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Research on current planting of İstanbul O-1, O-2 highways, and some connection roads

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Abstract

Aim of study: Highway landscape design studies are important landscape practices in terms of integrating nature with humans. Therefore, it is highly important that the design of the vegetative arrangements in highways are ecological, functional, aesthetic and also compatible with the environmental landscape. This study aims to examine the recent vegetation projects in highway landscape design, identificate the problems and proposing solutions accordingly.

Area of study: The study area were selected between Istanbul O-1 highway Barbaros-Altunizade, O-2 highway Levent-Batı Ataşehir and some connection roads that the current planting works.

Material and Methods: Natural and cultural properties of the investigation site and the selected plants, which are planted in this site, are evaluated ecologically, functionally and visually. Furthermore, some suggestions are made by evaluating the opinions of relevant people through a questionnaire accordingly.

Main results: As a result of the evaluation, the ecological and functional effects have been assessed. It is found that the majority of participants stated that the plant species and plant arrangements are not suitable for 14 selected areas.

Highlights: The use of plant species that require less water in planting works will be a more correct approach in countries which have scarce water sources as in the case of Turkey. For this reason, the list of air pollution resistant and xerophytic plants which grow in the Marmara region are created to be utilized in highway landscape planning.

Keywords: Highway landscape planning, highway planting, highway landscaping

İstanbul O-1, O-2 otoyolları ve bazı bağlantı yollarının güncel bitkilendirmelerine ilişkin araştırmalar

Özet

Çalışmanın amacı: Karayolu peyzaj planlama çalışmaları; doğa ile insanı bütünleştirme açısından önemli peyzaj uygulamalarıdır. Bu nedenle yol ve çevresinde yapılan bitkisel düzenlemelerin ekolojik, işlevsel ve estetik olması, çevre peyzajı ile uygunluğu oldukça önemlidir. Çalışmanın amacı otoyol peyzaj düzenlemelerindeki güncel bitkilendirme uygulamalarının incelenmesi, bitkilendirmeler ile ilgili sorunların belirlenmesi ve çözümlerine yönelik öneriler geliştirilmesidir.

Çalışma alanı: Çalışma alanı olarak güncel bitkilendirme çalışmalarının yapıldığı İstanbul O-1 otoyolu Barbaros-Altunizade arası, O-2 otoyolu Levent-Batı Ataşehir arası ve bazı bağlantı yolları seçilmiştir.

Materyal ve Yöntem: Araştırma alanının doğal ve kültürel özellikleri ile seçilen alanlarda kullanılan bitkilerin ekolojik, işlevsel ve görsel açıdan değerlendirilmesi yapılmıştır. Ayrıca uygulanan anket çalışması ile de konuyla ilgili kişilerin görüşleri değerlendirilmiştir.

Sonuçlar: Değerlendirme sonucunda ekolojik ve işlevsel etkiler değerlendirilmiştir ve belirlenen 14 alan için katılımcıların çoğunun bitki türlerini ve bitkisel düzenlemeyi uygun bulmadığı saptanmıştır.

Önemli Vurgular: Su fakiri ülkeler arasında yer alan ülkemizde yapılacak bitkilendirme çalışmalarında az su isteyen bitki türlerinin kullanımı daha doğru bir yaklaşım olacaktır. Bu sebeple otoyol peyzaj planlama çalışmalarında kullanılabilecek Marmara bölgesinde yetişen, kirli hava koşullarına dayanıklı ve kserofit bitkilerin listesi oluşturulmuştur.

Anahtar kelimeler: Karayolu peyzaj planlama, otoyol bitkilendirmesi, otoyol peyzaj tasarımı.

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Introduction

Highways are the most important landscape elements in establishment of relations between nature and humans. Despite this fact, highways are engineering works which have the most negative effect on nature at the same time. People can only observe and acknowledge the values of nature in places where it is possible to access. As such, it is essential to protect the nature, which has been neglected until present, and have an approach including landscape planning in addition to engineering works.

Only under these circumstances, highways will acquire the quality of integrating with the landscape through which it passes rather than dividing it (Başal, 1979).

Landscaping works on highways can be categorized under three main groups (Köseoğlu, 1980):

A-Repair of nature damaged by highway constructions and solving problems caused by opening of the road to usage (issues in excavation and filling slopes and material receiving places, stone and landslide, environmental pollution)

B-Works to provide safety and comfort of those using the highway (prevention of disturbance caused by headlamp lights in highways with traffic island, increase of visibility in humped roads, indication of bridges, intersections, settlements and recreation areas and etc.)

C- Protection and maintenance of highway landscape arrangements (facilities and planted areas).

The plant material has an important function in carrying out the works mentioned hereinabove. Plant material is utilized for numerous purposes ranging from aesthetic appearance to traffic safety and environmental protection in highway landscaping works. However, it should also be noted that in addition to the benefits of proper use of this material there are also hazards and harms arising from misuse (Altınçekiç and Altınçekiç, 1999)

Altınçekiç and Altınçekiç (1999) have listed the planting principles to be applied in highway landscaping works as follows:

-When choosing plant species, priority should be given to those within the natural vegetation of the region and then other species which can develop in the ecological conditions of the region should be brought if necessary.

-The planting to be performed must be in harmony with the general character of the environmental landscape through which the highway route passes. This is very important in terms of the relation and suitability between the highway and the environmental landscape.

-The existing vegetation cover on the highway route must be protected and this must be completed with the planting to be made and especially if there are endemic species, special importance should be paid for their detection and preservation (Selimoğlu, 1994).

-Planting made on highways must have an aesthetic quality whatever their purpose is (drawing attention to a specificpoint, highlighting certain geomorphological features of the area, making a framework for nice views and etc.) (Akdoğan, 1967).

-Soil and environment requirements must also be considered in addition to crown shape and beauty while choosing tree and shrub species. In addition, if mixed utilization of tree species is supported through sublayer shrubs, planting the roadside with these plant groups will become very interesting and create a much stronger relationship with the environmental landscape (Seçkin, 1986).

-The size of the plantation to be conducted (number of plants in the groups to be created, planting distances and etc.) should be in line with the speed of the project. The number of plants in the groups to be created should be kept higher and large numbers of each and every species should be used. However, groups and number of plants can be kept less in places such as resting areas where people may pay more attention to details (Özgüç, 1999).

-Species particularly resistant to dust and toxic gases caused by traffic should be selected in plantings made at the roadsides and traffic islands.

-Soil stabilization works to be done with plants after shaping the land at excavation and filling slope and material taking places, may change according to soil structure of the land.

-Plant curtains to be built in order to protect the highways from wind, should be positioned perpendicular to the wind direction and parallel to the leveling curves. Plant curtains to be formed for snow should be built at a distance of 20-25 m. It should be paid attention that these vegetative curtains do not hide the beauties of the landscape within the field of view seen from the highway.

-Dust and gas damage, arising from road traffic, should be blocked through plant curtains, in particular near residential areas. The width of the noise curtains which should be created by large species with a thick top changes between 6 to 30 m according to the noise intensity. Selection of leafy plants in green curtains against dust will have a positive effect (Ürgenç, 1998).

-Planting single plant species should be avoided in highways with traffic islands if especially the central traffic island is narrow. The size and pattern of the planting should be determined in line with the project speed of the highway. A zigzag planting technique is the ideal one. Shrubs and plants covering the ground must be mostly utilized. It is required to employ suitable culture forms insettlement areas and nearby places, and natural plant species for rural landscapes (Akdoğan, 1967).

-In as much as irrigation and caring opportunities are better in resting, recreation, service and facilities, the plant material to be used may be richer in terms of species and variety.

-It is required to utilize plants with different heights and intensities for signal effect on highways. For example, settlement areas can be highlighted with a different planting on the highways passing through the natural landscape. Planting with different species on intersections, bridges, overpasses, etc., has a priorly notifying effect to the users of the way.

-Industrial areas, sand, stone, gravel quarries, maintenance stations and etc. which deface the appearance of the landscape along the highway, should be concealed by plants.

-Salt-tolerant plant species must be planted in areas where there is the risk of snow and icing considering the problems to arise due to salt application.

-It should be considered as an economic approach to plant pioneering plants and species which are resistant to nutrient-poor environments and which develop the biological environments, instead of bringing up vegetal soil to excavation, filling and material receiving areas of highways before planting.

Furthermore, road and highway landscaping works, as well as maintenance work such as irrigation, fertilization, pruning and mulching are important for the plants to be healthy and long lasting in addition to fulfilling their expected functions. As such, maintenance and protection works are issues which should be emphasized at least as the construction works.

Material and Method

Material

The subject of the study consists of the evaluation of planting studies carried out currently on the O-1 (Barbaros-Altunizade) highway, O-2 (Levent-Batı Ataşehir) highway and some connection roads within the İstanbul province (Figure 1 and 2).

O-1 (Highway 1, Istanbul 1st beltway); It is the name of the highway passing through Istanbul. The highway opened in 1973 has a total of eight lanes and is 23 km long.

O-2 (Highway 2, Istanbul's 2nd beltway); It is the second highway surrounding Istanbul. It has a larger arc than the first beltwaynamed O-1. It is two-sided and has eight lanes. It passes over the Bosphorus like O-1. It uses the Fatih Sultan Mehmet Bridge when passing the Bosphorus. O-2 has direct access to O-1, O-3 and O-4.

Figure 1. Location of the research area

Figure 2. Research area

Method

A literature search was conducted and studies as regards the subject were examined subsequent to the determination of the area and subject of the study. The works of Akdoğan (1967), Pamay (1972), Özgen (1982), Selimoğlu (1994), Özgüç (1999), Yılmaz (1999), Karahan (2003) and Kurdoğlu (2005) were utilized particulary in the literature search.

It was proceeded to field study after sufficient information was obtained. At this stage, photographs of the area were taken, plant samples were collected from the area, and detection of existing plant taxa and determination of planting design were made.

Research area in the next stage was divided into three regions as O-1 (Barbaros-Altunizade) highway, O-2 (Levent-Batı Ataşehir) highway and some connecting roads and each region was discussed in line with the issue and the positive and negative sides of the current utilization were evaluated and revealed. Subsequently, evaluations as to planting applications were made in line with the results of hundred questionnaires as regards the current utilization of the area were made by landscape architects in Istanbul, academics from the faculty of landscape architecture department, senior students, and master and PhD students. Questionnaire work was conducted both in person and online.

There are 27 questions in the applied questionnaire work which consist of 19 pages. 14 of them are photographic questions in which the participants are asked to evaluate the ecological suitability, functionality and aesthetic principles of the current planting works in the area. Six questions as to the suitability of planting arrangements for the environmental landscaping, suitability of plant species employed, suitability of planting criteria, effectiveness of existing plant arrangements in prevention of air pollution, noise pollution, visual pollution and suitability of existing planting arrangement in terms of functional effectiveness were asked for each and every of the 14 selected areas.

SPSS (Statistical Package for the Social Sciences) was utilized to evaluate the data obtained as a result of the surveys conducted. All the questions were evaluated according to their percentage and frequency status.

The questions related to socioeconomic status of participants such their profession, age or their duration of stay in İstanbul and the other questions about the issues considered important by participants regarding the landscape design of the research area; the landscape elements which are preferred or non-preferred to be seen along the highway, the issues that need to be paid attention in terms of plantation in highway landscaping to identify the issues which should be highlighted or disregarded are crossed and the questions which have a meaningful relationship between each other are evaluated. In the course of the crossing of questions in the questionnaire, the Chi-square (x^2) independence test was applied which questions if there is a relationship between two variables as a statistical method. Confidence level was taken as $p \leq 0.05$ with a margin of error of 5%.

Results

Plant samples were collected and photographed at certain times during the detection of plant taxa between Barbaros-Altunizade districts on the O-1 highway and Levent-Batı Ataşehir districts on the O-2 highway and some connection roads. Subsequently the plant samples which collected were identified (Table 1, 2, 3).

Table 1. Plants existing between Levent-Batı Ataşehir districts

Broad-Leaved Trees	
Acer cappadocicum Gled.	*Gleditsia triacanthos* L.
Acer negundo L.	*Photinia serrulata* Lindl.
Aesculus hippocastanum L.	*Platanus orientalis* L.
Ailanthus altissima (Mill.) Swingle	*Populus tremula* L.
Cercis siliquastrum L.	*Quercus robur* L.
Fraxinus angustifolia Vahl	*Robinia pseudoacacia* L.
Coniferous Trees	
Cedrus atlantica (Endl.) Manetti ex Carrière	*Pinus nigra* Arnold.
Cedrus atlantica (Endl.) Manetti ex Carrière'Glauca' *	*Pinus pinea* L.
Cupressus arizonica Greene	*Taxus baccata* L.*
Cupressus sempervirens L.	X *Cupressocyparis leylandii* (A.B.Jacks. & Dallim.) Dallim.
Cupressus sempervirens var. *pyramidalis* (O.Targ.Tozz) Nyman*	
Shrubs and Bushes	
Berberis thunbergii D.C. 'Atropurpurea' *	*Phormium tenax* f. *atropurpureum* Voss.*
Buxus microphylla Siebb and Zucc.*	*Phormium tenax* J.R. Forst.& G. Forst*
Buxus sempervirens L.*	*Phormium tenax* 'Variegatum' *
Carex oshimensis f. *variegata* Hid. Takah.*	*Photinia* x *fraseri* Dress 'Red Robin' *
Carex oshimensis Nakai*	*Photinia* x *fraseri* Dress 'Red Robin Nana' *
Euonymus japonicus var. *aureomarginatus* Rehder*	*Pittosporum tobira* (Thunb.) W.T. Aiton *
Euonymus japonicus var. *aureovariegatus* Rehder *	*Pittosporum tobira* Ait. 'Nana' *
Euonymus japonicus var. *microphyllus* H.Jaeger *	*Platycladus orientalis* (L.) Franco*
Gaura lindheimeri 'Whirling Butterflies'*	*Prunus cerasifera* Ehrh.
Gaura lindheimeri 'Crimson Butterflies'*	*Prunus serrulata* Lindl. 'Kanzan' *
Juniperus sabina L.	*Rosa* sp.
Lavandula angustifolia Miller*	*Santolina chamaecyparissus* L.*
Nandina domestica Thunb.*	*Yucca filamentosa* L.
Groundcovers	
Carpobrotus acinaciformis (L.) L. Bolus*	*Ophiopogon japonicus* (Thunb.) Ker Gawl.*
Festuca ovina var. *glauca* (P. Beauv.) W.D.J. Koch*	
Seasonal Plants	
Begonia semperflorens Link& Otto*	*Viola* sp.*
Clambering Plants	
Hedera helix L.*	*Hedera helix*'Oro Di Bogliasco' *

* Species used in current planting works

Table 2. Plants on the connection roads

Broad-Leaved Trees	
Acer negundo L.	*Platanus orientalis* L.
Ailanthus altissima (Mill.) Swingle	*Robinia pseudoacacia* L.
Cercis siliquastrum L.	*Sophora japonica* L.
Coniferous Trees	
Cedrus atlantica (Endl.) Manetti ex Carrière'Glauca' *	*Cupressus sempervirens* var. *pyramidalis* (O.Targ. Tozz) Nyman*
Chamaecyparis lawsoniana (A.Murray) Parl	*Pinus nigra* Arnold.
Cupressus arizonica Greene	*Pinus pinea* L.

Table 2 (continued)

Cupressus sempervirens L.	X *Cupressocyparis leylandii* (A.B.Jacks. & Dallim.) Dallim.
Shrubs and Bushes	
Berberis thunbergii DC. 'Atropurpurea'*	*Photinia serrulata* Lindl.
Carex oshimensis Nakai*	*Photinia* x*fraseri* Dress 'Red Robin' *
Euonymus japonicus Thunb.*	*Photinia* x*fraseri* Dress 'Red Robin Nana' *
Euonymus japonicus var. *aureovariegatus* Rehder *	*Pistacia atlantica* Desf.*
Euonymus japonicus var. *microphyllus* H.Jaeger *	*Platycladus orientalis* (L.) Franco
Euonymus japonicus 'Microphyllus Variegatus' *	*Prunus cerasifera* Ehrh.
Euonymus japonicus 'Microphyllus Pulchellus' *	*Prunus cerasifera* subsp. *pissardii* (CarriŠre) Dost I*
Juniperus sabina L.	*Pyracantha coccinea* Roemer.
Lagerstroemia indica L.*	*Rosa* sp.
Lavandula angustifolia Miller*	*Rosmarinus officinalis* L.*
Loropetalum chinense (R.Br.) Oliv. *	*Santolina chamaecyparissus* L.*
Nandina domestica Thunb.*	*Spiraea* x *vanhouttei* (Briot) Zabel*
Nerium oleander L.	*Tamarix tetrandra* Pallas ex M.Bieb.
Osmanthus heterophyllus (G. Don.) P.S.Green*	*Viburnum tinus* L.
Phormium tenax f. *atropurpureum* Voss.*	
Groundcovers	
Carpobrotus acinaciformis (L.) L. Bolus*	*Ophiopogon japonicus* (Thunb.) Ker Gawl.*
Festuca ovina var. *glauca* (P. Beauv.) W.D.J. Koch*	*Thymus vulgaris* L.*
Seasonal Plants	
Begonia semperflorens Link& Otto*	*Tagetes eracta* L.*
Salvia splendens Sellow ex Schult.*	

* Species used in current planting works

Table 3. Plants existing between Barbaros-Altunizade districts

Broad-Leaved Trees	
Ailanthus altissima (Mill.) Swingle.	*Quercus coccifera* L.
Cercis siliquastrum L.	*Quercus ilex* L.
Melia azedarach L.	*Quercus robur* L.
Coniferous Trees	
Cedrus atlantica (Endl.) Manetti ex Carrière	*Cupressus sempervirens* var. *pyramidalis* (O.Targ. Tozz) Nyman*
Cedrus atlantica (Endl.) Manetti ex Carrière'Glauca'	*Pinus halepensis* Mill.
Cedrus libani A. Rich	*Pinus nigra* Arnold
Chamaecyparis lawsoniana (A.Murray) Parl	*Pinus pinea* L.
Cupressus arizonica Greene*	X *Cupressocyparis leylandii* (A.B.Jacks. & Dallim.) Dallim.
Cupressus sempervirens L.	
Shrubs and Bushes	
Euonymus japonicus Thunb.*	*Pistacia lentiscus* L.
Euonymus japonicus var. *aureomarginatus* Rehder*	*Platycladus orientalis* (L.) Franco*
Euonymus japonicus var. *aureovariegatus* Rehder *	*Prunus cerasifera* subsp. *pissardii* (CarriŠre) Dost I*

Table 3 (continued)

Laurus nobilis L.	*Photinia* x *fraseri* Dress 'Red Robin' *
Lavandula angustifolia Mill.*	*Photinia* x*fraseri* Dress 'Red Robin Nana' *
Nandina domestica Thunb.*	*Rosa* sp.
Nerium oleander L.	*Spiraea* x *vanhouttei* (Briot) Zabel*
Photinia serrulata Lindl.	*Viburnum tinus* L.
Pistacia atlantica Desf.	
Groundcovers	
Festuca ovina var. *glauca* (P. Beauv.) W.D.J. Koch*	*Ophiopogon japonicus* (Thunb.) Ker Gawl.*
Seasonal Plants	
Ageratum houstanianum Mill.*	*Tagetes eracta* L.*
Begonia semperflorens Link& Otto*	*Viola* sp.*
Salvia splendens Sellow ex Schult.*	
Clambering Plants	
Hedera helix L.*	

* Species used in current planting works

The plants in the tables consist of plant taxa used in the planting works performed in the previous years or in the last few years. Plant taxa specified in tables * are the plant taxa utilized in planting studies carried out in the last few years and evaluated particularly in our research.

Ürgenç (1998) has underlined that it is important to take into account the species naturally grown in the selection of species and emphasize that the species to be selected in the cities should be suitable for climate and soil condition in addition to their own habitat. For instance, green thick-leaved tree species are always considered to be more resistant in regions where air pollution is intense, and trees which lose their leaves in winters are considered to be less susceptible compared to coniferous trees. In this respect, this rule should be taken into account when choosing as the pollution rate the increases he proposed plant list below has been prepared by comparing Orçun's (1975) list of trees and shrubs resistant to polluted air conditions in city centers, Ürgenç's list of (1998) trees, shrubs and bushes resistant to polluted air conditions in the city center and the list of plants determined to be growing and being grown in the Marmara Region. Xerophytes suitable for landscaping have been also determined on the list of plants proposed to be used in the area by taking into consideration xerophyte landscaping list of Barış (2014) and Çakıroğlu (2011) (Table 4, 5).

Table 4. Air pollution resistant trees which grow in Marmara region (Orçun, 1975; Ürgenç, 1998; Çakıroğlu, 2011; Barış, 2014)

Coniferous Trees	**Evergreen Trees**
Cupressus sempervirens var. *horizontalis* (Mill.)Loudon	*Quercus coccifera* L.
Ginkgo biloba L.	*Quercus ilex* L.
Pinus nigra Arnold*	*Magnolia grandiflora* L.
Taxus sp.	
Deciduous Trees	
Acer campestre L.*	*Morus nigra* L.
Acer negundo L.*	*Platanus acerifolia* (Aiton) Willd. **
Acer palmatum Thunb.	*Platanus occidentalis* L.
Acer platanoides L.**	*Platanus orientalis* L.
Acer pseudoplatanus L.	*Quercus cerris* L.**
Acer saccharinum L.**	*Quercus frainetto* Ten.

Table 4 (continued)

Acer tataricum L.	*Quercus hartwissiana* Steven
Acer trautvetteri Medvedev.	*Quercus palustris* Münchh.
Aesculus x *carnea* Zeyh. **	*Quercus petraea* (Matt.) Liebl.
Alnus glutinosa (L.) Gaertn.	*Quercus pubescens* Willd.*
Betula alba L.	*Quercus robur* L.
Betula pendula Roth	*Quercus rubra* L.**
Betula verrucosa Ehrh.	*Robinia hispida* L.
Carpinus betulus L.	*Robinia pseudoacacia* L.* **
Castanea sativa Miller	*Robinia pseudoacacia* 'Umbraculifera'
Catalpa bignonioides Walter	*Salix alba* L.
Corylus colurna L.	*Salix babylonica* L.
Fagus orientalis Lipsky	*Sophora japonica* L.* **
Fagus sylvatica L.	*Sorbus aucuparia* L.**
Fraxinus angustifolia Vahl	*Sorbus torminalis* (L.) Crantz
Fraxinus excelsior L.	*Tilia cordata* Mill.
Fraxinus ornus L.	*Tilia platyphyllos* Scop.
Gleditsia triacanthos L.* **	*Tilia rubra* DC.
Juglans regia L.	*Tilia tomentosa* Moench**
Liriodendron tulipifera L.	*Ulmus campestris* L.
Malus floribunda Siebold ex Van Houtte*	*Ulmus glabra* Huds.
Melia azedarach L.	*Ulmus minor* Miller
Morus alba L.	

* Xerophytic plants ** Plants 1st degree resistant to polluted air conditions

Table 5. Air pollution resistant shrubs and bushes which grow in Marmara region (Orçun, 1975; Ürgenç, 1998; Çakıroğlu, 2011; Barış, 2014)

Evergreen Shrubs and Bushes	
Aralia japonica Thunb.	*Ilex aquifolium* L.
Aucuba japonica Thunb.	*Ilex colchica* Pojark.
Berberis julianae C.K. Schneid.	*Lavandula angustifolia* Miller
Berberis veitchii C.K. Schneid. *	*Ligustrum japonicum* Thunb.
Buxus microphyllus Siebold & Zucc.	*Ligustrum ovalifolium* Hassk.
Buxus sempervirens L.	*Mahonia aquifolium* (Pursh) Nutt.*
Camellia japonica L.	*Nerium oleander* L.
Cotoneaster franchetii Bois	*Osmanthus heterophyllus* (G.Don) P.S.Green
Elaeagnus glabra Thunb.	*Pittosporum tobira* (Thunb.) W.T. Aiton
Elaeagnus macrophylla Thunb.	*Pyracantha coccinea* M. Roem.*
Elaeagnus pungens Thunb.	*Viburnum tinus* L.*
Fatsia japonica (Thunb.) Decne. & Planch.	*Yucca filamentosa* L.*
Hypericum calycinum L.	
Deciduous Shrubs and Bushes	
Berberis crataegina DC.*	*Lonicera caprifolium* L.
Berberis thunbergii DC.*	*Lonicera caucasica* Pall.
Berberis vulgaris L.*	*Magnolia* x *soulangeana* Soul.-Bod.
Buddleja davidii Franch	*Magnolia stellata* (Siebold & Zucc.) Maxim
Buddleja variabilis Hemsl.	*Melia azedarach* L.**
Calycanthus floridus L.	*Mespilus germanica* L.

Table 5 (continued)

Chaenomeles japonica (Thunb.) Lindl. Ex Spach	*Nerium oleander* L.
Chimonanthus virginicus L.	*Philadelphus coronarius* L.
Clematis vitalba L.	*Prunus cerasifera* Ehrh.
Clematis viticella L.	*Prunus mahaleb* L.*
Crataegus monogyna Jacq.*	*Prunus spinosa* L.
Crataegus orientalis Pall. ex M. Bieb	*Rhamnus alaternus* L.
Crataegus oxyacantha L.	*Rhamnus cathartica* L.
Colutea arborescens L.	*Ribes rubrum* L.
Cornus alba L.	*Rosa* sp.*
Cornus mas L.	*Rubus fruticosus* L.ex Dierb.
Cornus sanguinea L.	*Rubus idaeus* L.
Corylus avellana L.	*Salix caprea* L.
Corylus colurna L.**	*Salix incana* Schrank.
Corylus maxima Mill.	*Salix matsudana* Koidzumi
Cotoneaster horizontalis Decne.	*Salix viminalis* L.
Cotoneaster salicifolius Franch.	*Sambucus ebulus* L.
Cytisus laburnum L.*	*Sambucus nigra* L.
Cytisus scoparius (L.) Link*	*Spiraea* x *bumalda* Burven
Deutzia gracilis Siebold & Zucc.	*Spiraea japonica* L.f.
Elaeagnus angustifolia L.*	*Spiraea salicifolia* L.
Euonymus europaeus L.	*Spiraea* x *vanhouttei* (Briot) Zabel
Euonymus japonicus Thunb.	*Symphoricarpos albus* (L.) S.F.Blake*
Euonymus latifolius (L.) Mill.	*Symphoricarpos* x *chenaultii* Rehder
Euonymus verrucosus Scop.	*Symphoricarpos orbiculatus* Moench
Forsythia x *intermedia* Zabel	*Syringa amurensis* Rupr.
Genista tinctoria L.	*Syringa vulgaris* L.*
Hibiscus syriacus L.	*Tamarix tetrandra* Pall. ex M. Bieb.
Hydrangea macrophylla (Thunb.) Ser.	*Viburnum lantana* L.*
Jasminum nudiflorum Lindl.	*Viburnum opulus* L.
Kerria japonica (L.) DC.	*Viburnum orientale* Pall.
Laburnum anagyroides Medik	*Weigela florida* (Bunge) A.DC.
Ligustrum vulgare L.	*Wisteria sinensis* (Sims) Sweet

* Xerophytic plants ** Plants 1st degree resistant to polluted air conditions

When taxa used in planting studies in the field of research are examined in the light of all these data in terms of ecological suitability, it is seen that imported plant taxa (such as *Photinia x fraseri* Dress 'Red Robin Nana') are predominantly utilized and also plants susceptible to polluted air conditions and exhaust gases (such as *Cedrus atlantica* (Endl. Manetti ex Carrière 'Glauca') are also included. Furthremore, it has been determined that although we are a country included in countries with scarce water sources, plant taxa that require little water have not been selected (*Phormium tenax* taxa).

Selection of species and taxa (such as *Photinia x fraseri* taxons, *Euonymus japonicus* taxa) resistent to dust and poisonous gases as well as insect and fungal diseases has not been given importance sufficiently in selection of plant taxa used in current planting. However, the basic rule that must be observed in the selection of plant taxa for highway plantation should be as selecting natural plant species and plants that have adapted to that region for many years, and plants that are resistant to dust and polluted air, as well as plants which are resistant to insect and fungal diseases and plants that require little water.

When the plant species in Tables 1, 2, 3 are examined in terms of function, it is seen that they are away from sufficient functioning in terms of traffic technique which should be evaluated in terms of size and dimension in highway planting.

This is because existing planting works are far from carrying out functions such as providing soil stabilization, preventing dust and noise, increasing the green view of the highway, not distracting the driver, providing the relation between the highway and the environment landscape and creating a signal effect in places such as bridge and intersection.

When the current planting works on the selected highway routes selected as the research area were examined in terms of visuality it was determined that it cannot sufficiently meet functions such as ensuring compliance and integration of the highway with the environmental landscape, curtaining the parts which needs to be closed, highlighting the places to be emphasized, making the road have a good view line and forming a frame for beautiful views.

80% of the participants using the specified parts of the O-1 Highway (between Barbaros-Altunizade) and O-2 Highway (between Levent-Batı Ataşehir) and the connection routes are female while 20% are male. This ratio is mainly arising from the fact that the ladies choose the Landscape Architecture profession in general.

54%, 43% and 3% of the participants are between the ages of 26-40, 19-25, and 41-60 respectively while there are no participants aged 61 or over.

31%, 28%, 20%, 16% and 5% of the participants are undergraduates, Landscape Architects, master students, academicians and PhD students respectively.

54%, 29%, 9%, 7% and 1% of the participants have been living in Istanbul for more than 20 years, between 0 and 5 years, between 6 and 10 years, between 11 and 15 years, between 16 and 20 years respectively.

The specified parts of O-1 Highway and O-2 Highway and connection roads are used by 94% of the participants while 6% of them are not used by the participants. Participants who stated that they do not use the road have mentioned that they use public transport such as metro, tram, Marmaray and sea transportation intensively.

37%, 27%, 18%, 11% and 7% of the participants have stated that they use the field once or less per month, several times a month, several times a year by marking the other option, several times a week and every day respectively.

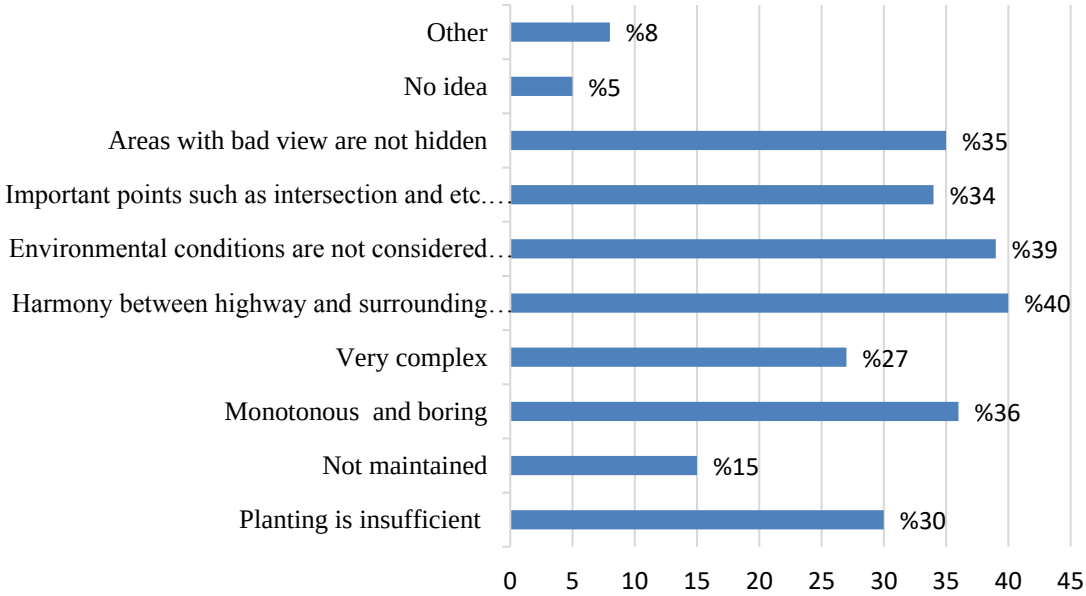

Figure 3. Issues that the participant consider important as to landscape design of the research area

42%, 36% and 21% of participants have stated that there was no difference in traveling on highways compared to roads, traveling on highways is more boring and traveling on highways is, on the contrary, more interesting. It is necessary first to identify and solve visual problems on the side of the highways with an eye to make the journey more interesting and different on the highways.

It was determined that 40%, 39% , 36%, 35% and 34% of the participants have stated that harmonisation of the highway and the environment could not be achieved, environmental conditions were not taken into consideration while choosing the plant species, the landscaping was monotonous and boring, the bad looking areas (construction sites, material purchasing places and etc.) were not concealed and the important points such as intersections and etc. were not emphasized while 30%, 27%, 15% and 8% of the participants have mentioned that planting was inadequate, the landscape layout was too complicated, maintenance was neglected and there were other problems and 5% of the participants have not stated any opinions when the question asked to the participants in order to determine the important issues related to landscaping of the research area was evaluated (Figure 3).

When the question asked to the participants as to the contribution of the current plant arrangements in the research area to the Istanbul urban identity was evaluated, it was observed that 42% and 58% of the participants stated that plant arrangements had contribution and plant arrangements had no contribution to the Istanbul urban identity respectively.

It was seen, when the participants' comments on the visual difficulty at arrival and decision points were evaluated, that 55%, 34%, 7% and 5% of the participants thought that there was visual difficulty in some cases, in most of the cases, in all of the cases and in none of the cases respectively.

It was seen, when the participants' were asked as to the most preferred and undesirable landscape elements to be seen along the highway, that 77 %, 60 %, 48%, 38% and 25% of the participants answered that the most preferred landscape elements were tree and bush groups, forests, vertical gardens and geological formations such as mountains and hills, slopes and etc. respectively.

73%, 70%, 69%, 42%, 38%, 29% and 27% landscape elements which are not preferred to be seen along the highway comprised construction sites, industrial establishments such as factories and etc., areas deteriorated due to human intervention, electricity lines and networks, excavation slopes, residential groups and plant arrangements with motifs and geometric shapes respectively.

When the participants were asked about the issues to be considered as important and unimportant in highway landscape arrangement in terms of plantation, harmony of plantation with the general character of the environmental landscape was considered important by all the participants. 95%, 94%, 82% and 66% of the participants have stated that first and foremost species in the natural vegetation cover should be used in landscape arrangements, points like road separation, intersection and etc. should be highlighted by plants, the different landscape units along the highway should be connected to each other and places and objects within sight limits should be closed.72% and 53% of the participants did not consider making vegetative arrangements with motifs and geometric shapes in the slopes and application of vertical gardens on the walls respectively (Figure 4).

In the next part of the questionnaire, participants were asked for 14 different areas if they consider the planting arrangement suitable for the environmental landscape, if they consider the plant species used (as size and the selected species) suitable, if they consider the size of the planting (number of plants in the groups, planting distance and etc.) harmonious with the speed of the planting, if the current planting arrangement will be effective in preventing air pollution, noise pollution and if the current planting arrangement has functional effectiveness (signaling, removing the fatigue of driver, limiting the area of interest and etc.) or not and the participants' evaluations were evaluated separately for each different areas.

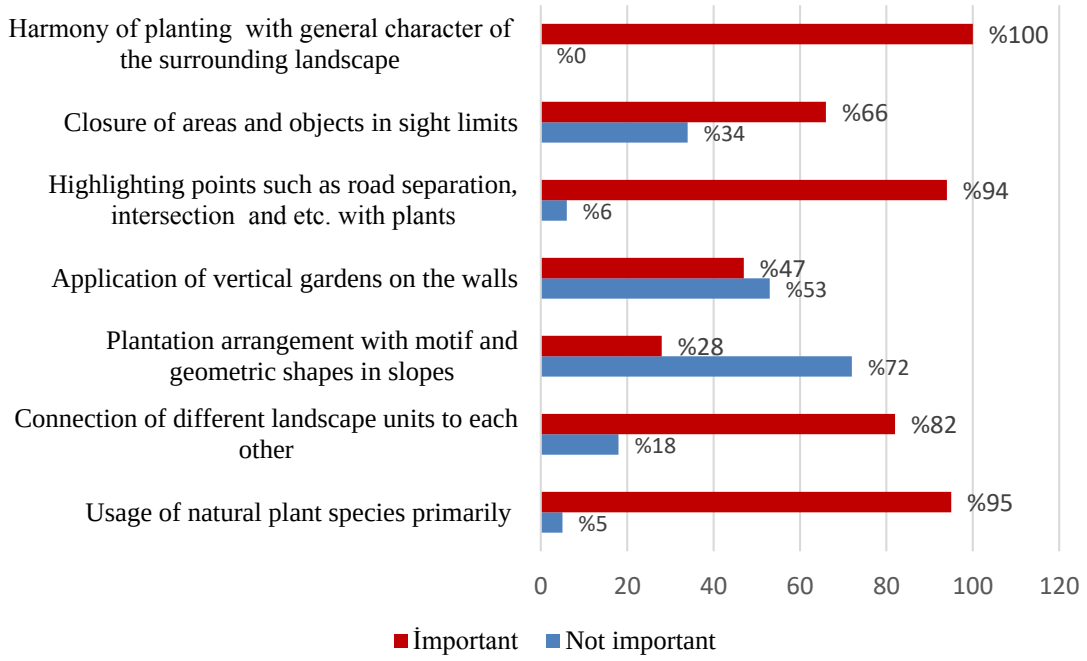

Figure 4. Participants' opinions on issues that need to be paid attention in terms of plantation in highway landscaping

In the next part of the questionnaire, participants were asked for 14 different areas if they consider the planting arrangement suitable for the environmental landscape, if they consider the plant species used (as size and the selected species) suitable, if they consider the size of the planting (number of plants in the groups, planting distance and etc.) harmonious with the speed of the planting, if the current planting arrangement will be effective in preventing air pollution, noise pollution and if the current planting arrangement has functional effectiveness (signaling, removing the fatigue of driver, limiting the area of interest and etc.) or not and the participants' evaluations were evaluated separately for each different areas separately.

It was determined that 58% of the participants did not consider the plant species suitable and 63% in the survey evaluations made in 14 different areas in which the current planting works were intense selected in the research area within the scope of the study. When the preferred species for use in the 14 fields were observed it is seen that usage of bushes (79%), ground cover (75%) and trees/shrubs (70%) were preferred mostly by the participants.

89.2% of those who use the road once a month or less have considered that the use of natural plant cover species primarily is important.

All of the participants aged between 41 and 60 considered that the landscape layout of the research area was very complex.

While 51.6% of participants aged 26-40 considered it important to employ species in the natural vegetation primarily, 57.4% of them did not consider vertical gardening on the walls important. 45.3% of participants aged 19-25considered it important to employ species in the natural vegetation primarily, 54.7 % of them considered vertical gardening on the walls important.

93.8% of the academicians and 57.1% of the landscape architects considered it unimportant vegetation arrangements in the slopes with motifs and geometric shapes.

43,3% of those living in Istanbul for 0-5 years considered the plantation inadequate. 36.7% of those living in Istanbul for 20 years and over considered the plantation inadequate and 40% of them stated that harmony of the highway and the surrounding area could not be achieved.

81.8% of those living in Istanbul for 20 years and over preferred to see park areas.

85.7% of those living in Istanbul for 11-15 years did not consider it important to apply vertical gardens on the walls. All of those living in İstanbul for 6-10 years have found the motif and geometric plantation arrangement in the slopes to be unimportant.

Discussion and Conclusion

The plant species that are used in current planting on the highway routes we have chosen as the research area mainly consist of imported plant species. It was also observed that most of them consisted of shrubs and seasonal flower species (Table 1, 2, 3).

There are also plants which are not resistant to polluted air and exhaust damages among the plant species used. Furthermore, plant taxa, which often require plenty of water, have been selected for usage.

It was determined that the current plantation was inadequate in terms of traffic technique, construction technique, and urban health (such as prevention of dust and noise, providing soil stabilization, not distracting the driver, harmony with the environmental landscape, creating signal effects at places such as bridges, intersections and etc.).

We can list the results of our survey conducted to test our evaluations obtained as a result of the visual evaluations in the field with landscape architects, academicians of landscape architecture department and students of landscape architecture department below:

It is seen that grass and seasonal flowers are used intensively in the research area. However, the use of plant species that require less water in planting works will be a more correct approach since we are a country included in countries with scarce water sources, plant taxa that require little water have not been selected. Landscaping plants resistant to drought and xerophytic landscaping plants predominantly should be preferred for these areas.

On the other hand seasonal flowers are constantly being renewed, which leads to large expenditures as regards cost and work power. Instead of using these plants, trees, bushes, shrub groups and ground-covering plants should be preferred. In this way, both construction and maintenance costs will be minimized, water saving will be ensured, and the environment will be harmonized with the landscape. Furthermore foreign originated plants should not be preferred in terms of cost and non-compliance with growing conditions.

Geometric shaped arrangements are considered complex and monotonous and they seem inadequate since they cannot be combined with tree and shrub groups and they do not have any functional effect.

The plants used in the field do not have an effective functional activity inasmuch as they are predominantly seasonal flowers and grass areas. In addition, other plant species utilized are not suitable and effective species to prevent air, noise and visual pollution.

When the participants were asked about landscaping elements they prefer to see and do not prefer to see in the field of research they answered that the landscaping elements they prefer to see (tree and shrub groups, forests, vertical gardens, geological formations such as mountains and hills, slopes and etc., water surfaces such as sea and etc.) should be increased and landscaping elements they do not prefer to see (industrial establishments such as construction sites, factories and etc., areas damaged due to human intervention, electricity lines and networks, excavation slopes, residential groups, plantation arrangements with motifs and geometrical shapes) should be minimised or completely removed by examining the areas that cause problems visually in the research area and their negative visual effects in the area should be turned to positive by hiding their bad appearance with appropriate landscaping elements or plant in.

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