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Full Length Research Paper

Determination of ecological environmental conditions for using natural vegetation samples in landscape architecture studies: Case study of Ayas Beli (Ankara)

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Ayaş Beli, the selected research area, is about 40 km. northwest of Ankara, the capital, and is approximately 10 km². The aim of the study is to provide for the utilization of compatible, economic and aesthetic samples; that exist in flora of Turkey; in the landscape architecture studies. In the study, in order to identify the suitable plants and their phenologic, geographic and ecologic features, field observations have been conducted; topography, geology, geomorphology, soil, forest planning maps, climate data and literature have been obtained; all data has been transferred to a computer and as a result of the queries and evaluations made with the help of Arc View GIS Program the result has been reached. In this research that has been conducted as a Doctoral Study 122 taxons belonging to 42 families, which are suitable for use in landscape architecture studies have been identified and their locations in the area, botanical features, ecological needs and tolerance status have been determined following the query and have been converted into a data base. In this article, the thesis work has been summarized. It includes field maps, the characteristics of a single species chosen as an example and research findings in brief.

Key words: Ayaş, natural vegetation, Arc view.

INTRODUCTION

When Turkey's natural structure that is, its soil, climate, topography and vegetation that reflect its ecology, is examined, it is seen that it has a remarkably rich potential. The fact that there exist three phytogeography zones (Euro-Siberian, Mediterranean, and Irano-Turanian) together in our country increases the richness of the natural vegetation (Altan et al., 1992). There are over 9000 samples in the flora of Turkey, of which 3000 are endemic. Despite this rich flora that hosts some very special plants, the utilization of appropriate samples of natural vegetation in landscape architecture studies is quite limited.

In Turkey, there are problems in protecting the natural vegetation samples. Natural areas are faced with increasing pressures and this also raises concerns about the natural vegetation. Today, some species are under threat and faced with extinction risk. It is observed that some other spread areas are being narrowed and that they do not exist in areas that they have previously been observed. Utilization of natural vegetation samples in landscape architecture studies, very important for regaining the species that are damaged or about to disappear when protecting those in their natural habitat (*in-situ*) is not possible. It is important to carry the natural samples to our gardens in terms of both providing them a protected environment and also making people recognize them which would create protection awareness.

The scope of landscape architecture also covers the problem areas with extreme environmental conditions. The fact that the maintenance needs of cultural plants are far more than those of natural ones limits the success in these areas. The chance of success increases in application with natural species having high tolerance values and with samples that have the same problems in nature (salinity, stoniness, high slope, dry conditions, etc). When we consider that the global warming brought about water problems, it becomes more important to utilize xeric species of steps.

Using samples of natural vegetation in landscape architecture studies, is an exercise that creates a landscape compatible with nature and at the same time compatible with economic conditions. In this way,

selection of plant material that matches the environmental conditions with minimum maintenance should be preferred as an economic approach in planning (Akdogan, 1972).

In our country, there exist samples of natural vegetation in different environments, growing conditions and features. If every person who wants to utilize natural vegetation samples sees them as seeds and move the natural plants to the gardens the result could be the loss of nature. Therefore, it is necessary that growers should be involved in the transfer of natural vegetation samples to the users and they should engage in production and growth activities (Stevens and Buchan, 1997).

The studies which evaluate the usability of natural vegetation samples in landscape architecture are mostly conducted through field trips aimed at detecting and diagnosing the suitable species, determining their habitus characteristics and which application area of landscape architecture they could be used. As the next step, these plants are subjected to experiments in different environments in order to find out the appropriate growth conditions. However, before conducting the experiments, the observation of the plants in their environments and the analysis of the conditions are important especially in cases where the same conditions exist.

In the doctoral study titled "A Research on the Evaluation of the Usability of Natural Vegetation Samples of Ayaş Beli and its Surroundings in Landscape Architecture Studies", the plants which are suitable for use in these studies have been determined. In the study, it was aimed at identifying the features of these plants and putting forward their environmental characteristics along with their phenologic observations. Therefore, the maps regarding the factors that affect plant growth have been transferred to computer environment and the points where the plants were collected have been marked while identifying for each plant group; height, slope group, exposure, geology, geomorphology, planning and various soil properties. As research findings; the photos of each plant, research maps indicating their position in the research field and tables listing plants' properties, spread areas and environmental characteristics have been given. In this article, the thesis is summarized and the field maps together with an example of one group and the main findings are given.

MATERIALS AND METHODS

Materials

The main materials of the study constitute samples collected from the natural vegetation of Ayaş Beli and its surroundings. In addition; literature and all kinds of resources related to the field, the topic and the method; maps and reports on the topographic structure, geology, geomorphology, soil structure and forestry planning status of the research area; meteorological data; analysis results of the soil samples taken from the field; herbarium material obtained from the plants removed from the field; plant samples and slides and photos used for visually reflecting the research field to the text; Arc View software that have been used to transfer every kind of data to the computer have been used as the research material.

Methods

The method of the research carried out in the identified subject and the field could be classified in general terms as:

1. Field work
2. Literature research and supply of data related to the field
3. Office work and herbarium studies
4. Transfer of data to a computer
5. Questioning and evaluation.

With field work, plant species suitable for utilization in various fields of landscape architecture in terms of environmental conditions and features have been identified. Samples of species have been dried and converted into herbarium material in order to be able to identify later. In the stages after the identification of the plants, follow up has been conducted through observation without the removal of the plants. Individual characteristics and seasonal changes of these species have been determined. In addition, in order to assess at the same time the information on the research area maps supplied by various institutions and organizations, necessary notes to mark the plants (locality, elevation, slope, direction, habitat and other observations) have been taken.

In the phase of literature research and supply of data related to the field; literature, maps and reports about the Arc View, which is a CBS software used in the evaluation of the use of plants in landscape architecture, research field characteristics and project in the computer, have been obtained and evaluated.

After examining all data, office work which is the phase of evaluation of data by relating them to the subject and the field and herbarium studies which constitute the identification of the plant samples obtained from the field have been carried out concomitantly. In transferring the data to the computer Arc View 3.2 software have been used. All the field maps have been numbered, as well as map information; field data and other information obtained from the literature have been evaluated with the same software through creating plants' database tables serving as research findings.

All information transferred to the computer has been compared with one another in the process of questioning and evaluation. Through utilizing the obtained database it is possible to conduct various inquiries for finding out suitable plants for the desired environment.

RESEARCH FINDINGS

Research area is on Ankara-Ayas highway, about 40 km. northwest of Ankara and is approximately 10 km². The starting point is the forest area near the village Ilyakut and the end point is the hills stretching near the village of Başbereket.

The annual average temperature of the research area is 11.4°C. The average temperature in July and August is 22.2°C while in January it is 0.5°C on average and the average low is -2.4°C. The vegetation period in the area have been identified as early April - end October. Average annual rainfall in the area is relatively higher than in other parts of Central Anatolia (300 - 400 mm.) with 439.7 mm. When the seasonal distribution of rainfall is examined it is seen that the rainiest seasons are winter and spring, while the least rainfall is observed in summer

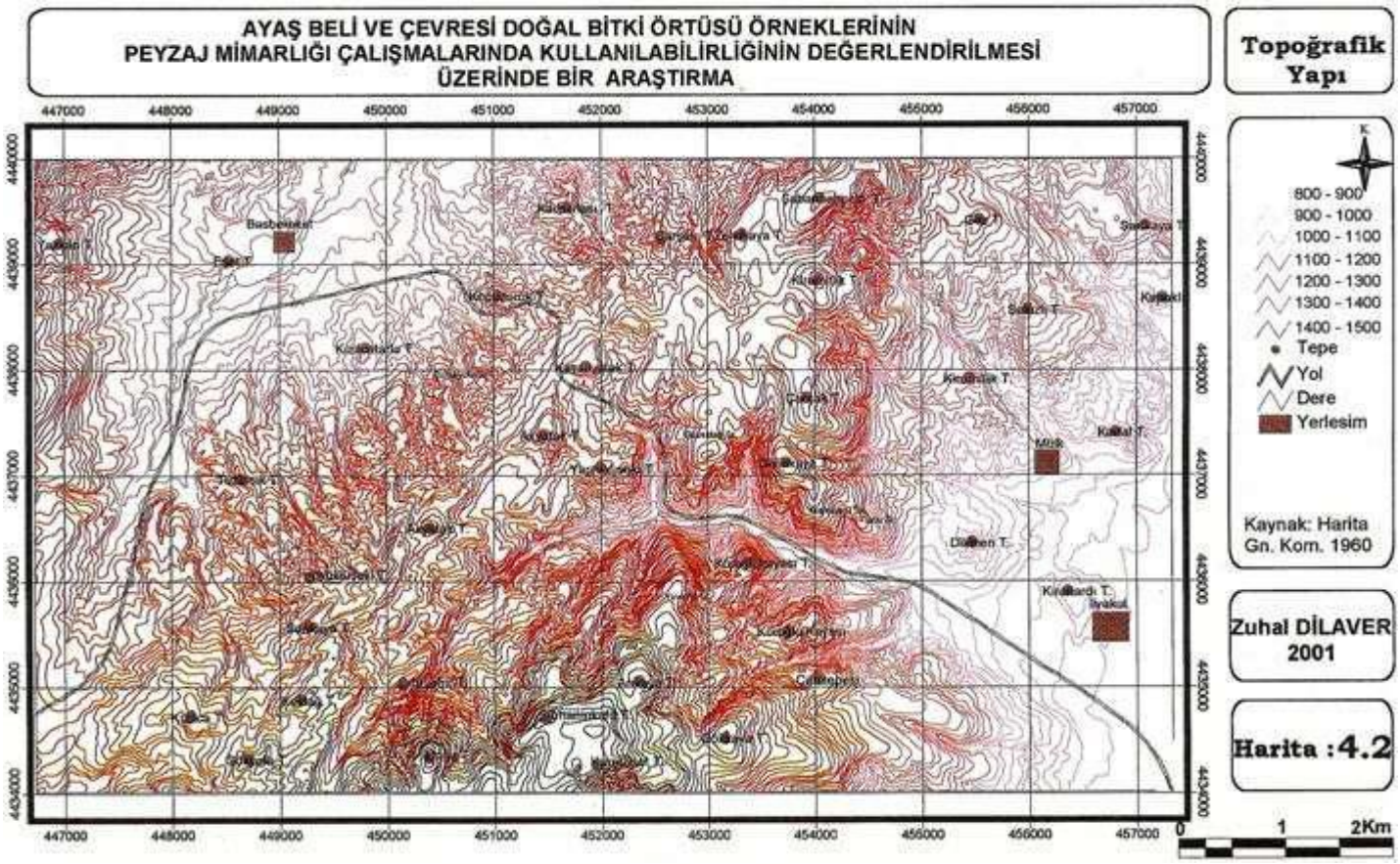

Figure 1. Topographical structure.

(DMİ, 1929 - 1990, Atalay, 1987). The average value of cloudiness is highest in December (7.1) and lowest in August (1.8). Annual average relative humidity is 54%, its highest being 72% (in the months of December and January) and its lowest being 38% (in August). The direction of the fastest wind is southwest/northeast, the most observed wind is in the direction of northeast. The average wind force is 1.2 (DMİ, 1929 - 1990).

The heights in the research area vary between 950 m. and 1249 m. The highest point is Gelinkaya Hill while other important ones are Köroğlu Rock Hill (1180), Köroğlu Rock (1195), Yapraklıseki Hill (1190), Akyatak Hill (1238) Kayalıyatak Hill (1210) and Kocadoruk Hill (1150). In addition, plant samples from Çorakyolu Ridge, Yuvacık Ridge, Güzeldağ Ridge, Kuşkayası Ridge and Tuzla Ridge have been examined (Figure 1).

Height grouping, slope and aspect analysis (Figures 2, 3, 4, 5) have been conducted after digitalization of the contours in Arc-View environment. It has been observed that slope values range between 0 - 60° and that samples obtained from areas with slopes of 15 - 25° are larger in number. As regards aspect, it has been established that the highest number of samples have been detected in areas exposed to southwest and west.

It has been detected that the plants observed in the research area are located in the cone deposits (K), plateaus (DIII), slopes (H) and valleys (V) (Figure 6).

In a large part of the research area Beypazarı formation (Tbe) and central Anatolian volcanites (Ti) are observed. There exist to a lesser extent Demirköy formation (Tde), Gölbaşı formation (Tg) and alluvium (Qa) (MTA, 1998) (Figure 7).

In terms of "Main Soil Types" the research area display a uniform soil structure. Only brown soil (B) is seen. Namely, II, III, IV, VI and VII groups of soil are observed (Figure 8). A very large portion of the plants observed are in the lands of group VII. In these lands, there exist many disadvantages for plant growth, like too steep slopes, erosion, soil shallowness, stoniness, dampness and salinity (Köy and Genel, 1992). There is no land in the research area where erosion is not seen. Mostly 3, and then respectively 4 and 2 degree erosions are observed in the area (Figure 9).

In order to examine the soil structure of the research area, the analysis of soil samples taken from 21 different environments has been conducted. Percentage organic material, lime (Figure 10), salinity, percentage N (Nitrogen), PPmP (Phosphorus) and PPmK (Potassium) values obtained as a result of the analysis have been utilized through converting into maps within the

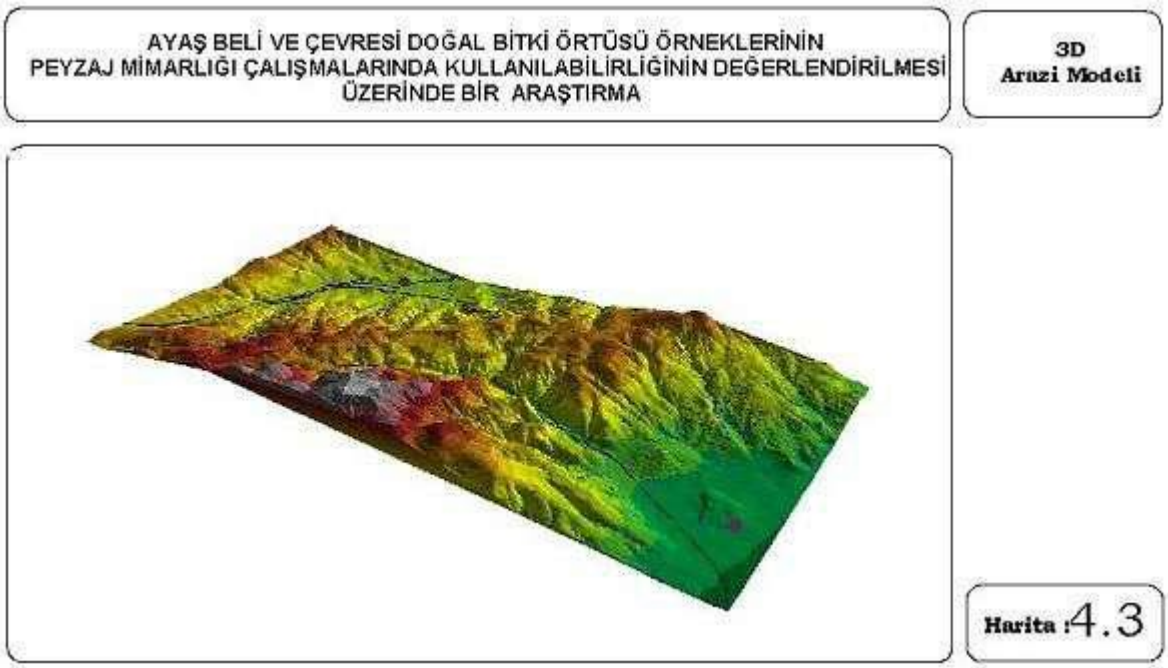

Figure 2. 3D land model.

Figure 3. Height groups.

framework of the study.

Another data obtained from the studies of Köy and Genel (1992), besides the soil data, is the Current land use. On this map, a large part of the research area is

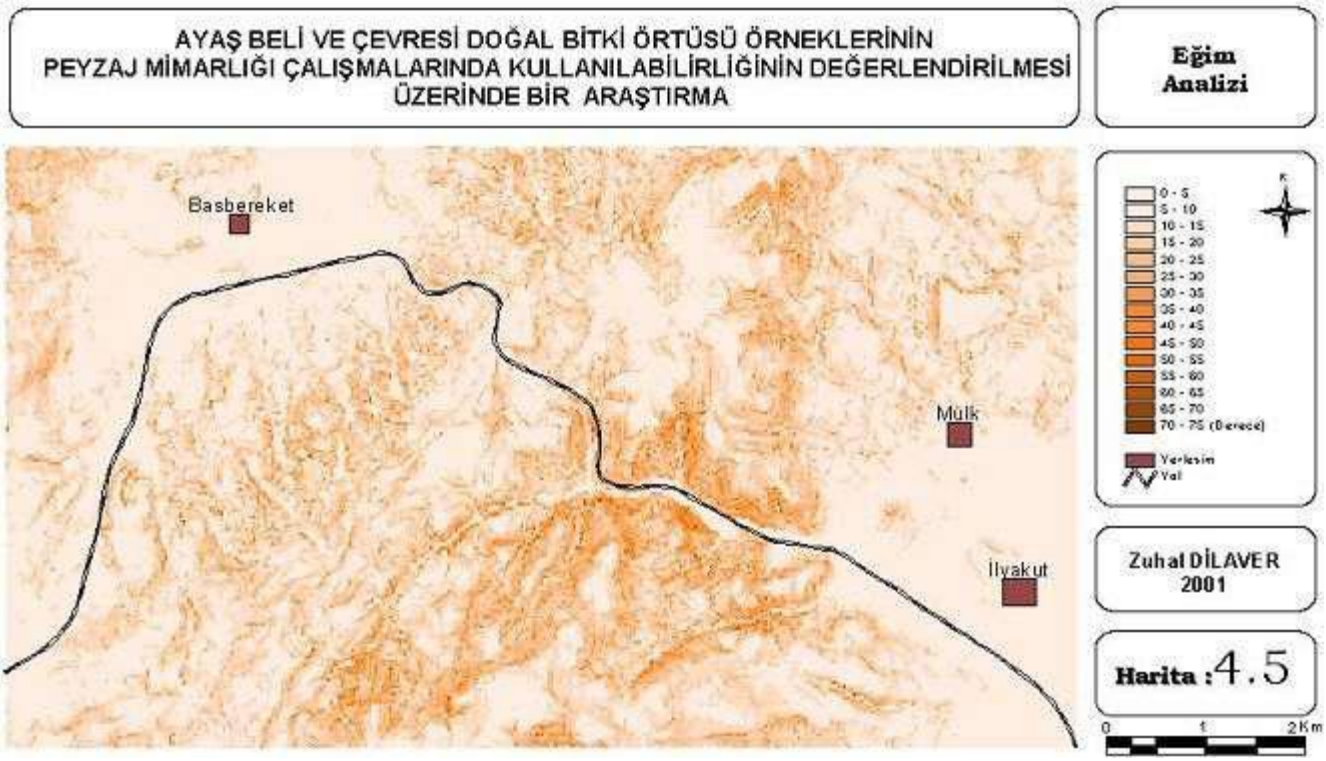

Figure 4. Slope analysis.

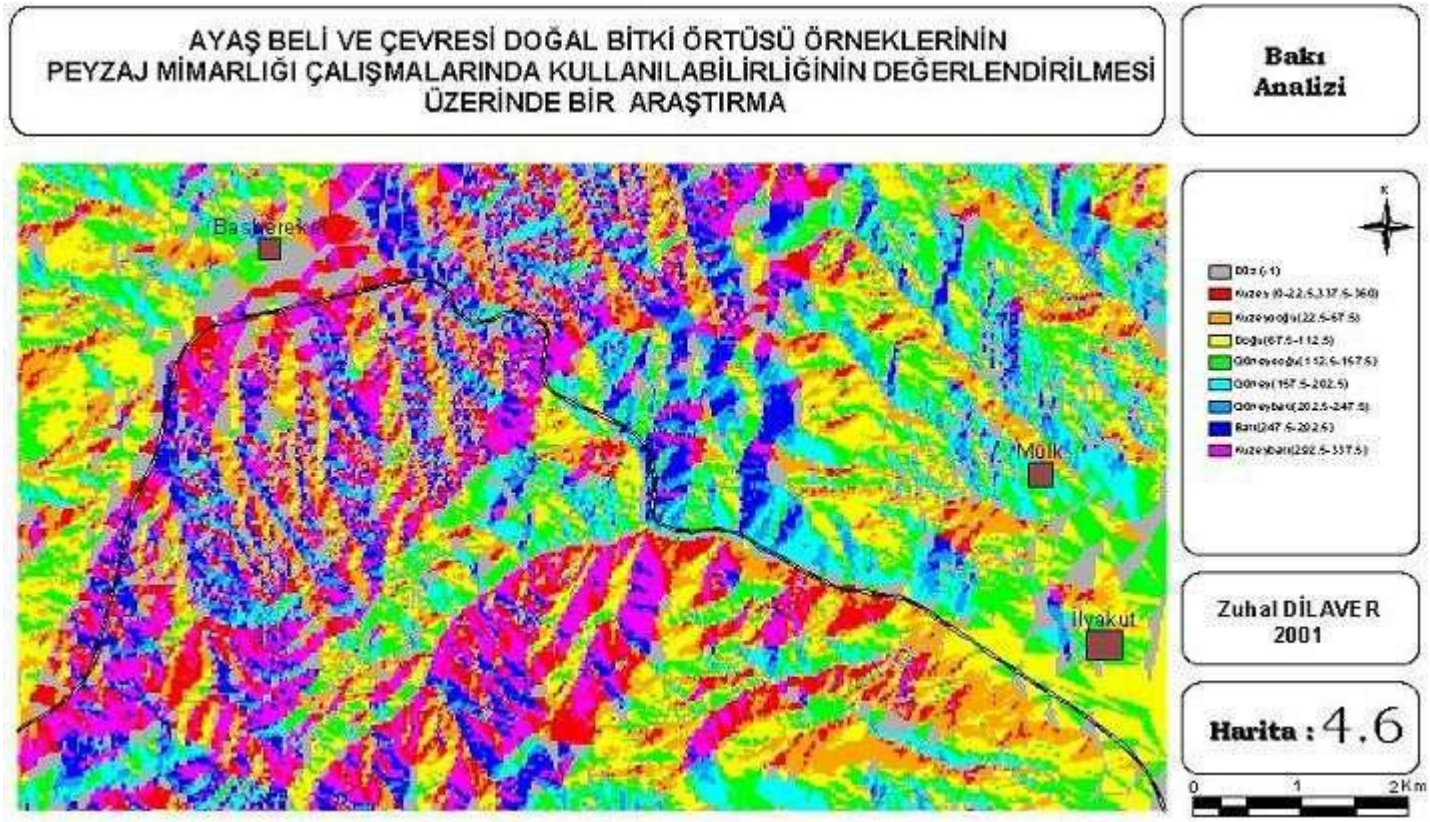

Figure 5. Aspect analysis.

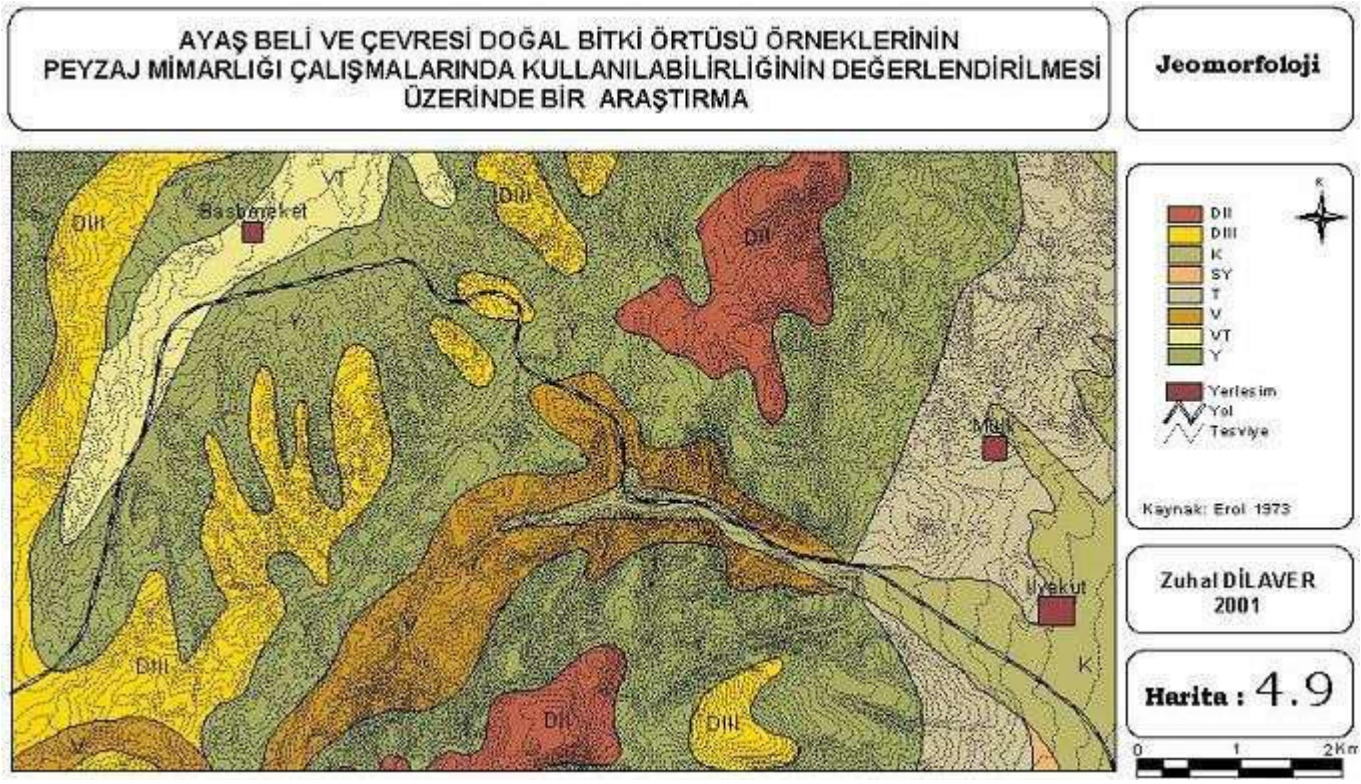

Figure 6. Geomorphology.

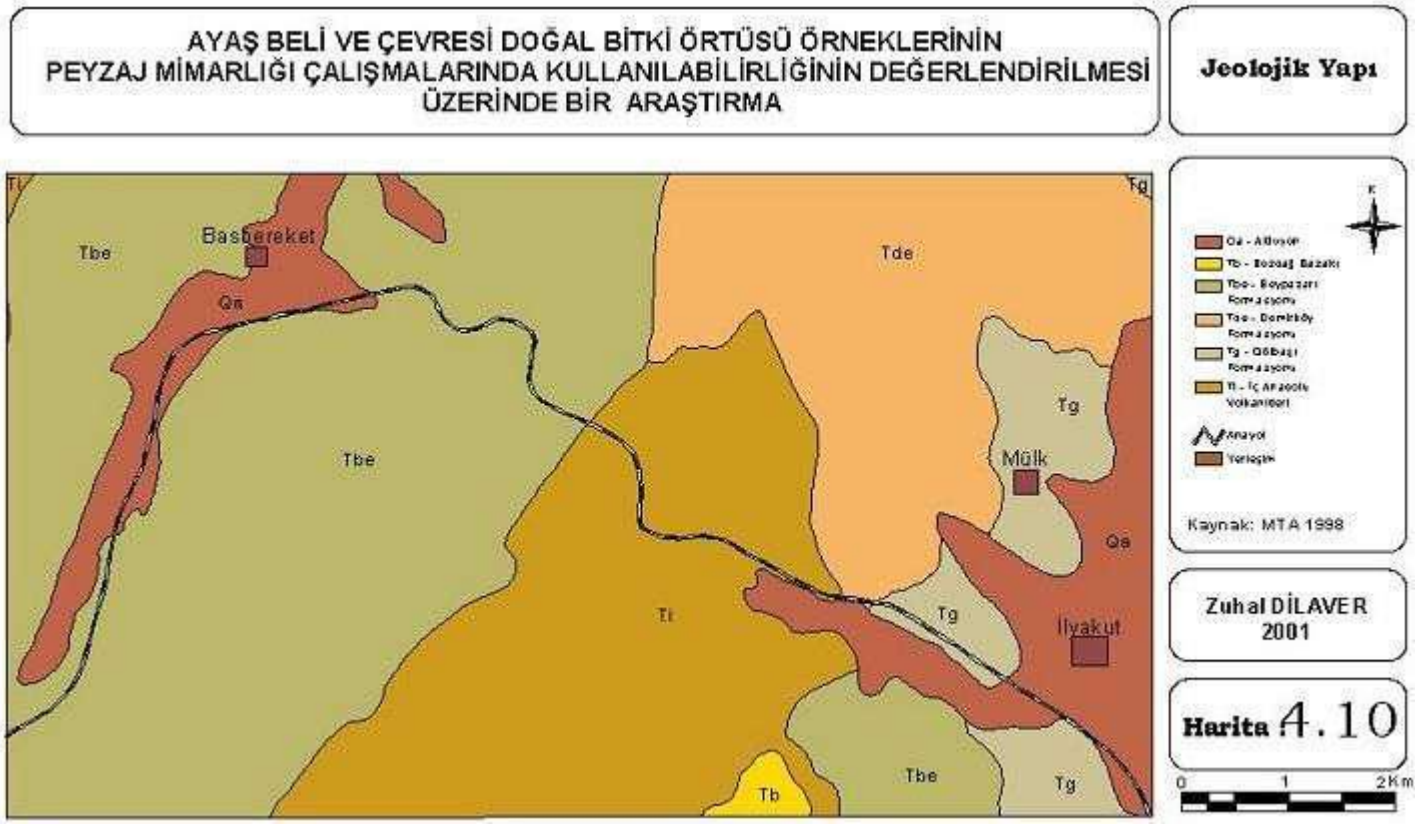

Figure 7. Geological Structure.

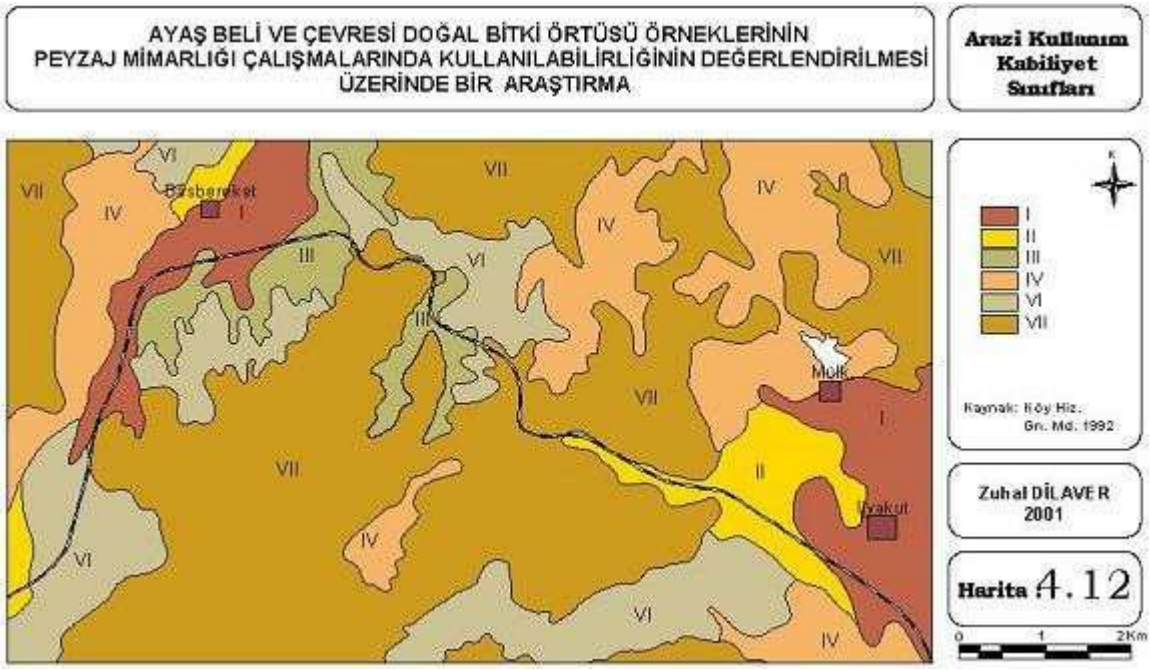

Figure 8. Land use capability classes.

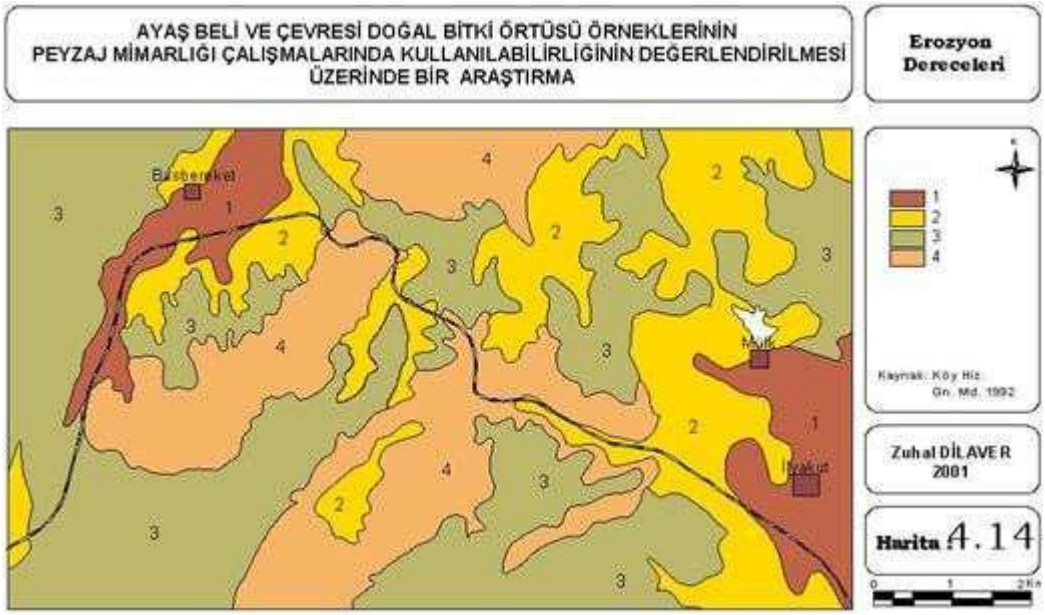

Figure 9. Erosion degrees.

seen as pasture and a relatively small part as dry agricultural land. Today, however, it was determined during the field work that dry agricultural land has extended towards pastures where the natural vegetation samples have been obtained.

There are found near Köroğlu Rock, Köroğlu Rock Hill and Gelinkaya Hill corrupt oak groves (*Quercus pubescens*). Inrelatively flat areas near Akyatak Hill there is also found corrupt juniper (*Juniperus oxycedrus*) groups. Located to the east of the area are forestation areas consisting of pine (Pinus) and Cedar (Cedrus) some of which are sections terraced. In these areas, as the plants are not fully developed yet, they do not exhibit a forestry structure. Step samples are located within the wide gaps between the plants in this forestation area placed steep slopes open to erosions. Ayaş Mountains

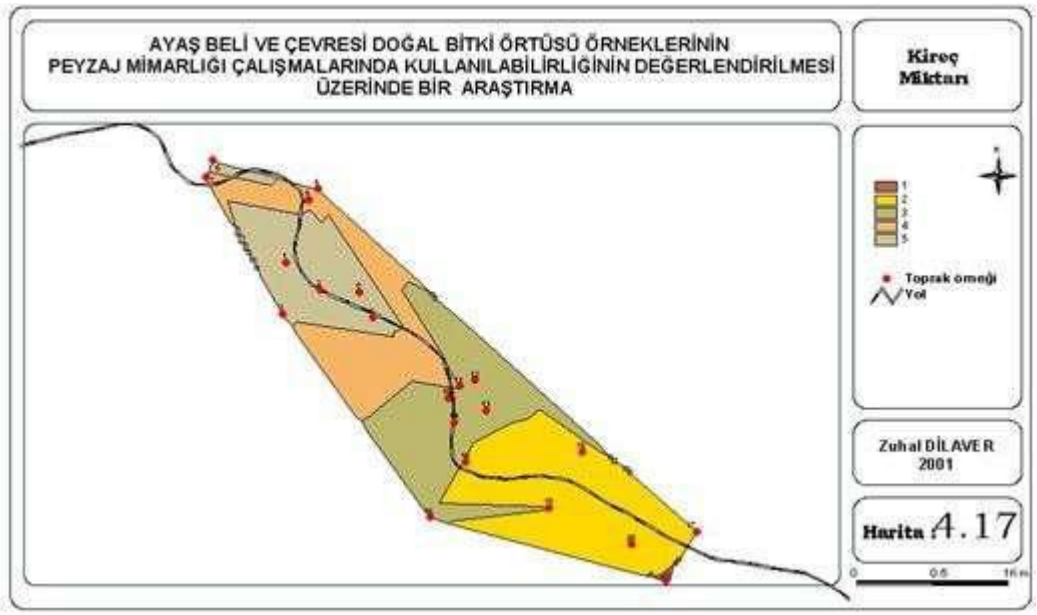

Figure 10. Amount of lime.

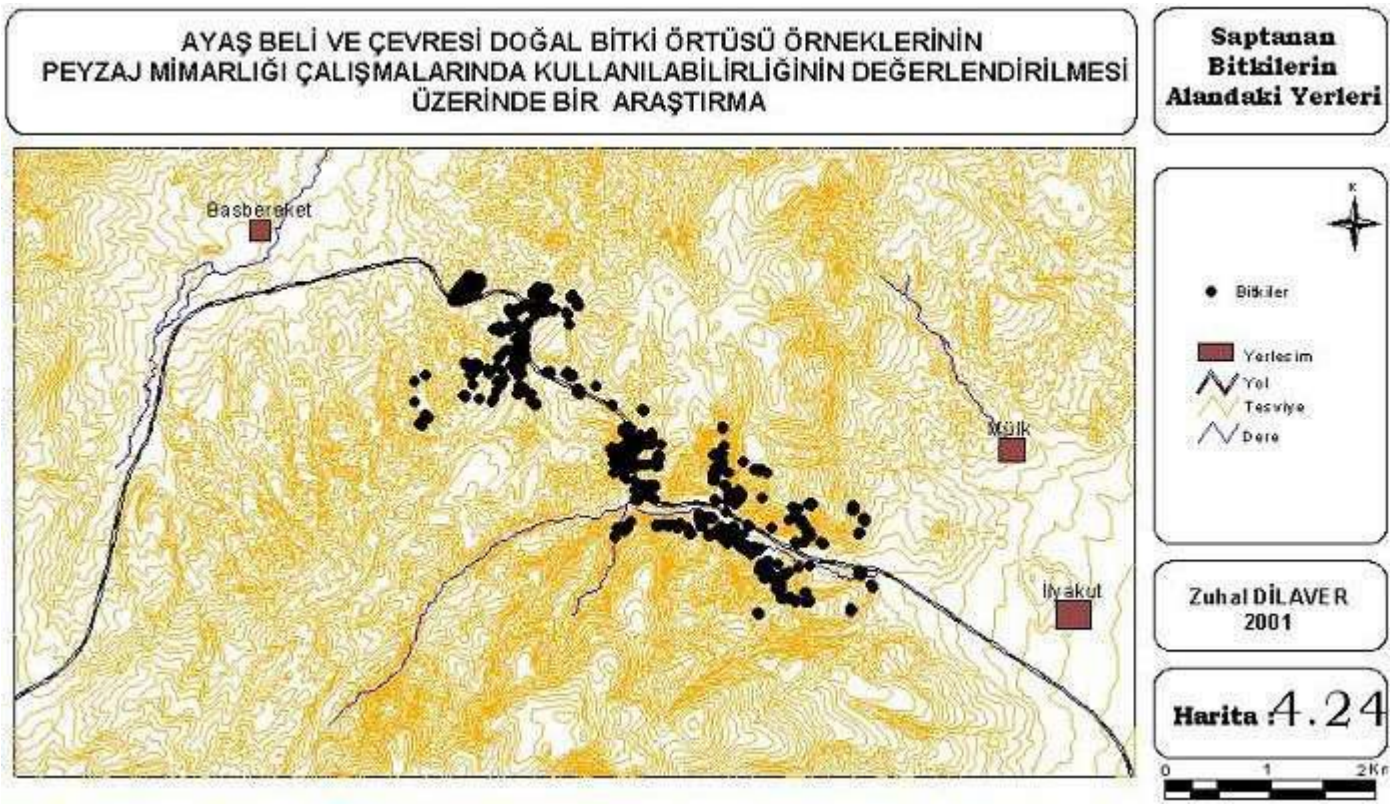

Figure 11. Locations of the identified plants in the area.

are overall steps in character. Chamaephytes, are widespread in these step units and cover 2/3 of the area. The Map of "Locations of the Identified Plants in the Area" has been produced by marking on a topographic map the points where the plant samples were found (Figure 11). After comparison of this map with all the

others, for each plant the area characteristic have been determined and tabled separately for each plant.

RESULTS AND DISCUSSION

As a result of the observations and research conducted in the research area, 122 taxons belonging to 42 families at the species and sub-species level and suitable for use in landscape architecture with their botanical, phenologic, ecological and sociological characteristics have been identified (Table 1).

Out of these, one is tree, 5 are small trees/shrubs, 8 are shrubs, 79 are perennials, 4 are biennials, 8 are annuals, 16 are geofits and 1 is parasit. On the other hand, 19 samples are endemic. Astragalus densiflorus subsp. ayashensis is a plant defined in this region and endemic to the region. The scope of the thesis includes photos, environment maps, characteristics and environmental characteristics tables for each and every plant identified. In this article, however, only *Aethionema dumanii* is given as an example.

Aethionema dumanii **M. Vural et N. Adıgüzel (Cruciferae)**

They are perennial plants which grow upwards, which are multi-bodied with thick woody roots. Their height reach approximately 10 - 20 cm. The leaves are fleshy, skin-like and scattered over the body homogenously. Flower color is pink and flowering is between 5 - 7 months. Its motherland is Turkey and it is endemic to Central Anatolia.

Concrete differences have been observed when living conditions and environmental characteristics tables of the plants identified have been examined.

It has been observed in the research area that topography and geographical features have significant impact on plants. In areas exposed to south, plants revive and blossom earlier and have shorter vegetation periods due to the excessive sunlight and low humidity. In areas exposed to north however, late flowering is observed. Flowering period is longer but less intense. *Rhus coriaria*, *Allium Huber-morathii* and *Androsace maxima* have not been detected in areas overlooking north while *Viburnum lantana*, *Ajuga chamaepitys subsp. chia var. chia*, *Dianthus zonatus var aristatus*, *Scutellaria orientalis subsp. pectinata*, *Scutellaria orientalis subsp*. *pinnatifida* and *Viola odorata* have not been detected in areas overlooking south.

It has also been observed that needs of vegetation change in accordance with slope values. While very steep slopes constitute a limiting factor for most species, in some it occurs to be a necessity. For example, *Tragopogon Coloratus*, *Tragopogon dubius*, *Lythrum salicaria* are not seen on very steep areas, while; *Arum detruncatum*, *A. huber-morathii*, *Allium lycanoicum*, *Lathyrus digitatus* are samples seen only in sloping fields. As a result of the geomorphologic evaluation, it has been established that many plants prefer interiors of small valleys to less sheltered slopes and ridges that are windier and less humid and that in such places species diversity and plant density increase.

Geological formations which are mostly observed in the research area are Beypazarı formation (Tbe) with generally lime surfaces and Central Anatolian Volcanits (Ti) widespread in Ankara. *Anchusa leptophylla subsp. leptophylla*, *Moltkia corulea*, *Aethionema dumanii*, *Scutellaria orientalis subsp. pectinata*, and *Linum usitatissimum* and *Linaria genistifolia subsp. genistifolia* located only on Beypazarı formation. On the other hand; *Vinca herbacea*, *A. detruncatum*, *V. lantana*, *Achillea biebersteinii*, *Inula montbretiana*, *S. orientalis subsp. pinnatifida*, *L. digitatus*, *A. lycanoicum*, *Jasminum fruticans*, *Cotoneaster nummularia*, *Centranthus longiflorus*, *Viola odorata* and *A. maxima* are not seen in this formation, but only exist in Central Anatolian Volcanits and other formations. Other species are not selective in terms of these features as they are seen in formations of any type. The map showing the amount of lime of the soil created after the analysis of soil samples taken from the research area supports these findings. The amount of lime is over 15% in the areas where the samples located only in Beypazarı formation are found. The existence of these plants in the area is an indication of lime in the soil. For plants seen only in other formations this rate is below 15%.

The plants have also been evaluated in terms of land use capability classes. It has been observed that all plants are located on VII, class soil that covers most of the area. This result is important in terms of suitability for use in problem areas. In addition, samples like *R. coriaria, Arum elongatum, A. arabicum, Hypericum avicullariifolium, Acinos rotundifolius, L. digitatus, C. longiflorus*, *A. huber-morathii*, *A. lycaonicum*, *Cotoneaster nummularia* and *Inula montbretiana* have been found only in that type of areas.

As a result, concerning the use of natural vegetation samples in landscape architecture studies; it has been concluded that findings from onsite examination of the environmental conditions of plants compared with maps about the various characteristics of the area, reveal significant findings about the area's ecological conditions. Moreover, the database formed during this study, provide significant convenience when utilizing the plants about both plant and environment. However, the information obtained as a result of this study is limited to the characteristics of the area and the diversity of natural vegetation where the study was conducted. By means of the execution of similar works in different areas with different environments it would be possible to add new plants and other information about the existing plants to the database. In this way, more results would be reached and it would be possible to utilize the plant more correctly. Thus, increasing this type of work and combining their results are of importance.

Table 1. Characteristics of plants found in research area natural vegetation as suitable for use in landscape architecture studies .

No.	Name of the plant	Life form	Plant height (min.) (cm)	Plant height (max.) (cm)	Color of flowers	Beginning of flowering period	End of flowering period	Endemism	Need for light
1	*Acantholimon acerosum*	perennial	15	60	pink	6	8	-	sunny
2	*Acanthus hirsutus*	perennial	10	45	yellow	5	7	endemic	sunny
3	*Achillea biebersteinii*	perennial	10	100	yellow	5	9	-	sunny
4	*Acinos rotundifolius*	annual	3	30	purple, pink	4	8	-	sunny
5	*Adonis aestivalis*	annual	10	50	red	5	5	-	sunny, half shadow
6	*Aethionema arabicum*	annual	10	15	white, pink	4	6	-	sunny
7	*Aethionema armenum*	perennial	10	20	pink, white	4	6	-	sunny
8	*Aethionema cordatum*	perennial	10	25	pink, white, yellow	5	6	-	sunny, half shadow
9	*Aethionema dumanii*	perennial	10	20	pink	5	7	endemic	sunny
10	*Ajuga chamaepitys subsp. chia var. chia*	perennial	5	15	yellow	4	7	-	sunny, half shadow
11	*Allium huber-morathii*	bulb	10	20	pink, purple	6	7	endemic	sunny
12	*Allium lycanoicum*	bulb	20	30	pink	5	6	-	sunny
13	*Allium scorodoprassum* subsp. *rotundum*	bulb	25	90	purple	5	7	-	sunny
14	*Althaea cannabina*	perennial	80	100	pink	6	8	-	sunny, shadow
15	*Anchusa leptophylla* subsp. *leptophylla*	perennial	40	70	blue	6	7	-	sunny
16	*Androsace maxima*	perennial	1	15	white, pink	4	5	-	sunny
17	*Anthemis tinctoria var. pallida*	perennial	20	45	white, yellow	6	7	-	sunny
18	*Anthemis tinctoria var. tinctoria*	perennial	20	45	yellow	5	9	-	sunny
19	*Arum detruncatum*	tuber	14	45	purple	5	7	-	sunny, half shadow, shadow
20	*Astragalus angustifolis* subsp. *pungens*	perennial	15	30	white	5	7	-	sunny
21	*Astragalus anthylloides*	perennial	5	10	pink	5	8	endemic	sunny
22	*Astragalus compactus*	perennial	10	15	pink	7	8	endemic	sunny, half shadow

Table 1. cont'd

23	*Astragalus densifolius* subsp. *ayashensis*	perennial	5	10	purple	5	6	endemic	sunny
24	*Astragalus lycius*	perennial	15	25	purple	5	6	endemic	sunny, half shadow
25	*Astragalus panduratus*	perennial	30	50	yellow	7	7	endemic	sunny
26	*Astragalus sigmoideus*	perennial	5	10	red	5	6	endemic	sunny, half shadow, shadow
27	*Bellevalia sarmatica*	bulb	20	40	white	4	6	-	sunny
28	*Berberis crataegina*	shrub	50	200	yellow	5	6	-	sunny, half shadow, shadow
29	*Bromus tomentellus*	perennial	30	50				-	sunny
30	*Bungea trifida*	perennial	6	23	yellow	5	7	-	sunny
31	*Campanula lyrata*	perennial	15	50	purple	4	7	endemic	sunny
32	*Carex halleriana*	perennial	7	25				-	sunny, half shadow
33	*Centaurea depressa*	annual	5	60	blue	5	7	-	sunny
34	*Centaurea pichleri subsp. pichleri*	perennial	6	12	blue - purple	5	7	-	sunny, half shadow
35	*Centranthus longiflorus*	perennial	70	200	pink	4	9	-	sunny
36	*Colchicum triphyllum*	corm	5	10	pinkish, white	2	4	-	sunny
37	*Colutea cilicica*	shrub	80	500	yellow	4	9	-	sunny
38	*Convolvulus holoseruceus subsp. holosericeus*	perennial	5	10	white, light yellow	5	7	-	sunny
39	*Coronilla varia subsp. varia*	perennial	15	50	pink	5	8	-	sunny, half shadow
40	*Cotoneaster nummularia*	shrub	80	250	white	4	6	-	sunny, half shadow
41	*Crataegus monogyna* subsp. *monogyna*	tree	100	1000	white	4	6	-	sunny, half shadow
42	*Crocus ancyrensis*	corm	5	10	dark yellow	2	4	endemic	sunny
43	*Crocus danfordiae*	corm	4	8	yellow, lilac,white	2	3	endemic	sunny, half shadow
44	*Crocus olivieri*	corm	4	10	dark yellow	2	4	-	sunny, half shadow

Table 1. cont'd

45	*Cruciata taurica*	perennial	10	45	yellow	3	7	-	sunny, half shadow
46	*Crupina crupinastrum*	perennial	19	80	purple	4	6	-	sunny
47	*Dactylorhiza iberica*	rhizome	20	40	pink	5	7	-	sunny
48	*Dianthus zonatus var aristatus*	perennial	7	30	dark pink	4	9	-	sunny, half shadow
49	*Digitalis lamarckii*	perennial	25	80	light brown	5	8	-	sunny
50	*Epilobium angustifolium*	perennial	50	250	dark pink, purple	6	8	-	sunny
51	*Epilobium hirsutum*	perennial	30	210	pink, purple	7	9	-	sunny
52	*Euphorbia macroclada*	perennial	20	70	greenish, yellow	5	9	-	sunny
53	*Falcaria vulgaris*	perennial	25	100	white	6	8	-	sunny
54	*Festuca ovina*	perennial	25	40		4	7	-	sunny, half shadow, shadow
55	*Fritillaria fleischeriana*	bulb	6	15	yellowish, brown	2	5	endemic	sunny
56	*Gagea granatellii*	bulb	5	10	yellow	2	5	-	sunny
57	*Genista sessilifolia*	shrub	15	100	yellow	5	6	-	sunny, half shadow
58	*Globularia orientalis*	perennial	18	28	purple	2	4	-	sunny, half shadow
59	*Globularia trichosantha*	perennial	5	15	blue-purple	4	7	-	sunny, half shadow
60	*Hedysarum varium*	perennial	15	40	yellow, purple-yellow	6	7	-	sunny
61	*Helianthemum canum*	perennial	10	15	yellow	5	8	-	sunny
62	*Helianthemum nummularium subsp. nummularium*	perennial	20	25	yellow	4	8	-	sunny
63	*Herniaria incana*	perennial	10	25	white	5	8	-	sunny
64	*Hypericum aviculariifolium subsp. depilatum var. depilatum*	perennial	5	60	yellow	5	8	-	sunny
65	*Hypericum lydium*	perennial	10	70	yellow	5	7	-	sunny
66	*Hypericum tetrapterum*	perennial	10	130	yellow	6	9	-	sunny
67	*Iberis attica*	annual	10	30	white, light pink	3	5	-	sunny
68	*Iberis taurica*	annual	10	20	white, light purple	4	6	-	sunny, half shadow
69	*Inula montbretiana*	perennial	10	30	light yellow	6	8	-	sunny
70	*Iris schachtii*	rhizome	7	25	light yellow	5	6	endemic	sunny, half shadow
71	*Jasminum fruticans*	shrub	50	200	yellow	5	5	-	
72	*Juniperus oxycedrus* subsp. *oxycedrus*	shrub	70	300				-	sunny, half shadow

Table 1. cont'd.

73	*Lathyrus digitatus*	perennial	15	40	purple	4	6	-	sunny
74	*Legousia speculum-veneris*	perennial	10	30	purple, white	4	6	-	sunny, half shadow
75	*Leontodon asperrimus*	perennial	9	32	yellow, pink, purple	6	7	-	sunny
76	*Linaria genistifolia* subsp. *genistifolia*	perennial	20	130	yellow	5	8	-	sunny
77	*Linum flavum*	perennial	20	35	yellow	5	6	endemic	sunny
78	*Linum hirsutum subsp. anatolicum var. anatolicum*	perennial	30	60	lilac, pink, white	5	6	endemic	sunny, half shadow
79	*Linum nodiflorum*	annual	5	50	yellow	4	6	-	sunny
80	*Linum usitatissimum*	annual	10	100	blue	4	4	-	
81	*Lythrum salicaria*	perennial	20	180	pink, purple	6	8	-	sunny
82	*Melica ciliata* subsp. *ciliata*	perennial	20	100		6	8	-	sunny
83	*Moltkia coerulea*	perennial	10	20	blue	4	6	-	sunny
84	*Muscari neglectum*	bulb	5	15	purple	3	5	-	sunny
85	*Muscari tenuiflorum*	bulb	15	35	lilac	4	7	-	sunny, half shadow
86	*Onosma angustissimum*	perennial	12	25	white	6	8	endemic	sunny
87	*Onosma tauricum var. tauricum*	perennial	12	25	yellow	3	6	-	sunny, half shadow
88	*Ornithogalum armeniacum*	bulb	9	20	white	4	8	-	sunny
89	*Paronychia kurdica* subsp. *kurdica var. kurdica*	perennial	5	15	white	5	7	-	sunny
90	*Polygala anatolica*	perennial	20	60	white, pink, purple	5	8	-	sunny, half shadow
91	*Potentilla reptans*	perennial	10	20	yellow	5	8	-	sunny
92	*Prunus cocomilia*	tree	150	250	white	4	5	-	sunny
93	*Pulicaria dysenterica*	perennial	30	75	dark yellow	7	9	-	sunny
94	*Pyrus amygdaliformis var. lanceolata*	tree	300	600	white	3	4	-	sunny
95	*Pyrus elaeagrifolia* subsp. *elaeagrifolia*	tree	100	1000	white	4	5	-	sunny, half shadow
96	*Quercus pubescens*	tree	100	1000		5	7	-	sunny, half shadow
97	*Ranunculus argyreus*	perennial	5	30	yellow	4	6	-	sunny, half shadow, shadow
98	*Ranunculus repens*	perennial	15	40	yellow	5	7	-	shadow
99	*Rhus coriaria*	shrub	50	300	white	6	7	-	sunny
100	*Rosa canina*	shrub	150	350	white, pink	5	7	-	sunny, half shadow
101	*Salvia cryptantha*	perennial	10	30	white, pink	5	7	-	sunny, half shadow

Table 1. cont'd

102	*Salvia hypargeia*	perennial	25	40	purple	6	7	endemic	sunny
103	*Salvia sclarea*	perennial	50	100	pink, lilac	5	8	-	sunny
104	*Sanguisorba minor*	perennial	10	75	white	6	7	-	sunny, half shadow, shadow
105	*Scorzonera cinerea*	perennial	20	60	yellow	7	8	-	sunny
106	*Scutellaria orientalis* subsp. *pectinata*	perennial	5	10	yellow	6	9	endemic	sunny
107	*Scutellaria orientalis* subsp. *pinnatifida*	perennial	5	15	yellow	4	8	-	sunny, half shadow
108	*Senecio vernalis*	annual	10	40	yellow	3	8	-	sunny, half shadow
109	*Stachys lavandulifolia var. lavandulifolia*	perennial	10	30	yellow	5	8	-	sunny
110	*Stipa lessingiana*	perennial	40	70		4	7	-	Sunny
111	*Teucrium chamaedrys* subsp. *chamaedrys*	perennial	5	50	pink, purple	6	9	-	sunny, half shadow, shadow
112	*Thymus longicaulis*	perennial	1	7	white, pink	5	8	-	sunny, half shadow
113	*Tragopogon coloratus*	annual	10	50	purple, pink	5	8	-	sunny
114	*Tragopogon dubius*	annual	15	80	yellow	5	6	-	sunny
115	*Tussilago farfara*	perennial	10	20	yellow	3	4	-	sunny, half
116	*Veronica multifida*	perennial	7	45	pink, blue	4	6	-	shadow sunny,
117	*Viburnum lantana*	shrub	200	600	creme	6	7	-	half shadow sunny
118	*Vicia cracca subsp. stenophylla*	perennial	30	50	purple	5	7	-	sunny, half shadow, shadow
119	*Vinca herbacea*	perennial	1	20	blue, purple	3	5	-	sunny, half shadow, shadow
120	*Viola occulta*	annual	3	15	white, creme	4	5	-	sunny
121	*Viola odorata*	perennial	3	12	purple	4	5	-	shadow

Table 2. *Aethionema dumanii* M. Vural et N. Adıgüzel - environmental characteristics.

Plant no.	Elevation	Slope groups	Aspect	Geology	Geomorphology	Planning
661	1150 - 1200	15 - 20	GB	Tbe	Y	Z-OT
672	1150 - 1200	5 - 10	KB	Tbe	Y	Z-OT
674	1100 - 1150	10 - 15	GB	Tbe	Y	Z-OT
862	1150 - 1200	25 - 30	KD	Tbe	Y	Z-OT
980	1100 - 1150	30 - 35	B	Tbe	Y	Z-OT
1137	1100 - 1150	0-5	DUZ	Tbe	DIII	Z-OT

Plant no.	BTG	AKYS	ERZ.	DTO	%OM	Lime	Salinity	%N	PPmP	PPmK
661	B	III	2		1 - 2	25 - 67	0.15 - 0.35	0.090 - 0.170	8 - 25	140 - 370
672	B	III	2		3 - 4	25 - 67	0.15 - 0.35	0.170 - 0.320	8 - 25	140 - 370
674	B	VII	4	t	4 - 9	25 - 67	0.15 - 0.35	0.170 - 0.320	8 - 25	140 - 370
862	B	VII	3		2 - 3	15 - 25	0.15 - 0.35	0.090 - 0.170	8 - 25	140 - 370
980	B	VII	4	t	3 - 4	25 - 67	0.15 - 0.35	0.090 - 0.170	8 - 25	370 - 1000
1137	B	VII	4	t	4 - 9	15 - 25	0.15 - 0.35	0.170 - 0.320	8 - 25	140 - 370

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