

ANALYSIS OF PLANT SPECIES USED IN URBAN OPEN SPACES: THE TRABZON CASE

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Abstract. The implementation phase of the present study was conducted in 3 stages. In the first stage, the plant material used in the open green spaces in the urban center of Trabzon province was analyzed and plant inventory was investigated in these spaces to determine the species, characteristics and intended use of the plants. Thus, it was determined that 129 plant taxa were used in Trabzon public open green spaces. Forty-two taxa were indigenous to Turkey and 87 were exotic. It was identified that 34 were in the gymnosperm plant group and 95 were in angiosperm plant group. It was identified that 21 taxa were highly prevalent (5) in urban open green areas, 24 taxa were very prevalent (4), 35 taxa were moderately prevalent (3), 22 taxa were less prevalent (2), and 27 taxa were not prevalent (1). In the second stage, the objectives of planting and planting designs were investigated. It was determined that the plants were used for both aesthetic and functional purposes in these areas, but their aesthetic use was more common. In the third stage, the occupant satisfaction levels for the planting designs in these urban open green spaces were determined using a survey conducted with the occupants.

Keywords: *plant taxa, planting design, plant use, aesthetic and functional plant design, Trabzon, Turkey*

Introduction

Turkey is one of the richest countries in indigenous vegetation. The presence of Mediterranean, Iranian-Turanian and European-Siberian floristic regions in Anatolia and their fusion in certain areas are the main reasons for this wealth (Davis, 1965-1988). Furthermore, diverse climate, and topographic, geological and geomorphological diversity, the presence of various aquatic environments such as seas, lakes and streams may be the other factors that affect herbaceous and woody plant diversity in Turkey (Turkmen, 1987; Özer et al., 2009). The most important factor is the presence of several topographic and geological structures in the country. Turkey, with around 9,000 plant species and 3000 endemic plants, is among the countries with the richest flora in its climate zone.

The abundant plant diversity in Turkey expands the choices in plant use. Plants are used for a wide variety of aesthetic and functional purposes (Tarakci Eren and Var, 2016). Esthetically they have the potential of creating positive perceptions about the location due to their properties such as the fruits, flowers and color, their two or three-dimensional views due to planting design aspects such as lighting, shadows and reflections, providing color, texture and form aesthetics due to seasonal changes, providing aesthetics images with branches and barks, harmonic and contrast views created with other landscape elements, creating focus on one element, and the potential of decorative features due to the beauty of structural and vegetal properties (Tarakci Eren et. al., 2016; Tarakci Eren et. al., 2017).

Functionally, they are used to create spaces, hierarchy in space, to emphasize structure in landscapes, to relate and connect various objects and spaces, to strengthen the topographic structure, to soften structural landscape, to create perceptual effects, for example, to make the space look more spacious, to create vistas, to provide inter-spatial

transition, to create attraction, to create a signal effect, to orient, to emphasize, to create focus, to allow the space to acquire character, to symbolize, to limit and create a border, to screen, to provide privacy and a habitat for the fauna and flora, to prevent erosion, avalanche and landslides, to reduce dust in the air and prevent noise, to balance the moisture and temperature, and to reduce the intensity of light in urban areas (Tarakci Eren et al., 2018). Furthermore, objectives such as improvement of landfills, providing a comfortable and safe journey on highways etc. could be listed (Lorenz, 1975; Cepel, 1988; Ürgenç, 1990; Walker, 1991; Walker, 1991; Braun and Fluckiger, 1998; Beckett et al., 1998; Novak et al., 2000; Tarakci Eren et al., 2017).

With the transformation of urban open green spaces into built areas, unplanned or uncontrolled changes have led to the destruction and fragmentation of natural urban spaces. This forced the inhabitants to live under adverse environmental conditions and experience psychological, recreational and social problems. Today, natural and cultural green spaces are replaced by masses of buildings. The decrease in open green species, especially in the cities, leads to the deterioration of the urban ecological balance (Akpinar et al., 1992). In order to eliminate these problems, environmental planning is prioritized in urban spaces. Especially, the plants are very important in the design of relevant open-green spaces (Erenberk, 1992). Plants attract individuals and animals with their flowers, leaves, trunks, fruits and fragrances (Sakıcı, 2009). Plants undertake the tasks of enclosure, bordering, creating personal spaces, softening, revitalizing, filtering the sun, cleaning the air, providing a habitat for birds and introducing the nature to human life (Tyson, 1998). The potential benefits of living in contact with nature were explored by scholars in environmental psychology, and it has been widely accepted in environmental literature that association with nature has positive effects on human psychology. It was reported that individuals benefit from the direct interaction with the nature (active contact) and watching the flowers in a park or trees through a window or by just viewing it (passive contact), and even knowing that these areas exist nearby please the individuals and provide psychological benefits (Ulrich and Parson, 1992). Plants used in urban environment have functional benefits for the ecosystem such as saving energy, humidification (Beckett et al., 2000; Akbari et al., 2001) noise reduction (Çepel, 1988; Walker, 1991; Bayramoğlu et al., 2014), reduction of the effects of wind, dust and greenhouse effects (Novak et al., 2000; Akbari, 2001; Novak and Crane, 2002) preventing light reflections (Heisler, 1986; Walker, 1991; Heisler and Grant, 2000). Furthermore, plants are also quite important to remind the time to individuals due to seasonal characteristics such as early flowering, late coloration and long flowering (Sakıcı, 2009).

Plant properties such as fragrance, edible fruits, seeds, color changes, as well as shading, visual buffer and wind chamber formation, especially creating wildlife habitat for birds and butterflies should be considered in plant selection. Non-stability of plants reminds us life. Birth, growth, death and re-existence, which are part of the life cycle, are events that we recognize by seasonal changes (Sakıcı, 2009). The growth and maturation of the flowers and the falling leaves in autumn remind individuals that the days pass quickly (Mcdowell, 1997). Plants also have several positive psychological effects. Plants play an important role in self-respect. In open green spaces, the planting design improves the value of the space, prevents monotony, allows for recreational activities and socialization. Urban open green spaces play a calming, relaxing role (Smardon, 1990). Landscape architects should design the landscape with knowledge on plant properties and their contribution to the space and should make decisions about

plant locations and plant species in the beginning of the design when conducting spatial arrangements. Unfortunately, several mistakes are made in plant design in current environmental arrangements. This also significantly affects the occupancy of the space. In the present study, the properties of the plant species preferred in the public open green spaces in Trabzon and their intended use were investigated, the occupant satisfaction levels were determined, and plant designs were analyzed.

Materials and methods

The study was conducted in the most heavily occupied green space in the province of Trabzon. Trabzon province is located in the Eastern Black Sea region. Trabzon is surrounded by Giresun province on the west, Gümüşhane province on the south, Rize province on the east, and the Black Sea on the north. Trabzon province is between north $0^{\circ} 33'$ and $41^{\circ} 07'$ latitudes and east $39^{\circ} 07'$ and $40^{\circ} 30'$ longitudes. Surface area of the province is 4685 km², the population is 786,326 based on 2017 data. Beach Park (1), Ganita Beach Park (2), Zağnos Recreation Area (3), Square Park (4), and Turkish-Japanese Friendship Park (5) were included in the study area. These areas are marked in the Trabzon urban center map presented in *Figure 1*.



Figure 1. Analyzed open and green spaces in Trabzon

On-site observation, examination, analysis, survey and evaluation methods were used in the study. Materials utilized in the first stage included five open green spaces in Trabzon urban center and the plant taxa used in these spaces. The methods included on-site observation, examination, analysis, and evaluation. Plant species in open and green areas in the study area were identified and their intended use were discussed. After identification of the plants, the frequencies of the species used in each open green space were determined (1: very low prevalence, 2 low prevalence, 3 moderate prevalence, 4 high prevalence, 5 very high prevalence) and the most preferred plant species were determined in Trabzon urban center. The materials used in the second stage included 5 open green spaces in Trabzon and planting designs utilized in these areas. The methodology included observation, examination, analysis and evaluation, similar to the first stage. The intended use of planting designs was analyzed based on both aesthetic (12 criteria) and functional criteria (14 criteria). The material used in the third stage included the open green spaces and their occupants. The survey methodology was used. Thus, the satisfaction levels of the occupants of these spaces were determined. In the present study, which was conducted in three stages, the data obtained in each stage were analyzed together. Furthermore, inadequate planting designs were examined, and solutions were recommended.

Findings

First stage findings

In the 5 urban open and green spaces determined as the study area, 116 species in 83 genera and 129 subspecies of the above-mentioned species were identified. 34 were in Gymnosperm plant group and 95 were in Angiosperm plant group. The taxa identified in all five parks out of the total 129 taxa were as follows: *Berberis thunbergii* 'Atropurpurea', *Buxus sempervirens*, *Cedrus deodara*, *Cedrus libani*, *Cercis siliquastrum*, *Euonymus japonica*, *Euonymus japonica* 'Aureus', *Euonymus japonica* 'Aureo-variegatus', *Hibiscus syriacus*, *Laurus nobilis*, *Laurocerasus officinalis*, *Morus alba* 'Pendula', *Picea pungens* 'Glauca', *Pittosporum tobira* 'Nana', *Platanus orientalis*, *Prunus cerasifera* 'Atropurpurea', *Rosmarinus officinalis*, *Syringa vulgaris*, *Tilia platyphyllos*, *Yucca filemantosa*. These included a total of 21 taxa. The taxa identified in 4 of the 5 parks were as follows: *Acer palmatum*, *Betula pendula*, *Campsis radicans*, *Cupressus arizonica* 'Glauca Multiponpon', *Cupressus macrocarpa* 'Goldcrest', *Ginkgo biloba*, *Hydrangea macrophylla*, *Juniperus pfitzeriana*, *Lagerstroemia indica*, *Ligustrum japonicum*, *Ligustrum japonicum* 'Variegatum', *Magnolia grandiflora*, *Nerium oleander*, *Philadelphus coronarius*, *Pinus pinea*, *Pittosporum tobira*, *Pittosporum tobira* 'Variegatum', *Platycladus orientalis*, *Rosa sp.*, *Spiraea x vanhoutteii*, *Taxus baccata*, *Thujo occidentalis*, *Thujo plicata*, *Viburnum opulus*, *Wisteria sinensis*. These included a total of 24 taxa. The taxa identified in 3 of the 5 parks were as follows: *Abies nordmanniana*, *Acer buergerianum*, *Aesculus hippocastanum*, *Albizia julibrissin*, *Azalea japonica*, *Citrus lemon*, *Cotoneaster frigidus* 'Cornubia', *Crataegus oxyacantha*, *Cryptomeria japonica* var. *Elegance*, *Cupressus sempervirens* 'Pyramidalis', *Cupressocyparis leylandii*, *Fagus orientalis*, *Hedera helix*, *Juniperus communis*, *Juniperus chinensis* 'Pfitzeriana Glauca', *Liquidambar orientalis*, *Liriodendron tuliphifera*, *Magnolia soulangeana*, *Parthenocissus tricuspidata* 'Vetchii', *Paulownia tomentosa*, *Phoenix canariensis*, *Photina fraseri*, *Phus typhina*, *Picea orientalis*, *Prunus serrulata* 'Kanzan', *Punica granatum*, *Pyracantha coccinea* 'Lalendei', *Quercus pontica*, *Rhododendron ponticum*, *Salix babylonica*, *Spartium junceum*, *Trachycarpus fortuneii*, *Viburnum tinus*, *Washingtonia filifera*, *Wisteria floribunda*. These included a total of 35 taxa. The taxa identified in 2 of the 5 parks were as follows: *Acer pseudoplatanus*, *Catalpa bignonioides*, *Citrus reticulata*, *Citrus sinensis*, *Cotoneaster franchetti*, *Cryptomeria japonica*, *Eriobotria japonica*, *Euonymus alatus* 'Compactus', *Forsythia x intermedia*, *Fraxinus excelsior*, *Hedera helix* 'Elegantissima', *Jasminum fruticans*, *Juniperus chinensis*, *Koelreuteria paniculata*, *Melia azaderach*, *Phyllostachys pubescens*, *Picea pungens*, *Pyracantha coccinea*, *Robinia pseudoacacia*, *Robinia pseudoacacia* 'Umbraculifera', *Rubus sp.*, *Viburnum plicatum* 'dur'. These included a total of 22 taxa. The taxa identified in only 1 park were as follows: *Acacia cynophylla*, *Acer negundo*, *Acer platanoides*, *Acer rubrum*, *Alnus orientalis*, *Alnus glutinosa*, *Camelia japonica*, *Chamaecyparis lawsoniana* 'Ellwoodii', *Chamaecyparis pisifera*, *Chamaecyparis nootkatensis* 'Pendula', *Cotoneaster dammeri*, *Crataegus levigata* 'Pauls Scarlet', *Cupressoparis leylandii* 'Multiponpon', *Eucalyptus camaldulensis*, *Jasminum officinale*, *Juniperus virginiana*, *Nandina domestica*, *Olea europaea*, *Pinus mugo*, *Pinus nigra*, *Pinus nigra pallasiana* var. *Pyramidalis*, *Pinus pinaster*, *Prunus avium*, *Quercus cerris*, *Sequoia sempervirens*, *Sequoiadendron giganteum*, *Vitis vinifera*. These included a total of 27 taxa (Table 1).

Table 1. The number of taxa identified in each urban open space based on genera, species, sub-species and plant groups

	Open green space code				
	1	2	3	4	5
Genus	77	70	56	37	46
Species	99	81	67	45	60
Subspecies	110	92	73	50	64
Gymnosperm	28	18	19	13	18
Angiosperm	82	74	54	37	46

As seen in *Figure 2*, it was determined that 21 out of 129 taxa were highly prevalent (5), i.e., these taxa were found in all five urban open green spaces, 24 taxa were prevalent (4), i.e., these taxa were found in four urban open green spaces, 35 taxa were moderately prevalent (3), i.e., these taxa were found in three urban open green spaces, 22 taxa were less prevalent (2), i.e., these taxa were found in two urban open green spaces, and 27 taxa were not prevalent (1), i.e., these taxa were found in only one urban open green space (*Tables 2 and 3*).

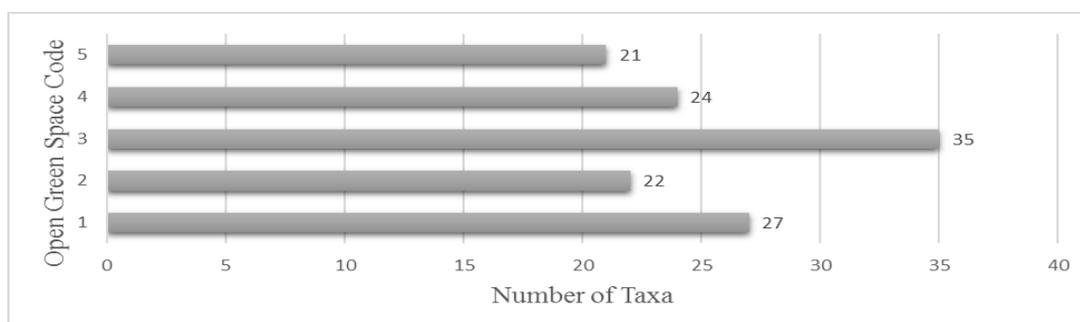


Figure 2. Distribution of 129 taxa identified in all urban green spaces based on the green space

Second stage findings

The reasons for the use of these taxa in plant designs in urban open and green spaces are summarized in *Table 4*. In this respect, aesthetic purposes were addressed in 12 headings and functional purposes were examined under 14 headings.

Initially, the purposes such as creating spatial subdivisions, changing scale and Vista were not taken into consideration when considering the aesthetic purposes at the Beach Park. In other words, aesthetical purposes (100%) and functional purposes (78%, 57) were mainly considered in this park. In Ganita Beach Park, 75% of aesthetic purposes and 57.14% of functional purposes were taken into consideration. In the Zağnos Recreation Area, 100% of the aesthetic purposes and 85.71% of the functional purposes were taken into consideration. 91% of the aesthetic purposes were taken into consideration in the Square Park, while 100% of the functional purposes were taken into consideration. In the Turkish-Japanese Friendship Park, 100% of the aesthetic and functional purposes were taken into consideration. All aesthetic purposes were taken into account in at least four of five urban open green spaces. Functional purposes were considered in at least two urban open green spaces (*Table 5*).

Table 2. The study area and properties

Beach Park	1	 <p>The beach park is a 9 km long and on average 250 m wide Trabzon coastal arrangement between the Ganita park and Beşirli district. Beach Park, is built on the reclaimed land to improve the reduced coastal areas in the city and it has several functions. Some include children's playgrounds, food and beverage areas, hiking and biking paths. Trabzon Beach Park included 99 species and 110 subspecies in 77 genera. 28 species were in Gymnosperm plant group and 82 were in Angiosperm plant group. It was found that the species were used for both functional and aesthetic purposes</p>
		
Ganita Beach Park	2	<p>It is a coastal park on the coastal road next to the Black Sea in the İskenderpaşa neighborhood in Ortahisar district. The park includes viewing areas, tea garden, restaurant, wildlife, hiking areas, children's playground, boating facilities, boat tours, fishing areas, sports areas. 81 species and 92 subspecies in 70 genera were determined. 18 were in Gymnosperm plant group and 74 were in Angiosperm plant group. Species were used for both functional and aesthetic purposes. However, it was determined that they were mainly used for aesthetic purposes</p>
Zağnos Recreation Area	3	 <p>Trabzon Zağnos Valley includes an area of approximately 96,000 square meters and about 700 m long to the South, between 100 and 150 meters wide, limited by Maras Street on the north. Zağnos Valley is located on Yavuz Sultan Selim Boulevard within the boundaries of Gülbahar Hatun neighborhood in Ortahisar District. The area includes an amphitheater, pond, viewing areas, water games, exhibition venues, wildlife, restaurant, tea house, waterfall, and hiking paths. In total, 67 species and 73 subspecies in 56 genera were determined. 19 were in Gymnosperm plant group, and 54 were in Angiosperm plant group. Species were used for both functional and aesthetic purposes. However, it was determined that they were mainly used for aesthetic purposes</p>
		
Square Park	4	<p>It is located in İskenderpaşa neighborhood in the central Ortahisar district in Trabzon on Uzun Street, between the Gazipaşa and Taksim ramps and covers an area of 15,000 square meters. It is bordered by Kemer kaya Street to the north, Çömlekçi Street to the east, Maraş Street to the west and Taksim park to the south. Since it is both a square and a park, it was coined as the Square Park. 37 different genera, 45 species in these genera and 50 varieties in these species with different forms and features were determined. 13 taxa were in Gymnosperm plant group and 37 were in Angiosperm plant group. Species were used for both functional and aesthetic purposes. However, it was determined that they were mainly used for aesthetic purposes</p>
Turkish-Japanese Friendship Park	5	 <p>Turkish-Japanese Friendship Park is located in Ortahisar District, Kalkınma neighborhood, Coastal Road area in Trabzon. Built on an area of 30,000 m², it is surrounded by the Black Sea on the north, Forum shopping mall on the south, 100th Year park on the east, and Değirmendere industrial site on the west. The area includes spaces that reflect the cultures of the two countries. It includes plants specific to Japanese gardens, dry stone gardens, ponds, tea houses, cascade ponds, plants, pergolas, etc. A total of 46 genera and 60 plant species and 64 subspecies in these genera were determined. 18 were in Gymnosperm plant group and 46 were in Angiosperm plant group. Species were used for both functional and aesthetic purposes in this park. However, two purposes were considered equally in planting designs</p>
		

Table 3. Plant taxa identified in the study area

Code	Plant taxa
1	<p><i>Acer buergerianum</i>, <i>Acer negundo</i>, <i>Acer palmate</i>, <i>Acer pseudoplatanus</i>, <i>Aesculus hippocastanum</i>, <i>Albizia julibrissin</i>, <i>Alnus orientalis</i>, <i>Azalea japonica</i>, <i>Berberis thunbergii</i> 'Atropurpurea', <i>Betula pendula</i>, <i>Buxus sempervirens</i>, <i>Camelia japonica</i>, <i>Campsis radicans</i>, <i>Catalpa bignonioides</i>, <i>Cedrus deodara</i>, <i>Cedrus libani</i>, <i>Cercis siliquastrum</i>, <i>Chamaecyparis lawsoniana</i> 'Ellwoodii', <i>Chamaecyparis pisifera</i>, <i>Chamaecyparis nootkatensis</i> 'Pendula', <i>Cotoneaster franchetti</i>, <i>Cotoneaster frigidus</i> 'Cornubia', <i>Crataegus oxyacantha</i>, <i>Cryptomeria japonica</i>, <i>Cryptomeria japonica</i> var <i>Elagance</i>, <i>Cupressus arizonica</i> 'Glauc Multiponpon', <i>Cupressus macrocarpa</i> 'Goldcrest', <i>Cupressus sempervirens</i> 'Pyramidalis', <i>Cupressoparis leylandii</i>, <i>Cupressoparis leylandii</i> 'Multiponpon', <i>Eriobotria japonica</i>, <i>Euonymus alatus</i> 'Compactus', <i>Euonymus japonica</i>, <i>Euonymus japonica</i> 'Aureus', <i>Euonymus japonicus</i> 'Aureo-variegatus', <i>Fagus orientalis</i>, <i>Forsythia x intermedia</i>, <i>Fraxinus excelsior</i>, <i>Gingko biloba</i>, <i>Hedera helix</i>, <i>Hibiscus syriacus</i>, <i>Hydrangea macrophylla</i>, <i>Jasminum fruticans</i>, <i>Juniperus communis</i>, <i>Juniperus pfitzeriana</i>, <i>Juniperus chinensis</i>, <i>Juniperus chinensis</i> 'Pfitzeriana Glauca', <i>Juniperus virginiana</i>, <i>Koelreuteria paniculata</i>, <i>Lagerstroemia indica</i>, <i>Laurus nobilis</i>, <i>Laurocerasus officinalis</i>, <i>Ligustrum japonicum</i>, <i>Ligustrum japonicum</i> 'Variegatum', <i>Liquidambar orientalis</i>, <i>Liriodendron tuliphifera</i>, <i>Magnolia grandiflora</i>, <i>Magnolia soulangeana</i>, <i>Melia azaderach</i>, <i>Morus alba</i> 'Pendula', <i>Nerium oleander</i>, <i>Parthenocissus tricuspidata</i> 'Vetchii', <i>Paulownia tomentosa</i>, <i>Philadelphus coronarius</i>, <i>Phoenix canariensis</i>, <i>Photinia fraseri</i>, <i>Phus typhina</i>, <i>Phyllostachys pubescens</i>, <i>Picea pungens</i>, <i>Picea pungens</i> 'Glauc', <i>Picea orientalis</i>, <i>Pinus pinea</i>, <i>Pinus pinaster</i>, <i>Pittosporum tobira</i>, <i>Pittosporum tobira</i> 'Nana', <i>Pittosporum tobira</i> 'Variegatum', <i>Platanus orientalis</i>, <i>Platycladus orientalis</i>, <i>Prunus avium</i>, <i>Prunus cerasifera</i> 'Atropurpurea', <i>Prunus serrulata</i> 'Kanzan', <i>Punica granatum</i>, <i>Pyracantha coccinea</i>, <i>Pyracantha coccinea</i> 'Lalendei', <i>Quercus pontica</i>, <i>Rhododendron ponticum</i>, <i>Robinia pseudoacacia</i>, <i>Robinia pseudoacacia</i> 'Umbraculifera', <i>Rosa</i> sp., <i>Rosmarinus officinalis</i>, <i>Rubus</i> sp., <i>Salix babylonica</i>, <i>Sequoia sempervirens</i>, <i>Sequoiadendron giganteum</i>, <i>Spartium junceum</i>, <i>Spirea x vanhouttei</i>, <i>Syringa vulgaris</i>, <i>Taxus baccata</i>, <i>Thujo occidentalis</i>, <i>Thujo plicata</i>, <i>Tilia platyphyllos</i>, <i>Trachycarpus fortuneii</i>, <i>Viburnum opulus</i>, <i>Viburnum plicatum</i>, <i>Viburnum tinus</i>, <i>Vitis vinifera</i>, <i>Washingtonia filifera</i>, <i>Wisteria floribunda</i>, <i>Wisteria sinensis</i>, <i>Yucca filementosa</i></p>
2	<p><i>Abies nordmanniana</i>, <i>Acacia cynophylla</i>, <i>Acer buergerianum</i>, <i>Acer negundo</i>, <i>Acer pseudoplatanus</i>, <i>Aesculus hippocastanum</i>, <i>Albizia julibrissin</i>, <i>Alnus glutinosa</i>, <i>Azalea japonica</i>, <i>Berberis thunbergii</i> 'Atropurpurea', <i>Betula pendula</i>, <i>Buxus sempervirens</i>, <i>Campsis radicans</i>, <i>Catalpa bignonioides</i>, <i>Cedrus deodora</i>, <i>Cedrus libani</i>, <i>Cercis siliquastrum</i>, <i>Citrus limon</i>, <i>Citrus reticulata</i>, <i>Cotoneaster franchetti</i>, <i>Cotoneaster frigidus</i> 'Cornubia', <i>Crataegus oxyacantha</i>, <i>Cryptomeria japonica</i>, <i>Cryptomeria japonica</i> var <i>Elagance</i>, <i>Cupressus macrocarpa</i> 'Goldcrest', <i>Cupressus sempervirens</i> 'Pyramidalis', <i>Cupressoparis leylandii</i>, <i>Eucalyptus camaldulensis</i>, <i>Euonymus japonica</i>, <i>Euonymus japonica</i> 'Aureus', <i>Euonymus japonicus</i> 'Aureo-Variegatus', <i>Fagus orientalis</i>, <i>Forsythia x intermedia</i>, <i>Fraxinus excelsior</i>, <i>Hedera helix</i> 'Elegantissima', <i>Hedera helix</i>, <i>Hibiscus syriacus</i>, <i>Hydrangea macrophylla</i>, <i>Jasminum fruticans</i>, <i>Juniperus pfitzeriana</i>, <i>Juniperus chinensis</i>, <i>Juniperus chinensis</i> 'Pfitzeriana Glauca', <i>Koelreuteria paniculata</i>, <i>Lagerstroemia indica</i>, <i>Laurus nobilis</i>, <i>Laurocerasus officinalis</i>, <i>Ligustrum japonicum</i>, <i>Ligustrum japonicum</i> 'Variegatum', <i>Liquidambar orientalis</i>, <i>Liriodendron tuliphifera</i>, <i>Magnolia grandiflora</i>, <i>Magnolia soulangeana</i>, <i>Melia azaderach</i>, <i>Morus alba</i> 'Pendula', <i>Nerium oleander</i>, <i>Parthenocissus tricuspidata</i> 'Vetchii', <i>Paulownia tomentosa</i>, <i>Philadelphus coronarius</i>, <i>Phoenix canariensis</i>, <i>Phus typhina</i>, <i>Picea pungens</i>, <i>Picea pungens</i> 'Glauc', <i>Picea orientalis</i>, <i>Pinus pinea</i>, <i>Pinus pinaster</i>, <i>Pittosporum tobira</i>, <i>Pittosporum tobira</i> 'Nana', <i>Pittosporum tobira</i> 'Variegatum', <i>Platanus orientalis</i>, <i>Platycladus orientalis</i>, <i>Prunus cerasifera</i> 'Atropurpurea', <i>Punica granatum</i>, <i>Pyracantha coccinea</i>, <i>Pyracantha coccinea</i> 'Lalendei', <i>Quercus pontica</i>, <i>Robinia pseudoacacia</i>, <i>Robinia pseudoacacia</i> 'Umbraculifera', <i>Rosa</i> sp., <i>Rosmarinus officinalis</i>, <i>Rubus</i> sp., <i>Salix babylonica</i>, <i>Spartium junceum</i>, <i>Spirea x vanhouttei</i>, <i>Syringa vulgaris</i>, <i>Thujo occidentalis</i>, <i>Tilia platyphyllos</i>, <i>Trachycarpus fortuneii</i>, <i>Viburnum opulus</i>, <i>Viburnum tinus</i>, <i>Washingtonia filifera</i>, <i>Wisteria sinensis</i>, <i>Yucca filementosa</i></p>

3	<p><i>Acer buergerianum</i>, <i>Acer negundo</i>, <i>Acer palmatum</i>, <i>Acer pseudoplatanus</i>, <i>Aesculus hippocastanum</i>, <i>Albizia julibrissin</i>, <i>Alnus orientalis</i>, <i>Azalea japonica</i>, <i>Berberis thunbergii</i> 'Atropurpurea', <i>Betula pendula</i>, <i>Buxus sempervirens</i>, <i>Camelia japonica</i>, <i>Campsis radicans</i>, <i>Catalpa bignonioides</i>, <i>Cedrus deodara</i>, <i>Cedrus libani</i>, <i>Cercis siliquastrum</i>, <i>Chamaecyparis lawsoniana</i> 'Ellwoodii', <i>Chamaecyparis pisifera</i>, <i>Chamaecyparis nootkatensis</i> 'Pendula', <i>Cotoneaster franchetti</i>, <i>Cotoneaster frigidus</i> 'Cornubia', <i>Crataegus oxyacantha</i>, <i>Cryptomeria japonica</i>, <i>Cryptomeria japonica</i> var <i>Elagance</i>, <i>Cupressus arizonica</i> 'Glauca Multiponpon', <i>Cupressus macrocarpa</i> 'Goldcrest', <i>Cupressus sempervirens</i> 'Pyramidalis', <i>Cupressoparis leylandii</i>, <i>Cupressoparis leylandii</i> 'Multiponpon', <i>Eriobotria japonica</i>, <i>Eounymus alatus</i> 'Compactus', <i>Euonymus japonica</i>, <i>Eouymus japonia</i> 'Aureus', <i>Euonymus japonicus</i> 'Aureo-Variegutus', <i>Fagus orientalis</i>, <i>Forsythia x intermedia</i>, <i>Fraxinus excelsior</i>, <i>Gingko biloba</i>, <i>Hedera helix</i>, <i>Hibiscus syriacus</i>, <i>Hydrangea macrophylla</i>, <i>Jasminum fruticans</i>, <i>Juniperus communis</i>, <i>Juniperus pfitzeriana</i>, <i>Juniperus chinensis</i>, <i>Juniperus chinensis</i> 'Pfitzeriana Glauca', <i>Juniperus virginiana</i>, <i>Koelreuteria paniculata</i>, <i>Lagerstroemia indica</i>, <i>Laurus nobilis</i>, <i>Laurocerasus officinalis</i>, <i>Ligustrum japonicum</i>, <i>Ligustrum japonicum variegatum</i>, <i>Liquidambar orientalis</i>, <i>Liriodendron tuliphifera</i>, <i>Magnolia grandiflora</i>, <i>Magnolia soulangeana</i>, <i>Melia azaderach</i>, <i>Morus alba</i> 'Pendula', <i>Nerium oleander</i>, <i>Parthenocissus tricuspidata</i> 'Vetchii', <i>Paulownia tomentosa</i>, <i>Philadelphus coronarius</i>, <i>Phoenix canariensis</i>, <i>Photina fraseri</i>, <i>Phus typhina</i>, <i>Phyllostachys pubescens</i>, <i>Picea pungens</i>, <i>Picea pungens glauca</i>, <i>Picea orientalis</i>, <i>Pinus pinea</i>, <i>Pinus pinaster</i>, <i>Pittosporum tobira</i>, <i>Pittosporum tobira</i> 'Nana', <i>Pittosporum tobira</i> 'Variegatum', <i>Platanus orientalis</i>, <i>Platyclusus orientalis</i>, <i>Prunus avium</i>, <i>Prunus cerasifera</i> 'Atropurpurea', <i>Prunus serrulata</i> 'Kanzan', <i>Punica granatum</i>, <i>Pyracantha coccinea</i>, <i>Pyracantha coccinea</i> 'Lalendei', <i>Quercus pontica</i>, <i>Rhododendron ponticum</i>, <i>Robinia pseudoacacia</i>, <i>Robinia pseudoacacia</i> 'Umbraculifera', <i>Rosa</i> sp., <i>Rosmarinus officinalis</i>, <i>Rubus</i> sp., <i>Salix babylonica</i>, <i>Sequoia sempervirens</i>, <i>Sequoiadendron giganteum</i>, <i>Sparteum junceum</i>, <i>Spirea x vanhouttei</i>, <i>Syringa vulgaris</i>, <i>Taxus baccata</i>, <i>Thujo occidentalis</i>, <i>Thujo plicata</i>, <i>Tilia platyphyllos</i>, <i>Trachycarpus fortuneii</i>, <i>Viburnum opulus</i>, <i>Viburnum plicatum</i>, <i>Viburnum tinus</i>, <i>Vitis vinifera</i>, <i>Washingtonia filifera</i>, <i>Wisteria floribunda</i>, <i>Wisteria sinensis</i>, <i>Yucca filementosa</i></p>
4	<p><i>Abies nordmanniana</i>, <i>Acer buergerianum</i>, <i>Acer palmatum</i>, <i>Aesculus hippocastanum</i>, <i>Albizia julibrissin</i>, <i>Berberis thunbergii</i> 'Atropurpurea', <i>Betula pendula</i>, <i>Buxus sempervirens</i>, <i>Cedrus deodara</i>, <i>Cedrus libani</i>, <i>Cercis siliquastrum</i>, <i>Citrus limon</i>, <i>Citrus reticulata</i>, <i>Citrus sinensis</i>, <i>Cupressus arizonica</i> 'Glauca Multiponpon', <i>Cupressus macrocarpa</i> 'Goldcrest', <i>Euonymus japonica</i>, <i>Eouymus japonia</i> 'Aureus', <i>Euonymus japonicus</i> 'Aureo-Variegutus', <i>Gingko biloba</i>, <i>Hibiscus syriacus</i>, <i>Hydrangea macrophylla</i>, <i>Juniperus pfitzeriana</i>, <i>Laurus nobilis</i>, <i>Laurocerasus officinalis</i>, <i>Ligustrum japonicum</i>, <i>Ligustrum japonicum</i> 'Variegatum', <i>Liquidambar orientalis</i>, <i>Liriodendron tuliphifera</i>, <i>Morus alba</i> 'Pendula', <i>Nerium oleander</i>, <i>Paulownia tomentosa</i>, <i>Photina fraseri</i>, <i>Picea pungens</i> 'Glauca', <i>Picea orientalis</i>, <i>Pittosporum tobira</i>, <i>Pittosporum tobira</i> 'Nana', <i>Pittosporum tobira</i> 'Variegatum', <i>Platanus orientalis</i>, <i>Platyclusus orientalis</i>, <i>Prunus cerasifera</i> 'Atropurpurea', <i>Prunus serrulata</i> 'Kanzan', <i>Rhododendron ponticum</i>, <i>Rosmarinus officinalis</i>, <i>Syringa vulgaris</i>, <i>Taxus baccata</i>, <i>Thujo occidentalis</i>, <i>Thujo plicata</i>, <i>Tilia platyphyllos</i>, <i>Yucca filementosa</i></p>
5	<p><i>Acer palmatum</i>, <i>Acer platanoides</i>, <i>Acer rubrum</i>, <i>Azalea japonica</i>, <i>Berberis thunbergii</i> 'Atropurpurea', <i>Betula pendula</i>, <i>Buxus sempervirens</i>, <i>Camelia japonica</i>, <i>Campsis radicans</i>, <i>Cedrus deodara</i>, <i>Cedrus libani</i>, <i>Cercis siliquastrum</i>, <i>Cotoneaster dammeri</i>, <i>Crataegus leevigata</i> 'Pauls Scarlet', <i>Cupressus arizonica</i> 'Glauca Multiponpon', <i>Cupressus macrocarpa</i> 'Goldcrest', <i>Cupressus sempervirens</i> 'Pyramidalis', <i>Cupressoparis leylandii</i>, <i>Cupressoparis leylandii</i> 'Multiponpon', <i>Eounymus alatus</i> 'Compactus', <i>Euonymus japonica</i>, <i>Eouymus japonia</i> 'Aureus', <i>Euonymus japonicus</i> 'Aureo-variegutus', <i>Fagus orientalis</i>, <i>Gingko biloba</i>, <i>Hibiscus syriacus</i>, <i>Juniperus communis</i>, <i>Juniperus pfitzeriana</i>, <i>Juniperus chinensis</i>, <i>Lagerstroemia indica</i>, <i>Laurus nobilis</i>, <i>Laurocerasus officinalis</i>, <i>Magnolia grandiflora</i>, <i>Morus alba</i> 'Pendula', <i>Nandina domestica</i>, <i>Philadelphus coronarius</i>, <i>Phus typhina</i>, <i>Phyllostachys pubescens</i>, <i>Picea pungens</i> 'Glauca', <i>Pinus mugo</i>, <i>Pinus nigra</i>, <i>Pinus nigra pallasiana</i> var. 'Pyramidalis', <i>Pinus pinea</i>, <i>Pittosporum tobira</i> 'Nana', <i>Platanus orientalis</i>, <i>Prunus cerasifera</i> 'Atropurpurea', <i>Prunus serrulata</i> 'Kanzan', <i>Quercus cerris</i>, <i>Quercus pontica</i>, <i>Rhododendron ponticum</i>, <i>Rosa</i> sp., <i>Rosmarinus officinalis</i>, <i>Salix babylonica</i>, <i>Sequoiadendron giganteum</i>, <i>Spirea x vanhouttei</i>, <i>Syringa vulgaris</i>, <i>Taxus baccata</i>, <i>Thujo occidentalis</i>, <i>Thujo plicata</i>, <i>Tilia platyphyllos</i>, <i>Viburnum opulus</i>, <i>Wisteria floribunda</i>, <i>Wisteria sinensis</i>, <i>Yucca filementosa</i></p>

Table 4. *Intended use for the plants in Trabzon urban open green spaces*

Urban open green spaces		Code	1	2	3	4	5
Aesthetic	Positive and negative perception capability of the plants	E1	V		V	V	V
	Two and three dimensionality	E2	V		V	V	V
	Seasonal changes	E3	V	V	V	V	V
	Creating color aesthetics with components such as leaves, flowers, fruits, etc.	E4	V	V	V	V	V
	Branching, bark and linearity	E5	V	V	V	V	V
	Creating contrast with other landscaping elements, form, texture and color effects	E6	V	V	V	V	V
	Attracting attention and focus as a solitary element	E7	V	V	V	V	V
	Creating impressive traces on the ground	E8	V		V	V	V
	Reflective element (mirror effect)	E9	V	V	V	V	V
	Light-shadow element	E10	V	V	V		V
	Audiovisual effects created by the wind	E11	V	V	V	V	V
	Decorative element or plastic object	E12	V	V	V	V	V
Functional	Creating spatial organizations	F1	V		V	V	V
	Creating spatial subsections	F2			V	V	V
	Definition and association of the design	F3	V	V	V	V	V
	Supporting or strengthening an existing design	F4	V	V	V	V	V
	Orientation	F5	V	V	V	V	V
	Scale diversification and creating an illusion	F6				V	V
	Creating spatial depth through layering	F7	V		V	V	V
	Creating vista or visual enclosure	F8				V	V
	Creating a background	F9	V	V	V	V	V
	Invitation	F10	V	V	V	V	V
	Distinguishing, emphasizing and creating a focus on the space	F11	V		V	V	V
	Creating a character for the space, defining or symbolizing the space	F12	V		V	V	V
	Bordering	F13	V	V	V	V	V
	Creating privacy (privacy control)	F14	V		V	V	V

Table 5. *Consideration of aesthetic and functional purposes in Trabzon urban green spaces*

	1	2	3	4	5
Aesthetic purposes (%)	100	75	100	91.6	100
Functional purposes (%)	78.57	57.14	85.71	100	100

When each aesthetic purpose was examined separately in five urban open green spaces, it was observed that the ‘positive and negative perceptions created by plants’ coded as E1, ‘two and three dimensionality’ coded as E2, and ‘creating impressive traces on the ground’ coded as ‘E8’ were not considered at the Ganita Beach Park. The ‘light-shadow element’ coded as E10 was not taken into consideration only in the Square Park (Fig. 3).

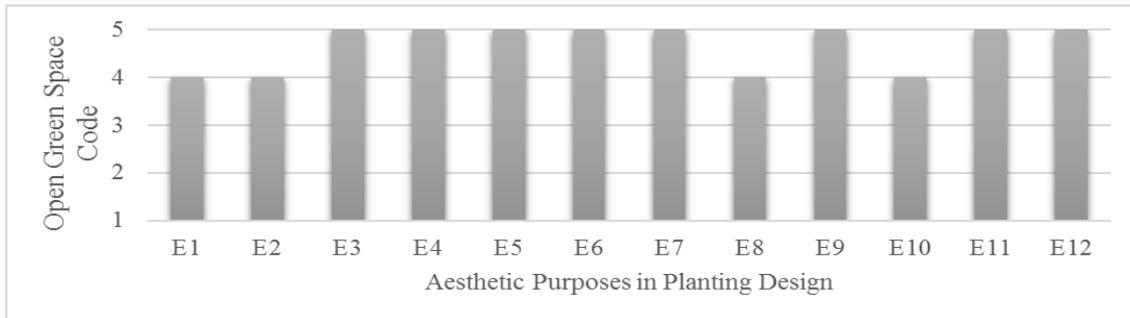


Figure 3. The number of urban open green spaces where aesthetic purposes were considered in plant design

When each functional purpose was examined in the five open green fields, it was determined that ‘creating spatial organizations’ coded as F1 was not considered in Ganita Beach Park, F2 was not considered in Coast and Ganita parks, F6 was not considered in Coast, Ganita and Zagnos open green spaces, F7 was not considered in Ganita Beach Park, F8 was not considered in Ganita and Zagnos open green spaces, F11, F12 and F14 was not considered in Ganita Beach Park (Fig. 4).

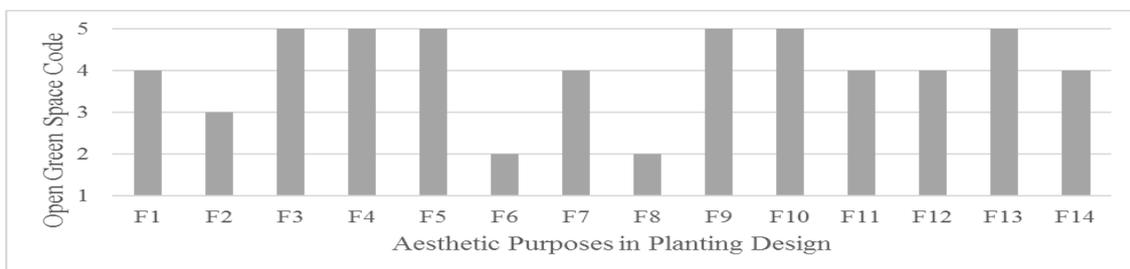


Figure 4. The number of urban open green spaces where functional purposes were considered in plant design

Aesthetic and functional planting was the aim in the Beach Park as observed in the planting design samples provided in four photographs in Table 6.

Table 6. Planting design samples in Beach Park

Beach Park			
			
A. purpose	F. purpose	A. purpose	A. purpose
<i>Forsythia x intermedia</i> <i>Cotaneaster frigida</i> 'Cornubia' <i>Prunus cerasifera</i> 'Atropurpurea'	<i>Cotaneaster frigida</i> 'Cornubia' <i>Prunus cerasifera</i> 'Atropurpurea'	<i>Spirea x vanhoutteii</i> <i>Morus alba</i> 'Pendula' <i>Washingtonia filifera</i>	<i>Washingtonia filifera</i> <i>Laurocerasus officinalis</i>

Mostly aesthetic planting was the aim in Turkish-Japanese Friendship Park as observed in the planting design samples provided in *Table 7*.

Table 7. *Planting design samples in Turkish-Japanese Friendship park*

Turkish-Japanese Friendship Park			
			
A. and F. purpose	A. purpose	A. purpose	A. purpose
<i>Prunus ceracifera</i> 'Atropurpurea'	<i>Acer rumbum</i> <i>Eounymus japonica</i> 'Aureus' <i>Buxus sempervirens</i>	<i>Camelia j.</i>	<i>Viburnum plicatum</i> <i>Pinus mugo</i>

Mostly aesthetic planting was the aim in the Square Park as observed in the planting design samples provided in *Table 8*.

Table 8. *Planting design samples in Square Park*

Square Park		
		
Aesthetic purpose	Aesthetic purpose	Aesthetic and functional purpose
<i>Prunus ceracifera</i> 'Atropurpurea'	<i>Betula pendula</i>	<i>Cedrus libani</i> <i>Hydrangea macrophylla</i>

Plant design samples and the plant taxa used in these designs are presented in *Table 9*.

Third stage findings

The determination of occupant satisfaction level of the occupants of open green spaces in Trabzon city was conducted with a scale where the values of 1 and 2 reflected dissatisfaction, 3 represented neither satisfaction nor dissatisfaction and 4 and 5 reflected satisfaction with the space. The Cronbach Alpha reliability test was used to determine the reliability of the scale and it was determined that the scale was reliable. The mean occupant satisfaction scores were calculated for the five urban open green spaces and the difference between these values was determined by one-way analysis of variance (*Tables 10 and 11*).

Table 9. Planting design samples

Zağnos Valley recreation area		
		
Aesthetic purpose	Aesthetic and functional purpose	Aesthetic and functional purpose
<i>Euonymus japonica</i> 'Aurea variageta'	<i>Trachycarpus fortuneii</i> <i>Olea europaea</i> <i>Prunus cerasifera</i> 'Atropurpurea'	<i>Wisteria sinensis</i>

Table 10. The occupants' satisfaction with planting designs in each urban open green space

	Urban open green space code					
	1	2	3	4	5	
Satisfied (mean)	3.40	3.10	3.55	3.04	3.53	F: 6.811
Satisfied (sd)	1.167	1.111	.996	1.261	1.238	Sig: .000

Table 11. Analysis of variance

	Sum of squares	df	Mean square	F	Sig.
Between groups	36.562	4	9.141	6.811	.000
Within groups	1066.937	795	1.342		
Total	1103.500	799			

In Table 12, the asterisk in the mean difference column indicates that there was a difference between the satisfaction levels for planting designs in urban open green spaces. There was a significant difference at 0.05 level between the satisfaction levels of planting designs in urban open green areas when denoted with an asterisk. Thus, the difference between the satisfaction level of the occupants for the Beach Park planting design and the Square Park (.356) was below the significance level of 0.05. In other words, satisfaction level for the Beach Park was higher than the satisfaction level for Square Park. Similarly, there were differences between the satisfaction levels for Ganita Park and the Zağnos Recreation Area and of Turkish Japanese Friendship Park planting designs.

Discussion and conclusion

The plants preferred in open green spaces designed in urban areas exhibit a dynamic structure and constantly change urban aesthetics and ecology. Especially when the selections are right and planted at the right location based on the aesthetic and functional purposes, planting design makes significant contributions to not only the urban aesthetics but also the value of the real estate in the city (Tyruainen, 1997). In

recent years, extensive research was conducted on plant material in urban open green areas and urban ecology (Düzenli et al., 2018; Potgieter et al., 2019; Schebella et al., 2019; Yan et al., 2019; Rumble et al., 2019; Yılmaz et al., 2018).

Table 12. Multiple correlation

	UOGA	UOGA	Mean difference (İ-J)	Standart error	Sig.
	I	J			
TUKEY HSD	1	2	.300	.130	.141
		3	-.150	.130	.775
		4	.356*	.130	.048
		5	-.131	.130	.849
	2	1	-.300	.130	.141
		3	-.450*	.130	.005
		4	.056	.130	.993
		5	-.431*	.130	.008
	3	1	.150	.130	.775
		2	.450*	.130	.005
		4	.506*	.130	.001
		5	.019	.130	1.000
	4	1	-.356*	.130	.048
		2	-.056	.130	.993
		3	-.506*	.130	.001
		5	-.487*	.130	.002
	5	1	.131	.130	.849
		2	.431*	.130	.008
		3	-.019	.130	1.000
		4	.487*	.130	.002

UOGA: urban open green spaces code

The open green space planning in urban areas often emphasizes the improvement of the quality of life of individuals (Fainstein and Campell, 1996; Salon, 2002; Mumcu et al., 2013), in this respect, it aims to ensure the use of indigenous plant species and to maintain sustainability of other areas of ecological concern (Forman, 2008).

Thanks to plant taxa used in urban open and green areas, the areas with a form and design acquire an anatomy as well. As the plants change, they occupy a place in the function of the urban ecosystem. Thus, functional objectives that planting designs should emphasize emerge.

Urban open green spaces that transform urban spaces into natural areas thanks to the plants, albeit partially, are usually under intensive human management or occupancy (Kurdoğlu et al., 2018). Transportation of plant taxa indigenous to rural areas to urban areas and their utilization in plant designs would lead to natural vegetation patterns. In contrast, the opposite would lead to a contradiction between indigenous and non-indigenous plant species in urban open green spaces.

In the present study, 10 of the 21 most prevalent plant taxa used in the open green areas in Trabzon city were selected from indigenous and 11 were selected from exotic

plants. Of the 129 taxa identified, only 42 were indigenous to Turkey. Although the diversity of plant species was sufficient, the selection of indigenous plant species was not sufficient. Plant species that reflect the characteristic of the region should be preferred. One of the study areas was rich in exotic species diversity when compared to the other areas due to the fact that its concept was Turkish-Japanese friendship.

Aesthetically positive plants are those that the designers want to be noticed or emphasized in a space, while negative plants are not to be noticed. The plants used in the open green areas in the city of Trabzon fulfilled this purpose with distinct aesthetic characters such as leaves, fruits, flowers and color effects, trunks or forms. Another aesthetic aim is the shadows and reflections provided by plants due to natural and artificial lighting elements. In the five urban open green areas reviewed in the present study, the plants exhibited two- or three-dimensional properties. In addition to the evergreen plants used, varieties that change with seasons were also preferred, thus creating impressive landscapes. Deciduous plants formed aesthetic values in winter with their trunks and branching calligraphy. They added an interesting character to the design with their extraordinary shoots and bark patterns. They created harmony or contrast with the pavements and other structural landscaping elements in study areas. In the five parks where the study was conducted in Trabzon, certain taxa were used as solitary plants (*Platanus orientalis*, *Acer rubrum*, *Gingko biloba*, *Salix babylonica* vb) or to attract the attention to certain sections. In order to make the monotonous pavements that are monotonous both horizontally and vertically entertaining, the plants were used as pavements or cover elements. Due to the wind speed and direction, especially the trees in the Beach Park and trees at Ganita Beach Park achieved movement and sound. In all the study areas, fine-delicate, drooping plants such as *Betula pendula* and *Salix babylonica* created an elegant appearance by swinging lightly with the wind.

It is known that plants are a design material in landscape design, and they are used when creating spaces just like other material. The crowns of plants are considered as the cover and trunks are considered as walls of the space. Thus, the plants are used in solitary or in groups to create spaces and sub-spaces in study areas. Also, linear, radial, clustered and grid type designs were adopted in the plant compositions in study areas. In study areas, primary, secondary and tertiary spaces were created based on the field composition and the hierarchical properties of the area. For this purpose, the color, size, linearity, or organization of the plant are considered in hierarchical orders (Yildizci, 1988). It is possible to clarify an existing or planned design with plant compositions, and to associate the objects and spaces in the design. Thus, the plant compositions in study areas aimed to support and to strengthen the design and to provide an integral visual perception.

Planting could associate the objects and spaces. Plants undertake separative and integrative functions in adjacent spaces structurally, create a determinative, rhythmic and emphasizing effects, and provide connections especially in rural and urban landscapes. Furthermore, planting design could be conducted to obtain effects such as strengthening or hiding the topographic structure. In the present study, it mostly strengthened the lines of design since these areas were urban areas without any slopes. The selected *Platanus orientalis* species at the Beach Park was planted in higher intervals from its crown, leading to an open and spacious perception. In contrast, *Ligustrum japonicum* species was planted in frequent intervals and adjacent to each other, creating a border effect and leading to closed perception. When the study areas are examined, it was observed that vistas were created with plant design in only two

urban open green areas. The creation of vista in the design of the study areas were mostly created with structural landscaping elements, with the only exceptions of the Square Park and Turkish-Japanese Friendship Park.

After the findings obtained by the researcher, it was determined that the occupant satisfaction was the highest in the planting designs at Zağnos Recreation Area. This was followed by the Turkish-Japanese Friendship Park, Beach Park, Ganita and the Square Park, respectively. Occupant evaluations demonstrated there were differences between the satisfaction levels of the occupants about the planting designs. The reason for this difference was the utilized plant taxa used as determined in the previous stages.

The three urban open green areas (Beach Park, Zağnos Recreation Area, Turkish-Japanese Friendship Park) investigated in the present study were built very recently. The other two areas were urban renewal projects and recently renovated areas. Therefore, the study findings demonstrated that there have been developments in the design of urban green open spaces and these were designed by expert teams, and the resulting planting designs were appreciated by the occupants.

According to these results, the following points should be considered in the selection of plant species in urban light green areas and in the implementation of planting designs;

In the first place, the designer should create a list of plants which can be used by considering ecological, edaphic and climatic data in the region. The designer should also take into account the structural and visual characteristics of the plants while creating these plant lists, such as the habitats of plants, body trunk bark, branches, shoots, bud, leaves, flowers, seeds and cones should be well aware. because the structural characteristics of the plants also form their visual characteristics. A planting design should be designed by taking one or more of the principles of harmony, contrast, repetition, rhythm, scale, ratio, emphasis, domination, balance and unity. the functions of these planting designs should be functional as well as aesthetic. In other words, except for the beautiful views that the aesthetic views of the plants offer, space creation, supporting the existing structural design, providing inter-space transition, creating emphasis and focus, limiting or creating a border, making screens, providing privacy privacy.

REFERENCES

- [1] Akbari, H. (2001): Shade trees reduce building energy use and CO₂ emissions from power plants. – *Environmental Pollution* 116(1): 119-126.
- [2] Akbari, H., Pomerantz, M., Taha, H. (2001): Cool surfaces and shape trees to reduce energy use and improve air quality in urban areas. – *Solar Energy* 70(3): 295-310.
- [3] Akpınar, N., Karadeniz, N., Talay, İ. (1992): Ülkemizde çim tohumlarının durumu ve geleceği. – *Peyzaj Mimarlığı* 92(2): 25-26.
- [4] Bayramoğlu, E., Özdemir, B., Demirel, Ö. (2014): Gürültü Kirliliğinin Kent Parklarına Etkisi Ve Çözüm Önerileri: Trabzon Kenti Örneği. – *İnönü Üniversitesi Sanat Ve Tasarım Dergisi* 4(9): 35-42.
- [5] Beckett, K. P., Freer-Smith, P. H., Taylor, G. (1998): Urban woodlands; their role in reducing the effects of particulate pollution. – *Environmental Pollution* 99: 347-360.
- [6] Beckett, K. P., Freer-Smith, P. H., Taylor, G. (2000): Particulate pollution capture by urban trees; effects of species and windspeed. – *Global Change Biology* 6(3): 995-1003.
- [7] Braun, S., Fluckiger, W. (1998): Soil amendments for plantings of urban trees. – *Soil and Tillage Research* 49(3): 201-209.

- [8] Cepel, N. (1988): Peyzaj Ekolojisi. – İstanbul Üniversitesi Orman Fak., Yayın No: 3510, İstanbul.
- [9] Davis, P. H. (1965-1985) Flora of Turkey and East Aegean Islands. – Edinburgh Univ. Press, Edinburgh.
- [10] Düzenli, T., Tarakci Eren, E., Baltacı, H., and Aktürk, E. (2018): Bitkisel Peyzaj Tasarımında Renk Tercihleri: Ktü Kanuni Kampüsü Örneği. – Journal of International Social Research 11(55).
- [11] Ekim, T., Koyuncu, M., Erik, S., İlarsan, R. (1989): Türkiyenin tehlike altındaki nadir ve endemik bitki türleri. – Türkiye tabiatını koruma derneği yayın no: 18, Ankara.
- [12] Erenberk, H. (1992): Büyük Ağaçların Söküm ve Dikimi. – Peyzaj Mimarlığı 92(2): 33-36.
- [13] Fainstein, S. S., Campbell, S. (2002): Readings in Urban Theory. – Wiley-Blackwell, London.
- [14] Forman, R. T. T. (2008): Urban Regions, Ecology and Planning Beyond City. – Cambridge University Press, Cambridge.
- [15] Heisler, G. M. (1986): Effects of individual trees on the solar radiation climate of small buildings. – Urban Ecology 9(3): 337-359.
- [16] Heisler, G. M., Grant, R. H. (2000): Ultraviolet radiation in urban ecosystems with consideration of effects on human healthy. – Urban Ecosystems 4(3): 193-229.
- [17] Leszczynski, N. A. (1999): Planting the Landscape. – John Wiley and Sons, Inc, London.
- [18] Lorenz, E. N. (1975): Climatic Predictability. – In: Bolin, B. et al. (eds.) The Physical Basis of Climate and Climate Modelling (Vol. 16). GARP Publication Series, Geneva, pp. 132-136.
- [19] Kelkit, A. (2002): Çanakkale kenti açık-yeşil alanlarda kullanılan bitki materyali üzerine bir araştırma. – Ekoloji 10(43): 17-21.
- [20] Kurdoğlu, B. Ç., Yeniçirak, P. Ö., Bayramoğlu, E. (2018): Ekolojik Duyarlilik Analizi: Kaçkar Dağları Milli Parkı Örneği. – Journal of International Social Research 11(61).
- [21] McDowell, M. J. (1997): The role and application of horticultural therapy with institutionalized older people. – Master Thesis, McGill University, Montreal.
- [22] Mumcu, S., Yılmaz, S., Özbilen, A. (2013): Ekolojik yaklaşımlar doğrultusunda çevresel tercih modeli. – Türkiye Ormancılık Dergisi 14(2): 143-151.
- [23] Novak, D. J., Civerolo, K. L., Rao, S. T., Sistla, G., Luley, C. J., Crane, D. E. (2000): A modeling study of the impact of urban trees on ozone. – Atmospheric Environment 34(10): 1601-1613.
- [24] Novak, D. J., Crane, D. E. (2002): Carbon storage and sequestration by urban trees in the USA. – Environmental Pollution 116(3): 381-389.
- [25] Potgieter, L. J., Gaertner, M., O'Farrell, P. J., Richardson, D. M. (2019): Perceptions of impact: invasive alien plants in the urban environment. – Journal of Environmental Management 229: 76-87.
- [26] Rumble, H., Angeoletto, F., Connop, S., Goddard, M. A., Nash, C. (2019): Understanding and Applying Ecological Principles in Cities. – In: Lemes de Oliveira, F., Mell, I. (eds.) Planning Cities with Nature. Springer, Cham, pp. 217-234.
- [27] Sakıcı, Ç. (2009): Ruh ve sinir hastalıkları hastanelerinde açık alan terapi ünitelerinin peyzaj tasarımı: Ataköy (Trabzon) ruh sağlığı ve hastalıkları hastanesi örneği. – Doktora Tezi, K. T. Ü. Fen Bilimleri Enstitüsü, Trabzon.
- [28] Schebella, M. F., Weber, D., Schultz, L., Weinstein, P. (2019): The wellbeing benefits associated with perceived and measured biodiversity in Australian urban green spaces. – Sustainability 11(3): 802.
- [29] Smardon, R. C. (1990): Perception and aesthetics of the urban environment: review of the role of vegetation. – Landscape and Urban Planning 15(1-2): 85-106.
- [30] Urgenc S (1990): Genel Plantasyon ve Adaclandırma Teknidi. – İstanbul Univ. Yayın No: 3644, İstanbul.

- [31] Ulrich, R. S. (2001): Effects of healthcare environmental design on medical outcomes. – In: Design and Health: Proceedings of the Second International Conference on Health and Design. Svensk Byggtjanst, Stockholm, pp. 49-59.
- [32] Uslu, O., Türkmen, A. (1987): Su kirliliği ve kontrolü. – TC Basbakanlık Çevre Gen Müd Yay Egt Dizisi, 1.
- [33] Tarakci Eren, E., Var, M. (2016): Parkların bitkisel tasarımında kullanılan taksonlar: Trabzon Kent Merkezi Örneği. – Artvin Çoruh Üniversitesi Orman Fakültesi Dergisi 17(2): 200-213.
- [34] Tarakci Eren, E., Alpak, E. M., Düzenli, T. (2016): Mevsimsel Bitki Görünümlerinin Tercih Ve Algusal Farklılıklarının Belirlenmesi. – Uluslararası Bilimsel Araştırmalar Dergisi (Ibad): 3(1): 145-154.
- [35] Tarakci Eren, E., Düzenli, T., Alpak, E. M. (2018): Sınır elemanı olarak kullanılan bitkiler ve kullanım işlevleri; KTÜ kampüsü. – Kastamonu Üniversitesi Orman Fakültesi Dergisi 18(2): 108-120.
- [36] Tarakci Eren, E., Yılmaz, S., Düzenli, T. (2017): Drawing a Planting Plan in the Process of the Environmental Design Project. – In: Salman, S. (ed.) Academic Researches in Architecture, Engineering Planning and Design. Gece Kitaplığı, Ankara.
- [37] Turkmen, N. (1987): Cukurova Universitesi Kampus Alanının Dogal Bitkileri, Hayat Formları ve Habitatları. – Doctoral Dissertation, Msc Thesis, Cukurova Universitesi, Adana.
- [38] Tyson, M. M. (1998): The Healing Landscape: Therapeutic Outdoor Environments. – McGraw-Hill, New York.
- [39] Tyruainen, L. (1997): The amenity value of the urban forest an application of the hedonic pricing method. – Landscape and Urban Planning 37: 211-222.
- [40] Walker, T. D. (1991): Planting Design. – Van Nostrand Reinhold, New York.
- [41] Yan, Z., Teng, M., He, W., Liu, A., Li, Y., Wang, P. (2019): Impervious surface area is a key predictor for urban plant diversity in a city undergone rapid urbanization. – Science of the Total Environment 650: 335-342.
- [42] Yılmaz, H. (1995): Erzurum kenti okul bahçelerinin peyzaj mimarlydy ilkeleri yonunden incelenmesi. – Ataturk Univ. Zir. Fak. Derg. 26(4): 537-547.
- [43] Yılmaz, S., Özgüner, H., Mumcu, S. (2018): An aesthetic approach to planting design in urban parks and greenspaces. – Landscape Research 43(7): 965-983.
- [44] Yıldızcı, A. C. (1982): Concept of open space, urban texture and green texture- urban landscape planning. – PhD Thesis. Istanbul Technical University, Istanbul (in Turkish).