 2018), and "ggrepel" (Slowikowski, 2022). Basal area of each tree has been registered as abundance data, and the relative abundance and relative importance values were calculated using the "Impotancevalue.comp" command of "BiodiversityR" (Kind and Coe, 2005) package.

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Results

Species richness and composition

A total of 211 different species were encountered with 9388 individuals being measured. 3435 individuals are in the diameter step below 20 cm, 3946 are in the 20-40 cm diameter category, and 2007 are greater than 40 cm. The top three species made up almost one third of the total plants (31.8%), while the top 10 most frequent accounted for 58% of the total plants and the top 30 tree species are 82.62% of the total woody plants in the grove (*Table 1*).

Table 1. *Size class distribution, relative abundance and importance value (IV) of the top 30 most frequent tree species in Emirgan Grove of İstanbul*

Species	Family	N/E	<20 cm	20-40 cm	>40 cm	Number of trees	Relative abundance %	Importance value
Fraxinus angustifolia Vahl	Oleaceae	N	202	846	434	1482	15,8	34.28
Cedrus libani A.Rich.	Pinaceae	N	236	225	352	813	8,7	18.89
Pinus pinea L.	Pinaceae	N	9	232	446	687	7.3	16.64
Robinia pseudoacacia L.	Fabaceae	E	84	385	51	520	5.5	13.41
Quercus robur L.	Fabaceae	N	76	244	154	474	5.0	12.54
Laurus nobilis L.	Lauraceae	N	233	177	1	411	4.4	11.1
Quercus coccifera L.	Fabaceae	N	154	172	3	329	3.5	7.64
Cercis siliquastrum L.	Fabaceae	N	179	100	13	292	3.1	8.35
Carpinus betulus L.	Betulaceae	N	126	87	17	230	2.4	6.6
Tilia tomentosa Moench	Malvaceae	N	26	141	52	219	2.3	6.26
Cedrus deodara (Lamb.) G. Don	Pinaceae	E	64	111	41	216	2.3	6.63
Ulmus minor Mill.	Ulmaceae	N	70	109	27	206	2.2	6.31
Aesculus hippocastanum L.	Sapindaceae	E	20	70	106	196	2.1	6.01
Fraxinus ornus L.	Oleaceae	N	147	47	0	194	2.1	5.09
Cupressus sempervirens L.	Cupressaceae	N	119	50	5	174	1.9	5.73
Gleditsia triacanthos L.	Fabaceae	E	24	118	21	163	1.7	5.39
Acer platanoides L.	Sapindaceae	N	111	37	6	154	1.6	4.99
Pinus pinaster Ait.	Pinaceae	E	1	50	46	97	1.0	2.71
Pinus halepensis Mill.	Pinaceae	N	0	43	53	96	1.0	2.26
Pinus nigra Arnold	Pinaceae	N	8	83	2	93	1.0	3.16
Tilia cordata Mill.	Malvaceae	N	38	47	2	87	0.9	3.03
Ailanthus altissima (Mill.) Swingle	Simaroubaceae	E	26	52	6	84	0.9	2.96
Ligustrum lucidum W.T. Aiton	Oleaceae	E	71	12	0	83	0.9	3.05
Prunus serrulata Lindl. **'Kanzan'**	Rosaceae	E	68	7	0	75	0.8	2.45
Platycladus orientalis (L.). Franco	Cupressaceae	E	61	10	2	73	0.8	2.73
Prunus spp.	Rosaceae	E	53	14	3	70	0.7	3.74
Phillyrea angustifolia L.	Oleaceae	N	58	9	0	67	0.7	
Liquidambar styraciflua L.	Altingiaceae	E	58	2	0	60	0.6	2.56
Platanus orientalis L.	Platanaceae	E	16	26	17	59	0.6	
Celtis australis L.	Ulmaceae	N	38	12	2	52	0.6	2.28

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Woody plant species' relative abundance and importance value was shown in *Table 1*. The five most important tree species according to the score were *Fraxinus angustifolia*, *Cedrus libani*, *Pinus pinea*, *Robinia pseudoacacia a*nd *Quercus robur* and they contributed 42.3% of relative abundance.

The relative abundance of the most common taxa in urban green spaces is a good tool for determining plant diversity (Kendall et al., 2014). The results show that the relative abundance of families was less than 30%, and the relative abundance of genus was less than 20% in the study area. At the species level, the most abundant tree in the grove is *F. angustifolia*, with a total number of 1482 trees (15.79%). When *Fraxinus ornus* (0.1%) and *F. excelsior* (2.1%) are also included, the genus *Fraxinus* is the most common genus with 17.9% relative abundance. The next two most frequent species were *C. libani* and *P. pinea*, with 813 and 687 individuals, respectively. *Pinus* is the second most abundant genus in the grove, and it made up 11.3 % of the plants throughout the grove.

Native and exotic trees distribution

The number of exotic tree species in the grove is 137 and it constitutes 65% of the total number of species. However, when the number of individuals belonging to exotic taxa is evaluated, its ratio in the total tree population is 29% with 2686 trees. While *F. angustifolia, Q. robur, Cercis siliquastrum, F. ornus, L. nobilis* are species that are both found in the natural vegetation and planted abundantly as ornamental plants in the grove, *Q. coccifera* and *P. latifolia* are only seen in natural vegetation on the slopes.

Size class distribution of trees

The information on diameter size of tree species in urban green areas gives important clues about the age of the trees, although the diameter size of the trees may differ depending on the tree species and habitat as well as the tree age. Size class distribution of the thirty most important tree species in Emirgan Grove was shown in *Table 1*. Tree size class was divided into 3 groups: young age group (lover than 20 cm), middle age group (20 cm – 40 cm) and old age group (more than 40 cm). The medium size class (stem diameter of 20-40 cm) had the greatest proportion of all stems recorded (42%). This could be explained by the presence of a large number of native slow-growing small tree growth throughout the study site such as *Q. coccifera, P. latifolia* and *F. ornus*, as well as the dense plantings in recent years.

Large individual specimens of greater than 40 cm only made up 21% of all stems measured. *P. pinea* (442 trees), *F. angustifolia* (434 trees), *C. libani* (352 trees), *Q. robur* (154 trees) and *Aesculus hippocastanum* (106 trees) had higher percentage in the old age group, occupying 4.7%, 4.6%, 3.7%, 1.6% and 1.1%, respectively, which indicated that they were planted during the 18th and 19th centuries, and *Q. robur* and *F. angustifolia* are also found naturally in the area.

The top five tree species in the young age group are *C. libani* (with 236 individual), *L. nobilis* (with 233), *F. angustifolia* (202 trees), *C. siliquastrum* (179 trees), *Q. coccifera* (154 trees) (*Figure 2*), which account for 2.5%, 2.5%, 2.2%, 1.9% and 1.6% of the total trees in this group respectively, but there are many individuals of these tree species in other diameter classes as well. This indicates that these species have been preferred as park trees from past to the present except *Q. coccifera* which grows spontaneously on the slopes in natural vegetation. *F. ornus, L. nobilis,* and *C. siliquastrum* are also found on these slopes naturally and also planted as ornamental trees abundantly in other parts of the grove. *Pyrus calleryana* **'Chantaclieer'** (15 trees**),** *Cupressus x leylandii* (20 trees),

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Parrotia persica (23 trees) were only found in the young age class which illustrated that they were planted in İstanbul urban parks in recent years. In addition to these, *Carpinus betulus* **'Pyramidalis'** and, *Acer platanoides* are among the species that have been planted in recent years. A large number of young *R. pseudoacacia* individuals reproduce from root and stump sprouts are also present in the grove.

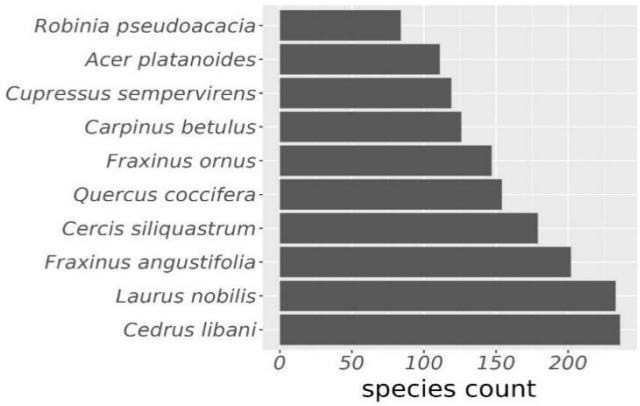

Figure 2. *The top 10 tree species in the small diameter class in the Emirgan Grove*

Visitor profiles

Gender, education, visiting frequencies, ages of the visitors were determined. Female visitors and visitors with either undergraduate or graduate degrees each make up more than half of the visitors (*Figure 3*). While more than half of the male visitors visit the grove once a week or more, 40% of female visitors have this visitation frequency. Female visitors are centered between ages 30-45, the age of male visitors is mostly between 35-55.

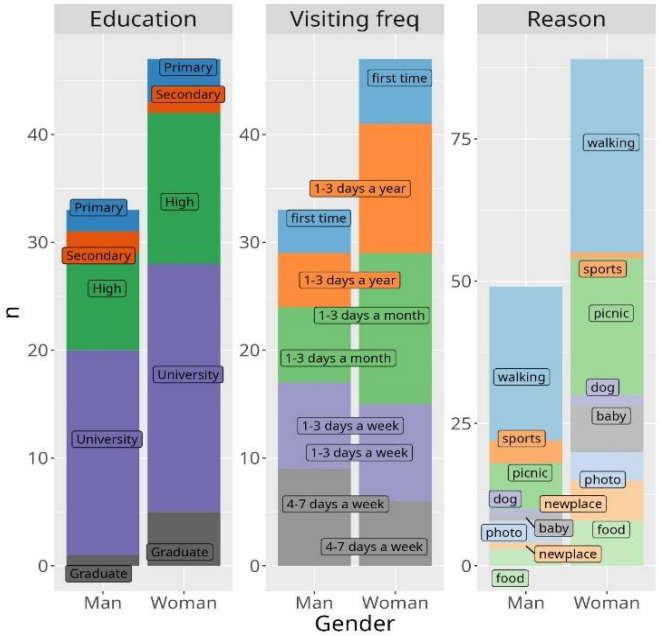

Figure 3. *The visitors' opinions on the environmental impact of the woody plant richness of the grove and the reasons for their visit*

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The grove is mostly visited for walking by visitors of all genders (*Figure 3*). Picnic is another popular activity for women. In her study in the same area Kart (2005) found that the grove is most often used by visitors for resting, picnic, and walking, respectively.

Visitors' awareness and knowledge in woody plant diversity at the grove

Visitors stated that the grove is rich in woody plant diversity (*Figure 4*). 50% of the male visitors estimated that there were 50-100 tree species in the grove and only 1 male visitor guessed exactly. Regarding female visitors, 4 of them estimated exactly, while approximately 25% of them guessed that there were 50-100 tree species (*Figure 4*).

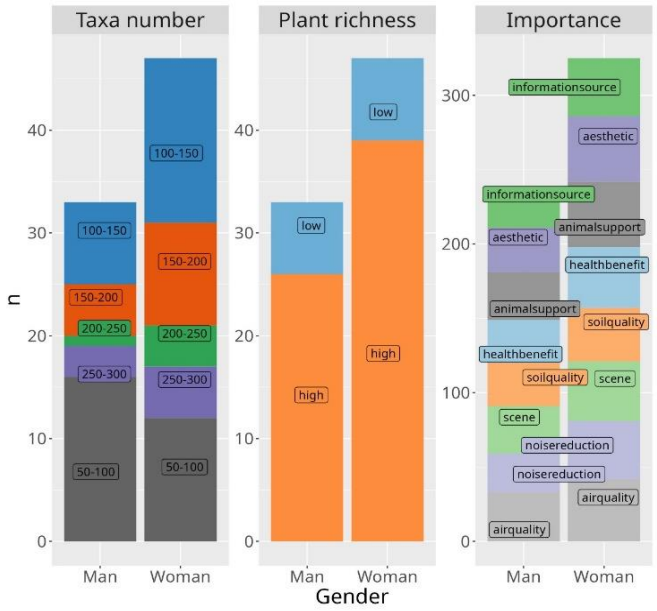

Figure 4. *Visitors' awareness, estimates, and knowledge in woody plant richness*

Visitors generally stated that the rich woody plant diversity in the grove will make positive contributions to the environment, and they said that it will mostly support the presence of animals, improve air quality, and increase the aesthetic value of the grove (*Figure 4*).

Visitors' awareness, estimates, and knowledge in woody plant richness

We expected that more frequent visitors would be aware of the plant richness of the grove and identify more tree species. We thought that more common trees would be more recognized, and that personal characteristic and the purpose of the visit might also be effective in the results.

As a result of the non-parametric analysis applied to both variables (awareness and plant species identification that did not show normal distribution, no significant difference was found between genders and education levels in terms of awareness and plant identification skills (*Table 2*). Significant differences were found between the age groups of the visitors in terms of awareness the plant species. It was found that plant awareness increased with increasing age. While the frequency of visiting the grove had a significant relationship noticing tree species, it had no significant relationship with species identification (*Table 2*).

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Table 2. *One-Way ANOVA (Non-parametric) Kruskal Wallis*

	Variable	χ^2	df	P
gender	Recognize	0.865	1	0.352
	Identification	0.14	1	0.700
age class	Recognize	10.36	4	0.035 *
	Identification	7.43	4	0.115
education	Recognize	7.27	4	0.122
	Identification	5.52	4	0.238
visiting frequency	Recognize	11.19	4	0.024 *
	Identification	5.17	4	0.270

We observed that more frequent visitors to the grove have noticed that many of these tree species are found in the grove, even if they could not have identified them. But it is not possible to say that there is a relationship between the frequency of occurrence of tree species and awareness of visitors (*Figure 5*). *Cedrus, Q. robur, C. siliquastrum, P. pinea* stood out as the most recognized trees in the grove (*Figure 5*). *C. siliquastrum* and *Tilia* spp. were recognized more often, independently from their abundance compared to other species. Since *C. siliquastrum* is a species that is commonly used in Istanbul and easily attracts attention during its flowering season and *Tilia* (Linden) has a distinct scent, these species were recognized more frequently, independently from their occurrence in the grove. Some visitors even stated that they have not seen a linden tree but have smelt its scent during their visits, therefore concluding that linden was present in the grove. There was a high number of visitors that said they saw *A. glutinosa* in the grove which is not present in the grove at all. This species that exists naturally in the forest of Istanbul was misidentified as *Morus* by some visitors. Another species that is not present at the grove, *Salix babylonica* L. was identified as present near the lake, mistaking it for the old *Styphnolobium japonica* (L.) Schott **'Pendula'** by the lake. The reason for *L. nobilis*, which is abundant at the site to be identified as "not-present/not-seen" was determined as the fruit and flower images. It was observed that the fruit and flowers of *L. nobilis*, which are not very noticeable among the leaves, were not known by many.

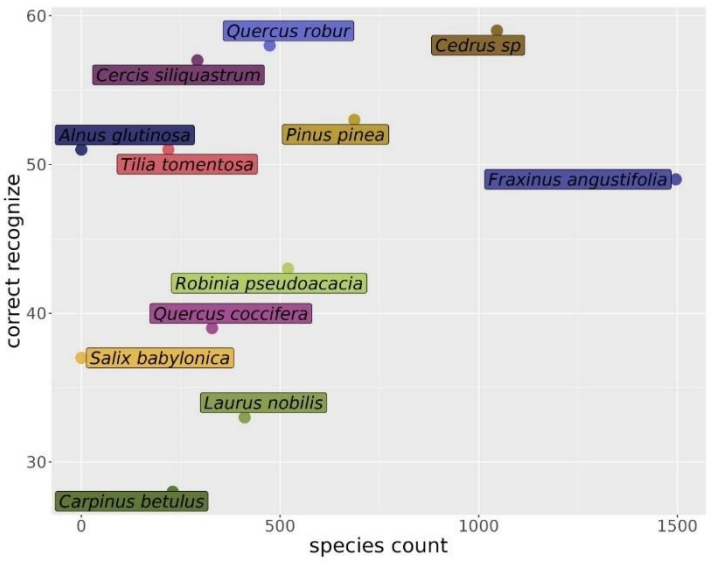

Figure 5. *The relation between the species detection score and the rate of occurrence of the species in the grove*

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It is not possible to say that there is a positive relationship between the abundance of tree species in the grove and their accurate identification by visitors (*Figure 6*).

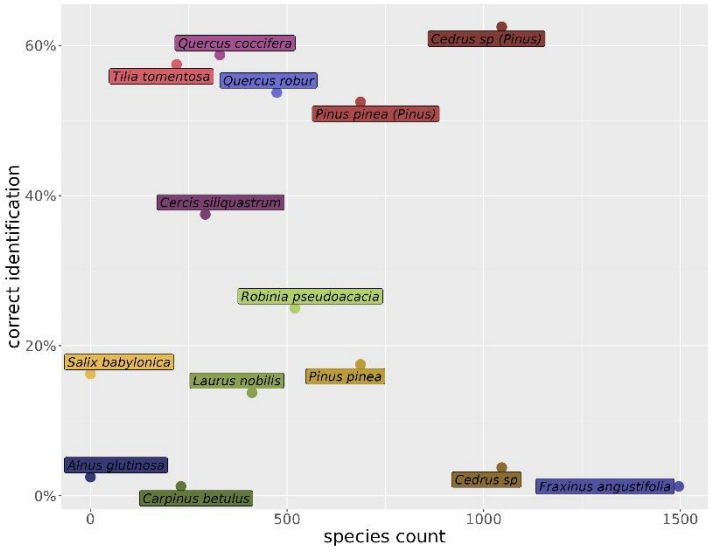

Figure 6. *The relationship between the species identification score and the rate of occurrence of the species in the grove*

As a matter of fact, *F. angustifolia*, which is the most abundant tree in the grove, is one of the least identified trees. Only 1 visitor correctly identified all 12 tree species *Quercus* sp, *P. pinea*, and *T. tomentosa* were the most identified trees while *F. angustifolia*, *C. betulus* and *A. glutinosa* were the least identified trees (*Figure 6*). Since *Q. robur* and *Q. coccifera* are known by their acorns rather than their leaves, they have been identified as oak or oak acorn without specifying the species. *P. pinea* was identified as pine by 53% of the visitors, while it was named as 'umbrella pine' by 18% of the visitors. Therefore, *P. pinea* was the most known tree in the grove with a 71% visitor identification rate. Three visitors were identified *Cedrus* as cedar but many visitors (62%) were named as 'pine', probably, because conifers are commonly known as pine in Turkey.

Many visitors were able to identify the *Pinus* (71%), *Quercus* (56%), *Tilia* (58%) and *C. siliquastrum* (38%), which are very common plants in İstanbul, as generic levels.

Discussions

Tree species richness and composition

The historical Emirgan grove, located on the shore of the Bosphorus, has a rich woody plant diversity with 211 tree and shrub species. However, the ten most common species accounted for 58% of all trees. Similar results, for the ten most common tree species, were found in many other cities, such as in Chicago 46% (Nowak et al., 2010); in Lisbon 73% (Soares et al., 2011) and in urban parks of Taipei 79% (Jim and Chen, 2009). The higher tree age and tree species diversity in an urban green area, the lower the risk of tree loss in the event of a disease and pest epidemic (Alvey, 2006). A tree population in

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different age classes and with high species diversity is also a necessity in order to ensure uninterrupted ecosystem functions of urban green spaces (Kendal et al., 2014). According to the 10/20/30 rule, most widely accepted and proposed by Santamour (1990), tree population in urban green spaces should include no more than 10% of any one species, 20% of any one genus and 30% of any family. Our results showed that, Emirgan grove has high tree species richness and diameter structural diversity. Except for *F. angustifolia*, no tree species has more than 10%, no genera have more than 20%, and no family has more than 30% percentage in the total tree population in the grove. The percentage of the *F. angustifolia* should reduce from 15.2% percent to 10% percent of the tree population or at least it should not be planted any more in the grove.

Information on diameter size class distribution of trees in urban green areas is a crucial knowledge for the sustainable management of the area and also gives important clues about tree species preference changes over time (Muthulingam and Thangavel, 2012; Xie, 2018). *F. angustifolia, A. hippocastanum, Q. robur, T. tomentosa* were planted widely in the past and present, while *P. calleryana* **'Chantaclieer'**, *C. x leylandii, Parrotia persica A. platanoides, T. cordata* were planted recent years. Tree age diversity is also an important tool to prevent disruption of ecosystem activities in an urban area due to age-related removal of trees or simultaneous failure of young trees.

The ratio of exotic woody flora of Emirgan grove (65%) was well above the exotic flora of the urban green areas of Istanbul reported as 52% and 55% (Çoban et al., 2020), The proportion of exotic species in urban flora was also reported as 51% in Central European cities (Lososová et al., 2012), 35% (ranging from 19-46%) in North American cities urban flora (Clemants and Moore, 2003), and 77% in Bangalore, India (Nagendra and Gopal, 2011). These exotic tree species and growth in Emirgan grove are important knowledge on urban tree species selection to increase species diversity in Istanbul green area. Because planting exotic species that have never been tested before in order to increase species diversity could lead to negative results (Raupp et al., 2006; Sjömann et al., 2012). Therefore, to increase species diversity in the urban green areas of Istanbul, species that have been growing and developing in locations such as Ataturk Arboretum, historical groves should be used instead of species that have never been tested before (Sjöman and Nielsen, 2010; Hirons et al., 2020).

The number of exotic woody species was higher than the number of native species in the grove. Although exotic woody species prevailed in total species with about 65%, their ratio in the total tree population is 29%. Similar results were found in ten Nordic cities (Sjömann et al., 2012). Some exotic ornamental shrub species especially add to the species richness at the grove. While the ratio of exotic species among the entire population is not at a worrying level. It should not be disregarded that this ratio could be the result of a high amount of natural vegetation present at the slopes of the grove.

Tree species awareness and identification skills of visitors

The failure of the visitors to provide correct answers in estimating the species richness can be explained by the fact that people cannot easily visualize all the species they have seen after the visit, since the area of the grove area is very large. Indeed, Southon et al. (2018) concluded that perceived species richness in the plot level is more accurate than site level assessments.

We expected that more frequent visitors would be aware of the plant richness of the grove, notice the most common trees and identify more tree species accurately. Because as the interaction between humans and nature increased, that is, as the number of visits

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increased, visitors started to learn about species diversity by observing plants in the environment and species awareness increased. However, while there was a meaningful relationship between the number of visits and the awareness of tree species, the frequency of visits did not contribute to the knowledge of species identification. On the other hand, we had hoped that people would notice and recognize the trees they saw more often. But although the abundance of trees somewhat contributed to their recognition, it was not effective in the species identification.

People who used the grove more frequently were more likely to notice different tree species could not find high relationship between the accuracy of perceived species richness estimates and activity type, gender, age, education. Visitors' plant species identification skills were found poor in Emirgan Grove. Similarly, poor species identification skills were reported in the Netherland (Hooykaas et al., 2019; Hoykaas et al., 2022) and in the UK (Robinson et al., 2016) among adults. Various studies also reveal comparable identification skills among students and instructors in different countries (Bebbington, 2005; Palmberg et al., 2015; Kaasinen, 2019). Most people do not see or recognize the plants commonly surrounded by, which is a phenomenon named 'plant blindness' (Wandersee and Schussler, 2001).

The results of our study showed no remarkable difference in tree species identification skills between male and female visitors. In contrast, Şat Güngör et al. (2018) stated that women had more plant identification knowledge compared to men, and also higher educated people had more knowledge than less-educated people.

The visitors were better able to identify trees that have distinctive habitus, fragrant or conspicuous flowers and typical fruit rather than the more abundant trees. *F. angustifolia*, which are the most abundant trees in the grove, are scattered all over the grove from the entrance, and although some of them are old and magnificent trees, they could not be identified by the visitors. On the other hand, *P. pinea*, with its typical umbrella-shaped crown, has been the most identified tree by visitors. *Salix babylonica*, which is never found in the grove, is distinguished by its distinctive appearance. Likewise, *Quercus* sp. can be distinguished easily by their typical fruit.

Conclusions

This is the first study to explore visitors' identification of the most common tree species found in an urban green area in Turkey. To achieve this, we first made a plant inventory to reveal the species richness and composition of the grove. Afterward, we collected data on tree species diversity awareness and species identification skills of visitors. Trees that have distinctive looks, fragrant or conspicuous flowers and typical fruits were better identified rather than the most abundant trees. The limited number of samples may not be sufficient to generalize the results of the study. However, this study provides sufficient information to reveal the woody plant diversity in the area and the visitors' identification of the species found in the grove and their perception of plant diversity.

Using "citizen science" to observe urban biodiversity is a practice that has been widely used in recent years. This study has demonstrated that in order to work with the public on efforts to observe, preserve, and plan urban plant biodiversity there is a need for serious preliminary work. Urban green spaces should not only be viewed as spaces for rest, exercise, and recreation, efforts to educate the public on biodiversity should also carried out. Many visitors have realized how little they know about tree species after the survey and have requested informative sources such as information boards, tags, and brochures.

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The main priority in the grove should be to protect the oldest and rare trees. To protect these, and to plan future tree populations local, regional, and national level policies as well as regulations are needed. Including the public along with local governments in these efforts will be beneficial in obtaining effective results. People usually care for and preserve what they know and have more knowledge about. Therefore, it is important in conservation studies that people recognize the plants commonly found in the environment and understand the benefits preserving and increasing biodiversity will provide.

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APPENDIX

Electronic appendix A. *Questionnaire*
Electronic appendix B. *Photographs of trees shown to visitors for plant identification*

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