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Evaluation of Gebze-Orhangazi-İzmir Highway's Landscape Plants[A]

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Abstract: In this study, Gebze-Orhangazi-İzmir Highway, which is the longest completed highway in Turkey with a length of 426 km, landscape plants have been examined in terms of ecological, aesthetic and suitability criteria. Gebze-Orhangazi-İzmir Highway consists of 7 sections, namely Gebze-Orhangazi, Orhangazi-Bursa, Bursa-Susurluk, Susurluk-Balıkesir, Balıkesir-Kırkağaç, Kırkağaç-Manisa, and Manisa-İzmir. It has been determined that 107 landscape plant taxa are used in the whole study area. It has been determined that Gebze-Orhangazi section has the highest taxa diversity and Bursa-Susurluk section has the least taxa diversity. It is seen that a total of 6,144,974 plants are used in the whole highway. Of landscape plants which are used as taxa, 59.81% are exotic (foreign), 40.19% are natural (domestic). It has been found that 74.77% of them are resistant to frost, 63.55% of them are resistant to drought, and 37.38% of them are resistant to salinity. It is observed that 92.52% of the taxa are suitable for the highway landscape.

Anahtar Kelimeler: Gebze-Orhangazi-İzmir Highway, Highway landscape, Landscape plants.

[A] This study was produced from part of Esra ÖZKAN 's Master Thesis. No ethics commission permission is required in this manuscript. The manuscript has been prepared in accordance with publication and research ethics.

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Gebze-Orhangazi-İzmir Otoyolunun Peyzaj Bitkilerinin Değerlendirilmesi

Öz: Bu çalışmada, 426 km uzunluğu ile Türkiye'nin yapımı tamamlanmış en uzun otoyolu olan Gebze-Orhangazi-İzmir otoyolu peyzaj bitkileri ekolojik, estetik ve uygunluk kriterleri bakımından incelenmiştir. Gebze-Orhangazi-İzmir Otoyolu; Gebze-Orhangazi, Orhangazi-Bursa, Bursa-Susurluk, Susurluk-Balıkesir, Balıkesir-Kırkağaç, Kırkağaç-Manisa ve Manisa-İzmir olmak üzere 7 ayrı kesimden oluşmakta olup çalışma alanının tamamında 107 farklı peyzaj bitki taksonunun kullanıldığı tespit edilmiştir. En yüksek takson çeşitliliğinin Gebze-Orhangazi kesiminde yer aldığı, en az takson çeşitliliğinin ise Bursa-Susurluk kesiminde olduğu belirlenmiş olup otoyol bütününde toplam 6.144.974 adet bitkinin kullanıldığı görülmüştür. Peyzaj bitkisi olarak kullanılan taksonların %59,81'inin egzotik (yabancı yurtlu), %40,19'unun doğal (yerli yurtlu) taksonlardan seçildikleri aynı zamanda taksonların %85,05'inin hava kirliliğine, %76,64'ünün rüzgara, %35,52'sinin dona, %74,77'sinin sıcaklığa %63,55'inin kuraklığa, %37,38'inin ise tuzluluğa karşı dayanıklı oldukları bulunmuştur. Taksonların %92,52'sinin otoyol peyzajı için uygun taksonlar olduğu görülmüştür.

Keywords: Gebze-Orhangazi-İzmir Otoyolu, Otoyol Peyzajı, Peyzaj Bitkileri.

Introduction

Described as ‘‘roads with special coating on which entry and exit are banned except specific places and conditions especially allocated for through traffic, where pedestrians, animals and non-motorized vehicles may not enter but from which authorized motor vehicles benefit, that are divided and bi-directional, each of the directions has three or more lanes, and where traffic is subjected to a special control", highways are transportation systems with high standards that allow fast and safe vehicle traffic and were started to be used in our country firstly in 1973 (Balkaya 2016, Dere 2017). Today, the total length of highways in Turkey has reached 3,164 km (Figure 1).

Figure 1. *Map of Highways in Turkey (Anonymous 2020)*

Landscape works carried out on roads are divided into three groups: 1. The solution of the problems that arise after the restoration of the nature that is deteriorated due to road construction and the opening of the road for use (problems in cutting and embankment slopes and the material receiving places, rockslide and landslide, environmental pollution), 2. Works aimed at ensuring the safety and comfort of road users (prevention of the disturbance caused by headlights on highways with a traffic island, an increase of the visibility distance in undulating lands, identification of bridge, crossroad, settlement and recreation areas, etc.), 3. The protection and maintenance of road landscaping (facility and planted areas) (Köseoğlu 1980). Elements of the plan such as the project speed of the road, road route, parallelism, cuttings and embankments, geometric road standards, and vegetation affect the relations between the roads and the landscape (Koç 1979, Koç and Şahin 1999, Dirik 2005).

In the design of high-standard highways that respond to the increasing traffic density and transportation needs, important solutions are required in terms of aesthetics as well as technical aspects (Balkaya 2016).

The purpose of landscaping carried out on highways; Repairing the natural structure destroyed by the road construction by using natural plants of that region, making improvements on the slopes where surface flows may occur, protecting the nearby settlements where the highway passes from negative effects such as noise, pollution, harmful gases, ensuring that the vehicles slow down without harming the driver in case they go off the road, it is to make the tunnel, toll booth entrances and exits and junction entrances and exits clear, that is, to minimize the negative effects that may occur on the highway and to ensure the safety and security of those travelling on the highway (Selimoğlu 1994, Karakaş 1998, Otuzoğlu et al. 2014).

Newly constructed roads should be built in harmony with nature without disturbing the natural structure of the region throughout their routes (Ertekin 2010) and plantation work should be prepared for roads by taking into account the general climate and environmental conditions (Selim ve Atabey 2020). Plantation works on highways are one of the primary factors that affect the relationship between the road line and the landscape and the plant taxa that are used for architectural, engineering, climatic and aesthetic functions (Türkdoğdu 2016) play a key role for a successful and permanent landscape.

From this point of view, the landscape plants used on "Gebze-Orhangazi-İzmir Highway'' which has the longest completed road network in Turkey were evaluated in terms of ecological, aesthetic and suitability criteria for highway landscape tree in this study.

Material and Method

The landscape (design) plants that were used for planting design projects on the route of Gebze-Orhangazi-İzmir Highway (Figure 2), which has the longest road network in Turkey and includes transitions to Kocaeli, Bursa, Balıkesir, Manisa, and İzmir provinces, and still take place within the borders of the highway constitute the main material of this study.

Figure 2. *The location of the study area (Original)*

The research method consists of three stages, namely data collection, land observation and evaluation of the obtained data.

In the first stage, the resources (thesis, book, report, article, etc.) related to the subject were investigated and collected, landscape projects of the study area and the project reports were obtained after having contacts with the related institutions.

In the second stage, the landscape projects were examined according to the principles of highway landscape planning and implementation (Köseoğlu 1980, Selimoğlu 1994, Karakaş 1998, Türkdoğdu 2016, Metin Öz 2019). The study area was visited and on-site observations were made for compliance of the project with the implementation in the field, then field study performed by taking photos of the study. The taxa used in the highway landscape design were identified with the studies. For the identified taxa, classifications were made in terms of:

a. Distributions,

b. Aesthetic characteristics,

c. Ecological tolerance and requirement status,

d. Distributions of maintenance needs,

e. Suitability status for highway planting.

Aesthetic characteristics are evaluated as:

- Form (pyramidal-columnar, round-spherical, spreading, weeping),
- Texture (coarse, medium, and fine),
- Colour of leaves (green, yellow-red, light green, dark green, red-green, green, yellow-green, grey-green, blue-green),

- Colour of flowers (yellow, red, white, pink, greenish yellow, cream-white, cream, pink-white, lilac-purple, different colours),
- Scent and emphasis effect (there is (+), there isn't (-)),
- Fall colour effect (active (+), not active (-)) (Pamay 1992, Pamay 1993, Hillier 1998, Güngör et al. 2002, Zencirkıran 2013, Anonymous 2019a, Anonymous 2019b, Anonymous 2019c).

Of taxa; ecological tolerance status (air pollution-wind-frost-temperature-salinity-drought resistances) (1. not resistant, 2. moderately resistant, 3. resistant), light requirements (1. penumbra, 2. sun/penumbra, 3. sun), Plant maintenance requirements (1. low, 2. medium, 3. high)) and suitability status to be road side tree (suitable (+), unsuitable (-)) were demonstrated by benefitting from researchers such as (Ermeydan et al. 2016, Zencirkıran and Akdeniz 2017, Akdeniz et al. 2017, Akdeniz et al. 2019, Anonymous 2019d).

At the third stage of the study, the obtained data was evaluated and time series analysis in SPSS 22 program was used for the evaluation of the data.

Results

6,144,974 plants in total were used in Gebze-Orhangazi-İzmir Highway landscape that was examined within scope of the study, 1.274.852 of which are trees, 4.739.179 of which are shrubs, 219 of which are palms, 24.585 of which are climbers, 400 of which are herbaceous plants, and 105.739 of which are groundcovers. In the study area, 107 taxa of landscape plants belonging to 75 genera in 49 families were determined (Table 1).

Table 1. The taxa identified throughout the whole study area (Gebze-Orhangazi-İzmir Highway)

FAMILY	GENUS	TAXA
Aceraceaea (Sapindaceae)	*Acer*	*Acer negundo* L.
		Acer platanoides L.
Aizoaceae	*Carpobrotus*	*Carpobrotus acinaciformis* L.
Anacardiaceae	*Schinus*	*Schinus molle* L.
Apacynaceae	*Nerium*	*Nerium oleander* L.
		Nerium oleander 'Nana'
Araliaceae	*Hedera*	*Hedera helix* L.
Arecaceae	*Washingtonia*	*Washingtonia filifera* Wendl.
Berberidaceae	*Berberis*	*Berberis thunbergii* 'Atropurpurea'
		Berberis thunbergii 'Atropurpurea Nana'
	Mahonia	*Mahonia aquifolium* Nutt.
Betulaceae	*Betula*	*Betula verrucosa* Roth.
	Carpinus	*Carpinus betulus* 'Fastigiata'
Bignoniaceae	*Catalpa*	*Catalpa bignonioides* Scop.
Buddleiaceae	*Buddleia*	*Buddleia davidii* Franch.
Caprifoliaceae	*Abelia*	*Abelia x grandiflora* 'Confetti'
		Abelia x grandiflora 'Prostata'

FAMILY	GENUS	TAXA
	Lonicera	*Lonicera caprifolium* L.
		Lonicera nitida L.
	Viburnum	*Viburnum tinus* L.
Celastraceae	*Euonymus*	*Euonymus alatus* L.
		Euonymus fortunei Turcz.
		Euonymus japonica 'Aurea'
Cornaceae	*Cornus*	*Cornus alba* L.
Crassulaceae	*Sedum*	*Sedum acre* L.
		Sedum sp.
Cupressaceae	*Cupressocyparis*	*x Cupressocyparis leylandii* M.L. Green.
	Cupressus	*Cupressus arizonica* Greene.
		Cupressus macrocarpa Hartw.
		Cupressus macrocarpa 'Goldrest'
		Cupressus sempervirens L.
	Juniperus	*Juniperus horizontalis* Moench.
	Thuja	*Thuja orientalis* L.
		Thuja orientalis 'Compacta'
		Thuja orientalis 'Pyramidalis'
Elaeagnaceae	*Elaeagnus*	*Elaeagnus angustifolia* L.
Escalloniaceea	*Escallonia*	*Escallonia sp.*
Fabaceae	*Cytisus*	*Cytisus praecox* 'Allgold'
Fagaceae	*Fagus*	*Fagus sylvatica* L.
	Quercus	*Quercus cerris* L.
		Quercus coccifera L.
		Quercus robur L.
Ginkgoaceae	*Ginkgo*	*Ginkgo biloba* L.
Hamamelidaceae	*Liquidambar*	*Liquidambar orientalis* Mill.
Hemerocallidaceae	*Hemerocallis*	*Hemerocallis hybrida* L.
Hippocastanaceae	*Aesculus*	*Aesculus hippocastanum* L.
Labiatae	*Rosmarinus*	*Rosmarinus officinalis* L.
Lamiaceae	*Lavandula*	*Lavandula angustifolia* Mill.
Lauraceae	*Laurus*	*Laurus nobilis* L.
Leguminosae	*Cercis*	*Cercis siliquastrum* L.
	Gleditsia	*Gleditsia triacanthos* L.
	Robinia	*Robinia pseudoacacia* L.
		Robinia hispida L.
		Robinia pseudoacacia 'Umbraculifera'
	Spartium	*Spartium junceum* L.
Lythraceae	*Lagerstroemia*	*Lagerstroemia indica* L.
Magnoliaceae	*Magnolia*	*Magnolia grandiflora* L.
Malvaceae	*Hibiscus*	*Hibiscus syriacus* L.
Meliaceae	*Melia*	*Melia azedarach* L.
Mimosaceae	*Acacia*	*Acacia retinoides* Schltr.
Moraceae	*Morus*	*Morus alba* L.
Myrtaceae	*Callistemon*	*Callistemon laevis* L.
Oleaceae	*Forsythia*	*Forsythia* x *intermedia* Zab.
	Fraxinus	*Fraxinus excelsior* L.
	Jasminum	*Jasminum nudiflorum* L.

FAMILY	GENUS	TAXA
	Ligustrum	*Ligustrum japonicum* Thunb.
	Olea	*Olea europaea* L.
		Olea oleaster L.
	Syringa	*Syringa vulgaris* L.
Onagraceae	*Gaura*	*Gaura lindheimeri* Engelm. & A.Gray.
Palmea	*Chamaerops*	*Chamaerops excelsa* L.
		Chamaerops humulis L.
Pinaceae	*Cedrus*	*Cedrus atlantica* Manetti.
		Cedrus deodora G.Don.
		Cedrus libani A.Rich.
Pinaceae	*Picea*	*Picea pungens* L.
		Picea pungens 'Glauca'
	Pinus	*Pinus brutia* Henry.
		Pinus nigra Arnold.
		Pinus pinea L.
Pittosporaceae	*Pittosporum*	*Pittosporum tobira* 'Nana'
Platanaceae	*Platanus*	*Platanus occidentalis* L.
		Platanus orientalis L.
Poaceae	*Miscanthus*	*Miscanthus sinensis* L.
	Panicum	*Panicum virgatum* 'Heavy Metal'
Punicaceae	*Punica*	*Punica granatum* L.
Rosaceae	*Cotoneaster*	*Cotoneaster horizontalis* Decne.
		Cotoneaster salicifolia L.
	Malus	*Malus floribunda* Sieb. ex Van Houtte.
	Photinia	*Photinia fraseri* 'Nana'
		Photinia fraseri 'Red Robin'
		Photinia serrulata Franch.&Sav.
	Prunus	*Prunus cerasifera* Ehrh.
	Pyracantha	*Pyracantha coccinea* Roem.
		Pyracantha coccinea 'Nana'
	Rosa	*Rosa canina* L.
		Rosa x hybrida L.
		Rosa 'meilland'
	Spirea	*Spirea vanhouttei* Zab.
Salicaceae	*Populus*	*Populus tremula* L.
	Salix	*Salix alba* L.
	Salix	*Salix babylonica* L.
Simaroubaceae	*Ailanthus*	*Ailanthus altissima* Mill.
Tamaricaceae	*Tamarix*	*Tamarix tetrandra* Pall.
Tiliaceae	*Tilia*	*Tilia tomentosa* Moench.
Ulmaceae	*Celtis*	*Celtis australis* L.
Vitaceae	*Ampelopsis*	*Ampelopsis quinquefolia* L.

Considering the distribution of taxa according to their families, it has been seen that taxa mostly belong to Rosaceae (13 taxa) and Cupressaceae (9 taxa) (Figure 2).

Table 2. Distributions of the taxa, determined at the whole study area, according to families

Families	N-Samp.Num.	GD (%)	N-Samp. Num.	SD (%)	N-Samp.Num.	VD (%)
Aceraceaea	1	1.33	2	1.87	0	0.00
Aizoaceae	1	1.33	1	0.93	0	0.00
Anacardiaceae	1	1.33	1	0.93	0	0.00
Apacynaceae	1	1.33	2	1.87	1	5.88
Araliaceae	1	1.33	1	0.93	0	0.00
Arecaceae	1	1.33	1	0.93	0	0.00
Berberidaceae	2	2.67	3	2.80	2	11.76
Betulaceae	2	2.67	2	1.87	1	5.88
Bignoniaceae	1	1.33	1	0.93	0	0.00
Buddleiaceae	1	1.33	1	0.93	0	0.00
Caprifoliaceae	3	4.00	5	4.67	1	5.88
Celastraceae	1	1.33	3	2.80	1	5.88
Cornaceae	1	1.33	1	0.93	0	0.00
Crassulaceae	1	1.33	2	1.87	0	0.00
Cupressaceae	4	5.33	9	8.41	3	17.65
Elaeagnaceae	1	1.33	1	0.93	0	0.00
Escalloniaceea	1	1.33	1	0.93	0	0.00
Fabaceae	1	1.33	1	0.93	0	0.00
Fagaceae	2	2.67	4	3.74	0	0.00
Ginkgoaceae	1	1.33	1	0.93	0	0.00
Hamamelidaceae	1	1.33	1	0.93	0	0.00
Hemerocallidaceae	1	1.33	1	0.93	0	0.00
Hippocastanaceae	1	1.33	1	0.93	0	0.00
Labiatae	1	1,33.	1	0.93	0	0.00
Lamiaceae	1	1.33	1	0.93	0	0.00
Lauraceae	1	1.33	1	0.93	0	0.00
Leguminosae	4	5.33	6	5.61	2	11.76
Lythraceae	1	1.33	1	0.93	0	0.00
Magnoliaceae	1	1.33	1	0.93	0	0.00
Malvaceae	1	1.33	1	0.93	0	0.00
Meliaceae	1	1.33	1	0.93	0	0.00
Mimosaceae	1	1.33	1	0.93	0	0.00
Moraceae	1	1.33	1	0.93	0	0.00
Myrtaceae	1	1.33	1	0.93	0	0.00
Oleaceae	6	8.00	7	6.54	0	0.00
Onagraceae	1	1.33	1	0.93	0	0.00
Palmea	1	1.33	2	1.87	0	0.00
Pinaceae	3	4.00	8	7.48	1	5.88
Pittosporaceae	1	1.33	1	0.93	1	5.88
Platanaceae	1	1.33	2	1.87	0	0.00
Poaceae	2	2.67	2	1.87	1	5.88
Punicaceae	1	1.33	1	0.93	0	0.00
Rosaceae	7	9.33	13	12.15	3	17.65
Salicaceae	2	2.67	3	2.80	0	0.00
Simaroubaceae	1	1.33	1	0.93	0	0.00
Tamaricaceae	1	1.33	1	0.93	0	0.00
Tiliaceae	1	1.33	1	0.93	0	0.00
Ulmaceae	1	1.33	1	0.93	0	0.00
Vitaceae	1	1.33	1	0.93	0	0.00

N-Samp. Num.: N sampling number GD: Genus Distribution SD: Species Distribution VD: Sub-species and variety distribution

The result of the evaluations made in terms of origin showed that among the landscape plants which are used as taxa in the study field, 59.81% are exotic (foreign) taxa and 40.19% are natural (domestic) taxa (Figure 3).

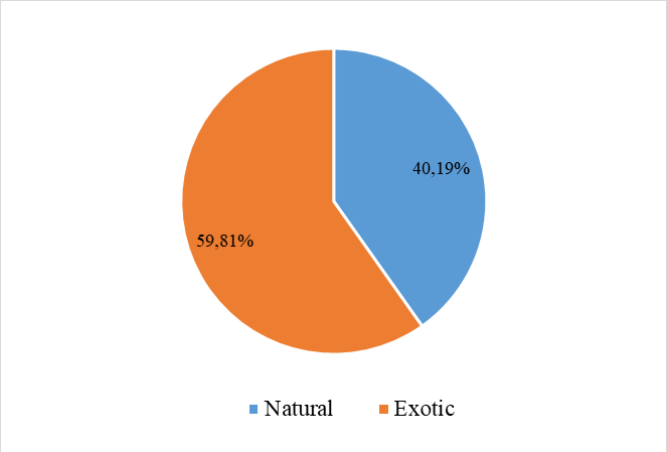

Figure 3. *Distribution of taxa determined throughout the study area according to natural and exotic species*

Evaluations made in terms of life forms showed that, 49.54% of the landscape plants in the project area are trees, 39.25% of which are shrubs, 2.80% of which are climbers, 2.80% of which are palms, and 5.61% of which are herbaceous plants and groundcovers (Figure 4). It was determined that among the taxa determined, 15.89% of which are from the Gymnospermae sub-group and 84.11% of which are from the Angiospermae sub-group (Figure 5).

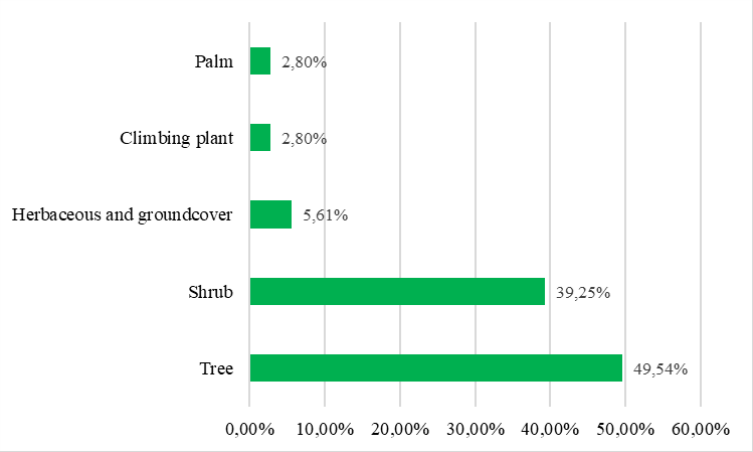

Figure 4. *Distributions of the taxa according to life forms*

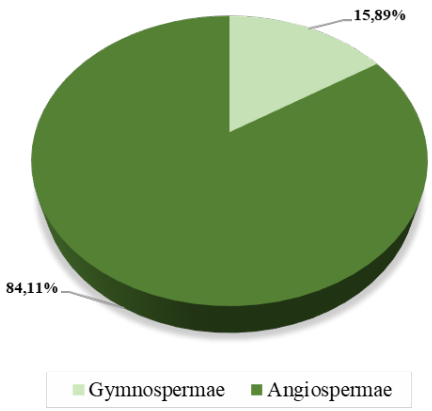

Figure 5. *Distributions of the taxa according to taxonomic groups*

It was identified that among the taxa determined, 27.10% of which have round-scattered form and 20.56% of which have scattered form (Figure 6), 23.37% of which have fine texture, 51.40% of which have medium texture, 25.23% of which have coarse texture (Figure 7), at the same time, 32.71% have smell effect, 65.42% of which have emphasis effect, and 30.84% of which have fall colour effect (Figure 8).

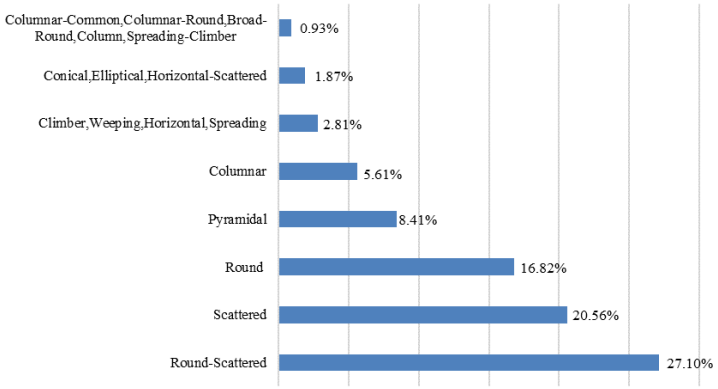

Figure 6. *Distributions of taxa according to their forms*

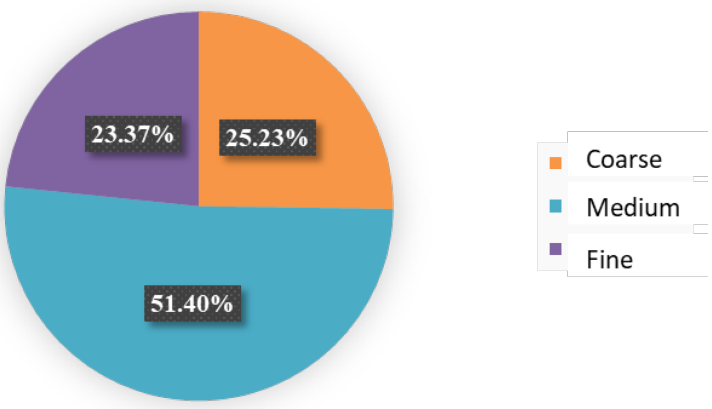

Figure 7. *Distributions of taxa according to their textures*

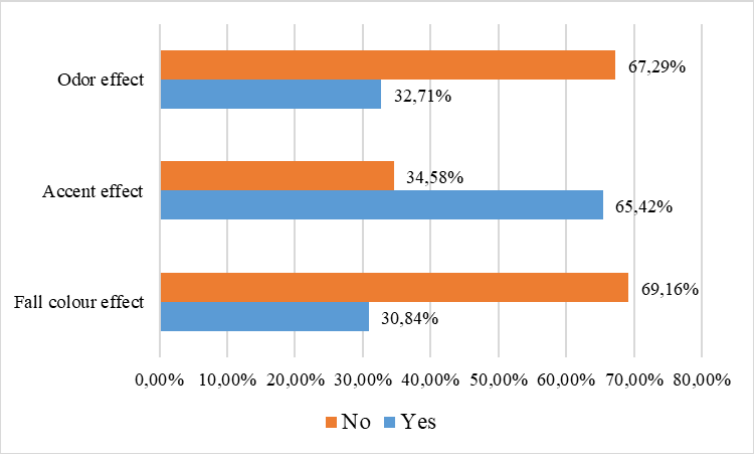

Figure 8. *Distributions of taxa according to their odor-accent-fall colour effects*

When the ecological tolerance status of the taxa in the whole study area is evaluated, it was determined that 85.05% of the taxa were resistant to air pollution, 76.64% of the taxa were resistant to wind, 35.52% of the taxa were resistant to frost, 74.77% of the taxa were resistant to temperature, 63.55% of the taxa were resistant to drought, and 37.38% of the taxa were resistant to salinity (Figure 9).

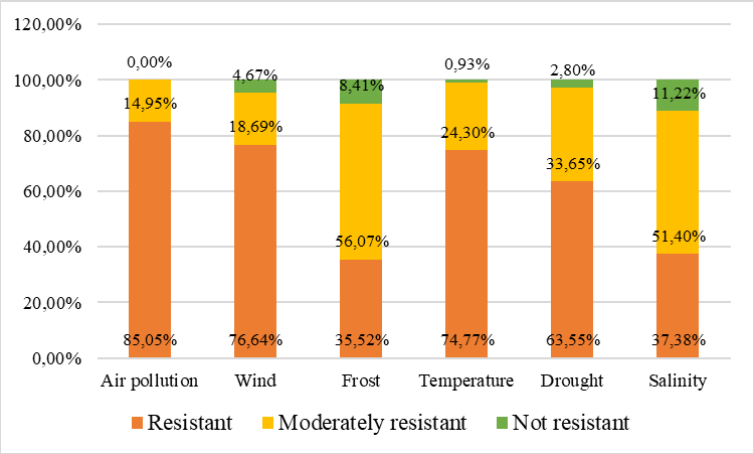

Figure 9. *Distributions of taxa according to their ecological tolerance*

In the evaluations made in terms of their light requirements, it was determined that 1.87% of the taxa required penumbra, 70.09% of which required penumbra/sun, and 28.04% of which required a sunny environment (Figure 10).

Evaluations made in terms of suitability for highway planting revealed that 92.52% of the taxa used were suitable and 7.48% of which were not suitable for this purpose (Figure 11).

As a result of the evaluations made in terms of their care requirements, it was determined that 57.01% of the taxa are in the group of the taxa that require low care, 40.19% fall in the group that require medium care, and 2.80% fall in the group that require high care (Figure 12).

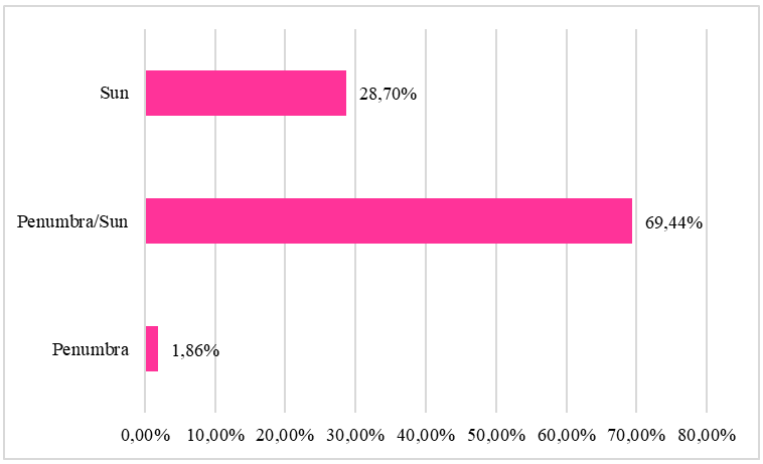

Figure 10. *Distributions of the taxa according to their light requirements*

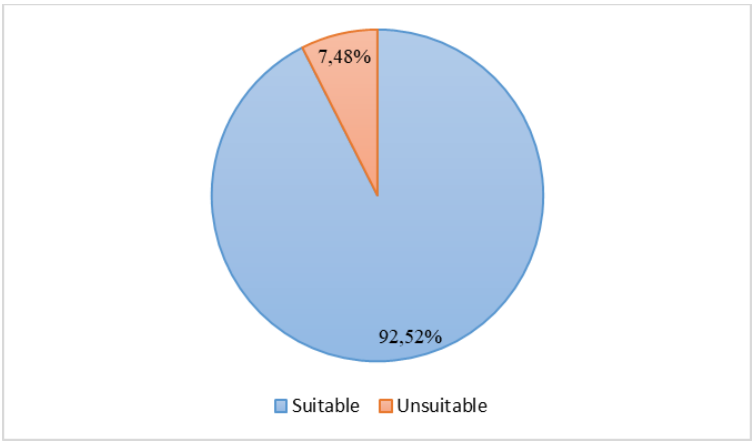

Figure 11. *Distributions of the taxa according to their suitability status for highway landscape tree*

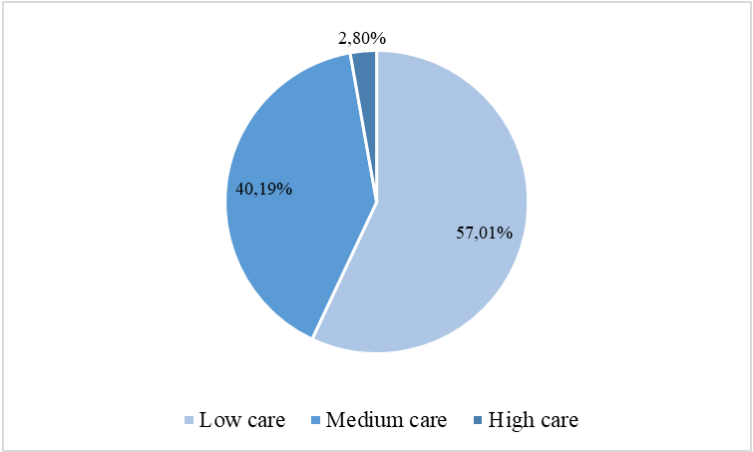

Figure 12. *Distributions of the taxa according to their care requirements*

Discussion and Conclusion

"Gebze-Orhangazi-İzmir Highway" is Turkey's longest highway with 426 km and was completed between 2015-2019. Within the scope of this study, the landscape plants which are used in the landscape design of the Gebze-Orhangazi-İzmir Highway were evaluated in detail.

It was seen that landscape plants belonging to 108 different taxa in total of 49 families and 75 genera area were used in the entire 426 km project field, and that 59.81% of the taxa used were exotic (foreign) and 40.19% natural (domestic) taxa. Although, the use of natural taxa is important for landscape applications compatible with ecology (Dilaver et al. 2020), it has been seen that they are used at low rate in the highway area.

In terms of landscape plants, it was determined that the highest diversity was between the Gebze-Orhangazi section (87 taxa) and the least diversity was between the Bursa-Susurluk section (32 taxa). At the same time, it was seen that the taxa of landscape plants that take place in the Angiospermae group were used at the highest rate in the Gebze-Orhangazi section with a rate of 82.76%, and the taxa of landscape plants in the Gymnospermae group were used at the highest rate in the Bursa-Susurluk section with a rate of 31.25%.

It was seen that the taxa in the form of trees were predominantly used throughout the highway route and the most intensively used ones were Cedrus libani A. Rich. and Pinus pinea L., however; it was determined that the taxa such as Pyracantha coccinea Roem., Nerium oleander L., and Tamarix tetrandra Pall out of the taxa in shrub form were the most intensively used ones.

As it is known, ecological tolerance that is described as "the equivalent of the reaction range to which plants can withstand under extreme environmental conditions" (Şahin 2018) has gained greater importance under the effects of climate change which we have started to experience more prominently in the recent years.

Stress factors such as drought, salinity, extreme hot and cold weather conditions, air pollution and strong wind caused by climate change cause the deterioration of the natural environment in which plants live, thereby resulting in productivity loss and stress formation in plants (Yener et al. 2020).

Therefore, the plant that is suitable for the green field systems is considered as a plant with high ecological tolerance, which is resistant not only to aesthetic criteria, but also to environmental and ecological factors (frost, salinity, drought, precipitation, etc.) of the implementation area. (Piccolo and Landi 2020).

Within this framework, as a result of the evaluation of the taxa used in the design of the study area within the scope of ecological tolerance, it was determined that 85.05% of the taxa were resistant to air pollution, 76.64% of the taxa were resistant to wind, 35.52% of the taxa were resistant to frost, 74.77% of the taxa were resistant to temperature, 63.55% of the taxa were resistant to drought, and 37.38% of the taxa were resistant to salinity. The findings demonstrate that some of the taxa may be affected by the effects of serious climate change that may occur in future periods and that the highest rate of exposure may be caused by drought and salt stress.

Within the framework of today's design approaches, it is determined in this study that 92.52% of the taxa used in the highway landscape were suitable for this purpose and only 7.48% were not suitable for this purpose

and seen that this situation will be inevitably affected by the effects of climate change to be experienced in the upcoming process.

On the other hand, wildlife transitions on highways have great importance for sustainability of natural life (Metin Öz 2019). Although the existence of the ecological bridge that is located in Balıkesir-Kırkağaç section, which will provide the transition of wildlife in the study area, is important, the existence of only one bridge is not considered enough for the natural habitats of wild animals because the road route generally passes through rural areas that are far from cities.

As a results of the study; it is great importance that the data obtained are taken into account for the highway landscapes that will be realized in the following years.

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No ethics commission permission is required in this manuscript. The manuscript has been prepared in accordance with publication and research ethics. The authors declare that there is no conflict of interest regarding the publication of this article.

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