FLORA OF MIDDLE EAST TECHNICAL UNIVERSITY CAMPUS (ANKARA)

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ABSTRACT

FLORA OF MIDDLE EAST TECHNICAL UNIVERSITY CAMPUS (ANKARA)

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Ankara is found in Irano-Turanian phytogeographical region of Turkey where plant diversity is fairly high. In this study, plant diversity of Middle East Technical University campus which take part within the province limits of Ankara was investigated.

This thesis is composed of two main parts. In the first part scopes of the study are stated. Historical background about Ankara province is explained. Information about phytogeography, geology, topography and climate of the region was given. In the second part an identification key for the families growing in the campus was given for the first time. Results of the study are given in accordance with "Flora of Turkey and the East Aegean Islands" (Davis, 1965-1988). Second part contains discussion of the results and conclusions which can be drawn from this study.

During the field trips between 1997 and 2000, 869 plant specimen were collected and identified. It was found that flora of Middle East Technical University campus is composed of 72 families, 251 genera and 463 species. It has also been determined that 48 plant species are endemic.

66.1 % of 463 species belongs to the first 10 families which contains the highest number of species. 33.9 % of the species belongs to the remaining 60 families. First 10 largest families are Asteraceae (67 species), Poaceae (57 species), Fabaceae (49 species), Lamiaceae (37 species), Brassicaceae (22 species), Apiaceae (16 species), Boraginaceae (16 species), Ranunculaceae (14 species), Papaveraceae (14 species) and Scrophulariaceae (14 species).23.9 % of the native plant species of Middle East Technical University campus flora belongs to the Irano-Turanian phytogeographical region, 7.9 % of the plant species belongs to the Mediterranean phytogeographical region and 6.1 % of the species belongs to the Euro-Siberian phytogeographical region. Phytogeographical origin of 62.1 % of the species is unknown.

At the end of this study, it can be concluded that Middle East Technical University campus contains around 30 % of the plant species of the flora of Ankara. It contains economically important plant species and their wild relatives. So it may serve as a plant genetic resource in the future. Furthermore, it has relatively high species and habitat diversity. Thus, it is also important from an ecological point of view. For these reasons necessary measures should be taken in order to preserve the plant diversity of Middle East Technical University campus.

Keyword:Middile East Technical University, Campus, Flora, Ankara

ÖZ

ORTA DOĞU TEKNİK ÜNİVERSİTESİ KAMPÜSÜ FLORASI (ANKARA)

Baş, Zübeyde Bilge

Yüksek Lisans, Biyoloji Bölümü

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Ankara, Türkiye'nin bitki çeşitliliğinin en fazla olduğu bölge olan İran-Turan fitocoğrafik bölgesinde yer alır. Bu çalışmada da Ankara sınırları içinde yer alan ve korunmuş bir alan olan Orta Doğu Teknik Üniversitesi Kampüsü'ndeki bitki çeşitliliği incelenmiştir.

Tez iki ana kısımdan oluşmuştur. İlk kısımda çalışmanın amaçları, bölgede yapılan çalışmalarla ilgili tarihi geçmiş, bölgenin fitocoğrafik, jeolojik topografik yapısı ve iklimi ile ilgili bilgiler verilmiştir. İkinci kısımda ise kampüs için ilk kez familya teşhis anahtarı verilmiştir. Bu kısım ayrıca "Türkiye ve Doğu Ege Adaları Florası"na (Davis, 1965-1988) uygun şekilde verilen çalışma sonuçlarını, sonuçlarla ilgili tartışmaları ve bu çalışmadan çıkartılabilecek sonuçları içermektedir

1997 ile 2000 yılları arasında yapılan arazi gezileri sırasında toplam 869 örnek toplanıp teşhis edilmiştir. Bunun yanısıra literatür taraması ile bu çalışma sırasında toplanmayan türler de eklenerek ODTÜ kampüsü florasının

72 familya, 251 cins ve 463 türden oluştuğu saptanmıştır. Bu bitki türlerinden 48 tanesi endemiktir.

463 bitki türünün % 66.1'inin en çok tür kapsayan ilk 10 familyaya dahil olduğu, %33.9'unun geri kalan 60 familyaya dahil olduğu belirlenmiştir. En çok tür kapsayan ilk 10 familya Asteraceae (67 tür), Poaceae (57 tür), Fabaceae (49 tür), Lamiaceae (37 tür), Brassicaceae (22 tür), Apiaceae (16 tür), Boraginaceae (16 tür), Ranunculaceae (14 tür), Papaveraceae (14 tür) ve Scrophulariaceae (14 tür) familyalarıdır.

ODTÜ Kampüsü florasındaki bitkilerin % 23.9'unun İran-Turan, % 7.9'unun Akdeniz, % 6.1'inin Avrupa-Sibirya fitocoğrafik bölgesine dahildir. Bitki türlerinin % 62.1'inin ise fitocoğrafik bölgesi bilinmemektedir.

Çalışma sonucunda ODTÜ kampüsünün Ankara florasındaki bitki türlerinin yaklaşık % 30'una sahip olduğu tespit edilmiştir. ODTÜ kampüsünün ekonomik açıdan önemli bazı bitki türlerini ve bunların akrabalarını içermesi nedeniyle gelecekte bitki genetik kaynağı olarak kullanılabileceği ve içerdiği bitki ve habitat çeşitliliği nedeniyle ekolojik açıdan da önemli bir koruma alanı olabileceği sonucuna varılmıştır. Bu nedenlerden dolayı kampüs alanının ve içerdiği biyoçeşitliliğin korunması için gerekli önlemlerin alınması gerektiği görüşü belirlenmiştir.

Anahtar kelimeler: Orta Doğu Teknik Üniversitesi, Kampüs, Flora, Ankara

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TABLE OF CONTENTS

LIST OF TABLES

TABLE

LIST OF FIGURES

FIGURE

LIST OF ABBREVIATIONS

METU	Middle East Technical University
PGR	Phytogeographical region
Ir-Tur	Irano-Turanian
Med	Mediterranean
Euro-Sib	Euro-Siberian
Temp.	Temperature
Precip.	Precipitation
GIS	Geographical Information System
IUCN	International Union for Conservation of Nature

CHAPTER 1

INTRODUCTION

1.1. Importance of Taxonomic Studies

"Classification is a natural occupation of man. We have no choice but to classify and identify –they are essential processes in our daily lives. We need to know whether we are talking about the same or different organisms, and to what group they belong. A plant's name is the key to its literature, in other words the key what we know about it"(Davis and Heywood, 1973).

"People have always needed to name things in order to have a means of communication. In scientific work it is essential that we should be able to apply names with precision, for the validity of much research hinges on the identification of materials involved" (Porter 1967).

Taxonomy is a synthetic science which gets information from nearly all scientific fields such as morphology, embryology, cytology, ecology, genetics, biochemistry, statistics, geology, etc. (Davis and Heywood, 1973). However, at the same time, as quoted from the two authors above, taxonomic studies form a basis for all scientific studies in biology.

Biologists must know the name of the organism they are working with, before studying it. Naming organisms is one of the functions of taxonomy which provide stability of nomenclature. If nomenclature is unreliable or wrong the value of the work is greatly diminished, in many cases worthless. Experiments can not be repeated unless the organisms used are correctly identified. Findings of the scientific work even on the molecular level may be decisively influenced by the choice of a particular species. So, taxonomy is fundemental to other sciences and this is a study performed with the idea that a taxonomic study made in this area would be beneficial for further studies in other branches of biology.

From equator to temperate regions number of species decreases gradually. Number of plant species in Amazons is 200, 000 whereas Sicily has 2,300 species, England has 1,600 species, Ireland has 1,100 plant species. The number of plant species decreases to 500 in Iceland which is situated northern parts of Europe. Italy, Greece and Balkan peninsulas contains around 5,000 species whereas Europe, which has more complete floristic studies has 11,000 species and North America which is also floristically well studied has 16,000 species(Doğan, 1998).

According to our present knowledge total number of species is between 1.5 and 2 million and 20 % of these are compromised plant species. However some researchers propose that number of species on the Earth changes between 10 million and 80 million (Doğan, 1997). The great difference between these numbers is due to lack of knowledge.

Our knowledge of the World's flora is extremely uneven and for this reason its classification can be considered in four overlapping phases (Davis and Heywood, 1973).

(1) *The pioneer (exploratory) phase*, primarily concerned with identification. Here the flora is known mainly from limited herbarium material. Much of the flora of the tropics falls in this category. Here morphology and distribution provide the data on which the taxonomist must rely on.

(2) *The consolidation phase*, in which species have been studied both in herbarium and field for a considerable period. Herbarium representation is rich and regional and local variation of species are rather well known. Much of the flora of Southern Europe and the Near East falls into this category.

(3) *The biosystematics phase*, dealing with plants whose geographical variation is not only well known but for which cytological or biosystematic information is also available. Flora of North-Western and Central Europe, North America and Japan falls into this category.

(4) *The encyclopedic phase* co-ordinates the other three. All available evidence is taken into consideration to express the taxonomic and evolutionary relationships of plants at all level of the hierarchy.

When national potentials of plant diversity taken into consideration, floristic works of Turkey seems to be still in the first phase of taxonomic studies. In the 21st century flora of Turkey should be urgently become well-known in the most upper level. This will enable us to conserve nature and benefit from these biological resources effectively (Doğan, 1998).

Even, Turkey is a country where taxonomic studies are insufficient, existing taxonomic literature reveals that Turkey has a flora composed of 9,000 species, which is a number close to the number of species of whole Europe (Davis, 1965-1988). So, Turkey is a rich country in respect of plant biodiversity which should be conserved for the sake of future.

1.2. Biodiversity Conservation

One of the subjects, which get information from taxonomic studies, is biodiversity conservation. The term "biodiversity" signifies the integration of ecology and genetics in conservation theory (Frankel *et al.* 1995). It represents diversity at all levels of biological organization – the community, the species, the organism, and the gene.

Diversity is indeed the essence of life. It is necessary for survival and adaptation. Thus, diversity should be maintained for two reasons. First, this genetic variation is a resource for species own survival, adaptation and future evolution. Second, a small fraction of the genes are a potential resource for improving the productivity of other populations or species. Modern biotechnology and genetic engineering offer new tools to extract such useful genes from wild species and transfer them to related or unrelated species (Frankel *et al.* 1995).

The rich biodiversity of Turkey due to its geomorphologic, topographic and climatologic diversity is stated in many publications. For example, National Plan for *in situ* Conservation of Plant Genetic Diversity (Kaya *et al.* 1997), OECD Environmental Success Report (1999), 4th Environmental Council Report (2000). These publications also stress the importance of protection of this rich plant biodiversity, explain present situation of conservation studies and offer suggestions for future conservation studies.

Beside having high biodiversity, Turkey is the most important genetic source of cultivated plants in temperate regions. Two of the plant gene centers defined by Vavilov (1951) comprise Turkey. In addition to this, Turkey is the diversity center for wild relatives of many annual, perennial, herbaceous and woody plants, and cultivated plants (Kaya *et al.* 1997).

Plants with economic importance that are thought to have gene centers in Anatolia or that are thought to have important centers of diversity in Anatolia are listed in National Plan for *in situ* Conservation of Plant Genetic Diversity (Kaya *et al.* 1997). Some of them are given below.

a) *Cereals:* Species of *Triticum* and wild relatives such as *Aegilopes, Hordeum, Secale, Avena.*

b) *Legums:* Turkey has a high genetic diversity in this group of plants. Some of them are; *Cicer, Lens.*

c) *Industrial Plants:* Cultivated plants in this group are, *Brassica napus, Linum ussitatissimum, Cannabis sativa, Rosa damascena.* In addition to these plants, there are naturally growing plants which have the potential to be used in industry, such as *Cephalaria syriaca* and *Boreava Orientalis* may be used as oil and protein sources. *Orchideaceae, Glycyrrhiza, Gentiana lutea* may be used in beverage and medicine industry. *Isatis* species, *Junglans regia, Rubia tinctoria* plants are used in order to obtain dyes.

d) *Medical and aromatic plants:* Most of them are growing in wild. Such as, *Orchis, Thymus, Origanum, Salvia, Rosa canina, Digitalis.*

e) *Feed plants:* Due to overgrazing, productivity of pastures is greatly reduced. However, many plant species used as animal feed still grows in pastures. Such as, *Leguminosae, Gramineae, Vicia faba,* and other *Vicia* spp., *Lathyrus, Onobrychis, Trifolium, Medicago, Melilotus* species.

f) *Garden plants: Pyrus communis, Malus sylvestris, Prunus* species and 4 wild relatives, *Amygdalus communis* and 12 wild relatives used as fruit trees. *Lactuca sativa* and 17 wild relatives, *Allium cepa, A. sativum,* and wild relatives, *Brassica oleraceae* and wild relatives used as vegetable plants. Plants with tubers and bulb, such as *Galanthus, Eranthis* used as ornamentals.

g) *Forest trees: Pinus* spp., *Abies* spp., *Cedrus libani, Fagus orientalis, Picea orientalis, Quercus* spp., *Populus* spp.

In order to benefit from these plants in the future, genetic resources for these and others must be conserved (Kaya *et al.*1997). METU campus flora includes many of the species listed above. Thus, it may be included in the future conservation programs.

Increasing human population and technology cause a high increase in the use of biological resources. Human beings are using nature for their own sake without concerning the whole ecosystem. There is an argument that whether human or so called *Homo economus* is a keystone species or an external disturbing factor. Since human is a biotic factor itself and it has strong interaction with ecosystem due to its activities (mainly economic activities), it can not be separated from the ecosystem and can not be accepted as external disturbing factor. So, human and its activities may be detected as a subsystem called economic subsystem within the total ecosystem(O'Neil and Kahn, 2000).

If human's economic subsystem is a part of the whole ecosystem, stability of economic subsystem can only be maintained by the maintenance of the whole ecosystem.

Protecting biodiversity is important in the maintenance of the whole ecosystem. So, biodiversity conservation ensures human's future existence beside maintaining resources for economy.

Anatolia has highly modified in its biological composition due to long term effect of civilizations settled here. It is proposed that the steppe that covers most of Anatolia today, was formed by antropogenic effects (Fourth Environmental Concil Report 2000). This transformation was accelerated in the last century.

Beside the rapid increase in human population, starting from 1950s increasing industrialization and infrastructure investments, use of modern technologies in agriculture, migration from rural areas to urban areas, and increase in tourism resulted in an increase in the constraint on natural resources. Coasts were highly damaged, water resources were polluted, an important part of agricultural fields were opened to industrialization and settlement. Forests, which are very important in the protection of biodiversity and ecological balance, were becoming narrower as a result of wrong policies and applications. 50% of pastures and more than 40% of wet grounds were lost and as a concequence ecological balance was upset. In the 20th century 12 plant species were lost, 388 plant species are still endangered. Half of these plants are endemic plants for Turkey (4th Environmental Council Report 2000 and OECD Environmental Success Report 1999).

Although nature conservation activities have started in 1950s in Turkey, since the importance of nature conservation was underestimated in legal and administrative domain and since enough financial support was not provided efforts were ineffective and targets for conservation could not be reached,(4th Environmental Council Report 2000).

National Plan for *in situ* conservation of Plant Genetic Diversity gives a list of legal regulations related with nature protection, international agreements accepted by Turkey and a list of foundations in which Turkey is a member. Further more, Turkey has natural conservation areas such as, forests, pastures and agricultural fields. There are also conservation programs in force, such as natural areas, national parks, nature protection areas, biogenetic reserve areas, preservation forests, gene conservation forests, gene conservation and management areas. Beside these conservation practices, Turkey took part in most of the international declerations of biodiversity conservation. One of them is Rio Decleration (1992). In this decleration the integral and inter-dependent nature of the Earth was emphasized. Therefore, all states should have the right for development but also have the responsibility for the protection of the nature for sustainable development of whole human population (Agenda 21). Although Turkey has accepted Rio Declaration and other similar agreements, environmental problems can not be solved since the national regulations (laws) have not been changed in accordance with those of international declarations.

In order to improve conservation programs and policies, some suggestions were made in 4th Environmental Council organized in İzmir in November 2000. Some of them are given below.

National and international principles and results for conservation of natural habitats and biological diversity should be integrated into all plans and programs. Results of Agenda 21, National Environmental Action Plan, Biological Diversity Strategy and Action Plan, National Plan for *in situ* Conservation of Plant Genetic Diversity should be realized. Nature conservation programs should be based on regulations of laws related with educational, scientific and financial tools. Financial resources reserved for conservation programs should be increased. Qualified personnel should be provided for the institutions working in this field. Programs for the education of politicians, decision makers, and public should be developed and applied. Inventories for biological diversity should be completed in accordance with European Union Nature Protection Regulations and other international agreements. Rare or endangered places or areas which support a high level of biological diversity should be defined. National data base which enable correct evaluation of programs in application should be prepared and observational programs for determining the changes in ecosystems in conservation areas should be used. This is pointed out also in National Plan for *in situ* Conservation of Plant Genetic Diversity. In National Plan for *in situ* Conservation of Plant Genetic Diversity suggest to use Geographical Information System (GIS) for monitoring conservation areas.

A center of GIS was established in 1997 by The General Directorate of Agricultural Research with the financial support of The Ministry of Agriculture and Rural Affairs, World Bank and Global Environmental Facilities. GIS is a new information technique that supplies many advantages to prepare up-to-date maps and to give many opportunities about evaluating huge amount of data in most accurate and fast way. Rapid increase in population, limited natural resources and environmental pollution cause an increasing demand fast and accurate information about the earth. Today, a lot of information about physical structure of the earth are obtained with remote sensing techniques, and used in GIS (Geographical Information System and Remote Sensing Research Center 1998). GIS can make possible the connection of information about ecosystems, location of species, habitat distributions with maps formed in computer media. With use of remote sensing techniques and GIS, conservation areas can be easily managed.

In order to promote and catalyze knowledge about biodiversity, including its origin, composition, ecosystem function, maintenance, and conservation an international plan was founded in 1991. Since knowledge about this subject is fundemental to restoration of damaged ecosystems, meeting these challenges posed by the loss of biodiveristy will require sound policy decisions based on accurate information that is widely based, including considerations of socio-economic aspects. Therefore the knowledge provided by the science of biodiversity will be of crucial importance. The international operational plan called DIVERSITAS which is founded in 1991 (DIVERSITAS, 1996) explains the scientific research program for biodiversity conservation. In this program there are ten element each focused on a fundamental scientific question about life's biodiversity. Five core Programme Elements represent the central part of the DIVERSITAS research effort. There are also five Special Target Areas of Research (STARs) which focus on problems of special concern within biodiveristy science and that are often neglected or receive only limited attention.

The Core Program Elements

1) The Effect of Biodiversity on Ecosystem Functioning.

2) Origins Maintenance and Change of Biodiversity.

3) Systematics: Inventorying and Classification in Biodiversity.

4) Conservation, Restoration and Sustainable Use of Biodiversity.

5) Monitoring of Biodiversity.

Special Target Areas of Research

6) Soil and Sediment Biodiversity

7) Marine Biodiversity

8) Microbial Biodiversity

9) Freshwater Biodiversity

10) The Human Dimensions of Biodiversity

All these Programme Elements are conceptually joined. The strength of DIVERSITAS research agenda lies in the interrelationship among its Elements.

The third element in theCore Programme reveals the importance of systematic studies in biodiversity science. It is widely recognized that the Earth's biodiversity is poorly known. At the same time the understanding of the relationships of organisms is still in its infancy, yet it is this information that serves as an organizing framework for both basic and applied biology. Finally, although the world's natural history collections (museums, herbaria, living culture facilities, and seed banks) currently house nearly two billion specimens, very little of the information associated with these is available electronically to all countries of the world.

Increased capacity to undertake systematics research will promote the documentation of components of biodiversity and endemism, recognition of regions of critical conservation concern, and support for efforts to manage habitats, ecosystems and landscapes as well as agroecosystems and fisheries.

This Programme Element is dedicated to promoting systematic/taxonomic research in all countries in order to support ongoing activities to conserve and sustainably use their biodiversity. This will be achieved through international programs of systematic inventorying, phylogenetic research, the creation of systematic knowledge data bases, and the promotion of systematic infrastructure and training. The knowledge generated by systematics is critical for the conservation and sustainable use of the components of biodiversity.

1.2.1. Biodiversity Conservation in Ankara Province

For protecting biodiversity functional conservation areas are needed. A functional conservation area is a geographic domain that maintains focal ecosystems, communities, species, and supporting ecological processes within their natural ranges of variability. Such areas are needed, because conserving intact examples of communities and ecosystems to protect the vast majority of species is important for biodiversity conservation (Poiani *et al.* 2000).

Ankara is the rapidly developing capital city of Turkey. Many buildings, roads and factories are being constructed each year. Nature is being destroyed in this way. The city has a flora consisting of 1,115 seeded plant species and it has an endemism rate of 15.4%(Akaydın, 1996). So, to maintain this diversity and protect endemic plant species, functional conservation areas are needed. Middle East Technical University (METU) campus with a relatively large surface area and containing several habitats may be one of these conservation areas. In all biodiversity conservation activities taxonomic studies are prerequisites for the recognition of diversity in a region. A taxonomic study in METU campus would be useful in order to determine whether it should be regarded as a functional conservation area or not.

1.3. History of Floristic Studies in Ankara Province

Starting from 1800s many botanists collected plants from Ankara (Davis, 1966; and the citations given in there). Some of them are Bornmuller, J.F.N. (1892); Freres des E. C. (1900); Handel-Mazzetti, H. F. Von (1912-1914); Müller, K. O. (1928-1929); Krause, K. (1931-1938); Balls, E. K. (1933); Birand, H. (1933-1958); Kasaplıgil, B. (1939-1940); Kuntay, S. (1945); Karamanoğlu, K. (1947-1949);

Başarman, M. (1946-1950); Okyar, (Atay), S. (1956); Soyerman, A. (1956); Tutel, B. (1956); Walter, H. (1955); Zohary (1959-1964); and Alinoğlu (1964-65).

One of the earliest publications including plant species cited in Ankara is "Flora Orientalis" written by Boissier (1867-1888). This work is composed of five volumes and a supplementary volume. Flora Orientalis contains 60 plant species growing in Ankara (Akaydın 1996).

In 1927 Sir R. Lindsay made a collection of plants in Turkey, especially in the environs of Ankara and results of this study was published in the Kew Bulletin, in the series "On The Flora Of The Nearer East" (Zohary and Heywood 1973).

"Flora of Turkey and the East Aegean Islands" published by Davis (1965-1988) also contains many plant species collected from Ankara.(Babaç *et al* 1992)

Beside these works, there are local floras for Ankara. First one of them was written by K. Krause. He made collections in the environs of Ankara and elsewhere in Turkey in the years 1927,1931, and 1933; in 1934 he published his "Ankara'nın Floru" (Zohary and Heywood 1973). Some selected research titles published about Ankara province are listed as follows: "Ecology of Steppe Plants From Ankara" by Birand, H. A.(1938); "Ankara Vilayetinin Zirai Bünyesi" by Özkan, H. (1960); "Flora of Beynam Forest" by Akman, Y.(1972); "The Vegetation of Beynam Forest" by Akman, Y. (1972); "Contribution to the knowledge of the synantrophic flora of Ankara, Turkey (list of 53 species of synantrophic plants collected in Ankara)" by Hantz, J. (1980); "Flora of Çile Mountain" by Seraz (1985).

"Flora of Beytepe Campus" was written by Erik in 1995. This is a flora of 425 plant species found in the campus area of Hacettepe University at Beytepe.

"Flora of Ankara City" written by Akaydın in 1996 contains 1115 species of natural flora of Ankara. "Natural Plants of Capital City" (Erik *et al.* 1998). This book contains 350 colorful illustrations of plant species growing in Ankara. "Fieldguide To Wildflowers of METU Campus" (Kaya *et al.* 1999). This book contains colorful illustrations of 251 plants and their descriptions in the Midlle East Technical University Campus. "Investigation of the flora of the Ankara Ahlatlıbel dryland range and the distributions of the important range plant species" is composed of 2 plant species (Kendir, 1991). "Step Flora of the Vicinities of Eymir and Mogan Lake" contains 200 plant species (Demir, 1992). "Floristic research of distribution of step formations between Taşpınar, İncek, Tuluntaş villages (Ankara)" lists 203 plant species (Yağcı, 1994).

1.4. Scope of the study

Scope of this study are

- to add some new information to the to the taxonomic knowledge of METU campus and Ankara city which would be useful for future scientific studies.
- to find out whether METU campus would be a valuable place for conservation and to provide information for probable biodiversity conservation studies in the campus area.
- to provide information about plant species that are wild relatives of important crop plants which may be used as genetic resources.

- to prepare a family key for the species found in METU.
- to provide plant specimens which can be used as herbarium material in the case of establishment of a herbarium in METU.

CHAPTER 2

ECOLOGY AND PHYTOGEOGRAPHY

2.1. Phytogeography

Turkey is one of the richest countries in the world in terms of plant diversity. Davis pointed out that flora of Turkey is very rich and important as well as attractive for the following reasons (Davis *et al.* 1971).

- Turkey is located at the intersection of the phytogeographical regions (PGR) of Euro-Siberian (Euro-Sib.), the Mediterranean (Med.), and the Irano-Turanian (Ir-Tur), and for this reason possesses a rich flora;
- Turkey is situated on the road from Southwest Asia to Europe and forms a bridge by which Asian plants may spread into Southern Europe;
- Turkey is the genetic center of a large number of genera and species, *i.e.* an area of genetic diversity;
- Turkey is rich in endemic species. Endemism in Turkey is *circa* 30% of total number of native species. This high figure have several natural causes. The remarkable mosaic pattern of endemism, especially in Ir-Tur. and Med. regions are not only related to the Turkey's diverse topography and climate and their history, but also to varied soil types which occur,

including such extreme habitats as salt steppe, limestone clifts, screes, gypsum and serpentine. Polyploidy is an other important factor in high rate of endemism.

- It is the country of origin or homeland of many cultivated plants

Without some reference to phytogeographical areas (phytochria), it is difficult to discuss the distribution plant species in Turkey. The phytochrion is primarily a floristic concept, being based on the distribution of taxa of various ranks, with particular reference to endemism. Climax vegetation and marker species have often been used for delimiting phytogeographical boundaries in Turkey. However, Davis has preferred to delimit the regions by the flora and vegetation as they are today, instead of delimiting phytogeographical boundaries according to climax vegetation, since knowledge about plant distribution in the South-West Asia is incomplete (Davis *et al.* 1971)

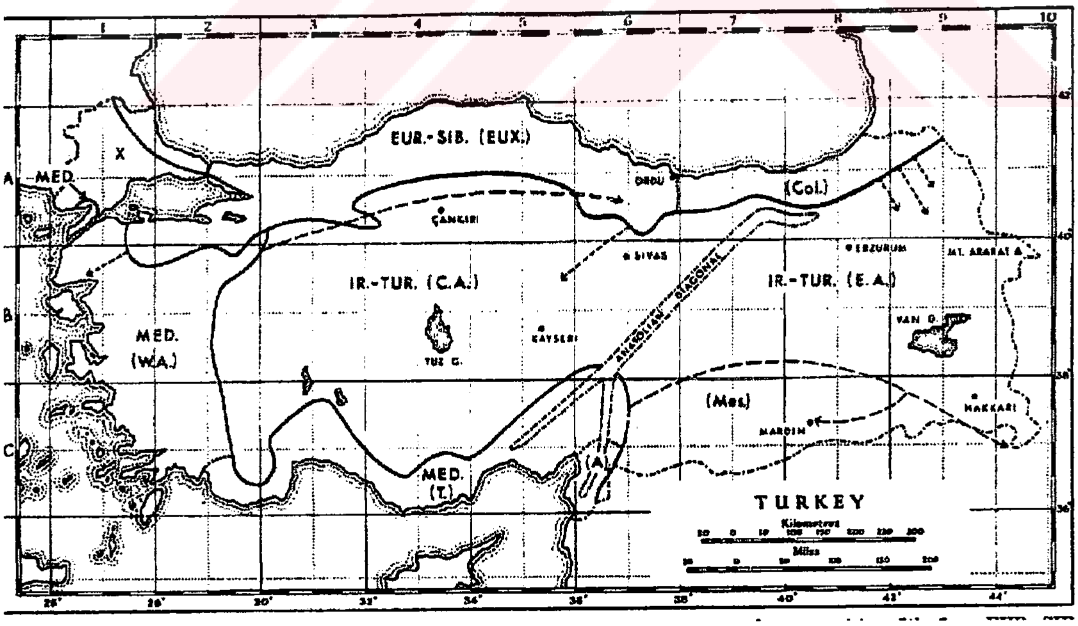

Figure 2.1. Phytogeographical Regions of Turkey (Davis *et al.* 1971)

Central Anatolia is the west border of Ir-Tur PGR. This region is well characterized climatically, floristically and vegetationally. The main features of its climate are (1) continentality, manifested by the extreme ranges in temperature, both diurnal and annual; (2) low precipitation; (3) requirement of two seasons of rest in the plant life, the hot and dry summer, and the cold , harsh winter (Zohary 1973). Therefore, plants of this region should have properties which enable them to adapt climatic conditions and survive. This may be a reason for rich plant diversity and high rate of endemism in this region.

According to Zohary (1973) Ir-Tur phytogeographical region is subdivided into a western and an eastern subregion. Each of these subregions can be subdivided further into provinces. West Ir-Tur subregion covers Iran-Anotolian province which involves the Inner Anatolia. This is the largest and the most important province in the West Irater sub region, because of high rate of endemism and species diversity.

Ir-Tur PGR is represented by paleoboreal steppe (a kind of grassland) flora. The term "steppe" is derived from the name of one of the commonest genera in the Eurasian grassland. Examples for genera of characteristic plants of this region are given by Zohary (1973). Some of them are *Erysimum, Isatis, Cochleria, Delphinium, Amygdalus, Onobrychis, Echinops, Nepeta, Scrophularia, Achillea*. In treeless low, flat steppes of central Anatolia, *Artemisia santonicum* is often a leading species, replaced in some particularlly sandy areas by *A. scoparia* . Characteristic species are *Achillea santolina, Euphorbia macroclada, Globularia orientalis, Isatis glauca, Linum hirsutum* subsp. *anatolicum, Phlomis armeniaca, Poa bulosa, Teucrium orientale* and several species of *Stipa* and spiny *Astragalus* (Ekim and Güner 2000).

Central Anatolian anthropogenic steppe was formed through the attempts of agricultural practices, use of wood as an energy source, grazing etc. In ancient times there were pine and quercus forests around Ankara. The pine forest near Beynam is the remainings of these forests. Presence of shrubs such as *Rosa hemispherica, Berberis crateagina, Prunus spinosa, Genista* and *Jasminum fruticans* also supports this hypothesis. Removal of forests had resulted in low mountain steppes characterized by lack of primary vegetation (forest) or degraded steppe forests with shrubs (Çetik, 1985).

In protected places of low mountain steppes, species of *Poaceae* family has high frequency and high abundance values. This situation was observed in Kepekli Boğazı in the south Ankara (Çetik, 1985). Abundance of *Poaceae* species is high in conserved areas around Kepekli Boğazı. Moreover this protected area has a rich species composition. Species diversity and richness in unprotected areas of Kepekli Boğazı are not as high as it is in the portected areas of in Kepekli Boğazı.

It was suggested by Takhtajan that (cited in Akman,1993) before Ir-Tur flora had occupied Central Anatolian Plateau, flora of this region was typically Mediterranean. Furthermore, Northern part of the Central Anatolia is the place where Euxinian and Eurosiberian PGR meet. So, Ankara is found in the west border of Ir-Tur PGR but it is also under the effect of Mediterranean and Euro-Siberian PGR.

Present natural vegetation of the campus area is low mountain steppe vegetation (Figure 2.1). It exhibits characteristic feature of the steppe. It possesses many plants belonging to the genera listed in Zohary (1973) as the characteristic plants of Ir-Tur vegetation or steppe vegetation. However, today an important part of campus area is covered by an artificially created pine forest (Figure 2.2). Afforested areas form a different habitat within steppe vegetation of the campus. In addition to this, there are also wet areas formed by small streams. These places also forms another type of habitat within the campus area (Figure 2.3). Presence of different habitats in an area may be a reason for higher rate of diversity.

Figure 2.2. Steppe vegetation in METU campus

Figure 2.3. Afforested area in METU campus

Figure 2.3 Wet ground in METU campus

2.2. Geological Structure of the Region

The age of the metamorphism in the glaucophanitic greenshcist facies and the lowsonite-glaucophane facies is considered as pre-Mesozoic in West Central Anatolia. Towards the west part of Ankara mica schists, glaucophane schists, and in general greenschist predominate. And the age of this formation which is named in the Ankara Section as the "Dikmen" series is not definitely known (Campbell 1971). On the other hand fossiliferious (fusulinidea) and sandy permo-carboniferous limestone formations overlie this series at Dikmen. Hence the metamorphic series is older than permo-carboniferous.

Some plant fossils and some characteristic marine fossils found in some formations that are thought as Palezoic or accepted as metamorphic and age of which can not be determined revealed that most parts of the field belongs to the Carboniferous and Permian (Yalçınlar 1976).

Carboniferous nature of Ankara region is represented by Dinansian , Vestfalean and Stephanian (at the same time Uralean) layers. Visean and Uralean is composed of fossiliferous calcer formations. All these carboniferous formations with marine and continental origin is partially covered at some places with fossiliferous Permian layers.

Generally gray or blackish schists found below Visean calcerous facies and expand towards Mogan in the south and Dikmen in the north, represents the lower carboniferous central facies. Such schists found between Yalıncak village and Mogan lake contain plant fossils. This implies that these folded schists are from continental origin.

2.3. Topography of the Region

Ankara is located in the north-western part of Central Anatolia. Central Anatolia is a predominantly rolling Plateau, the bulk of which range from 900 to 1200 m in altitude while more or less secluded in the north, east and south by higher mountain ranges, it is open to the wide valley coming from the west.

Ankara is lower towards the west and higher towards the east and the north-east. In the south west of Ankara there are 1000-1100 m elevated depositional plateau surfaces and disected by 100-125 m deep valleys (Erol 1973). METU campus is located in this part of Ankara. The altitude of the campus varies between 850-1100 m. with a mild gradient slope. Altitude tend to increase from north to south gradually. In the east-west direction field is in the form of plateaus interrupted with 50-100 m deep valleys between them.

2.4. Soil

The rocky crust of the earth, the parent rock, for soil formation, is slowly fragmented into smaller pieces and into individual minerals by the action of wind, water, ice, and temperature changes. These fragments are altered by mechanical and physical processes, mixed with organic materials, and changed by biological processes to form the extremely variable substance called soil.

Soil is a three-phase system of solids, liquids, and gases. The solid phase consists of mineral and organic particles separated by a network of pores, some filled with gases and others filled with water. The properties of each phase vary with the type of soil (Klein 1988).

The type of parent rock is of major importance in the type of soils developed in a particular location. Chalky soils develop on chalk, sandy soil develop on sandstone, clayey soils on shales and organic soils on peat (Eyre 1963). Sedimentary rocks produce soils that tend to be neutral or slightly alkaline, while soils found above igneous granites are usually more acidic.

Parent rocks in the Central Anatolian steppe is of two type one of them is hard limestone and the other is soft chalk, marl etc (Zohary 1973). Most of the study area has brown steppe soil formed from this calcerous parent rock. Brown steppe soil are similar to sierozems which are developed from calcareous rocks and which occur in areas with a rainfall about 200-300mm, and with mild to cool winter and long, hot, dry summers. But unlike sierozems brown steppe soils are formed under more favorable conditions. They are well developed and widespread in Central Anatolia. The surface of some brown steppe soils are brown or grayish-brown clays that are weakly granular and highly calcareous, and contain few limestone particles and pebbles. Subsoil is lighter in color, ranging from grayish-brown to yellowish-brown. It consists of locally deep beds of highly calcareous clay or clay and limestone. The climate under which this soil is developed is semi-arid with relatively stable winter rains, ranging between 250-350 mm and with occasional showers in summer (Zohary 1973).

Natural vegetation of this kind of soil is represented in Central Anatolia by two types: one consists of pure steppe led by *Artemisia fragranse* or other dwarf shrubs such as *Thymus*, spiny *Astragalus* species, *Globularia* species and others; the second is the forest steppe or steppe forests made up of remotely scattered trees (*Quercus*, *Crateagus*, *Pyrus*, etc.) interspaced by a steppe of dwarf shrubs or herbs (Zohary, 1973).

Study area has steppe vegetation similar to steppe described by Zohary (1973). In addition to this, study area has afforestation sites. These places, afforested with *Pinus* species, occupies a large area in the campus. Soils of afforestation areas are slightly more acidic then steppe areas in the campus and has slightly less organic mater content (Zeydanlı 1998).

2.5. Climate

Climate is an important factor for plant life. By climate, plant geographer means all those features of the environment which arise from or depend directly on the atmosphere. Of these the most important to plant geographers are temperature and rainfall. The climatologist is also deeply interested in barometric pressure and in the movements of great air masses. Both of these are prime importance in determining the distribution and amount of rainfall and heat over the surface of the world but their effect on plants which is mainly indirect. Wind, atmospheric humidity, evaporating power of the air are also important climatic factors but they are highly variable depending on other factors. For the purpose of plant biogeography temperature and rainfall, which are more stable, are the most important factors (Gleason and Cronquist, 1968).

Climate of Inner Anatolia resembles that of Mediterranean climate of West and South Anatolia. In most areas, however, precipitation is less and much of it falls as snow. Winter temperatures are much lower. In summer, temperatures soar during the day and drop suddenly at night. A striking feature of the climate, which must do much to control vegetation, is the very low summer humidity, and correspondingly high saturation deficit. This favors a predominantly herbaceous and suffruticose flora, and (with the exception of some conifers) precludes the growth of evergreen trees and shrubs. In general vegetation of the plateau (exception for a few late-flowering perennials and halophytes) is desiccated by mid-summer; leaves of most herbaceous species wither after flowering (Zohary, 1973).

2.5.1. Temperature

Monthly maximum, minimum and average temperatures of Ankara is given in Table 2.1 (Akman, 1999).

The following formula is used for calculating the annual average temperature difference.

A= t (highest)- t (lowest)

In this formula

A is the annual average temperature difference

t(highest) is the highest average temperature throughout the year

t(lowest) is the lowest average temperature throughout the year

If the values in Table 2.1 are substituted in this formula, the average annual temperature difference of Ankara can be calculated as.

A= 23.3 – 0.3 = 23.0 °C

Table 2.1: Monthly max (M). and min (m). temperatures, and monthly average (t) temperature.

Months	M	m	t
January	4.1	-3.5	0.1
February	5.6	-3.0	1.0
March	10.8	0.0	4.7
April	17.4	4.8	11.2
May	22.4	9.4	16.1
June	26.5	12.3	20.0
July	30.1	15.2	23.1
August	30.3	15.4	23.3
September	25.7	11.2	18.4
October	19.9	6.6	12.9
November	13.5	2.8	7.7
December	6.5	-0.8	2.5
Annual (average)	**17.7**	**5.9**	**11.8**

2.5.2. Precipitation

Precipitation together with temperature forms the most important element of climate. Some investigators classify according to the amount of annual precipitation (Akman 1999). Such classification is given below.

Annual Precipitation	**Type of Climate**
Lower than 120mm	Deserts
120-250 mm	Arid
250-500 mm	Semi-arid
500-1000 mm	Semi-humid
1000-2000 mm	Humid

According to these values Ankara has a semi-arid climate.

Table 2.2 gives the average monthly precipitation and the average annual precipitation of Ankara (Akman, 1999).

Maximum precipitation P(max) = 51.4 mm

Minimum precipitation P(min) = 10.7 mm

Total annual precipitation P = 377 mm

Table 2.2: Average monthly and annual precipitation of Ankara.

Months	P
January	40.5
February	35.6
March	35.7
April	39.9
May	51.4
June	31.4
July	14.2
August	10.7
September	17.6
October	23.1
November	30.9
December	46.0
Annual	**377.0**

2.5.3. Determination of Climate by De Martonne Method

This method makes a more realistic classification of climate possible. The following formula is used to calculate drought index of a region.

I = [(P/T+10) + (12p/t+10)] / 2

In this formula

I: Drought index

P: The amount of annual precip.(mm)

T: Mean annual temp. ($^{\circ}$C)

p: The Amount of precip. of the most driest month (mm)

t: The mean temp. of the driest month ($^{\circ}$C)

10: It is the constant used to prevent minus results.

If the data given in Table 2.1 and 2.2 are substituted in this formula the drought index of Ankara can be calculated.

P = 377 mm   T = 11.8°C   t= 23.3°C   p=10.7mm

I = [(377/11.8+10) + (12 x 10.7/23.3+10)]/2   I = 10.6

Climates are classified with regard to the drought index into four groups.

Drought Index	**Climate Range**
I = 10	Semi-arid
$10<I<15$	Semi-arid with low humidity
$15<I<20$	Semi-arid, humid

I>20	Humid and cold humid

According to this classification, climate of Ankara with a drought index of 10.6 is Semi-arid with low humidity.

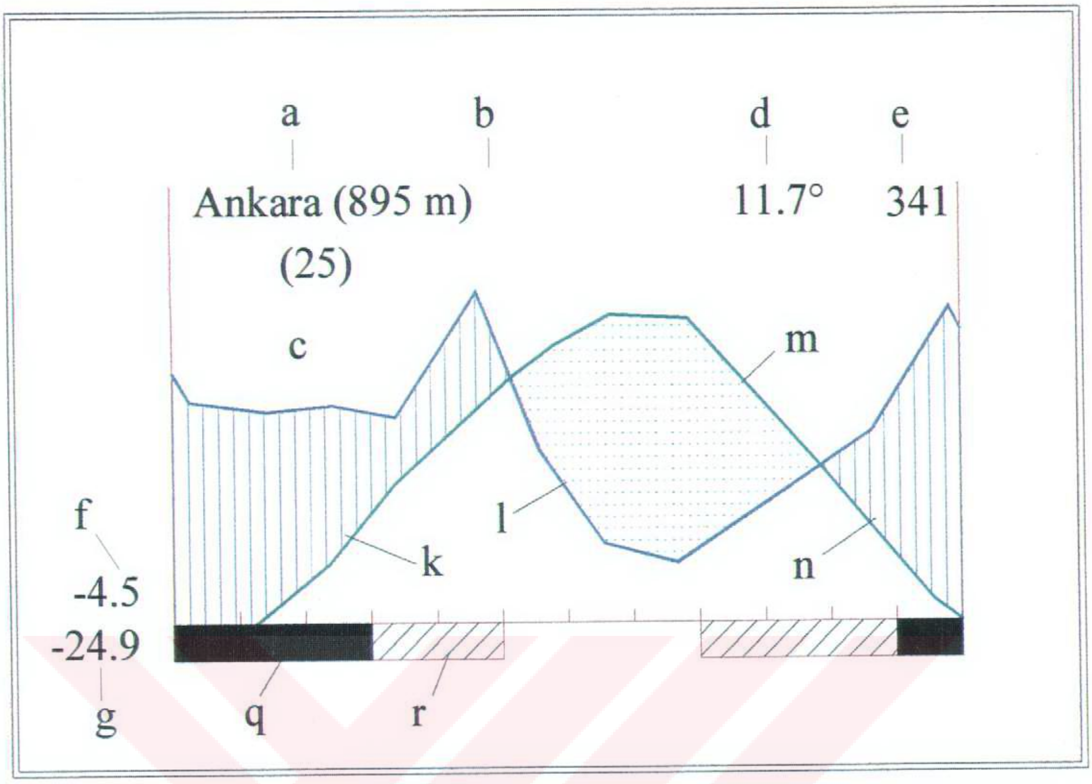

Figure 2.4. The climate diagram of Ankara (Cox & Moore, 1993)

Abscissa: Months

Ordinate: One Division = 10°C or 20mm rain

a = station,

b = height above sea-level,

c = durations observations in years,

d = mean annual temperature in °C,

e = mean annual precipitation in mm,

f = mean daily minimum of the coldest month,

g = lowest temperature recorded,

k = curve of mean monthly temperature,

l = curve of mean monthly precipitation,

m = relative period of drought (dotted),

n = relative humid season (vertical shading),

q = months with mean daily minimum below 0°C (diagonal shading),

r = late or early frost do occur.

2.5.4. Determination of Climate by Emberger Method

Emberger has started his studies about climate in 1933. Emberger has worked on the Mediterranean climate and problems related with it (Akman 1999).

In the idea of Emberger, a single formula about climate can not be applied to all kinds of climates in the world and can not be used by all fields of science effectively because different fields of science has somewhat different view of climate classification. According to Emberger climatic classifications which are used by biologists and plant biogeographers should be ecophysiologic. It should be static and it should depends on photoperiodism, temperature, and precipitation. Emberger used the factor, photoperiodism, for the first time. This system does not have an approach which depends on dynamic factors that are not biologically important.

According to the principles of Emberger, Mediterranean climates are also important for Turkey because two thirds of Turkey is under the effect of Mediterranean climates. Mediterranean climate is a kind of nontropical climate which has both a diurnal and seasonal photoperiodism, in which precipitation occurs during cold or relatively cold seasons, which has a dry summer season that has also accordance with a maximum summer temperature.

Emberger proposed the following formula in order to determine the layers of the Mediterranean climate and degree of drought.

$Q = (2000P)/ M^2 - m^2$

In this formula

Q: Precipitation-temperature index

P: Annual precipitation(mm)

M: The max. temperature of the hottest month in Kelvin

m: The min. temperature of the coldest month in Kelvin

2000: The constant number

If the data given in Table 2.1 and 2.2 are substituted in this formula precipitation index for Ankara can be calculated.

P =377 mm M = 30.3+ 273= 303.3 K m = -3.5+273 = 269.5 K

$Q = 2000 \times 377 / 303.3^2 - 269.5^2$

Q = 38.9

In accordance with Q and P values Mediterranean climates are classified in five groups.

Q and P Values	**Type of Climate**
Q<20 and P<300	Very arid Mediterranean climate
20<Q<32 and 300<P<400	Arid Mediterranean climate
32<Q<63 and 400<P<600	Semi-arid Mediterranean climate
63<Q<98 and 600<P<800	Mediterranean climate with low precipitation
Q = 98 and P>1000	Mediterranean climate with high precipitation

According to this classification Ankara with a Q value of 38.9 and P value of 377 has semi-arid Mediterranean climate.

CHAPTER 3

MATERIALS AND METHODS

The study area is the part of METU campus bordered by Eskişehir road in the north, road passing through Ahlatlıbel in the south, Bilkent University campus in the west, and Konya road in the east. Part of the campus around Eymir Lake was not included in the study area, because there is a flora prepared for Eymir.There is a study made in METU too. This study is a fieldguide which contains illustrations of 251 plants and their descriptions given in alphabetical order of plant families.

The study area is found in B4 grid square adopted by Davis (1965-1988). It has an area of 3065 hectare.

3.1. Collection

Two main approaches for collection are possible: (1) to collect as many plants as possible. (2) to collect certain groups. In this study the first approach was adopted because there is not enough specimens in herbaria collected from the study area (Davis 1965). So, it is needed to collect as many plants as possible. Between March 1997 and August 2000, 28 field trips were done in the study area and 869 plant specimens were collected.

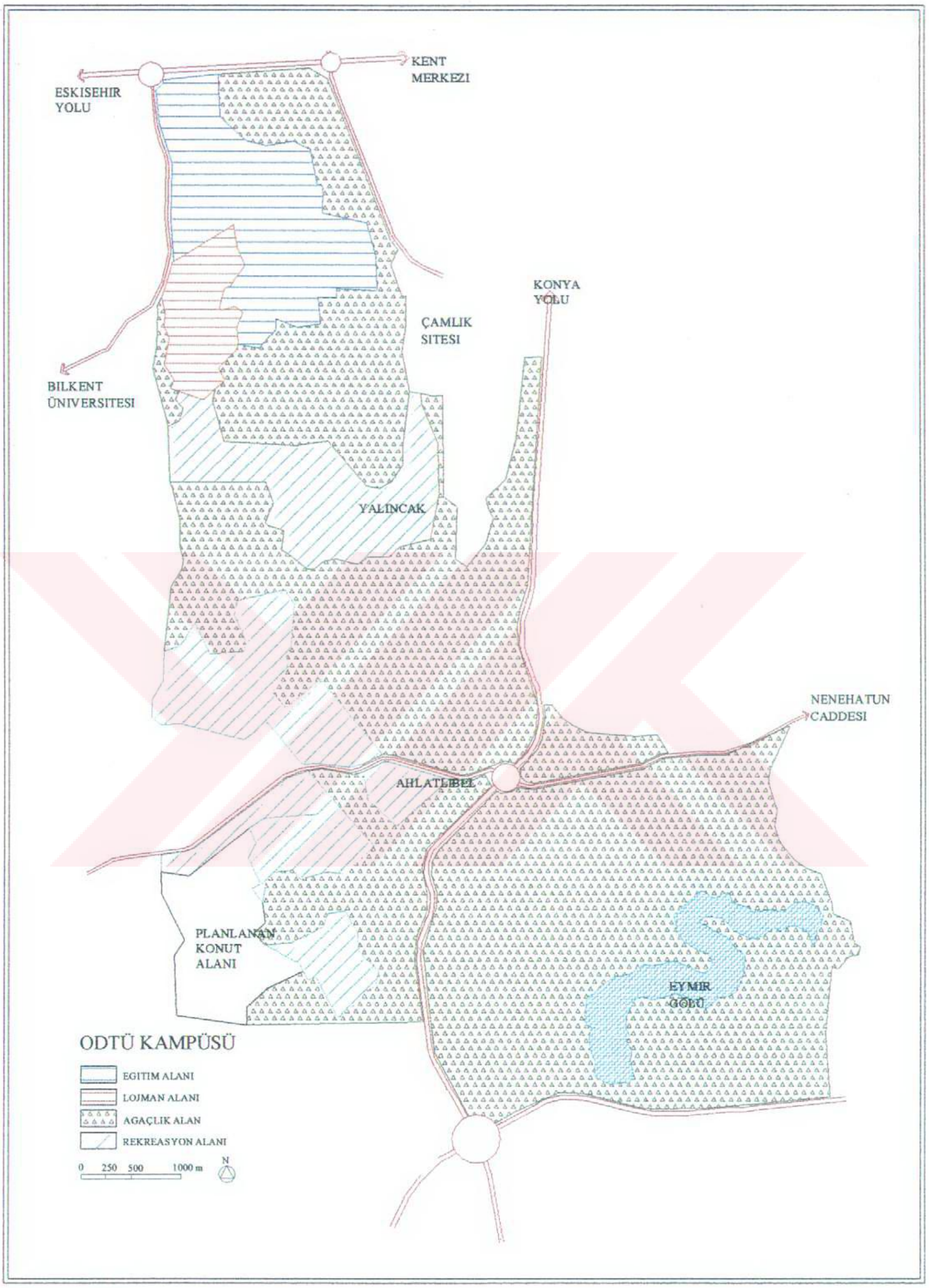

Figure 3.1. Map of study area.

Specimens require, as much as possible, a complete representation of the characters of the plant. If the plants are not too large, an entire individual plant should be included on the herbarium sheet; Otherwise the specimen should be made up , if possible, entirely from the parts of one individual plant. Ideally, the specimen should represent all the character combinations which can be detected (Benson 1962). Common plants are often the least well represented in herbaria, so that the herbarium often provides a false picture of their distribution. Good material of common plants, may therefore, add considerably to knowledge of them (Davis, 1965).

As described above, to provide specimens which can be easily identified, herbaceous plants are collected entirely as much as possible and attention was paid to collect specimens containing flowers or fruits or if possible both of them. Several specimens of similar plants were collected from different locations in the study area.

3.2. Pressing and Drying

A standard press, 45 cm to 70 cm, and newspapers were used in order to dry plant specimens. A newspaper was folded and plant specimen was put in it. Plant specimens collected in the field trip was prepared in the same way and they are put in the press. A label was put in each newspaper containing plant specimen. The date of collection and location of collection were written on these labels. Then, the press was tightened with ropes. Until the specimens had dried, newspapers had replaced by new ones.

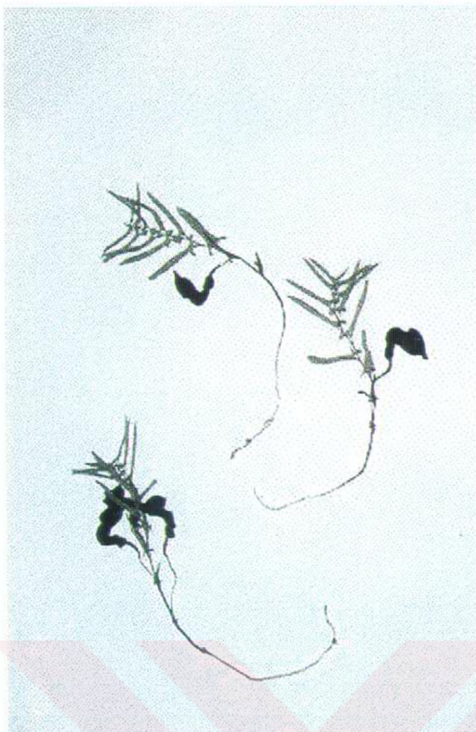

Figure 3.2. *Aristolochia morarum*

Figure 3.3. *Morina persica*

3.3. Identification

After making collection, the next step in taxonomic procedure is identification. The first step in this process is to sort the specimens into families. For this purpose family keys may be used. "The identification of flowering plant families" by Davis &Cullen (1979) was used to identify specimens at family level.

If the provenance of the plants is known and a local flora for that region is available, then genera and species of the specimens can be identified more easily by using such a flora. So, flora written by Akaydın (1996) for Ankara " Flora of Ankara City" was used for this purpose. "Flora of Turkey and the East Aegean Islands" written by Davis (1965-1986) was also used for species and generic identification.

Beside floras stated above, previously identified specimens from Hacettepe Herbarium and books containing illustrations ("Başkent'in Doğal Bitkileri" (Erik *et* *al.* 1998), and "Fieldguide to Wildflowers of METU Campus" Kaya *et al.* 1999)) were also used for identification at the early stages of the study. Prof. Dr. Musa Doğan and Assoc. Prof. Dr. Galip Akaydın were consulted about the identification of some specimens.

The features of floral morphology are the most important characters in the classification of flowering plants. These features are easily observed and they are practical for use in keys and descriptions. Morphology currently provides most of the characters used in constructing taxonomic systems (Jones 1986). Therefore, for the identification of plants in this study, mainly their morphological characters were used (Davis 1965-1988).

A key for the families found in the campus is also given in chapter 4. An intended key is formed for the families of flora of METU campus. Identification of Flowering Plant Families (Davis and Cullen 1979) was used to construct this key.

Identified plant specimens were listed in Chapter 5 "Results". Taxonomic groups are given in accordance with the order given in "Flora of Turkey" by Davis (1965-1988). For each species, location where the plant specimen was collected was given firstly. Since whole study area is found in B4 grid square, this information was not stated for each species separately. Then, approximate altitude of the location was given. After this, date of collection and collection number was indicated. For most of the plant species there are more than one specimen but only one of them was stated in the list. At the end of the list of plants collected during this study, another list was given. In this list plant species that are not collected during this study but stated in

"Fieldguide to Wild Flowers of METU" (Kaya *et al.* 1999) are given in an alphabetical order of families.

CHAPTER 4

IDENTIFICATION KEY FOR THE FAMILIES

1a. Evergreen, cotyledon number more than 2, usually coniferous **Gymnospermae**

2a. Mature leaves scale-like, imbricate and adpressed or linear-lanceolate and articulate at the base **62. Cupressaceae**

2b. Mature leaves oblong-linear, not articulate at the base

3a. Leaves without resin canals; fruit surrounded by a fleshy aril **68. Taxaceae**

3b. Leaves with resin canals; Fruit a woody cone, exarilate **1. Pinaceae**

1b. Not as above

4a. Two (rarely one) lateral cotyledons; leaves usually with reticulate venetion; flowers usually 2-, 4-, or 5-merous or polymerous; vascular bundles of the stem usually in a ring; taproot usually present; bracteoles (when present) usually 2, lateral; pollen grains usually not monocolpate (Dicotyledons) (to page 41)

5a. At least some of the petals free at the base, or petals absent

6a. At least the male flowers borne in usually deciduous catkins; flowers always unisexual and apetalous; always woody

7a. Leaves pinnate; fruit a nut wit a large solitary seed with complex and folded cotyledons **64. Junglandaceae**

7b. Leaves simple or lobed; fruit and seed not as above

8a. Ovules many, parietal; seeds many, wooly; male catkins are pendulous with deciduous, laciniate bracts **49. Salicaceae**

8b. Ovules solitary or few; seeds few, glabrous; male catkins not as above

9a. Styles 3, often divided; fruit schizocarpic; seeds carunculate **46. Euphorbiaceae**

9b. Styles 1-6, simple; fruits not schizocarpic; seeds not carunculate

10a. Male catkins compound, flowers in groups 2-3 adherent to bract; style 2 **60. Betulaceae**

10b. Male catkins simple, flowers not grouped and adherent to a bract; styles 1 or 3-6 **48. Fagaceae**

6b. Flowers not in catkins (or if so then plant herbaceous), polypetalous or apetalous, bisexual or unisexual; herbaceous or woody

11a. Gynoecium of 2 or more free carpels

12a. Trees with exfoliating bark, palmately lobed leaves and unisexual flowers in pendulous, globose heads **47. Platanaceae**

12b. Not as above

13a. Perianth and stamensperigynous **18. Rosaceae**

13b. Perianth and stamens hypogynous

14a. Leaves succulent; stamens in 1 or 2 whorls

20. Crassulaceae

14b. Leaves not succulent; stamens spirally arranged, numerous and indefinite **2. Ranunculaceae**

11b. Gynoecium of 1 carpel, or syncorpous (if subapocarpous then carpels united near the base or by a common style)

15a. Perianth of 2 whorls, calyx and corolla both present (calyx rarely obsolescent; excluding aquatic plants with minute, quickly cadocous petals, and branch parasites with opposite leathery leaves)

16a. Stamens more than 2 x the number of petals

17a. Peianth and stamens perigynous or epigynous

18a. Placentation free-central; ovary partly inferior

67. Portulaceae

18b. Placentation not free-central; ovary mostly superior or fully inferior

19a. Sepals 2, calyprate; herb **4. Papaveraceae**

19b. Sepals 4-5, not calyprate; trees or shrubs

20a. Leaves stipulate **18. Rosaceae**

20b.Leaves exstipulate **1.Saxifragaceae**

17b. Perianth and stamens hypogynous

21a. Placentation axile or free-central

22a. Placentation free-central; sepals 2 **67. Portulaceae**

22b. Placentation axile; sepals usually 5, rarely three

23a. Leaves alternate

24a. Inner whorl of perianth segments tubular or bifid, nectariferous; fruit a group of partly to fully coalescent follicles **2.Ranunculaceae**

24b. Not as above

25a. Stamens free, anthers 2-celled **72. Zygophyllaceae**

25b. Stamens united into a tube around the styles; anthers 1-celled **13. Malvaceae**

23b. Leaves opposite

26a. Leaves simple, exstipulate, often with pellucid glands; stamens often united in bundles

12. Hypericaceae

26b. Leaves pinnate, stipulate, without pellucid glands, stamens free **72. Zygophylaceae**

21b. Placentation parietal or marginal

27a. Carpel 1; fruit a legume with marginal Placentation; leaves bipinnate or phyllodic **17. Fabaceae**

27b. Carpels 2 or more; fruit not a legume; placentation parietal leaves not as above

28a. Leaves opposite

29a. Styles numerous; flowers 3-merous **4.Papaveraceae**

29b. Stlye 1-5; flowers 4-5-merous

30a. Style 1; stamens not united in bundles; leaves without pellucid glands **7. Cistaceae**

30b. Style 3-5; stamens united in bundles; leaves with pellucid glands **12. Hypericaceae**

28b. Leaves alternate

31a. Flowers zygomorphic; sepals 4-8 **6. Resedaceae**

31b. Flowers actinomorphic; sepals 2, caducous.

4.Papaveraceae

16b. Stamens 2 x the number of petals or fewer

32a. Stamens and perianth perigynous, or ovary fully or partly inferior

33a. Carpel 1 with marginal placentation; fruit a legume

17. Fabaceae

33b. Carpel usually more than 1, syncarpous, placentation not marginal; fruit never a legume

34a. Placentation parietal

35a. Aquatic herb; stamens 2+4 **5. Brassicaceae**

35b Terrestrial herbs; stamens 4-5 or 8-10

21. Saxifragaceae

34b. Placentation axile, basal, apical or free central

36a. Stamens antipetalous; trees or shrubs with simple leaves

16.Rhamnaceae

36b. Stamens antisepalous or 2x as many as petals; herbaceous or woody, leaves simple to compound

37a. Flowers born in umbels, sometimes condensed into heads; leaves usually compound; ovary inferior

22. Apiaceae

37b. Flowers usually not born in umbels; leaves usually simple; ovary superior or inferior

38a. Style 1

39a. Ovary inferior

40a. Sap milky; petals 5; ovary 3-locular

28. Campanulaceae

40b. Sap watery; petals 2or 4; ovary (-1)4(-5)-locular

65. Onagraceae

38b. Styles more than 1, often 2, divergent

41a. Trees or shrubs with opposite, lobed or compound leaves; fruit samara **57. Aceraceae**

41b. Herbs; hair simple or 0; fruit various, not a woody capsule **21. Saxifragaceae**

32b. At least 1 whorl of the perianth hypogynous, or stamen hypogynous or inserted on the top of hypogynous disc in which the ovary may be immersed

42a. Placentation free-central

43a. Sepals 4-5, plant never scapose and succulent; leaves usually opposite, always entire **9. Caryophylaceae**

43b. Sepals 2, or if more then plant scapose and succulent; leaves alternate or opposite, entire or dentate **67. Portulaceae**

42b. Placentation axile, parietal, basal or marginal

44a. Placentation axile, sometimes almost apical

45a. Anthers opening by terminal pores; stamens not antipetalous

8. Polygalaceae

45b. Anthers opening by longitudinal slits or stamens antipetalous

46a. Herbs

47a. Fruit +- 10(-8)-locular due to 5(-4) secondary septa; leaves simple, entire **14. Linaceae**

47b. Fruit 2-5 (-8)-locular; leaves lobed or compound

48a. Flowers 4-merous; ovary 4-sided; stamens 4-8, alternating with nectariferous staminodes **21. Saxifragaceae**

48b. Not as above

49a. Disc present; leaves pinnate or trifoliate

72. Zygophylaceae

49b. Disc absent; leaves simple or palmately lobed or pinnatisect, rarely trifoliate **15. Gereniaceae**

46b. Trees, shrubs or climbers

50a. A well-developed hypogynous disc present below and around the ovary

51a. Flowers unisexual **27. Aceraceae**

51b. Flowers bisexual

52a. Leaves pinnate, usually fleshy; stipulates persistent; stamens with basal scales **72. Zygophyllaceae**

52b. Not as above

53a. Ovary 3-5-locular, flowers usually zygomorphic

63. Hippocastanaceae

53a. Ovary 2(-3)-locular; flowers actinomorphic

57. Aceraceae

50b. Hypogynous disc absent **30. Oleaceae**

42b. Placentation parietal, basal or marginal

54a. Flowers zygomorphic

55a. Ovary of 1 carpel with marginal placentation; fruit a legume, sometimes indehiscent or lamentoid **17. Fabaceae**

55b. Ovary of 2 or more carpels, or if one carpel then with basal placentation; fruit various never a legume

56a. Carpels open at apex; some or all of the petals laciniate

6. Resedaceae

56b. Carpels closed at the apex; no petals laciniate

4. Papaveraceae

54b. Flowers actinomorphic.

57a. Stamens anti petalous; ovary apperantly 1-carpellate, placentation basal or marginal **3. Berberidaceace**

57b. Stamens not antipetalous; ovary 2-5 carpellate, placentation basal or parietal

58a. Stamens alternating with multifid staminodes

21. Saxifragaceae

58b. Stamens not alternating with staminodes

59a. Stamens 2-4; carpels apperently 2; ovary divided by a membranous false septum **5.Brassicaceae**

59b. Stamens4-10; carpels 2-5; false septum absent

11. Tamaricaceae

15b. Perianth of 2 whorl, sometimes petaloid or 0; if perianth of 2 whorls then the segments of each whorl +- indistinguishable

60a. Stamens not borne on the perianth, ovary nake

61a. Flowers unisexual

62a. Ovary 3-locular; styles 3 **46. Euphorbiaceae**

62b. Ovary 1-2- or 4-locular, styles 1-2

63a. Stamens 2, anther cells back to back **30. Oleaceae**

63b. Stamens more than 2, anther cells not back to back

64a. Seed with a straight embryo; stinging hairs present or plant rough to touch; stamens sensitive, inflexed in bud; often with cytoliths

70. Urticaceae

64b. Seed with a curved embryo; stinging hairs absent; stamens neither sensitive nor inflexed in bud; cytoliths absent

65a. Perianth greenish or absent; stamens free

66a. Leaves all opposite; fruit splitting into 2 mericarps

46. Euphorbiaceae

66b. Leaves alternate at least above; fruit not as above

61. Chenopoiaceae

65b. Perianth scarious; stamens often cannate below

58. Amaranthaceae

61b. Flowers bisexual

67a. Trees or non-succulent shrubs

68a. Stamens 2; leaf base not oblique **30. Oleaceae**

68b. Stamens 4-8; leaf base oblique **45. Ulmaceae**

67b. Herbs, climbers or succulent shrubs

69a. Leaves stipulate (rarely apparently exstipulate), the stipules usually united into a sheath (ochrea); fruit a 3-sided nut

10. Polygonaceae

69b. Leaves exstipulate; fruit not a 3-sided nut

70a. Carpels open at the apex; placentation parietal **6. Resedaceae**

70b. Carpels closed at the apex; placentation basal or free central

71a. Ovule solitary, basal; leaves often alternate

72a. Perianth green, membranous or 0; stamens free

61. Chenopodiaceae

72b. Perianth scarious; stamens often cannate below

58. Amaranthaceae

71b. Ovules numerous on a free central placenta; leaves frequently opposite

73a. Sepals free; stamens opposite to, or more numerous than the sepals **9. Caryophylaceae**

73b. Sepals united; stamens as many as, and alternating with, the sepals **29. Primulaceae**

60b. Stamens apparently borne on the perianth or ovary partly or fully inferior (female flowers sometimes without a perianth)

74a. Trees or shrubs

75a. Stamens alternating with sepals **16. Rhamnaceae**

75b. Stamens opposite or more numerous than the sepals

76a. Lepidote scales present; fruit enclosed in a berry-like calyx

76b. Lepidote scales absent; fruit not as above

77a. Ovary inferior

78a. Placentation parietal **21. Saxifragaceae**

78b. Placentation axile or basal **48. Fagaceae**

77b. Ovary superior

79a. Inflorescence borne on current years' shoots; fruit a group of 2(3) samaras **57. Aceraceae**

79b. Inflorescence borne on old wood; fruit a legume

17. Fabaceae

74b. Herbs, climbers or parasites

80a. Branch parasites with forked branching **43. Loranthaceae**

80b. Root parasites or free living plants

81a. Ovary superior

82a. Leaves opposite, usually entire **19. Lythraceae**

82b. Leaves alternate, usually lobed or compound **18. Rosaceae**

81b. Ovary partly or fully inferior

83a. Ovary 6-locular; perianth 3-lobed or tubular and zygomorphic, bizare **44. Aristolochiaceae**

83b. Not as above

84a. Ovules 1-5 , seed 1 **61. Chenopodiaceae**

84b. Ovules and seed numerous

85a. Styles 2; placentation parietal **21. Saxifragaceae**

85b. Style 1; placentation axile **65. Onagraceae**

5b. Petals all united at the base, sometimes very shortly so

86a.Ovary superior

87a. Flowers actinomorphic

88a. Stamens 2, anther cells back to back; plants woody **30. Oleaceae**

88b. Not as above

89a. Carpels several, free; plants always succulent **20. Crassulaceae**

89b. Ovary syncarpous, or at least with the styles united, rarely one carpellate, when fruit a legume; plants seldom succulent

90a. Corrola scarious, 4-lobed; stamens 4, exserted; leaves often with parallel veins and all basal **41. Plantaginaceae**

90b. Not as above

91a. Stamens antipetalous; placentation axile, free-central, or basal

92a. Placentation free-central, ovules usually numerous though fruit often 1-seeded

93a. Sepals 2, usually free **67. Portulacaceae**

93b. Sepals (-4)5(-9), connate **29. Primulaceae**

92b. Placentation basal, ovule 1, pendulous; fruit 1-seeded

66. Plumbaginaceae

91b. Stamens antisepalous or more numerous than the corolla lobes; placentation never free-central

94a. Leaves bipinnate or phyllodic; fruit a legume **17. Fabaceae**

94b. Not as above

95a. Anthers poricidal

96a. Leaves alternate **35. Solanaceae**

96b. Leaves opposite **32. Gentianacea**

95b. Anthers open by longitudinal slits

97a. Leaves alternate or all basal

98a. Stamens hypogynous; procumbent herbs with milky sap **28. Campanulaceae**

98b. Stamens epipetalous; milky sap absent (except in many convolvulaceae)

99a. Flowers in scarpioid cymes or the calyx with appendaged sinuses; style gynobasic or terminal **34. Boraginaceae**

99b. Flowers neither in scarpioid cymes (though often in dichasia) nor the calyx appendaged; style terminal

100a. Ovules 1-2 per loculus (4 in all)

101a. Sepals free; corolla lobes contorted and infolded, twiners, herbs, or dwarf shrubs **33. Convolvulaceae**

101b. Sepals connate; corolla lobes imbricate; trees or shrubs **34. Boraginaceae**

100b. Ovules numerous in each loculus

102a. Corolla lobes usually folded, contorted or valvate; septum often oblique, internal phloem present **35. Solanaceae**

102b. Corolla lobes imbricate; septum horizontal; internal phloem absent **36. Scrophulariaceae**

97b. Leaves opposite

103a. Milky sap usually present; fruit often of 2 follicles and seeds with silky appendage

104a. Pollen granular, transferred directly from anthers; corona absent; corolla lobes contorted in bud **31. Apocynaceae**

104b. Pollen (often in pollinia) transferred by means of specialised translators; corona usually present; corolla lobes contorted or valvate in bud. **59. Asclepediadaceae**

103b. Milky sap absent; fruit a capsule or fleshy; seeds without a silky appendage **32. Gentianaceae**

87b. Flowers zygomorphic

105a. Stamens more numerous than the corolla lobes, or anthers poricidal

106a. Anthers poricidal; leaves undivided; ovary syncarpous **8. Polygalaceae**

106b. Anthers opening by slits, leaves dissected or compound; ovary of 1 carpel

107a. Leaves pinnate or trifoliate, perianth not spurred **17. Fabaceae**

107b. Leaves laciniate; perianth spurred **2. Ranunculaceae**

105b. Stamens as many as corolla lobes or fewer, not poricidal

108a. Stamens as many as corolla lobes, zygomorphy weak

109a. Stamens antipetalous; placentation free-central **21. Primulaceae**

109b. Stamens antisepalous; placentation axile

110a. Flowers in scorpioid cymes; fruit of 4, 1-seeded nutlets **34. Boraginaceae**

110b. Flowers not in scorpioid cymes; fruit a many seeded capsule **36. Scrophulariaceae**

108b. Stamens fewer than corolla lobes, 4 or 2; zygomorphy pronounced

111a. Placentation axile; ovules 4 or many

112a. Ovules numerous but not superposed (that is vertical row in each loculus)

113a. Corolla lobes variously imbricate in bud; septum horizontal; leaves opposite or alternate; internal phloem absent **36. Scrophulariaceae**

113b. Corolla lobes usually folded, contorted or valvate in bud; septum usually oblique; leaves alternate; internal phloem present **35. Solanaceae**

112b. Ovules 4, or more numerous and superposed

114a. Fruit a capsule; ovules 4-many, usually superposed **38. Acanthaceae**

114b. Fruit not a capsule; ovules 4, side by side

115a. Style gynobasic, or if terminal then a corolla with a reduced upper lip; fruit usually of 4 1-seeded; corolla often strongly bilabiate; calyx often 2-lipped **40. Lamiaceae**

115b. Style terminal, upper lip of corolla well-developed; fruit usually a berry or drupe; corolla less strongly zygomorphic; calyx +- actinomorphic **71. Verbanaceae**

111a. Placentation parietal, free-central, basal or apical; ovules many or1-2

116a. Ovules many; fruit a capsule, rarely a berry **37. Orobanchaceae**

116b. Ovules 1-2; fruit indehiscent, often dispersed in the calyx

39. Globulariaceae

86b. Ovary partly or fully inferior

117a. Inflorescence an involucrate capitulum (or the flowers rarely in superimposed, spiny-bracted whorls); ovules always solitary

118a. Each flower with a cup-like involucel; stamens 4, free; ovules apical

26. Dipsacaceae

118b. Involucel 0; stamens 5, usually syngenesious; ovule basal

27 Asteraceae

117b. Inflorescence and ovules not as above

119a. Leaves alternate or basal

120a. Stamens antipetalous **29. Primulaceae**

120b. Stamens not antipetalous **28. Campanulaceae**

119b. Leaves opposite or appearing whorled

121a. Stamens 1-3; ovary with 1 ovule; fruit a cypsela **24. Valerianaceae**

121b. Stamens 4 or more; ovary with usually 2 or more ovules; fruit not a cypsela

122a. Stipules interpetiolar (or sometimes intrapetiolar), sometimes leaf-like; ovary 2-locular; flowers usually actinomorphic; fruit capsular, fishy or schizocarpic **50. Rubiacea**

122b. Stipules usually absent; ovary 2-5-locular, usually 3-locular, rarely only one locus fertile; flower often zygomorphic, sometimes twinned; fruit a berry or a drupe **23. Caprifoliaceae**

4b. One terminal cotyledon; leaves usually with parallel venation; flowers usually 3-merous; vascular bundles scattered in the stem; taproot usually absent; bracteol (when present) usually 1, adaxial; pollen grains usually monocolpate (Monocotyledons)

123a. Ovary partly or fully inferior

124a. Flowers actinomorphic or sometimes zygomorphic; stamens 6,4 or 3, or (if aquatic) 3-many **52. Iridaceae**

124b. Flowers strongly zygomorphic (rarely asymmetric); stamens 5, 2, or 1

53. Orchidaceae

123b.Ovary superior or naked if perianth absent

125a. Perianth well-developed, never scarious throughout, sometimes reduced to a single bract-like segment **51. Liliaceae**

125b. Perianth entirely scarious, or reduced to bristles, hairs, narrow scales or lodicules, or 0

126a. Flowers imbricated in distichous or cylindrical spikelets (sometimes 1-

126b. Flowers arranged in heads, superposed spikes, cymes, fascicles or panicles, rarely solitary

128a. Flowers usually bisexual; ovules 3-many **54. Juncaceae**

flowered), each flower subtended by a membranous bract

127a. Leaf phyllotaxis1/2; leaf sheaths usually with free margins; spikelets always distichous (sometimes 1-flowered), subtended by a pair of sterile bracts (glumes); each flower enclosed between a membranous bract (lemma) and adaxial bracteole (palea); perianth reduced to 2(-3) lodicules; stigmas usually 2 **56. Poaceae**

127b. Leaf phyllotaxis 1/3 ; leaf sheaths closed; spikelets distichous or cylindrical, usually not subtended by sterile bracts at the base; each flower subtended by a membranous bract (glume); perianth represented by bristles, hair, scales, or 0; stigmas 2-3 **55. Cyperaceae**

128b. Flowers unisexual; ovule solitary **69. Typhaceae**

CHAPTER 5

RESULTS

SPERMATOPHYTA

GYMNOSPERMAE

1. PINACEAE

1. CEDRUS Link

1. *C. libani* A. Rich

Near computer engineering, c.900m, 26/08/2000, Baş 869

2. PINUS L.

2. *P. sylvestris* L.

Slopes facing Bilkent, c. 1000 m, 29.5.1999, Baş 786.

3. *P. nigra* Arn.

Slopes facing Bilkent, c. 1000 m, 29.5.1999, Baş 785.

ANGIOSPERMAE

DICOTYLEDONES

2. RANUNCULACEAE

3. CONSOLIDA (DC) S. F. Gray3

4. *C. hellespontica* (Boiss.) Chater

Around stadium, open places, c. 900 m ,28.6.1997, Baş 531.

4. ADONIS L.

5. ***A. annua*** L.

Around new biology building, c.875 m, 9.5.1997, Baş 24. **Med. lement**

6. ***A. flammae*** Jacq.

Around Yalıncak, inside the forest, c. 1000 m, 17.5.1997, Baş 49.

5. RANUNCULUS L.

7. ***R. sericeus*** Bank & Sol.

Above Yalıncak, deep soil on calcareous rock, open places, c. 1100 m, 7.6.1997, Baş 345. **Ir-Tur element**.

8. ***R. constantinopolitanus*** (DC) d'Urv.

Yalıncak, beside the stream, c. 950 m, 19.4.1998, Baş 621.

9. ***R. argyreus*** Boiss.

Around yalıncak, step, c. 1000 m, 17.5.1997, Baş 79.

10. ***R. reuterianus*** Boiss.

Around new biology department, c. 875, 9.5.1997, Baş 17. **Endemic**

11. ***R. arvensis*** L.

Behind Yalıncak, open places, c. 950 m, 2.2.1999, Baş 744.

3. BERBERIDACEAE

6. BERBERIS L.

12. ***B. vulgaris*** L.

Near civil engineering, cultivated, c. 900 m, 2.5.1999, Baş 753.

4. PAPAVERACEAE

7.GLAUCIUM Adans.

13. ***G. corniculatum*** (L.) Rud. subsp: ***corniculatum***

Around Yalıncak, step, c. 100 m, 17.5.1997, Baş 82.

14. ***G. grandiflorum*** Boiss & Huet. var. ***grandiflorum***.

Behind the nursery, c. 900 m, Çelik- Baş 180. **Ir-Tur element**.

8.PAPAVER L.

15 .***P. rhoeas*** L.

Around civil engineering, c. 900 m, 17.5.1997, Baş 98.

16. ***P. lacerum*** Popov.

Below prep school, c. 850 m, 28.6.1998, Baş 669.

17. ***P. commutatum*** Fisch. & Mey.

Around architecture, c. 875 m, 28.5.1997, Baş 167.

18. ***P. dubium*** L.

Slopes facing Bilkent, open places, c. 1000 m, 29.5.1999, Baş 784.

19. ***P minus*** (Boiv.) Meikle

Around new biology building, c. 875 m, 28.5.1997, Baş 148. **East Med. element.**

9. HYPECOUM L.

20. ***H. procumbens*** L.

Around Yalıncak, c. 950 m, 19.4.1998, Baş 629. **Med. element.**

21. ***H. imberbe*** Sibth. & Sm.

Around library, c. 875 m, 21.5.1997, Baş136.

22. ***H. pendulum*** L.

Around Yalıncak inside the forest, c. 1000m, 17.5.1997, Baş 76.

5. BRASSICACEAE

10. DIPLOTAXIS DC.

23. ***D. tenuifolia*** (L.) DC.

Slopes facing Bilkent, upper part, open area, c. 1100m, 29.5.1999, Baş 807.

11. RAPHANUS L.

24. ***R. raphanistrum*** L.

Around Yalıncak, inside the forest, c. 1000 m, 17.5.1997, Baş 42.

12. CRAMBE L.

25. ***C. tataria*** Sebeök. var. ***tataria*** Ic. Schulz.

Around mechanical engineering, c. 900m, 20.5.1997, Baş 106.

13. RAPISTRUM Crantz.

26. ***R. rugosum*** (L.) All.

Çamlık jogging track, inside the forest, c. 900 m, 28.6.97, Baş 511.

14. CARDARIA Desv.

27. *C.* ***draba*** (L.) Desv. subsp. ***draba.***

Near nursery, 28.5.1997, c. 875 m, Güzer-Baş 169.

15. ISATIS L.

28. *I.* ***glauca*** Aucher ex Boiss. subsp. ***glauca***

Around stadium, open places, c. 900m, 28.4.97, Baş 536. **Ir-Tur element**.

16. AETHIONEMA R. Br.

29. ***Ae. armenum*** Boiss.

Above aeronautical engineering, open places, c. 950 m, 29.5.1999, Baş 767. **Ir-Tur element**

17. THLASPI L.

30. *T.* ***perfoliatum*** L.

Around purification establishment, c. 850, 29.3.1997, Baş 5.

18. CAPSELLA Medik.

31. *C.* ***bursa-pastoris*** (L) Medik.

Behind mathematics department, c. 875 m,6.4.1998, Baş 607.

19. ALYSSUM L.

32. ***A. huetii*** Boiss.

Around library, afforested area, 21/5/1997, Baş 135. **Endemic, Ir-Tur element.**

33. ***A. blepharocarpum*** Dudley& Hub.-Mor.

Around Yalıncak, inside the forest, c.900 m, 19/4/1998, Baş 628. **Endemic, Ir-Tur element.**

34. ***A. hirsutum*** Bieb.

Around Yalıncak, step, c. 1000 m, Baş 80.

35. ***A. pateri*** Nyar.

Below Yalıncak, c. 950 m, 5.7.1997, Baş584.

36. ***A. sibiricum*** Willd.

Around new staff house, open area, c.850 m, 26.6.1997, Baş 452.

20. ERYSIMUM L.

37. ***E. diffusum*** Ehrh.

Around new biology building, inside the forest, c. 875 m, Baş 223. **Euro-Sib element.**

21. CAMELINA Crantz

38. ***C. hispida*** Boiss.

Above Yalıncak, deep soil on calcareous rock, c. 1100 m, 7.6.1997, Baş 340.

6. RESEDACEAE

22. RESEDA L.

39. ***R. lutea*** L. var. ***lutea***

Below prep school, inside the forest, c. 850 m, 28.6.1998, Baş 654.

7. CISTACEAE

23.HELIANTHEMUM Adans.

40. ***H. nummularium*** (L) Miller.

Around Yalıncak, step, c 1000 m, 17/5/1997, Baş 96. **Endemic.**

41. ***H. canum*** (L) Baumg.

Slopes facing Bilkent , under trees, c. 1000 m, 10/6/2000, Baş 843.

42. ***H. salicifolium*** (L) Miller

Above Yalıncak, calcareous soil, open area, c. 1100 m, 7/6/1997, Baş 421.

24.FUMANA Spach

43. ***F. aciphylla*** Boiss.

Below new biology building, c. 875 m, 28/6/1998, Baş 692. **Ir-Tur element.**

8. POLYGALACEAE

25. POLYGALA L.

44. ***P. anatolica*** Boiss. & Heldr.

Below Yalıncak, open places inside the forest, c. 950 m.10.6.2000, Baş 852.

9. CARYOPHYLACEAE

26. MINUARTIA L.

45. ***M. meyeri*** (Boiss.) Bornm:

Around new biology building, inside the forest, c. 875 m, 4.6.1997, Baş 272. **Ir-Tur element.**

46. ***M. anatolica*** (Boiss.) Woron. var. ***arachnoidea*** McNeill

Above Yalıncak deep soil on calcerous rock, open places, c. 1100 m, 7.6.1997, Baş 349. **Endemic, Ir-Tur element**.

47. ***M. corymbulosa*** (Boiss. & Bal.) McNeill var. ***corymbulosa***.

Around new staff house, open places, c. 850 m, 26.6.97, Baş 451**. Endemic, Ir-Tur element.**

27. HOLOSTEUM L.

48. ***H. umbellatum*** L.

Ahlatlıbel, inside the forest, c. 1150m, 12.4.1998, Baş 618.

28. DIANTHUS L.

49. ***D. crinitus*** Sm. var. ***crinitus.***

Beside the Konya road, c. 1100 m, 16.7.1998, Baş 734.

29. SILENE L.

50. ***S. otites*** (L.) Wibel

Around new staff house, c. 850 m, 26.6.1997, Baş 474.

51. ***S. vulgaris*** (Moench) Garcke

Above Yalıncak deep soil on calcareous rock, open places, c. 1100 m, 7.6.1997, Baş 384.

52. ***S. dichotoma*** Ehrh. subsp. ***dichotoma.***

Around new biology building, inside the forest, c. 875 m, Baş 241.

10. POLYGONACEAE

30. RUMEX L.

53. ***R. crispus*** L.

Around new biology building inside the forest, c. 875 m, 4.6.1997, Baş 237.

11. TAMARICACEAE

31. TAMARIX L.

54. ***T. smyrnensis*** Bunge

Behind social science building, c. 875 m, 28.6.1998, Baş 699.

12. HYPERICACEAE

32. HYPERICUM L.

55. ***H. elongatum*** Ledep subsp. ***microcalycinum*** (Boiss. & Heldr.) Robson

Behind Yalıncak, open places, c. 950 m, 19.6.1999, Baş 817. **Ir-Tur element.**

56. ***H. avuculariifolium*** Jaub. & Spach

Below Yalıncak, open places inside the forest, c. 950 m, 10.6.2000, Baş 849. **Endemic, Ir-Tur element.**

57. ***H. perforatum*** L.

Beside the Konya road, c. 1100 m, 16.7.1998, Baş 742.

13. MALVACEAE

33. MALVA L.

58. ***M. sylvestris*** L.

Around dormitories, under trees, c. 900 m, 12.8.1999, Baş 835.

34. ALCEA L.

59. ***A. pallida*** Waldst. & Kit.

Beside Konya road, c. 1100 m, 16.7.1998, Baş 709.

14. LINACEAE

35. LINUM L.

60. ***L. flavum*** L. subsp. ***scarinerve*** (Davis) Davis

Around new staff house, open area, c. 850 m, 26.6.1997, Baş 431. **Endemic Ir-Tur element.**

61. ***L. nodiflorum*** L:

Slopes facing Bilkent, open places, c. 1000 m, 29.5.1999, Baş 782. **Medit. element.**

62. ***L. hirsutum*** L. subsp. ***anatolicum*** (Boiss.) Hayek. var. ***anatolicum***.

Below Yalıncak, open places inside the forest, c. 900 m, 10.6.2000, Baş 845. **Endemic, Ir-Tur element**.

15. GERENIACEAE

36. GERENIUM L.

63. ***G. tuberosum*** L.

Behind Yalıncak, open places, c. 950 m, 2.5.1999, Baş 748.

37. ERODIUM L'.He'rit.

64. ***E. ciconium*** (L.) L' He'rit.

Around Yalıncak, c. 1000 m,19.4.1998, Baş 630

65. ***E. cicutarium*** (L.) L'He'rit. subsp. ***cicutarium*** Ic: Ross-Craig.

Around new biology building, inside the forest, c. 875 m, 28.5.1997, Yılmaz- Baş 183. **Med. element**.

66. ***E. acaule*** (L.) Becher & Thell.

Around purification foundation, c. 850 m, 29.3.1997, Baş 7. **Med.element**

16. RHAMNACEAE

38. RHAMNUS L.

67. ***R. oleoides*** L. subsp. ***graecus*** (Boiss. & Reut.) Holmboe

Above Yalıncak, c. 1100, 7.6.1997, Baş 405. **Med. element.**

17. FABACEAE

39. CERCIS L.

68. ***C. siliquastrum*** L. subsp. siliquastrum

Behind physics, c. 875 m, 20.5.1997, Baş 118.

40. GENISTA L.

69. ***G. sessilifolia*** DC.

Around new staff house, c. 850 m, 26.6.1997, Baş 477. **Ir-Tur element**.

41. ROBINIA L.

70. ***R. pseudoacaia*** L.

Yalıncak, near fountain, c.1000 m, 29.5.1999, Baş 815.

42. COLUTEA L.

71. *C. cilicica* Boiss.& Bal.

Çamlık jogging track, c. 900 m, 28.6.1997, Baş 520.

43. ASTRAGALUS L.

72. ***A. hamosus*** L.

Above Yalıncak, deep soil on calcerous rock, open places, c.1100 m, 7.6.1997, Baş 356.

73. ***A. microcephalus*** Willd.

Beside Konya road, c. 1100 m, 16.7.1998, Baş 723. **Ir-Tur element**.

74. ***A. micropterus*** Fischer

Around new staff house, c. 850 m, 26.6.1997, Baş 454. **Endemic, Ir-Tur element.**

75. ***A. brachypterus*** Fischer

Above aeronautical engineering, c. 950 m, 29.5.1999, Baş 772. **Endemic, Ir-Tur element.**

76. ***A. lycius*** Boiss.

Around new biology building, c. 875 m, 28.5.97, Baş 159. **Endemic**.

77. ***A. angustifolius*** Lam.

Above Yalıncak deep soil on calcareous rock, open places, c. 1100 m, 7.6.1997, Baş 355.

78. ***A. vulnerariae*** DC.

Beside Konya road, c. 1100 m,16.7.1998, Baş 735. **Endemic**.

44. VICIAL.

79. ***V. cracca*** L.

Above aeronautical engineering, c. 950 m, 29.5.1999, Baş 777.

80. ***V. noeana*** Reuter ex Boiss.

Behind physics department, c. 875 m, 20.5.1997, Baş 119. **Ir-Tur element**.

45. LENS Miller

81. ***L. orientalis*** (Boiss.) Hand.-Mazz.

Around new biology building, inside the forest, c 875 m, 4.6.1997, Baş 279.

82. ***L. culinaris*** L.

Below prep school, inside the forest, c. 850 m, 28.6.1998, Baş 667.

46. LATHYRUS L.

83. ***L. inconspicuus*** L.

Around new staff house, c. 850 m, 26.6.1997, Baş 439.

84. ***L. cicera*** L.

Around Yalıncak, inside the forest, c. 1000 m, 17.5.1997, Baş 43.

85. ***L. sativus*** L.

Behind physics department, c. 875 m, 20.5.1997, Baş 112.

86. ***L. nissolia*** L.

Above Yalıncak deep soil on calcareous rock, open places, c. 1100 m, 7.6.1997, Baş 341.

87. ***L. aphaca*** L.

Behind physics department, c. 875 m, 20.5.1997, Baş 108

47. PISUM L.

88. ***P. sativum*** L. subsp. ***elatius*** (Bieb.) Aschers.& Graebn.

Around Yalıncak, open places inside the forest, c. 1000 m, 20.5.2000, Baş 837.

48. TRIFOLIUM L.

89. ***T. lucanicum*** Gasp.

Around new biology building inside the forest, c. 875 m, 4.6.1997, Baş 276. **Med. element**.

90. ***T. arvense*** L.

Beside Konya road, c. 1100 m, 16.7. 1998, Baş 702.

49. MELILOTUS L.

91. ***M. officinalis*** (L.) Desr.

Around new biology building, inside the forest, c 875m, 4.6.1997, Baş 278.

50. MEDICAGO L.

92. ***M. x varia*** Martyn

Behind the nursery, open places, c 875 m, 28.5.1997, Güleç-Baş 178.

93. ***M. noeana*** Boiss.

Yalıncak road, open area, c. 950 m, 10.6.2000, Baş 858. **Ir-Tur element**.

94. ***M. minima*** (L.) Bart.

Around stadium, open area, c. 900 m, 28.6.1997, Baş 537.

51. LOTUS L.

95. ***L. corniculatus*** L.

Behind Yalıncak, open area, c. 950 m, 19.6.1999, Baş 819.

96. ***L. aegaeus*** (Gris.) Boiss.

Around stdium, open area, c. 900 m, 28.6.1997, Baş530. **Ir-Tur element.**

52. CORONILLA L.

97. ***C. scorpioides*** (L.) Koch

Around Yalıncak, inside the forest, c. 1000 m, 17.5.1997, Baş 44.

98. ***C. varia*** L.

Yalıncak jogging track, inside the forest, c. 950 m,28.6.1997, Baş 561.

53. HEDYSARUM L.

99. ***H. varium*** Willd.

Below prep school, inside the forest, c. 850 m, 28.6.1998, Baş 665. **Ir-Tur element.**

54. ONOBRYCHIS Adans.

100. ***O. montana*** DC. Subsp. ***cadmea*** (Boiss.) P. W. Ball

Around new staff house, c. 850 m, 26.6.1997, Baş 476.

101. ***O. viciifolia*** Scop.

Below prep school, inside the forest, c. 850 m, 28.6.1998, Baş 666.

102. ***O. tournefortii*** (Willd.) Desv.

Around library, c. 875 m, 28.6. 1998, Baş697. **Endemic.**

55. ALHAGI Adans.

103. ***A. pseudalhagi*** (Bieb.) Desv.

Yalıncak, beside the stream, under trees, c. 950 m, 26.8.2000, Baş 865. **Ir-Tur element.**

18. ROSACEAE

56. AMYGDALUS L.

104. ***A. x balansae*** Boiss.

Ahlatlıbel, c. 1150 m, 12.4.1998, Baş 615. **Endemic.**

57. POTENTILLA L.

105. ***P. argentea*** L.

Çamlık jogging track, inside the forest, c. 900 m, 28.6.1997, Baş 517.

106. ***P. recta*** L.

Below Yalıncak, c. 950 m, 10.6.2000, Baş 848.

58. AGRIMONIA L.

107. ***A. eupatoria*** L.

Above Yalıncak, open places, c. 1100 m, 5.7.1997, Baş 574.

59. SANGUISORBA L.

108. ***S. minor*** Scop. subsp.***muricata*** (Spach) Briq.

Around new biology building, c. 875 m, 4.6.1997, Baş 258.

60. ROSA L.

109. ***R. foetida*** J. Herrm.

Above Yalıncak, c. 1100 m, 7.6.1997, Baş 368. **Ir-Tur element**.

110. ***R. canina*** L.

Yalıncak, beside the stream, c. 950 m, 10.6.2000, Baş 857.

61. CRETAEGUS L.

111. ***C. monogyna*** Jacq.

Slopes facing Bilkent, c.1000 m, 29.5.1999, Baş 803.

62. PYRUS L.

112. ***P. eleagnifolia*** Pallas

Yalıncak, jogging track, c.950 m, 19.4.1998, Baş 623.

63. MALUS L.

113. ***M. sylvestris*** Miller.

Behind social science building, c. 875 m, 9.5.1997, Baş 34.

19. LYTHRACEAE

64. LYTHRUM L.

114. ***L. salicaria*** L.

Below prep school inside the forest, c. 850 m, 28.6.1998, Baş 661. **Euro-Sib element.**

20. CRASSULACEAE

65. SEDUM L.

115. ***S. acre*** L.

Above Yalıncak, deep soil on calcareous rock, c. 1100 m, 7.6.1997, Baş 332.

21. SAXIFRAGACEAE

66. SAXIFRAGA L.

116. ***S. tridactylites*** L.

Around new biology building, inside the forest, c. 875 m, 4.6.1997, Baş 266.

22. APIACEAE

67. ERYNGIUM L.

117. ***E. campestre*** L.

Around new staff house, c. 850 m, 26.6.1998, Baş 468.

68. BIFORA Hoffm.

118. ***B. radians*** Bieb.

Above Yalıncak on calcareous soil, open places, c. 1100 m, 7.6.1997, Baş 425.

69. CONIUM L.

119. ***C. maculatum*** L.

Near Yalıncak fountain, c. 1000 m, 29.5.1999, Baş 814.

70. BUPLEURUM L.

120. ***B. croceum*** Fenzl

Below prep school inside the forest, c. 850 m, 28.6.1998, Baş 675. **Ir-Tur element.**

121. ***B. sulphureum*** Boiss. & Bal.

Beside Konya road, c. 1100m, 16.7.1998, Baş 706. **Endemic, Ir-Tur element.**

71. FALCARIA L.

122. ***F. vulgaris*** Brenh.

Aroun new biology building inside the forest, c. 875 m, 4.6.1997, Baş 268.

72. PEUCEDANUM L.

123. ***P. palimbioides*** Boiss.

Around new biology building inside the forest, c. 875 m, 28.5.1997, Baş 142. **Endemic, Ir-Tur element.**

73. TURGENIA L.

124.***T. latifolia*** (L.) Hoffm.

Below prep school inside the forest, c 850 m, 28.6.1998, Baş 674.

74. ORLAYA L.

125. ***O. daucoides*** (L.) Greuter.

Above Yalıncak, deep soil on calcareous rock, c. 1100 m, 761997, Baş 375. **Medit. element.**

75. DAUCUS L.

126. ***D. carota*** L.

Around new staff house, c. 850 m, 26.6.1997, Baş 435.

76. ARTEDIA L.

127. ***A. squamata*** L.

Around new staff house, c. 850 m, 26.7.1997, Baş 436.

23. CAPRIFOLIACEAE

77. LONICERA L.

128. ***L. caucasica*** Pallas subsp. ***orientalis*** (Lam) Cham & Long

Around chemical engineering, c. 900 m, 19.4.1998, Baş 642. **Endemic**

24. VALERIANACEAE

78. VALERIANA L.

129. ***V. tuberosa*** L.

Above Yalıncak, deep soil on calcareous rock, open places, c. 1100 m, 7.6.1997, Baş 378.

79. VALERIANELLA Miller

130. ***V. carinata*** Lois.

Around new biology building, inside the forest, c. 875 m, 4.6.1997,Baş 267.

131. ***V. pumila*** (L.) DC.

Near chemichal engineering, c. 875 m, 19.4.1998, Baş 641.

132. ***V. vesicaria*** (L.) Moench

Around Yalıncak, inside the forest, c. 1000 m, 17.5.1997, Baş 77.

25. MORINACEAE

80. MORINA L.

133. ***M. persica*** L.

Above Yalıncak, open area, c. 1100 m, 5.7.1997, Baş 564. **Ir-Tur element**.

26. DIPSACACEAE

81. SCABIOSA L.

134. ***S. argentea*** L.

Beside Konya road, c. 1100 m, 16.7.1998, Baş 716.

135. ***S. hispidula*** Boiss.

Around new staff house, c. 850 m, 26.6.1997, Baş 448.

136. ***S. rotata*** Bieb.

Around new staff house, c. 850m, 26.6.1997, Baş 472. **Ir-Tur element.**

27. ASTERACEAE

82. XANTHIUM L.

137. ***X. strumarium*** L.

Yalıncak, beside the road, open area, c. 900 m, 26.8.2000, Baş 868.

83. INULA L.

138. ***I. oculus-christi*** L.

Beside Konya road, c. 1100 m, 16.7.1998, Baş 728. **Euro-Sib element.**

84. HELICHRYSUM Gaertner

139. ***H. arenarium*** (L.) Moench subsp. ***aucheri.***

Beside Konya road, c. 1100 m, 16.7.1998, Baş 731. **Ir-Tur element**.

85. SENECIO L.

140. ***S. vulgaris*** L.

Around Yalıncak, inside the forest, c. 1000 m, 17.5.1997, Baş 56.

141. ***S. vernalis*** Waldst. & Kit.

Around new staff house, open area, c. 850 m, 26.6.1997, Baş 458.

86. ANTHEMIS L.

142. ***A. armenica*** Freyn & Sint.

Above Yalıncak on calcareous soil, open places, 7.6.1997, Baş 412. **Endemic, Ir-Tur element.**

143. ***A. cotula*** L.

Around new staff house, c. 850 m, 26.6.1997, Baş 437.

144. ***A. tinctoria*** L.

Around stadium, open places, c. 900 m, 28.6.1997, Baş 535.

145. ***A. triumfettii*** (L.) All.

Beside Konya road, c. 1100 m,16.7.1998, Baş727.

87. ACHILLEA L.

146. ***A. allepica*** DC. subsp. ***allepica***

Around new biology building, inside the forest, c. 875 m, 4.6.1997, Baş 251. **Endemic, Ir-Tur element.**

147. ***A. biebersteinii*** Afan.

Beside Konya road, c. 1100 m, 16.7.1998, Baş 726. Ir-Tur element.

148. ***A. cappadocica*** Hausskn. & Bornm.

Above Yalıncak, deep soil on calcareous rock, open area, c. 1100 m, 7.6.1997, Baş 365. **Endemic, Ir-Tur element.**

88. ONOPORDUM L.

149. ***O. achanthium*** L.

Around new biology building, inside the forest, c. 875 m, 4.6.1997, Baş 253.

89. CARDUUS L.

150. ***C. nutans*** L.

Slopes facing Bilkent, open area, c. 1000 m, 29.5.1999, Baş 788.

151. ***C. pycnocephalus*** L.

Near industrial engineering, c. 900 m, 20.5. 1997, Baş 103.

90. JURINEA Cass.

152. ***J. pontica*** Hausskn. & Freyn ex Hausskn.

Below prep school, inside the forest, c. 850 m, 26.6.1998, Baş 672. **Endemic, Ir-Tur element**.

91. ACROPTILON Cass.

153. ***A. repens*** (L.) DC.

Around new staff house, open area, c. 850 m, 26.6.1997, Baş 463. **Ir-Tur element.**

92 CENTAUREA L.

154. ***C. virgata*** Lam.

Çamlık jogging track, inside the forest, c. 900 m, 16.7.1997, Baş 597. **Ir-Tur element.**

155. ***C. solititialis*** L.

Beside Konya road, c. 1100 m,16.7.1998, Baş 732.

156. ***C. iberica*** Trev. ex Sprengel

Around new biology building, inside the forest, c. 875 m, 4.6.2997, Baş 264.

157. *C.* ***urvillei*** DC. subsp. ***stepposa*** Wagenitz.

Above Yalıncak, open area, c. 1100 m, 5.7.1997, Baş 576. **Ir-Tur element**.

158. *C.* ***carduiformis*** DC.

Around new staff house, c. 850 m, 26.6.1997, Baş 466.

159. *C.* ***pichler*** Boiss.

Above Yalıncak, on calcareous soil, open area, c. 1100 m,7..61997, Baş 418.

160. *C.* ***triumfettii*** All.

Below Yalıncak, c.950 m, 5.7.1997, Baş 590.

161. *C.* ***depressa*** Bieb.

Below prep school, c. 850 m, 28.6.1998, Baş 671.

93. CRUPINA (pers.) DC.

162.*C.* ***crupinastrum*** (Moris) Vis.

Çamlık jogging track, inside the forest, c. 900 m, 28.6.1997, Baş 516.

94. XERANTHEMUM L.

163. *X.* ***annuum*** L.

Below Yalıncak, c. 950 m, 5.7.1997, Baş 592.

95. CHARDINIA Desf.

164. *C.* ***orientalis*** (L.) O. Kuntze

Around new biology building, inside the forest, c. 875 m, 4. 6.1997, Baş 255. **Ir-Tur element**.

96. ECHINOPS L.

165. *E.* ***ritro*** L.

Çamlık jogging track, inside the forest, c. 900 m, 16.7.1997, Baş 598.

97. CICHORIUM L.

166. *C.* ***intybus*** L.

Around library, c. 875 m,16.7.1997, Baş 600.

98. TRAGOPOGON L.

167.***T. porrifolius*** L.

Yalıncak, beside the stream, wet ground, c. 900 m, 10.6.2000, Baş 856. **Med. element.**

168. ***T. latifolius*** Boiss.

Below prep school, inside the forest, c. 850 m, 28. 6. 1998, Baş 660. **Ir-Tur element.**

169. ***T. buphthalmoides*** (DC.) Boiss.

Near nursery, open places, c. 875 m, 28.5.1997, Aras-Baş 188. **Ir- Tur element.**

99. LEONTODON L.

170. ***L. asperrimus*** (Willd.) J. Ball

Above aeronautical engineering, c. 950 m, 29.5.1999, Baş 774. **Ir-Tur element.**

100. PILOSELLA Hill

171. ***P. x macrotricha*** (Boiss.) C. H. & F. W. Schultz

Beside Konya road, c. 1100 m, 16.7.1998, Baş 715.

101. LAPSANA L.

172. ***L. communis*** L.

Near nursery, c. 875 m, 28.5.1997, Yılmaz & Baş167.

102. TARAXACUM Wiggers

173. ***T. scaturiginosum*** G. Hagl.

Around Yalıncak, inside the forest, c. 1000 m, 17.5.1997, Baş 57.

174. ***T. buttleri*** van Soest.

Behind social science building, c. 875 m, 6.4.1998, Baş 608.

103. CREPIS L.

175. ***C. alpina*** L.

Above Yalıncak, deep soil on calcareous soil an calcareous rock, open area, c. 1100 m, 7.6.1997, Baş 366.

176. ***C. foetida*** L.

Above Yalıncak, open area, c.1100 m, 5.7. 1997, Baş 566.

28. CAMPANULACEAE

104. ASYNEUMA Griseb. & Schenk

177. ***A. virgatum*** (Labill.) Bornm. subsp. ***virgatum***

Above aeronautical engineering, c. 950 m, 29.5.1999, Baş 765.

29. PRIMULACEAE

105. ANDROSACE L.

178. ***A. maxima*** L.

Above Yalıncak, on calcareous soil, open places, c. 1100 m, 7.6.1997, Baş 379.

106. LYSIMACHIA L.

179. ***L. vulgaris*** L.

Near Çamlık housing estate, c. 950 m, 28.6.1997, Baş 548.

107. ANAGALLIS L.

180. ***A. arvensis*** L. var. ***coerulea*** (L.) Gouan

Behind social science building, c. 875 m, 6.6.1998, Baş 653.

30. OLEACEAE

108. JASMINUM L.

181. ***J. fruticans*** L.

Slopes facing Bilkent, upper part, open area, c. 1100 m, 29.5.1999, Baş 797. **Med. element**.

31. APOCYNACEAE

109. VINCA L.

182. ***V. herbaceae*** Woldst. & Kit.

Ahlatlıbel inside the forest, c. 1150 m,12.4 1998, Baş 619.

32. GENTIANACEAE

110. CENTAURIUM Hill

183. *C. pulchellum* (Swartz) Druce

Beside Konya road, c. 1100 m, 16.7.1998, Baş 703.

33. CONVOLVULACEAE

111. CONVOLVULUS L.

184. ***C. lineatus*** L.

Near Çamlık housing estate, step (upper part), c. 950 m, 28.6.1997, Baş 555.

185. ***C. holosericeus*** Bieb. subsp. ***holosericeus.***

Çamlık jogging track, inside the forest, c. 900 m, 28. 6 1997, Baş 509.

186. ***C. arvensis*** L.

Around library, c. 875 m, 28.6.1998, Baş 696.

187. ***C. galaticus*** Rostan ex Choisy

Around stadium, c. 900 m, 28.6.1997, Baş 700. **Endemic, Ir-Tur element**.

34. BORAGINACEAE

112. LAPPULA Fabricius

188. ***L. barbata*** (Bieb.) Gürke

Around new biology building, inside the forest, c. 875 m, 4.6.1997, Baş 234. **Ir-Tur element**.

113. PARACARYUM (DC) Boiss.

189. ***P. racemosum*** (Schereber) Britten var. ***racemosum***.

Above aeronautical engineering, c. 950 m, 29.5.1999, Baş 776. **Endemic, Ir-Tur element.**

190. ***P. ancyritanum*** Boiss.

Around Yalıncak, step, c.1000 m, 17.5.1997, Baş 78. **Endemic, Ir-Tur element.**

114. MOLTKIA Lehm.

191. ***M. coerulea*** (Willd.) Lehm.

Slopes facing Bilkent, open places, c. 1000 m, 29.5.1999, Baş 806. Ir-Tur element.

192. ***M. aurea*** Boiss.

Behind Yalıncak, open palaces, c. 950 m, 2.5. 1999, Baş 745. **Endemic, Ir-Tur element.**

115. ONOSMA L.

193. ***O. tauricum*** Pallas ex Willd.

Above Yalıncak deep soil on calcareous rock, open places, c. 1100 m, 7.6.1997, Baş 353.

194. ***O. aucheranum*** DC.

Above Yalıncak, deep soil on calcareous rock, open places, c. 1100 m, 7.6.1997, Baş353. **East Med. element.**

195. ***O. hebebulbum*** DC.

Below Yalıncak, c. 950 m, 5.7.2997, Baş 585. **Ir-Tur element**.

116. CERINTHE L.

196. ***C. minor*** L. subsp. ***auriculata*** (Ten.) Domac.

Beside Konya road, c. 1100 m, 16.7.1998, Baş 706.

117. ANCHUSA L.

197. ***A. leptophylla*** Roemer & Schultes subsp. ***leptophylla***

Near industrial engineering, c. 900 m, 20.5.1997, Baş104

198. ***A. undulata*** L. subsp. ***hybrida*** (Ten.) Coutinho.

Around Yalıncak, inside the forest, c. 1000 m, 17.5.1997, Baş 62. **Med. element.**

199. ***A. azurea*** Miller

Around new biology building, inside the forest, c. 875 m, 4.6.1997, Baş 242.

118. NONEA Medicus

200. ***N. macrosperma*** Boiss. & Heldr.

Around new biology department, c. 875 m, 9.5.1997, Baş 10. **Endemic, Ir-Tur element.**

35. SOLANACEAE

119. HYOSCYAMUS L.

201. ***H. niger*** L.

Below Yalıncak, open places inside the forest, c. 950 m, 10.6.2000, Baş 853.

202. ***H. reticulatus*** L.

Below Yalıncak, open places inside the forest, c. 950 m, 10.6.2000, Baş 854. **Ir-Tur element**.

36. SCROPHULARIACEAE

120. VERBASCUM L.

203. ***V. ancyritanum*** Bornm.

Çamlık jogging track, inside the forest, c. 900 m,28.6.1998, Baş 701. **Endemic. Ir-Tur element**.

121. SCROPHULARIA L.

204. ***S. xanthoglossa*** Boiss. var. ***decipens*** (Boiss. & Kotschy) Boiss.

Around geological engineering, c. 900 m,29.5.1999, Baş 759. **Ir-Tur element.**

122. VERONICA L.

205. ***V. tryphyllos*** L.

Near Yalıncak jogging track, c. 950 m, 19.4.1998, Baş 626.

206. ***V. samuelssonii*** Rech.

Around purification foundation, wet ground, c. 850 m, 29.3.1997, Baş 6. **East Med. element**.

207. ***V. persica*** Poiret

Behind mathematics department, c. 875 m, 6.4.1998, Baş 606.

208. ***V. pectinata*** L.

Around Yalıncak, inside the forest, c. 1000 m, 17.5.1997, Baş 60.

209. ***V. multifida*** L.

Around new biology building, inside the forest, c. 875 m, 4.6.1997, Baş 269. **Endemic, Ir-Tur element.**

37. OROBANCHACEAE

123.OROBANCHE L.

210. ***O. oxyloba*** (Reuter) G. Beck

Beside Konya road, c. 1100 m, 16.7.1998, Baş 710.

211. ***O. minor*** Sm.

Below prep school, inside the forest, c.850 m, 28.6.1998, Baş 659.

212. ***O. anatolica*** Boiss. & Reuter.

Around new staff house, c.850 m, 26. 6. 1997, Baş 429.

38. ACANTHACEAE

124. ACANTHUS L.

213. ***A.hirsutus*** Boiss.

Above Yalıncak, calcareous soil, open places, c.1100 m, 7.6.1997, Baş 423. **Endemic, Ir-Tur element .**

39. GLOBULARIACEAE

125. GLOBULARIA L.

214. ***G. orientalis*** L.

Beside Konya road, c. 1100 m, 16.7.1998, Baş 708. **Ir-Tur element.**

215. ***G. trichosantha*** Fisch. & Mey.

Ahlatlıbel, c. 1150 m, 12.4.1998, Baş 617.

40. LAMIACEAE

126. AJUGA L.

216. ***A. salicifolia*** (L.) Schreber

Above Yalıncak, c. 1100 m, 7.6.1997, Baş 420. **Ir-Tur element.**

217. ***A. chamaecpitys*** (L.) Schreber

Around library, c. 875 m, 21.5.1997, Baş 133.

127. TEUCRIUM L.

218. ***T. pruinosum*** Boiss.

Above Yalıncak, open area, c.1100 m, 5ç7ç1997, Baş 570. **Ir-Tur element.**

219. ***T. chamaedrys*** L. subsp. ***chamaederys.***

Near Çamlık housing estate, open area, c.950 m, 28.6.1997, Baş 551. **Euro-Sib. Element.**

220. ***T. polium*** L.

Around new staff house, c. 850 m, 26.6.1997, Baş 459.

128. SCUTELLARIA L.

221. ***S. orientalis*** L. subsp. ***pectinata*** (Bentham) Edmondson

Çamlık jogging track, inside the forest, c. 900 m, 28.6.1997, Baş 521. **Endemic, Ir-Tur element.**

129. PHLOMIS L.

222. ***P. pungens*** Willd.

Çamlık jogging track, inside the forest, c. 900 m, Baş 515.

130. LAMIUM L.

223. ***L. amplexicaule*** L.

Around Çamlık jogging track, inside the forest, c.900 m, 19.4.1998, Baş 636. **Euro-Sib element**.

224. ***L. purpureum*** L.

Yalıncak, beside the stream, c. 950 m, 2.5.1999, Baş 751. **Euro-Sib element**.

131. WIEDEMANNIA Fisch. & Mey.

225. ***W. orientalis*** Fisch. & Mey.

Around Yalıncak, inside the forest, c. 1000 m, 17.5.1997, Baş 58. **Endemic, Ir-Tur element.**

132. MARRUBIUM L.

226. ***M. parviflorum*** Fisch. & Mey. subsp. ***oligodon*** (Boiss.) Seybold

Around new biology building, c. 875 m, 4.6.1997, Baş 219. **Endemic**.

133. STACHYS L.

227. ***S. cretica*** L. subsp. ***anatolica*** Rech.

Around library, c. 875 m, 28.6.1998, Baş 695. **Endemic, Ir-Tur element.**

228. ***S. iberica*** Bieb.

Below Yalıncak, c. 950 m, 5.7.1997, Baş 587. **Ir-Tur element**

229. ***S. annua*** (L.) L. var. ***lycaonica*** Bhattacharjee

Around Çamlık jogging track, c.900 m, 28.6.1997, Baş 513. **Ir-Tur element**.

134. NEPETA L.

230. ***N. nuda*** L.

Above Yalıncak, open places, c. 1100 m, 7.6.1997, Baş 372.

135. PRUNELLA L.

231. ***P. orientalis*** Bornm.

Near Çamlık housing estate, open places, c. 950 m, 16.7.1997, Baş 594.

142. ACINOS Miller

232. ***A. rotindifolius*** Pres.

Below prep school, inside the forest, c. 850 m, 28.6. 1998, Baş 655.

136. THYMUS L.

233. ***T. longicaulis*** C. Persl

Behind Yalıncak, open places, c. 950 m, 19.6.1999, Baş 818.

137. ZIZIPHORA L.

234. ***Z. capitata*** L.

Below prep school, inside the forest, c.850 m, 28.6. 1998, Baş 663. **Ir-Tur element.**

138. SALVIA L.

235. ***S. tchihatcheffii*** (Fisch. & Mey.) Boiss.

Around new biology building, inside the forest, c. 875 m, 4.6.1997, Baş 233. **Endemic, Ir-Tur element.**

236. ***S. cryptantha*** Montbret & Aucher ex Bentham

Around Yalıncak, step, c. 1000 m, 17.5.1997, Baş 95. **Endemic, Ir-Tur element.**

237. ***S. hypargeia*** Fisch. & Mey.

Around stadium, open places, c.900 m, 28.6.1997, Baş 532. **Endemic Ir-Tur element.**

238. ***S. sclarea*** L.

Below Yalıncak, c. 950 m, 5.7.1997, Baş 588.

239. ***S. aethiopis*** L.

Around new biology building, c. 875 m, 28. 5.1997, Baş 152.

240. ***S. cyanescens*** Boiss. & Bal.

Beside Konya road, c. 1100 m, 16.7.1998, Baş 725. **Endemic, Ir-Tur element.**

241. ***S. virgata*** Jacq.

Near prep school, c. 850 m, 28.6. 1998, Baş 687. **Ir-Tur element**.

242. ***S. verticillata*** L.

Around new staff house, c. 850 m, 26.6.1997, Baş 457. **Ir-Tur element**.

243. ***S. russellii*** Bentham

Below new biology building, c. 850 m, 28.6.1998, Baş 689. **Ir-Tur element**.

41. PLANTAGINACEAE

139. PLANTAGO L.

244. ***P. holosteum*** Scop.

Beside Konya road, c. 1100 m, 16.7.1998, Baş 721. **Med. element.**

245. ***P. lanceolata*** L.

Around new staff house, open places, c. 850 m, 26.6.1997, Baş 445.

42. ELAEAGNACEAE

140. ELAEAGNUS L.

246. ***E. angustifolia*** L.

Around the department of architecture, c. 875 m, 4.6.1997, Baş 330.

43. LORANTHACEAE

141. VISCUM L.

247. ***V. album*** L.

Around Yalıncak deep soil on calcareous rock, open places, 7.6.1997, Baş 333.

44. ARISTOLOCHIACEAE

142. ARISTOLOCHIA L.

248. ***A. maurorum*** L.

Around Yalıncak, open places, c. 950 m, 20.5.2000, Baş 838. **Ir-Tur element.**

45. ULMACEAE

143. ULMUS L.

249. ***U. glabra*** Hudson

Near nursery, c. 875 m, 19.4.1998, Baş 648. **Euro-Sib element**.

46. EUPHORBIACEAE

144. EUPHORBIA L.

250. ***E. macroclada*** Boiss.

Çamlık jogging track, inside the forest, c. 900 m, 28.6.1997, Baş 519. **Ir-Tur element.**

47. PLATANACEAE

145. PLATANUS L.

251. ***P. orientalis*** L.

Behind social science building, c 875 m, 27.5.1998, Baş 651.

48. FAGACEAE

146. QUERCUS L.

252. ***Q. robur*** L.

Above stadium, c. 900 m, 10.6.2000, Baş 860. **Euro-Sib element.**

49. SALICACEAE

147. SALIX L.

253. ***S. babylonica*** L.

Behind physics, c. 875 m, 19.4.1998, Baş 645.

148. POPULUS L.

254. ***P. alba*** L.

Behind civil engineering, c.875 m, 2.5.1999, Baş 754.

50. RUBIACEAE

149. ASPERULA L.

255. ***A. pestalozzae*** Boiss.

Above Yalıncak, deep soil on calcareous rock, open places, c. 1100 m, 7.6.197, Baş 344. **Endemic, Euro-Sib element.**

150. GALIUM L.

256. ***G. verum*** L. subsp. ***verum***

Beside Konya road, c. 1100 m, 16.7.1998, Baş 717. **Euro-Sib element.**

257. ***G. spurium*** L. subsp. ***ibicinum***

Around new biology building, inside the forest, c. 875 m, 4.6.1997, Baş 236. **Ir-Tur element.**

258. ***G. floribundum*** Sm. subsp. ***floribundum***

Below prep school, inside the forest, c. 850 m, 28.6.1998, Baş 658. **Ir-Tur element.**

151. CRUCIATA Miller

259. ***C. taurica*** (Pallas ex Willd.) Ehrend.

Behind Yalıncak, open places, c.950 m, 2.5.1999, Baş 743. **Ir-Tur element**

MONOCOTILEDONAE

51. LILIACEAE

152. ALLIUM L.

260. ***A. wiedemannianum*** Regel

Beside Konya road, c. 1100 m, 16.7.1998, Baş 712. **Ir-Tur element.**

261. ***A. atroviolaceum*** Boiss.

Around new staff house, c. 850 m, 26.6.1997, Baş 434.

262. ***A. scorodoprasum*** L. subsp. ***rotundum*** (L.) Steam

Above Yalıncak, deep soil on calcareous rock, open place, c. 1100 m, 7.6.1997, Baş 336. **Med. element.**

263. ***A. sphaerocephalon*** L.

Near Çamlık housing estate, upper part, step, c. 950 m, 28.6.1997, Baş 546. **Euro-Sib element.**

264. ***A. stylosum*** O. Schwarz.

Slopes facing Bilkent, open area, c. 1000 m, 10.6.2000, Baş 840. **Endemic, Ir-Tur element.**

153. ORNITHOGALUM L.

265. ***O. narbonense*** L.

Around new biology building, inside the forest, c. 875 m, 4.6.1997, Baş 215. **Med. element.**

154. MUSCARI Miller

266. ***M. tenuiflorum*** Tausch

Yalıncak, beside the stream, c. 950 m, 19.4.1998, Baş 620.

267. ***M. neglectum*** Guss.

Yalıncak beside the stream, c. 950 m, 2.5.1999, Baş 749.

155. BELLEVALIA Lapeyr.

268. ***B. clusiana*** Griseb.

Around new biology building, inside the forest, c. 875 m, 9.5.1997, Baş 9.**Endemic, Ir-Tur element**.

156. GAGEA Salisb.

269. ***G. peduncularis*** (J. & C. Persl) Pascher

Around purification foundation, c. 850 m, 29.3.1997, Baş 2. **Med. element**.

52. IRIDACEAE

157. CROCUS L.

270. ***C. olivieri*** Gay subsp. ***olivieri***

Ahlatlıbel, inside the forest, c. 1150 m, 12.4.1998, Baş 613.

53. ORCHIDACEAE

158. ORCHIS L.

271. ***O. laxiflora*** Lam.

Yalıncak, beside the stream, wet ground, c. 950 m, 19.6.1999, Baş 825. **Med. Element**

54. JUNCACEAE

159. JUNCUS L.

272. ***J. sparganiifolius*** Boiss. & Kotschy ex Buchenau

Around new biology building, inside the forest. c. 875 m. 4.6.1997. Baş 283. **Endemic, East Med. element**

273. ***J. articulatus*** L.

Çamlık jogging track, inside the forest, c. 900 m, 28.6.1997, Baş 521. **Euro-Sib element.**

55. CYPERACEAE

160. CAREX L.

274. ***C. divisia*** Hudson

Around new staff house, c. 850 m, 26.6.1997, Baş 479. **Euro-Sib element.**

275. ***C. melunostachya*** Bieb. ex Willd.

Above Yalıncak, deep soil on calcareous, rock, c. 1100 m, 7.6.1997, Baş 392.

276. ***C. distans*** L.

Yalıncak, beside the stream, c. 950 m, 2.5.1999, Baş 750.

56.POACEAE

161. TRACHYNIA Link

277 ***T. distachya*** (L) Link

Around new biology building, inside the forest, c. 875 m, 4.6.1997, Baş311. **Med. Element**.

162. AGROPYRON Gaertner

278. ***A. cristatum*** (L) Gaertner

Around new staff house, open area, 26.6.1997, Baş 502.

163. ELYMUS L.

279. ***E. repens*** (L) Gould

Beside Konya road, c. 1100 m, 16.7.1998, Baş 740. **Ir-Tur Element**

280. ***E. hispidus*** (Opiz) Melderiz subsp. ***hispidus***

Below prep school, inside the forest, c. 850 m, 28.6.1998, Baş 677.

164. EREMOPYRUM (Ledeb.) Jaub. et Spach

281. ***E. triticeum*** (Gaertner) Nevski

Above Yalıncak, on calcareous soil open places, 7.6.1997, Baş 399.

165. AEGILOPS L.

282. ***Ae. speltoides*** Tausch

Around new biology building, inside the forest, c. 875 m, 4.6.1997, Baş 325.

283. ***Ae. markgrafii*** (Greuter) Hammer

Around architecture, c. 875 m, 28.5.1997, Baş 165. **East Med. element.**

284. ***Ae. cylindirica*** Host

Around stadium, upper part , open places, c. 900 m, 28.6.1997, Baş 544. **Ir-Tur element.**

285. ***Ae. umbellulata*** Zhukovsky subsp. ***umbellulata***

Around new staff house, open places, c. 850 m, 26.6.1997, Baş 499. **Ir-Tur element.**

286. ***Ae. triuncialis*** L. subsp. ***triuncialis***

Around Yalıncak, step, c. 1000 m, 17.5.1997, Baş 94.

287. ***Ae. geninculata*** Roth

Around new biology building, inside the forest, c. 875 m, 4.6.1997, Baş 310. **Med. element**.

166. TRITICUM L.

288. ***T. baeoticum*** Boiss.

Around Yalıncak, step, c. 1000 , 17.5.1997, Baş 93.

167. HORDEUM L.

289. ***H. murinum*** L.

Behind physics department, near road, c. 875 m, 20.5.1997, Baş 123.

290. ***H. bulbosum*** L.

Above Yalıncak, calcareous soil, open places, c. 1100 m, 7.6.1997, Baş 396.

168. TAENIATHERUM Nevski

291. ***T. caput-medusae*** (L.) Nevski

Above Yalıncak, open places, c. 1100 m, 5.7.1997, Baş 579.

169. BROMUS L.

292. ***B. intermedius*** Guss.

Around new biology building, inside the forest, c. 875 m, 4.6.1997, Baş 328.

293. ***B. japonicus*** Thunb.

Above Yalıncak, calcareous soil, open places, c. 1100 m, 7.6.1997, Baş 409.

294. ***B. tectorum*** L.

Around Yalıncak, step, c. 1000 m, 17.5.1997, Baş 86.

295. ***B. sterilis*** L.

Around new biology building, inside the forest, c. 875 m, 4.6.1997, Baş 306.

296. ***B. faciculatus*** C. Persl.

Around department of architecture, c. 875 m, 28.5.1997, Baş 164. **East Med. element.**

297. ***B. cappadocicus*** Boiss. & Bal. subsp. ***cappadocicus***

Slopes facing Bilkent, c. 1000 m, 29.5.1999, Baş 810.

170. AVENA L.

298. ***A. sterilis*** L.

Near prep school, c. 850 m, 28.6.1998, Baş 688.

299. ***A. sativa*** L.

Around Yalıncak, inside the forest, c. 1000 m, 17.5.1997, Baş 64.

171. KOELERIA Pers.

300. ***K. cristata*** (L.) Pers.

Çamlık jogging track, inside the forest, c. 900 m, 28.6.1997, Baş 523.

172. ALOPECURUS L.

301. ***A. arundinaceus*** Poiret

Around Yalıncak, inside the forest, c. 1000 m, 17.5.1997, Baş 72. **Euro-Sib. Element.**

302. ***A. myosuroides*** Hudson var. ***myosuroides***

Near chemical engineering, c. 900 m, 19.4.1998, Baş 643. **Euro-Sib. Element.**

173. PHLEUM L.

303. ***P. exaratum*** Hochst. Ex Griseb.

Around Yalıncak, deep soil on calcareous rock, c. 1100 m, 7.6.1997, Baş 395.

174. FESTUCA L.

304. ***F. arundinacea*** Schreber subsp. ***arundinacea***

Near geological engineering, c. 900 m, 29.5.1999, Baş 764.

305. ***F. heterophylla*** Lam.

Above aeronautical engineering, c. 900 m, 29.5.1999, Baş 780. **Euro-Sib element.**

175. LOLIUM L

.306. ***L. perenne*** L.

Around stadium, open places, c. 900 m, 28.6.1997, Baş 539. **Euro-Sib element.**

307. ***L. rigidum*** Gaudin.

Near nursery, inside the forest, c. 875 m, 28.5.1997, Şahin & Baş 205.

308. ***L. multiflorum*** Lam.

Around new staff house, open area, c. 850 m, 26.6.1997, Baş 482.

176. VULPIA C. C. Gmelin

309. ***V. fasiculata*** (Forsskal) Fritsch

Near Yalıncak fountain, c. 1100 m, 29.5.1999, Baş 816. **Med. element.**

310. ***V. ciliata*** Dumort

Near nursery, inside the forest, c. 875 m, 28.5.1997, Dalkılıç & Baş 210.

311. ***V. unilateralis*** (L.) Stace

Around new biology building, inside the forest, c. 875 m, 4.6.1997, Baş 293.

177. POA L.

312.***P. trivialis*** L.

Yalıncak, Beside the stream, c. 950 m, 19.6.1999, Baş 830.

313. ***P. pratensis*** L.

Beside Konya road, 16.7.1998, Baş 712.

314. ***P. nemoralis*** L.

Above Yalıncak deep soil on calcareous rock, open places, c. 1100 m, 7.6.1997, Baş 401.

315. ***P. bulbosa*** L.

Around Yalıncak, step, c. 1000 m, 17.5.1997, Baş 85.

178. PUCCINELLA Parl.

316. ***P. distans*** (Jacq.) Parl.

Near nursery, open area, c. 875 m, 28.5.1997, Güner & Baş 204.

179. SCLERCHLOA P. Beauv.

317. ***S. dura*** (L.) P. Beauv.

Around Yalıncak, inside the forest, c. 1000 m, 17.5.1997, Baş 67. **Euro-Sib element.**

180. DACTYLIS L.

318. ***D. glomerata*** L.

Behind Yalıncak, open area, c. 950 m, 19.6.1999, Baş 822.

181. BRIZA L.

319. ***B. media*** L.

Around new biology building , inside the forest, c. 875 m, 4.6.1997, Baş 329.

182. ECHINARIA Desf.

320. ***E. capitata*** (L.) Desf.

Around Yalıncak, inside the forest, c. 1000 m, 17.5.1997, Baş 65.

183. MELICA L.

321. ***M. uniflora*** Retz.

Near Çamlık housing estate, upper part, open places, c. 950 m, 16.7.1997, Baş 595. **Euro-Sib element.**

322. ***M. penicillaris*** Boiss. & Bal.

Below prep school, inside the forest, c. 850 m, 28.6.1998, Baş 677. **Ir-Tur element.**

323. ***M. ciliata*** L.

Above Yalıncak, open area, c. 1100 m, 5.7.1997, Baş 578.

184. STIPA L.

324. ***S. holosericea*** Trin

Near Çamlık housing estate, upper part, step, c. 950 m, 28.6.1997, Baş 558. **Ir-Tur element.**

325. ***S. lessingiana*** Trin. & Rupr.

Around new staff house, open area, c. 850m, 26.6.1997, Baş 494.

185. PHRAGMITES L.

326. ***P. australis*** (Cav.) Trin. ex Steudel

Yalıncak, near the stream, c. 950 m, 2.5.1999, Baş 752. **Euro-Sib element**.

186. DIGITARIA Heister ex Haller

327. ***D. sanguinalis*** (L.) Scop.

Below Yalıncak, beside the road, c. 900 m, 26.8.2000, Baş 866.

187. PENNISETUM L.C. M. Richard

328. ***P. orientale*** L.C.M. Richard

Beside Konya road, c. 1100 m, 16.7.1998, Baş 739. **Ir-Tur element.**

188. CHRYSOPOGON Trin.

329. ***C. gryllus*** (L.) Trin

Beside Konya road, c. 1100 m, 16.7.1998, Baş 737.

189. BOTHRIOCHLOA O. Kuntze

330. ***B. ischaemum*** (L.) Keng

Beside Konya road, c. 1100 m, 16.7.1998, Baş 738.

List of plants which were not collected in this study but stated in "Fieldguide to Flowers of METU campus" (Kaya *et al.* 1999).

57. ACERACEAE

Acer negundo

A. platanoides

58. AMARANTHACEAE

Amaranthus deflexus

22. APIACEAE

Bupleurum rotundifolium

Echinophora tenuifolia (Ir-Tur element)

E. tournefortii (Ir-Tur element)

Foeniculum vulgare

Scandix pecten-veneris

59. ASCLEPIADACEAE

Cynanchum acutum

27. ASTERACEAE

Achillea nobilis

Anthemis cretica

Arctium minus

Bellis perennis

Centaurea drabifolia

C. kotschyii

Chondrilla juncea

Cirsium arvense

Cnicus benedictus

Conyza canadensis

Corlina corymbose (Med. Element)

Lactuca serriola (Euro-Sib. element)

Onopordum turcicum (Ir-Tur element)

Pilosella hoppeana

Picris strigosa (Ir-Tur element)

Pulcaria dycenterica

Scariola viminea

Scolymus hispanicus (Med. element)

Scorzonera cana

Sonchus asper

Taraxacum officinale

T. hybernum

Tragopogon dubius

T. longirostris

Tripleurospermum sevanense

Xanthium spinosum

3. BERBERIDACEAE

Mahonia aquifolium

60. BETULACEAE

Alnus glutinosa

34. BORAGINACEAE

Arnebia decumbens (Ir-Tur element)

Cynoglossum officinale (Euro-Sib. element)

Echium italicum (Med. Element)

Heliotropium ellipticum (Ir-Tur element)

5. BRASSICACEAE

Alyssum murale

A. strigosum

Brassica nigra

Erysimum crassipes

Lepidium latifolium

Sinapis arvensis

9. CARYOPHYLLACEAE

Gypsophila perfoliata

61. CHENOPODIACEAE

Chenopodium album

C. foliosum

Kochia scoparia

Suaeda eltonica

33. CONVOLVULACEAE

Convolvulus elagantissimus (Med. Element)

62. CUPRESSACEAE

Juniperus oxycedrus

26. DIPSACACEAE

Dipsacus laciniatus

Scabiosa micrantha

46. EUPHORBIACEAE

Euphorbia aleppica

E. rigida (Med. element)

17. FABACEAE

Astragalus christianus

A. lydius (Endemic, Ir-Tur element)

A. strictifolus (Ir-Tur element)

Galega officinalis (Euro-Sib element)

Genista aucheri (Endemic, Ir-Tur element)

Glycyrihiza glabra

Melilotus alba

M. indica

Onobrychis hypergyrea

Ononis spinosa

Trifolium pratense

T. repens

T. retusum

48. FAGACEAE

Quercus cerris

32. GENTIANACEAE

Centaurium erythrea

15. GERENIACEAE

Geranium dissectum

63. HIPPOCASTANACEAE

Aesculus hippocastanum

52. IRIDACEAE

Crocus chrysanthus

Gladiolus anatolicus (Endemic, Ir-Tur element)

54. JUNCACEAE

Juncus inflexus

64. JUNGLANDACEAE

Junglans regia

40. LAMIACEAE

Ballota nigra (Endemic, Ir-Tur element)

Lycopus europaus (Euro-Sib element)

Mentha longifolia

Mollucella laevis (Ir-Tur element)

Prunella vulgaris (Euro-Sib element)

Salvia argentea (Med. element)

S. candidissima

S. suffriticosa (Ir-Tur element)

Teucrium parviflorum (Ir-Tur element)

51. LILIACEAE

Gagea villosa (Med. element)

Ornithogallum oligophyllum

13. MALVACEAE

Althea cannabina

Malva neglecta

30. OLEACEAE

Fraxinus exelsior

65. ONAGRACEAE

Epilobium hirsutum

4. PAPAVERACEAE

Fumaria officinalis

F. parviflora

Glaucium flavum

Papaver macrostemum (Ir-Tur element)

41. PLANTAGINACEAE

Plantago major

66. PLUMBAGINACEAE

Plumbago europaea (Euro-Sib element)

56. POACEAE

Cynodon dactylon

Bromus inermis

Setaria viridis

8. POLYGALACEAE

Polygala supina

10. POLYGONACEAE

Polygonum arenastrum

P. lapathifolium

Rumex patienta

67. PORTULACEAE

Portulaca oleracea

2. RANUNCULACEAE

Adonis aestivalis

Consolida orientalis

C. regalis

Nigella segetalis

Ranunculus brutius

R. neopolitanus

18. ROSACEAE

Potentilla reptans

Rosa hemispherica (Ir-Tur element)

Rubus sanctus

50. RUBIACEAE

Cruciata articulata (Ir-Tur element)

Galium aparine

Rubia tinctorium (Ir-Tur element)

36. SCROPHULARIACEAE

Kickxia spuria

Linaria genistifolia (Endemic, Ir-Tur element)

Linaria iconia (Endemic, Ir-Tur element)

Odontites verna (Euro-Sib element)

Scrophularia canina (E. Med. element)

S. scopolii

Veronica polita

68. TAXACEAE

Taxus baccata

69. TYPHACEAE

Typha latifolia

70. URTICACEAE

Urtica dioica (Euro-Sib element)

24. VALERIANACEAE

Valeriana dioscoridis (E. Med. element)

71. VERBANACEAE

Verbana officinalis

72. ZYGOPHYLLACEAE

Tribulus terrestris

CHAPTER 6

DISCUSSION

During this study 869 plant specimens were collected in the campus area between March 1997 and August 2000. Identification of plant specimens has shown that this collection is composed of 56 families, 189 genera and 330 species.

Another study called "Fieldguide to Wildflowers of METU" was made in the same area by Kaya *et al.*(1999) and contains plants which were not collected in our study. The list of these plant species were given in Chapter 5. Plants given in this list is made up of 16 families 62 genera and 133 species.

Collectively, the flora of METU campus is composed of 72 families, 251 genera and 463 species. 21 species are not native to METU but they are cultivated. These species are given below.

Acer platonoides
Acer negundo
Aesculus hippocastanum
Alnus glutinosa
Berberis vulgaris
Cedrus libani
Cercis siliquastrum
Fraxinus exelcior
Juglans regia
Juniperus oxycedrus
Lonicera caucasica
Mahonia aquifolium
Malus sylvestris
Pinus sylvestris
Platanus orientalis
Populus alba
Quercus cerris
Robinia pseudoacacia

Salix babylonica *Ulmus glabra*

Taxus baccata

All of these species belong to the subdivision of Spermatophyta. Gymnospermae subdivision contains 5 species. Angiospermae subdivision contains 458 species. There are 378 species of dicotyledons and 80 species of monocotyledons.

First 10 families which contain the highest number of species are given in Table 6.1 and also interpreted in Figure 6.1. First family which contains the highest number of species is Asteraceae with 67 species. It is followed by Poaceae which contains 57 species, Fabaceae with 49 species, Lamiaceae with 37 species, Brassicaceae with 22 species, Apiaceae with 16 species, Boraginaceae with 16 species, Ranunculaceae with 14 species, Papaveraceae with 14 species and Scrophulariaceae with 14 species. Families which have the same number of plant species are given according to their evolutionary sequence. Total number of species in these 10 families contain 311 species and the other 60 families are composed of 150 species. Thus 69.1% of the whole flora is represented by the first 10 largest families and the remaining 33.9 % is represented by the other 60 families.

Table 6.1. First10 largest families.

Rank	Name of Family	# of Species	Ratio (%)
1	Asteraceae	67	14.5
2	Poaceae	57	12.3
3	Fabaceae	49	10.6
4	Lamiaceae	37	8.0
5	Brassicaceae	22	4.8
6	Apiaceae	16	3.5
7	Boraginaceae	16	3.5
8	Ranunculaceae	14	3.0
9	Papaveraceae	14	3.0
10	Scrophulariaceae	14	3.0
	Other Families	157	33.9
	Total	463	100.0

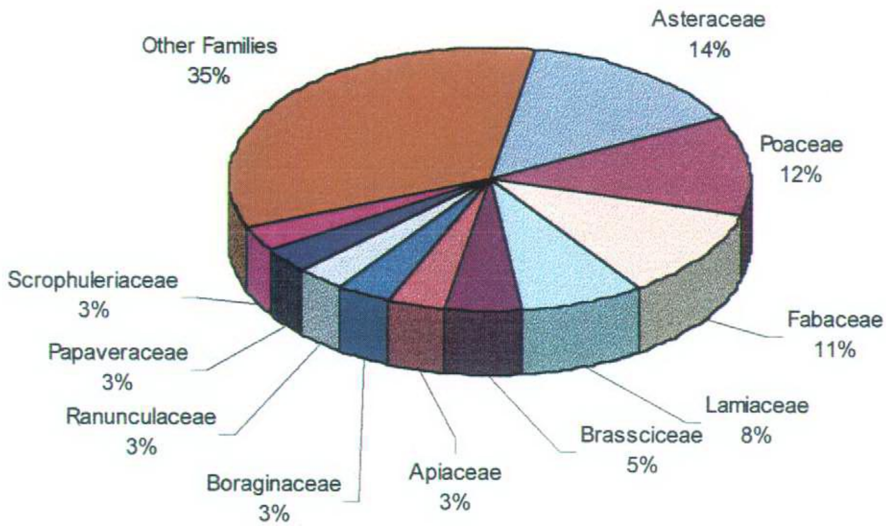

Figure 6.1. First 10 largest families

In terms of the number of species, first 10 richest genera are *Salvia* (12 species), *Astragalus* (10 species),*Centaurea* (10 species), *Ranunculus* (7 species), *Allyssum* (7 species), *Bromus* (7 species), *Papaver* (6 species), *Veronica* (6 species), *Aegulops* (6 species), and *Lathyrus* (5 species). *Trifolium*, *Anthemis*, *Tragopogon*, *Convolvulus*, *Allium* also contains 5 species. All of the genera in this table belong to the first 10 largest families. 76 species belong to the first 10 largest genera. This makes 16.5 % of the total number of species. Remaining 385 species belong to the other 240 genera. Ratio of the species in this group is 83.5% within the total number of species.

Table 6.2. First 10 largest genera

Rank	Name of Genus	# of Species	Ratio (%)
1	*Salvia*	12	2.6
2	*Astragalus*	10	2.2
3	*Centaurea*	10	2.2
4	*Ranunculus*	7	1.5
5	*Alyssum*	7	1.5
6	*Bromus*	7	1.5
7	*Papaver*	6	1.3
8	*Veronica*	6	1.3
9	*Aegulops*	6	1.3
10	*Lathyrus*	5	1.1
	Other genera	387	83.6
	Total	463	100.0

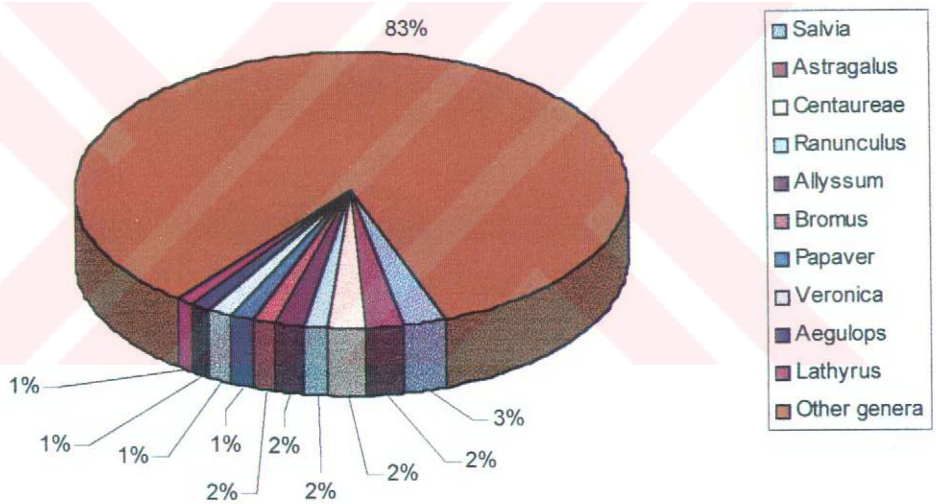

Figure 6.2. First 10 largest genera

When Table 6.1 and 6.2 are examined, it can be seen that the study area mostly contains plants which are the characteristic plants of Ir-Tur phytogeographical region. Table 6.3 also confirms this result.

Table 6.3. Distribution of plants into phytogeographical regions.

PGR	# of species	Ratio (%)
Ir-Tur	106	23.9
Med	35	7.9
Euro-Sib	27	6.1
Unknown or Multiple	274	62.1

Distribution of plants into PGR was determined by checking the information given in "Flora of Turkey" (Davis 1965-1988). Cultivated plant species are excluded in this process. PGRs of 168 species was determined. PGR of remaining 274 native species are unknown or they belong to more than one PGR. 106 species (23.9 % of total) belongs to Ir-Tur PGR, 35 species (7.9% of total) belongs to Med. PGR and 27 species (6.1 % of total) belongs to Euro-Sib. PGR.

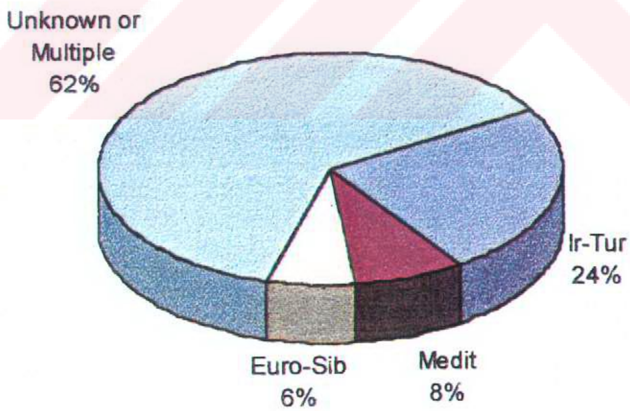

Figure 6.3. Distribution of species on the basis of phytogeographical regions

63.1 % of the plants whose PGR is known belongs to the Ir-Tur PGR. Therefore campus area exhibit typical steppe vegetation except for the artificial afforestation areas. Today a large area of the campus is covered by artificial pine forest. Observations during this study have revealed that many species are in common both in open places (steppe) and afforested areas such as *Globularia orientalis, Linum hirsitum, Linum nodiflorum, Poa bulbosa, Coronilla varia, Coronilla scarpioides,Hydeserum varium, Anthemis tinctoria, Crepis alpina, Scutuleria orientalis, Teucrium polium,* etc. This had also been confirmed by the study performed by Zeydanlı (1998). This study states that afforestation sites have not decreased plant diversity and did not change community structure very much. However, total cover abundance of METU afforestation sites is much less than steppe. Understory within the afforestation areas is not as abundant as open areas. It is also suggested by Zeydanlı (1998) that, as the succession proceeds, even it is a slow progressing process, it may cause changes in the vegetation. This means that in the future plants which are characteristic to the steppe vegetation may disappear from these areas.

Table 6.4 shows the number of endemic plant species which are native to the campus area in the area. There are 47 endemic plant species in the campus and the rate of endemism in the campus is 10.4 %. Rate of endemism of Ankara is calculated as 15.4 % in the "Flora of Ankara City" (Akaydın 1996). Lower rate of endemism in the campus is probably due to the relatively small study area.

Table 6.4. Rate of endemism in the study area.

	# of Species	Ratio (%)
Endemic	47	10.2
Not Endemic	416	89.8
Total	463	100.0

When METU campus flora is compared with "Flora of Ankara City" (Akaydın 1996), it can be deduced that METU campus contains more than 1/3 of the plants found within the boundaries of Ankara. Moreover, 52 plants are found in the flora of METU campus which have not been stated in the flora of Ankara (Akaydın 1996). List of these plant species is given below.

Aegilops markgrafii
Aesculus hippocastanum
Amaranthus deflexus
Arnebia decumbens
Berberis vulgaris
Brassica nigra
Bromus faciculatus
Bromus inermis
Bromus intermedius
Cedrus libani
Cercis siliquastrum
Cnicus benedictus
Convolvulus elagantissimus
Crocus chrysanthus
Cynoglossum officinale
Euphorbia rigida
Fraxinus exelsior
Galium aparine
Geranium dissectum
Gladiolus anatolicus
Glaucium flavum
Gypsophila perfoliata
Juncus inflexus
Juglans regia
Kickxia spuria
Kochia scoparia
Lens culinaris
Lolium multiflorum
Lolium rigidum
Malus sylvestris
Mahonia aquifolium
Melica uniflora
Melilotus indica
Pinus nigra
Pinus sylvestris
Platanus orientalis
Populus alba
Puccinella distans
Ranunculus brutius
Robinia pseudoacacia
Rosa hemispherica
Rumex patienta
Salvia argentea
Salyx babylonica
Scabiosa micrantha
Scrophularia canina
Suaeda eltonica
Taraxacum hybernum
Taraxacum officinale
Tripleurospermum sevanense
Typha latifolia
Valeriana dioscoridis

Plant species found in this study were also compared with the list of plant species of Ankara given in the Database of Plant Species of Turkey (Babaç *et al.* 1992). There are 98 families, 495 genera and 1437 taxa from Ankara province. Therefore METU campus contains more than 2/3 of the families found in Ankara province. At least one half of the genera and approximately 1/3 of the species of flora of Ankara are found in METU campus. Moreover, 48 endemic plant species are found in the campus in comparison with 271 endemic plant species of Ankara. This means that about 18% of the endemic plant species of Ankara are found within the campus. As a conclusion of these comparisons, plant species in METU campus represents a large part of the flora of Ankara. Further studies made in this field may increase the number of plant species stated in the flora of METU campus.

Comparison of flora of METU campus with the list of plants formed according to IUCN categories given in Red Data Book of Turkish Plants (Ekim *et al.* 2000) showed that campus area contains 2 plant species classified in VU (Vulnerable), 2 plant species in LR/cd (Lower Risk/ conservation dependent) and 2 plant species in LR/nt (Lower Risk/ near threatened) categories.

<u>Vulnerable (VU)</u>

Onosma hebebulbum

Suaeda eltonica

<u>Lower Risk/ conservation dependent (LR/cd)</u>

Verbascum ancyritanum

Salvia tchihatcheffii

<u>Lower Risk/ near threatened (LR/nt)</u>

Alyssum blepharocarpum

Minuartia corymbulosa var *corymbulosa*

In addition to this, campus area contain agricultural , vegetable, medicinal and aromatic plant species which are determined as "target species" in National Plan of *in situ* Protection of Plant Genetic Resources (Kaya *et a.l* 1997). Therefore campus area is important both for the protection of plant species given in IUCN categories and for the conservation of plant species which are considered to be genetic resource.

CHAPTER 7

CONCLUSION

METU campus is a protected area within the boundries of Ankara. In addition to the plant species given in "Fieldguide to Wildflowers of METU" (Kaya *et al.* 1999), plant species determined during this study make up a fairly large collection of plant biodiversity. More than 1/3 of the plants given in "Flora of Ankara City" is found in METU campus. Besides this, it has been shown that METU campus is very rich in species of Poaceae family which is an important family in agricultural practices.

Plant diversity in METU campus is crucial both in ecological and economical point of view. Preserving plant biodiversity in natural habitats (*in situ* conservation) is a more efficient way of conservation than *ex situ* conservation of plants. So, protection of the campus will make possible to preserve an area within the city with its relatively high plant diversity together with its natural habitats. The METU campus flora has many economically important plants or their wild relatives. In this respect, if the campus area is protected, it may serve as a plant genetic resource in the future.

Therefore, The METU campus should be saved as a conservation area and necessary measures should be taken to protect the area from the threat of construction. In addition to this, afforestation practices should be applied carefully, since afforestation studies may cause dramatic changes in community structure and habitat conditions in the area. This may result in the loss of steppe plant biodiversity. To prevent this, open areas should be saved within afforested area and afforestation practices should be applied carefully. Ecological consequences of such applications should be taken into consideration.

Finally, it is hoped that this study will be a useful resource in further scientific studies in this area. This flora may be helpful for students studying in this field of science. It is also hoped that specimen collected during this study will be a beginning for the establishment of herbarium which is a well-developed subject in many universities.

REFERENCES

Akaydın, G. 1996. *Ankara Şehri Florası* (Doktara Tezi). Hacettepe Üniversitesi Ankara.

Akman, Y. 1993. *Biyocoğrafya.* Palme yayınları, Ankara:38, 184-192.

Akman, Y. 1999. *İklim ve Biyoiklim.* Kariyer Matbaacılık Ltd. Şti. Ankara.

Babaç,M.T. *et al.* 1992. *Türkiye Bitkileri Veri Tabanı, Türkiye Bilimsel vet Teknik Araştırma Kurumu,* Elazığ.

Benson, L. 1962. *Plant Taxonomy.* The Roland Press Company, New York.

Campbell, A. S. (ed.) 1971. *Geology and History of Turkey.* The Petroleum Exploration Society of Libya on the Occasion of the 13th Annual Field Conference Tripoli, Libya:205-206.

Cox, C. B. , P. D. Moore 1993. *Biogeography. An Ecological and Evolutionary Approach.* Blackwell Scientific Publications, London.

Çetik, R. 1985. *Türkiye Vejetasyonu I İç Anadolu'nun Vejetasyonu ve Ekolojisi.* Selçuk Üniversitesi Yayınları No:7 Konya.

Davis, P.H.*et al.* (ed) 1971. *Plant Life of South-West Asia* The Botanical society of Edinburgh, Great Britain:15-27.

Davis, P. H., V. H. Heywood 1973. *Principles of Angiosperm Taxonomy.* Robert E. Krieger Publishing Company, Huntington, New York:1-4, 259-270.

Davis, P.H., J. Cullen 1979. *The identification of flowering plant families.* Cambridge University Press, Great Britain.

Davis, P.H. (ed), 1965-1988. *Flora of Turkey and the East Aegean Islands.* Vol:1-10 Edinburgh University Press.

Demir, F., 1992. *Eymir ve Mogan Gölleri Çevresinin Step Florası*, Yüksek lisans tezi, Ankara Üniversitesi

Demiriz, H. 1993. *An Annotated Bibliography of Turkish Flora and Vegetation.* TÜBİTAK, Ankara.

DIVERSITAS, 1996. *DIVERSITAS: An International Programme of Biodiversity Science. Operational Plan.* DIVERSITAS, Paris.

Doğan, M. 1997. *Türkiyede Biyoçeşitlilik ve Bitkisel Gen Kanakları Gerçeği,* Çevre ve İnsan sayı:33 p: 48-51

Doğan, M. 1998. *Türkiye Florası,* Çevre ve İnsan, Sayı: 41 p: 46-49.

Dördüncü Çevre Şurası Sonuç Raporları, 2000. Çevre Bakanlığı, İzmir:33-45

Earth Summit Agenda 21 United Nations Programme of Action From Rio, 1997. United Nations Department of Public Information.

Ekim, T. *et al.* 2000. *Türkiye Bitkileri Kırmızı Kitabı,* Türkiye Tabiatı Koruma Vakfi, Van Yüzüncüyıl Üniversitesi, Ankara.

Ekim, T., A. Güner, 2000. *The Floristic Richness of Turkey,* Curtis's Botanical Magazine, Vol:17, Part:2: 48-59.

Erik, S. 1994. *Beytepe Kampüsü (Ankara) Florası.* Hacettepe Fen ve Mühendislik Bilimleri Dergisi, Cilt 15: 49 – 105 Ankara.

Erik, S. *et al.* 1998. *Başkent'in Doğal Bitkileri.* Ankara Valiliği Çevre Koruma Vakfı Başkalığı, Ankara.

Erinç, S. 1977. *Vejetasyon Joğrafyası.* İstanbul Üniversitesi Yayınları No: 2276, Coğrafya Enstitüsü Yayınları No: 92, Edebiyat Fakültesi Basımevi: 133-247.

Erol, O. 1973. *Ankara Şehri Çevresinin Jeomorfolojik Ana Birimleri,* Ankara Üniversitesi, Dil Tarih Coğrafya Fakültesi Yayınları No: 240, Ankara.

Eyre, S. R. 1963. *Vegetation and Soils.* Aldine Publishing Company, Chicago:25-44

Frankel, O.H. *et al.* 1995. *The Conservation of Plant Biodiversity.* Cambridge University,Cambridge.1-10.

Geographical Information System & Remote Sensing Research Center, 1998. The Republic of Turkey The Ministry of Agriculture and Rural Affairs, Ankara:1-4.

Gleason, H. A., A. Cronquist 1968. *The Natural Geography of Plants.* Colombia University Press, USA:239-261.

Kaya, Z. *et al.* 1997, *Türkiye Bitki Genetik Çeşitliliğinin Yerinde Korunması Ulusal Planı, Çevre Bakanlığı, Ankara.*

Kaya, Z. *et al.* 1999. *Fieldguide to Wildflowers of METU Campus.* ODTÜ Doğa Topluluğu, Ankara.

Kence, A. 1987. *Biodiversity in Turkey.* Environmental Problems Foundation of Turkey, Ankara: 25-35, 63-89.

Kendir, H. 1991. *Investigation of the flora of Ankara-Ahlatlıbel dryland range and distribution of some of the important range plant species,* Yüksek Lisans tezi, Ankara üniversitesi.

Klein, R. M., D. T. Klein 1988. *Fundamentals of Plant Science*. Harper & Row Publishers, New York: 4-6, 92-117.

OECD Çevresel Başarı Raporu, Türkiye, 1999. Ekonomik İşbirliği ve Kalkınma Teşkilatı:85-103.

O'Neil, R., J. R. Kahn 2000. *Homo economus as a Keystone Species*. BioScience Vol. No. 4 333-336.

Poiani, K.A. *et al.* 2000. *Biodiversity Conservation at Multiple Scales: Functional Sites, Landscapes, and Networks*. BioScience, Vol. 50 No. 2 :133-146.

Poter, C. L: 1967. *Taxonomy of Flowering Plants*. W. H. Freeman Company, San Francisco.

Tivy, J. 1999. *Biogeography A study of Plants in the Ecosphere*. Longman, Malaysia:215-220.

Tunçdilek, N. 1987. *Geoekolojinin ilkeleri: Doğal Bölgeler*, İstanbul Üniversitesi Edebiyat Fakültesi Yayın No: 3417 İstanbul:200-201.

Yağcı, A. 1994. *Taşpınar, İncek, Tulumtaş Köyleri arasında Yayılış Gösteren Step Formasyonlarının Floristik Yönden Araştırması (Yüksek Lisans Tezi)*. Gazi Üniversitesi.

Yalçınlar, İ. 1976. *Türkiye Jeolojisine Giriş (Palazoik açıdan)*. İstanbul Üniversitesi Edebiyat Fakültesi Yayınları No: 2089, Coğrafya Enstitüsü Yayınları No: 87, Edebiyat Fakültesi Matbaası, İstanbul: 198-221.

Zeydanlı, U. 1998. Effects of Land Use Practices on Steppe Plant Biodiversity *Implications for in situ Conservations*. METU Ankara.

Zohary, M. 1973. *Geobotanical Foundations of the Middle East*. Gustav Fischer Verla G. Stuttgart Swets & Zeitlinger, Amsterdam.