

**Effects of Global Warming on the Species Composition and Vegetation Productivity
in Arid Areas**
**- Species Composition and Stand Structure of Predominant Vegetation Types
in the Eastern Mediterranean Region of Turkey -**

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1. Introduction

There are various vegetation types along the climatic and topographic gradient in Turkey (Yilmaz, 1998; Altan, 2000). The forestland of Turkey is found on the mountains bordering the Black Sea, Marmara, the Aegean and the Mediterranean, and is located in an altitude belt of 0 to 2000 meters above sea level (Roda et al. 1999). In the Eastern Mediterranean Region, the most frequently occurring evergreen forests consist of *Pinus brutia*. Other needle-leaf forest trees are *Pinus halepensis* in the coastal regions, and *Abies cilicia* and *Cedrus libani* in the higher part of mountains. The most commonly occurring deciduous forest trees are various *Quercus* species such as *Q. coccifera*, *Q. infectoria*, *Q. cerris*, which are widespread in this region. These trees are more often found in single-species forests, but may also be seen in mixed formations. Other common trees, mostly seen in mid-altitude mixed forests, are *Carpinus*, *Fraxinus*, *Styrax*, and some maquis species (Maki) such as *Arbutus andrachne* and *Quercus coccifera* (Sano et al. 2003; Ando et al. 2004). Steppe-type vegetation is widespread in the dry and cold climatic zone, although anthropogenic, or man-made destruction is clearly visible as well as the lowlands of Central and Western Europe (Vera 2000).

Expected incomes of the Vegetation Sub-Group until March, 2007 is as follows; (1) to estimate species composition and productivity of vegetation, (2) to estimate and simulate changes of vegetation by global climate change, and (3) to estimate water budget in the Cukurova Plain in future (Tamai et al. 2004). The objectives of the research in 2004 are estimation of future conditions from the present status on (1) species composition and stand structure

of dominant communities, (2) horizontal and vertical distribution of typical vegetations, and (3) regeneration and growth patterns of main tree species in the Eastern Mediterranean Region of Turkey

2. Study area and methods

In 2003, species composition, stand structure and environmental factors were measured at seven plots relatively good conditions left from the Mediterranean coast to the mountain (ca. 0-1500 m a. s. l.) in the following regions; (1) Yumurtalik, (2) Catalan, (3) Karatepe, and (4) Aladag (Sano et al. 2004). Yumurtalik was the lowest part of the research area facing the Mediterranean Sea, and Catalan and Karatepe were located at relatively lower to mid-altitude parts. Aladag was in the highest parts among these research sites over 1200 m a.s.l. On 17-25 September 2004, species composition, stand structure and environmental measurements were researched in three regions located at ca. 100-2000 m a. s. l. We set up additional seven plots in (1) Aladag, (2) Catalan, and (3) Adana (Table 1). We measured DBH (Diameter at breast height, 1.3 m), tree height, location of tree base and crown projection area for each individual; slope direction, inclination, altitude, location (latitude and longitude), soil and air temperature, soil moisture and forest floor vegetation for each plot; and elongation growth of *Pinus brutia*. Growth cores with increment borers and hemispherical photographs using NIKON Coolpix 950 digital camera with a fisheye converter were taken in each plot for analysis.

3. Results

Tree species composition with relative basal area (BA%) in each plot is shown as Table 2. There were eleven species occurred in our research plots in 2004. Dominant tree species were *Quercus coccifera* with many maquis species in low land area, *Pinus brutia* in the mid-altitude regions, *Abies cilicica*, *Cedrus libani* and *Pinus nigra* in the subalpine region. *Pinus brutia* and *P. nigra* were found relatively large area from mid- to high-altitude area, sometimes which formed pure stands.

Plot 1 represented an old-aged *Pinus brutia* stand with many maquis species such as *Phillyrea latifolia* and *Arbutus unedo*, located at the north of Bekirl. Plot 2 was estimated as an early successional community near Plot 1 with many *P. brutia* regenerations on the forest floor. Plot 3 was located in a *Pinus nigra* pure stand near the timberline of Mt. Akinek with few regenerations of *P. nigra* on the understory. Plot 4 represented a successfully regenerating area of *Pinus nigra*, downward of Plot 3. Plot 5 was in the *Cedrus* basin with big *Cedrus libani* trees near a spring water with *Pinus nigra* and *Abies cilicica*. Plot 6 included partly disturbed area by stream water with *Cedrus libani* and *Pinus nigra*, near Plot 5. Plot 7 was a high maquis community dominated by *Quercus coccifera*, an evergreen oak in the campus of Cukurova University.

4. Further Research and Analysis

Further researches and analyses are required on (1) measurement of water potential and photosynthesis of main species, annual elongation of *Abies cilicica*, *Pinus nigra* and *Cedrus libani* in addition to *Pinus brutia* and soil properties in predominant vegetation types, (2) photographs analyzing size and age structure of each stand and growth patterns of trees in relation to past climate data, (3) making vegetation map by analyzing satellite, and (4) estimation of the future condition of vegetation in the Eastern Mediterranean Region of Turkey using all data.

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Table 1 Stand characteristics of seven plots sampled in 2004

Plot	1	2	3	4	5	6	7
Dominant	<i>Pinus brutia</i>	<i>Pinus brutia</i>	<i>Pinus nigra</i>	<i>Pinus nigra</i>	<i>Cedrus libani</i>	<i>Abies cilicica</i>	<i>Quercus coccifera</i>
Size mxm	20x20	20x20	20x40	20x20	20x40	20x40	10x10
Altitude m	263	329	1951	1840	1403	1379	102
North	371647.9	371603.4	373728.6	373731.7	373628.8	373625.9	370351.1
East	351116.6	351137.6	352813.7	352843.2	352853.7	352851	352118.2
Facing	S70W	S55W	N60E	N70W	N80E	N80W	N80E
Inclination	18	22	18	20	10	15	32
District	Catalan	Catalan	Aladag	Aladag	Aladag	Aladag	Adana
Date	20040917	20040917	20040921	20040921	20040922	20040923	20040925

Table 2 Species composition and dominance (Basal Area %) of trees in each plot

Plot	7	1	2	6	5	4	3
District	Adana	Catalan	Catalan	Aladag	Aladag	Aladag	Aladag
Altitude m	102	263	329	1379	1403	1840	1951
Species							
<i>Cistus creticus</i>	3.13						
<i>Pistacia terebinthus</i>	1.62						
<i>Phillyrea latifolia</i>	2.41	0.26					
<i>Quercus coccifera</i>	78.58	0.03					
<i>Pinus brutia</i>	14.27	99.55	100				
<i>Arbutus unedo</i>		0.10					
<i>Myrtus communis</i>		0.07					
<i>Juniperus excelsa</i>				11.75			
<i>Abies cilicica</i>				35.48	2.38		
<i>Cedrus libani</i>				24.87	87.22		
<i>Pinus nigra</i>				27.91	10.41	100	100
BA (m ² /ha)	1.22	31.13	8.09	40.14	40.78	73.27	46.57