Natural Environment and Culture
in the Mediterranean Region
Natural Environment and Culture
in the Mediterranean Region

Edited by

Recep Efe, Georges Cravins, Munir Ozturk
and Ibrahim Atalay

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PREFACE

The aim is to examine, for both natural and cultural environment in the Mediterranean Basin. Thirty-one reviewed papers were accepted for publication. They are grouped in two sections in this volume: Natural Environment in the Mediterranean Basin and Cultural Environment in the Mediterranean Basin.

Contributions in each chapter are prepared by experts in the respective fields and mirror the advancement in the approach. This book contains important future tasks of the particular fields and supplies extensive bibliographies at the end of each chapter, as well as tables and figures that illustrate the research findings. All these make this book highly useful and a must read for students, researchers and professionals in geography, geomorphology, ecology, forestry, hydrology, climate soil and environmental sciences.

The Mediterranean Basin is one of the largest archipelagos in the world, surrounding the Mediterranean Sea and stretching west to east from Portugal to Jordan and north to south from northern Italy to Morocco. The Mediterranean Sea covers about 2,500,000km² with an average depth of 1,500 metres. The coastline extends 46,000km running through 22 countries.

The region is known for its particularly mild climate with uniform and moderate temperatures. Rainfall patterns are however, more unpredictable with a high of 1,200mm per year in Antalya (Turkey), Genoa (Italy) to a low of 100mm per year in Djerba (Tunisia).

The mountains as high as 4,500 meters and peninsulas add to its spectacular scenery. A large part of the basin was once covered by evergreen, deciduous and conifer forests, eight thousand years of human settlement and habitat modification have distinctly altered its natural environment and biodiversity. There are now roughly 300 million people living around Mediterranean Sea. The greatest impacts of this demographic outburst have been deforestation, intensive grazing and fires, and infrastructure development, especially on the coast. The area is a meeting place of three continents, which contribute to its high ecodiversity. Its 22,500 endemic plant species are more than four times the number found in all the rest of Europe. Tourism development has placed significant pressure on the region's coastal ecosystems, because it is the
biggest large-scale tourist attraction in the world, with 120 million visitors travelling in the area every year. Sensitive dune ecosystems remain as a major threat to coastal areas due to the infrastructural constructions and direct impacts of people. The Mediterranean Basin today is among the four most significantly altered hotspots on Earth. Much of this updated information will be presented in the book.

This book contains a selection of papers of scientists from a range of disciplines interested in the Mediterranean region as one can observe from the contents of the book. It will present a timely and wide-ranging overview of the “Environment and Culture in the Mediterranean Region”. The book will examine geomorphology, environmental geography, geographical information science, human-environment interactions, karst landforms, ecology, land degradation, land use, land cover change, sustainability, biogeography, climate and climate change, desertification, ecosystem geography, and eco-tourism. The aim of this book is to link the rapid developments in mountain environments, natural hazards, political geography, population geography, remote sensing, tourism geography and urban geography in the Mediterranean ecosystems.

Finally, I particularly wish to express my thanks to, Prof. Dr. h.c. Ibrahim Atalay, Prof. Dr. Münir Öztürk and Prof. Dr. Georges Cravins, who assisted significantly with the selection and editing of papers for this volume, and to Dr. Andy Nercessian and his team at Cambridge Scholars Press for preparing the book for publication.
PART I

NATURAL ENVIRONMENT
IN THE MEDITERRANEAN REGION
CHAPTER ONE

MEDITERRANEAN ECOSYSTEMS OF TURKEY: ECOLOGY OF THE TAURUS MOUNTAINS

IBRAHIM ATALAY, RECEP EFE AND ABDULLAH SOYKAN

Introduction

Mediterranean ecosystems are limited to five relatively small areas around the world: the region bordering the Mediterranean Sea; Central Chile; the Cape region of South Africa; Southwestern and Southern Australia; and California south to northern Baja California. These ecosystems largely occur along the western edges of continents between the 30° and 40° parallels in both northern and southern hemispheres. The Mediterranean climate is characterized by mild, rainy winters and warm, dry summers (Köppen 1923, Emberger et al. 1962, Gottman 1979, Atalay 1993, 2002, Atalay et al. 1998, Erinç 1969, Koçman 1993, Naveh & Lieberman 1984, Turkes 1996). This special and unique climate has great influence on natural physical processes, including on soil formation, ecological conditions, landform development, and karst topography as well as on human activities (Atalay, 1987b, 1987c, 1994, 1995, 1999, 2002, 2006; Atalay and Tetik & Yeşilkaya 1997; Di Castri et al. 1981; Efe, 1998, 2004a, 2004b, 2005; Efe and Greenwood 2007; Kaniewski et al. 2007). Globally, the total area over which Mediterranean climate prevails is only about 2 million square kilometres. About half of this area occurs in the Mediterranean Basin: Although plant species and communities differ between the regions, the dominant vegetation is evergreen woodland with evergreen sclerophyllous shrubs and trees like carob tree (*Ceratonia siliqua*), cork oak (*Quercus suber*), holm oak (*Quercus ilex*), mastic tree (*Pistacia lentiscus*), kermes oak (*Quercus coccifera*) and the fodder shrub (*Medicago arborea*) These species are resistant to summer droughts, have deep rooting systems and resprouting capacity.

Throughout the world, the Mediterranean biome is characterized by evergreen or drought deciduous shrublands. The *chaparral* of southern California is echoed in the old world Mediterranean *maquis*, the Chilean *matorral*, South African *fynbos* and the Australian *mallee* scrub communities.

The landforms of the Mediterranean areas of the world constitute a distinct group, primarily due to the geographical position of the region, which has largely determined the peculiar present morphoclimatic conditions and the marked climatic changes of the recent geological past (Paskof 1973). On the other hand, the use of seedlings has many advantages over planting when reforesting or afforesting bare karstic lands with shallow or medium depth and soil cracks which contain fine soils, creating physiologically deep soil. On serpentine parent material with shallow soil depth, in most cases, the application of seedings is inevitable (Boydak & Ayhan 1990; Boydak 1996, 1997; Atalay 1987a, 1987c, 1993, 1997, 2001; Atalay and Tetik 1997, Atalay *et al.* 1998).

This paper presents an overview of the ecological characteristics of Taurus Mountains in the Southern Turkey in the eastern part of Mediterranean Basin.

**Study Area, Materials and Methods**

The Taurus Mountains are a wide and long mountain range in the Mediterranean region of Turkey, running approximately 560 kilometres parallel to the Mediterranean coast, and forming the southern border of the Anatolian plateau. It is Turkey’s second range of folded mountains, after the Northern Anatolian Mountains rising at the western-most range of the Great Himalayas. The range starts from the western part of Teke Peninsula in the west and extends to the upper side of the Euphrates (Firat) and Tigris (Dicle) rivers in the east after making a long curve and is connected
to the Zagros Mountains in Iran. Its northeastern extension across the Seyhan River near Adana is known as Anti-Taurus (Fig. 1-1).

In this study 1/100,000 scaled topographical maps and 1/500,000 scaled geological maps were used together with DEM (Digital Elevation Model). In addition to these, field studies were conducted during 1980 - 2007.

The topographical maps were scanned and transferred to the computer to supply a base for the study. Map sections were coordinated as a standard map projection, UTM (Universal Transverse Mercator–UTM–WGS84). The geological maps and drainage characteristics were also scanned and placed over the base maps, obtained from topographical maps.

For overlapping and processing the scanned maps, ArcGIS Desktop v.9x software was used. Coordinated map sections were transformed to layers by the method of Screen Digitizing.

**The Topographical and Geomorphological Properties of the Taurus Mountains**

The Taurus Mountains are the largest and most important karstic area both in Turkey and in the Mediterranean Region. It has a 200 km wide zone in the east – west direction along the coast between the Mediterranean Sea and Central Anatolia, composed mainly of the limestone. The limestones are heavily folded and thrusted because of the Alpine orogeny, which was a result of the collision of the Eurasian and African plates. Karstic land forms such as polje, doline, uvala, lapies development is influenced by the faults and thrusts and by the border to the surrounding insoluble and impervious schists.

The central Taurus Mountains are mainly composed of Permian metamorphic limestones. Mesozoic limestones and dolomites occur in over 1000 meter thick layers. They are surrounded by various rocks from Cambrian to Tertiary era. The limestone is often surrounded by an ophiolitic melange from the Late Cretaceous forming an impermeable base or cover.

These Mountains, lie within the Alpine-Himalayan orogenic belts. The ecological characteristics of the Mediterranean region are mainly determined by the Taurus Mountains. The altitude, exposure, direction, and parent materials of the Taurus range result in the formation of different and special habitat both for plant and animal life as well as human activities. In order to explain the importance of the region, its
impact on natural environment, it is necessary to enlighten some facts on
the formation and the evolution of the Taurus Mountains.

**The Formation of the Taurus Mountain Range**

The Taurus Mountain range was occupied by Tethys Sea during the
Mesozoic era, when the African and the Anatolian microplates and the
Euro-Siberian plate got dissected by the convectional flow occurring on the
upper mantle (asthenosphere) of the Earth. As a result of the sea-floor
spreading, ultrabasic magma spread all over the deeper parts of the Tethys
Sea. During the Mesozoic era, sediments, mostly composed of carbonates,
accumulated within the deeper part of Tethys (Ketin 1983, Atalay 1987b)
resulting in a 4000 meters thickness of the carbonates. The pelagic debris
materials and flysch, derived from the adjacent lands were swept into the
trench, continental slope by turbidity currents in Tethys. The flysch
deposits widely occur on ophiolites and pedidotite in the Taurus
Mountains.

Tethys started to close up due to the moving of the African plate
towards the north direction at the end of Mesozoic era and the area was
uplifted and converted into land. First karstification process may have
started at the end of the Mesozoic era (Fig. 1-2). During the Alpine
orogenic period, which occurred at the end of the Oligocene, Taurus area
was subjected to the compressional movements leading to the uptrust
and/or overturn and these tectonic activities resulted in the formation of
nappe structure in the Taurus. In the mountains extending western and
eastern part of Antalya Gulf nappe structure is clearly visible. The oceanic
crust composed of peridotite was divided into many stripped and or as
slivers of layered mass and trust in the semi horizontal direction toward
the upper part of the mountains. The squeezing and stripping of the
peridotite led to the formation of serpentine and the ophiolitic series
containing limestone lenses and masses. Ophiolites which occur in the
Taurus are important evidence of intensity of plate tectonic.

After the alpine orogenic movement in the neotectonic period in the
Taurus Mountains the African plate moving beneath the Anatolian plate
resulted in the extensional tectonic regime which led to the vertical
tectonic movements responsible for the block faulting movements in the
area. Some parts of the Taurus Mountains were cut by fault lines as in the
Antalya- Egirdir line, and some part collapsed and was uplifted. Tectonic
basin or corridor within the Taurus Mountains was formed. For example
Bucak, Korkuteli, Acipayam depressions were formed.
The depressed areas were occupied by neogene lakes in which clayey, carbonate and sandy sediments were deposited. The uplifting process continued during the Pleistocene time. The movement in the Taurus Mountains accelerated karstification process and fluvial in the karstic land erosional and depositional activities. The surface drainage shifted from the surface to the deeper part. The cave systems which are found in different level in the vertical direction imply the uplifting movements (Atalay 2003).

The poljes found in the Taurus Mountains are of tectonic origin. The enlargement of the tectonic depression is associated with the karstification process. The hums called the remnant hills of the old topography of the karstic lands which are found in the depression indicate the intense
karstification. The Antalya travertine deposits can be accepted as a production of the karstic dissolution which occurred in the Taurus Mountains. The rich calcium bicarbonate water evaporated in the Antalya depression so that travertine formation attaining more than 300 m thickness was formed (Efe et al. 2007).

**Climate in the Turkish Mediterranean Region**

The climate of the Mediterranean region of Turkey is somewhat different from other regions, including other regions that are principally characterized by Mediterranean ecosystems. This is mostly related to the topographic effects on the climate. The Taurus Mountains’ abrupt rise on the Mediterranean coast contributes to the distribution of precipitation and winds. The precipitation regime shows a highly irregular behaviour in both the spatial and temporal dimensions (Efe 1998, Atalay 2002).

The general atmospheric circulation in the region is under the impact of tropical continental, tropical maritime and polar air masses. During summer is influenced by tropical air masses coming from the Azores (maritime tropical, mT) and northern Africa, notably the Sahara region (continental tropical, cT). In general, precipitation and/or frontal activities do not occur between May and September. The dominant wind during this period blows in the direction of NE-SW, due to a difference in atmospheric pressure in the Aegean Sea. The winds blow during the summer period from high pressure in the Balkan region towards low pressure in the Persian Gulf.

Sometimes temperatures reinforced by regional winds blowing from the Sahara can cause a sudden decrease in relative humidity to 20% and temperatures rise up to 40 °C.

Frontal activities originating from the Mediterranean Sea generally affect only the Mediterranean region of Turkey. The fronts coming from the northern sectors seldom reach to the Mediterranean region due to the Taurus Mountain Range. Fronts from southwest to the northeast are intercepted by these Mountains. Thus, the southwest facing slopes of the Taurus receive abundant rain. The amount of the mean annual rainfall is more than 1000 mm in the vicinity of Antalya and it exceeds 2000 mm in the southwest slope of Geyik Mountains, NE of the Antalya Gulf. The rain shadow areas occurring in the tectonic depression receive less precipitation (Burdur 400mm, Isparta 581mm, Mut 400mm). On the other hand, orographic or relief rainfall occurs on the slopes facing the Mediterranean Sea. The warm maritime air is forced to rise when confronted by a coastal mountain barrier. The Taurus Mountains reduce
the water holding capacity of rising air by enforced cooling and increase the amounts of cyclonic rainfall by retarding the speed of depression movement. They also tend to cause air streams to converge and funnel through valleys crossing the Taurus Mountains. The mean annual rainfall varies between 300 – 750mm in other parts of the Mediterranean Basin, being less than 500 mm in the southern part of Spain (Malaga, 447mm), and the other islands of the Mediterranean Sea.

The relative humidity of the Mediterranean coastal belt is generally more than 80 %. This high humidity decreases due to evaporation therefore fog and dew occur during the early morning the decreases in air temperature. These events decrease intensity of drought conditions.

Foehn or föhn events also occur due to the air masses come from the northern sectors in the Mediterranean region. When the air mass crosses the Taurus Mountains and the descending air is compressed and warmed and relative humidity falls to 10 percent, and temperature rises up to 40 °C. This low moisture content and warm air encourages the increase of forest fire. Conversely, the humid air coming from the Mediterranean Sea increases the humidity and decreases the evapotranspiration.

The frontal activities which affect the Mediterranean region change frequently, the amount of the rainfall greatly changes in winter months. For example, the mean annual rainfall of Antalya is about 1000mm. However, from year to year, rainfall varies between 700 and 1400mm.

**Soil Formation in the Turkish Mediterranean Region**

Climate, parent material, and topographic factors such as altitude, exposure, and slope inclination, determine soil forming processes and soil types in the region. The climate exerts a powerful influence on soil-forming processes. In the wet winter season, rates of weathering and leaching are at maximum levels. Different parent materials are subjected to chemical weathering along cracks and fissures. The weathering processes of hydrolysis and hydration are carried out by rain water charged by carbon dioxide, both from the atmosphere and from soil air, whose higher content of CO₂ comes from the activities of soil fauna and soil micro-organisms. The rainwater with a pH of 5.5, readily attacks soil minerals, and where the parent rock is limestone, cause rapid dissolution by carbonation.
Fig. 1-2: Schematic Formation and Evolution of the Taurus Mountains
Fig. 1-3: Temperature and Precipitation Diagram of Adana

Fig. 1-4: Temperature and precipitation diagram of Antalya
Simultaneously with weathering during the winter leaching also follows, resulting in the removal of weathered product (cation and anions) and any free calcium carbonate (decalcification) from the soil profile. The rates of soil formation and the thickening vary considerably between different parent materials.

In addition to the leaching of ions from the soils, winter precipitation causes the leaching of clay and silt particles from the A into the B horizon to give a clay-enriched or textural B horizon. The blocky structure of B horizon indicates the accumulation of the clay material.

Weathering and leaching occurring during the winter period are responsible for the production of the clay minerals, oxides and hydroxides of iron and aluminium (sesquioxides), and silica. The oxidation of the iron as ironsesquioxide leads to the reddening of the soil, and the development of a red hue will increase with time, and thus the degree of reddening can be used as an indicator of the age of a soil. The reddish soil can be regarded as the climatic soil types of the Mediterranean climate. It is classified as Alfisol, according to 7th Soil approximation, as Chromic Luvisol in the FAO system, and it is termed as terra rossa in the classic soil classification.

![Temperature and precipitation diagram of Isparta](image-url)
Towards the higher part of the Taurus Mountains the organic matter content of the soil increases due to decrease of biological activities and the colour of the soil is brownish reddish.

Table 1-1: Rainfall changes in the Mediterranean Region.

<table>
<thead>
<tr>
<th>Stations</th>
<th>Average (mm)</th>
<th>Maximum (mm)</th>
<th>Pos. Deriv. (mm)</th>
<th>Rate (%)</th>
<th>Minimum (mm)</th>
<th>Neg. derivation (mm)</th>
<th>Rate (%)</th>
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<tr>
<td>Antalya</td>
<td>1173</td>
<td>1914</td>
<td>+ 741</td>
<td>+ 63</td>
<td>533</td>
<td>- 640</td>
<td>- 55</td>
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<tr>
<td>Anamur</td>
<td>1032</td>
<td>1415</td>
<td>+ 383</td>
<td>+ 37</td>
<td>540</td>
<td>- 492</td>
<td>- 48</td>
</tr>
<tr>
<td>Mersin</td>
<td>617</td>
<td>1035</td>
<td>+ 418</td>
<td>+ 68</td>
<td>278</td>
<td>- 339</td>
<td>- 55</td>
</tr>
<tr>
<td>Adana</td>
<td>646</td>
<td>1246</td>
<td>+ 600</td>
<td>+ 93</td>
<td>370</td>
<td>- 276</td>
<td>- 43</td>
</tr>
<tr>
<td>Antakya</td>
<td>1173</td>
<td>1550</td>
<td>+ 377</td>
<td>+ 32</td>
<td>651</td>
<td>- 522</td>
<td>- 44</td>
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<tr>
<td>Maraş</td>
<td>723</td>
<td>1133</td>
<td>+ 410</td>
<td>+ 57</td>
<td>309</td>
<td>- 414</td>
<td>- 57</td>
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<tr>
<td>Isparta</td>
<td>619</td>
<td>879</td>
<td>+ 260</td>
<td>+ 42</td>
<td>332</td>
<td>- 287</td>
<td>- 46</td>
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<td>Burdur</td>
<td>437</td>
<td>615</td>
<td>+ 178</td>
<td>+ 41</td>
<td>258</td>
<td>- 179</td>
<td>- 41</td>
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<td>447</td>
<td>716</td>
<td>+ 239</td>
<td>+ 50</td>
<td>303</td>
<td>- 174</td>
<td>- 24</td>
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<td>Pozanti</td>
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<td>1172</td>
<td>+ 469</td>
<td>+ 67</td>
<td>304</td>
<td>- 399</td>
<td>- 57</td>
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<tr>
<td>Konya</td>
<td>335</td>
<td>500</td>
<td>+ 165</td>
<td>+ 49</td>
<td>143</td>
<td>- 192</td>
<td>- 57</td>
</tr>
</tbody>
</table>

The soil formation of the Mediterranean region in Turkey can be summarized as follows:

The climatic soil type of the Mediterranean region is the Reddish Mediterranean soil or Alfisols (Xeralf). This soil occurs on every parent material on slightly undulating and well drained flat lands.

In the coastal belt of the Mediterranean Sea and the forested lands, red Mediterranean soil occurs on the sandstone and gravelly deposits as well as ultrabasic rocks and marly deposits.

**Soil profile Characteristics of Red Mediterranean Soils**

O horizon, litter is only found in the closed forest canopy, especially pure *pinus brutia* forest. In the lower Mediterranean belt there is no organic horizon due to completely decaying of organic material, but in the upper part the thickness of the organic material increases to 1 cm.

A horizon, reddish, dark reddish, reddish brown, yellowish in colour, neutral and weak alkaline reaction, (pH 6.9-7.8), carbonates completely leached, secondary calcification occurs where the water containing calcium bicarbonate infiltrates on the slope, granular structure and clayey and loamy texture.

B horizon, weak reddish and yellowish in colour, block and coarse blocky structure, calcium carbonate accumulation only occurs where annual rainfall is less than 600–700 mm. It has weak alkaline reaction (pH 7.5-7.8).
C horizon is seen on weathered parent material such as schists, sandstone. There is no C horizon in general on the limestone.

The reddish Mediterranean soil is seen in very limited areas due to intense erosion.

**Reddish Mediterranean Soils in the Karstic Lands**

Reddish Mediterranean soils are common both on and in the karstic lands of the Taurus Mountains. There is a close relationship between the reddish Mediterranean soil and limestones. No soil cover seen on the steep slopes and/or slope area of karstic lands because atmospheric water (rain and snow waters) can easily penetrate along the cracks and fissures. Water is only held in the thick cracks and the surfaces between the layers. The weathering process for the soil formation occurs at the cracks of the rocks. Therefore, soil appears along the cracks and bedding surfaces of the limestones (Atalay 1995, 1997, 2006; Efe 1998, 2000).

Reddening processes easily take places in the karstic lands because air and water is very well circulated, depending on the cracked structure. The oxidation of iron is as $\text{Fe}_2\text{O}_3$, reflecting reddish colour. This situation explains why reddish soils are common in the karstic land. Soil which is derived from the limestones is clayey in texture. The limestone is mostly composed of calcium carbonate and clay; calcium carbonates are dissolved by carbonic acid ($\text{H}_2\text{CO}_3$), and HCl, and transported as calcium bicarbonate in the water. This process is realized that clay is remained as the result of the calcium carbonate removals. For this reason, the soil texture of the karstic land is clayey in texture (Atalay 1997, 2006a).

Red Mediterranean soil in karstic area has formed over a long period. The existence of the eolian sediments in the soil and boxite deposits in the big holes explains this situation.

Karstic land also creates special habitat for the growth of shrubs and trees. The plant roots growing within the cracks and fissures easily develop and follow the water infiltrating and seepage along the cracks. During the growing season, comprising 4 and 5 months, the height of the roots attain a length of 1 meter. This is why karstic land is very suitable habitat for the natural regeneration (Atalay 1995, 1997d; Boydak 1990, 1996). Thus, protected karstic land is covered by the dense forest.

On the other hand the structure of the limestones prevents the loss of the water by evaporation, because infiltrated water is held by the soil in the deeper part and reflection is high due to the white colour of the limestone.
Fig. 1-6: Soils usually red (Alfisol) and reddish brown in color on the limestone and occurs in the cracks of limestone.

Fig. 1-7: Soil profile in the Acipayam Polje in Taurus Mountains.
In some karstic lands the soil which developed on the cracks is transported in a vertical direction. This is related to the widening of the cracks by dissolution. This situation leads to the vertical transportation of the soils.

The physical composition, layer sequences or layer inclination and the distribution of crack, all determines the formation and the distribution of soil. For example comprehensive and hard limestone produce thin soil due to there fact that it is responsible for fewer thin cracks and a more compact structure. There is a close relationship between layer and the soil appearance. Soil occurs in the bedding surface. In other words soil is found along the layer. On the other hand, thin-layered limestone has much more soil than the thick limestones in weak zones are also favourable for the soil formation due to fact that it is easily weathered.

Karstic holes and/or depressions contribute a somewhat humid habitat for the growth of some plants. Hydrophilic such as Acer, Fraxinus, Sorbus grow on the bottom land of the small karstic depressions. The small karstic depressions are ‘U’ and ‘V’ shaped, and deep canyons create suitable habitats for both endemic and relict species and communities. In other words relict and endemic species are sheltered in the karstic depression. Luquidambar orientalis, one of the relict and endemic species, occurs in the lower part of Aksu valley, Sorbus torminalis and Quercus vulcanica
are found in the karstic depression of the Davraz and Dedegöl Mountains. The karstic depression of the Taurus, Barla and Dedegöl mountains, the eastern part of Lake Beyşehir, are the spreading area of *Quercus vulcanica*. This endemic species only grows within the karstic depressions, when its branches grow up from the wall of dolines; they dry up due to wind effect (Fig. 1-4).

**Vegetation Formations of the Mediterranean Region**

Different vegetation formations are distributed in the Mediterranean Region of Turkey under varying climatic conditions and topography.

The shrubby and steppe-like vegetation which is a characteristic of present day wild landscapes in the region has been accepted by biogeographers (Polunin and Huxley 1992, Ajbilou *et al.* 2005, and Thirgood, 1982) as a consequence of human pressures superimposed upon climatic trends. The effects of these human impacts, and their relationships with both degenerative and regenerative trends in vegetation, are common in the region (Atalay 2002; Efe, 2004).

The climax vegetation in the region is evergreen oak woodland which get degenerate into maquis under light exploitation. Maquis formation is typically 1-3 m high, and is more widespread than relict evergreen forests. Many plants that are present in the forest but which prefer more open habitats grow abundantly in maquis (tree heath, buckthorn, holly oak, strawberry tree, myrtle, and juniper). The result is a dense, almost impenetrable shrub community, with plant species varying in different parts of the Mediterranean. Excessive exploitation leads to the formation of a low mixed heath, garrigue, which is a very diverse community of low shrubs and flowers, typically less than 1 m high. The community is colourful and aromatic, with species varying according to the local conditions. The common feature of garrigue formation is the resistance of plants to grazing by sheep and goats due to their poisonous, thorny or "waxy" nature.

Prolonged degeneration can lead to the almost complete disappearance of shrubs leading to the formation of steppe grassland and stony pasture. Such eroded, rocky terrains which support only grasses, annuals and bulbs which indicate the pathways of regeneration should be the cessation of human activity, for example, through the abandonment of agricultural land. However, regeneration of garrigue to maquis and then forest is clearly a much slower process than degeneration, as soil erosion will have reduced soil depth, water-holding capacity and nutrient content. In some cases, extreme degeneration can make regeneration impossible.
A different view of vegetation dynamics has been given lately by several researches (Grove et al. 1991, Grove and Rackham 1993, 2001) which advocates that the use of terms such as "potential climax" and "degradation" is not correct because there is little evidence that maquis, garrigue and steppe can change from one into another (Smithson et al. 2002).

The main characteristics of the Mediterranean plants are their resistance against the summer drought. A range of structural modifications in these plants favour drought tolerance, needle-leaf form, elimination of all leaves and formation of a photosynthesizing stem, sticky, waxy or hairy leaf cuticles; leaf stomata sunk in surface depressions; loss of transpiring leaves in summer (drought-deciduousness); dull coloured leaves and stems to increase reflectivity (higher albedo). A high ratio of below-ground roots to above-ground shoots favours moisture absorption by these plants. A widespread adaptation is the sclerophyllous leaf type.

Although the main characteristics of the Mediterranean vegetation are similar in the all part of the Mediterranean region in the world, The Mediterranean vegetation in Turkey considerably differs ecologically as compared to other Mediterranean regions.

It can be divided into two main ecoregions: 1. Mediterranean biome; 2. Mediterranean orobiome. While the Mediterranean biome extends along the coastal belt of Mediterranean Sea, the second covers mountainous areas above 1000 m.

The vegetation of the Mediterranean biome is divided into three groups: 1) *Pinus brutia* forest; 2) Maquis; and 3) Garrigues. It begins at the sea level and extends up to 1000/1500 meters (Efe 1998, Atalay 2002).

**Ecological Features of Red Pine (*Pinus brutia* Ten.)**

Red pine (*Pinus brutia* Ten) is one of the main forest trees of Turkey and is widespread in the Mediterranean, Aegean, southern parts of Marmara, the western and middle section of Black Sea and the western part of the Southeastern Anatolian geographical regionb. These forests constitute one-seventh of the total forest area of Turkey and cover 3 million hectares with an annual production or biomass by such forests is about 5 million m$^3$ and annual timber and wood production is some 4 million m$^3$.

This tree has special importance because it is resistant to summer drought and grows on all parent materials and has fast regeneration capability.