

## **Vegetation of Uludağ Fir (*Abies bornmulleriana* Mattf.) and Oriental Beech (*Fagus orientalis* Lipsky.) Mixed Forests in Ayıkaya-Bolu**

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### **Abstract**

The study was carried out in Bolu-Ayıkaya region between 800-1,740 m asl. The investigations were carried in Uludağ fir-oriental beech stands to determine the changes of vegetation and also to support the plant sociology studies. The main trees in the region where the research area is located are: *Abies bornmulleriana* Mattf., *Fagus orientalis* Lipsky., *Pinus nigra* Arnold., *Pinus sylvestris* L., *Carpinus betulus* L., *Quercus* sp., *Acer* sp.

The size of sample plots (50 in total) was fixed to 20 x 20 m (400 m<sup>2</sup>) on average by using the “minimum area” method. A total of 1,742 herbaceous and woody plant specimens were collected in all plots. All specimens have been identified by using the Flora of Turkey by Davis. 97 species, 15 subspecies and 7 varieties have been determined. The number of endemic taxa found in the area is 3.

**Keywords:** Uludağ fir, Oriental beech, vegetation, Ayıkaya

### **Introduction**

Plant Geography and Plant Sociology that are two branches of Botany are very closely related. Both of them investigate the plant species' distribution over the world and determine the relations between plant communities, and also environmental factors (ANŞIN & ÖZKAN, 1982).

The functions of Plant Sociology are to investigate the floristic characters of plant communities, to determine the specific structures and species compositions, to show the characteristic distributions and relations with their environment, to divide the plants into sociological units. For example, in the Austrian Forestry, ZUKRIGL (1976) included the following topics in the Plant Sociology: the site classification and site mapping, silvicultural planning, yield research, forest inventory and set aside of some forest areas (ÖZALP, 1989).

The Braun-Blanquet school affects the studies in Plant Sociology. This method is used in many parts of the world for the evaluation of plant cover. The method was explained in a detailed manner in some books (BRAUN-BLANQUET, 1921, 1928, 1964). The book includes the definition of vegetation units and the classification and characterization of them. It also covers the ecology of society, distribution of society.

With 8,792 plant species, Turkey has a rich flora. Out of them 8,575 species are

native, whereas 79 and 138 species of plants are endemic to Turkey. The endemism ratio of Turkey is 30.9%. If we compare the total species number of Turkey with that of Europe, which is 11,557 according to the Flora Europea, we can perceive the richness of the flora of our country. The reasons of this richness are as follows:

1. Anatolia is a bridge between the floras of South Europe and Southwest Asia.
2. Anatolia takes part in the crossroad of three phytogeographical regions.
3. Anatolia has various climate, geomorphology and topographic features. These phenomena caused the extraordinary variety of habitats and ecosystems.
4. Anatolia is the centre of genetic diversity of many genera.
5. Anatolia has a high species endemism.
6. There are many cultivated plants originated from Anatolia and adjacent territories (TURGUT, 1996).

Today, the forest studies have to be combined with Plant Sociology research. The appropriate choice of silvicultural methods and the correct determinations of site conditions provide very productive and high-quality forest lands. In these circumstances the floristic researches become inevitable. For instance, ÇEPEL (1966) considers the

investigation relations between site conditions and the existing vegetation as a first duty of the forester. It reveals that determination of trees, shrubs and subflora in the choosen area as well as determination of the relations between silvicultural characteristics of the main trees and accompanying flora is important.

The investigations in this region were carried especially in Uludağ fir-oriental beech mixed stands to determine the changes of flora and also to support the flora and plant sociology studies.

### Geographical situation of the region

Bolu is situated in the Euro-Siberian phytogeographical region, at 40 44' N latitude and 31 37' E longitude. This region encompasses north districts which have humid-mesothermal and humid-microthermal climate conditions, and Marmara district except from Biga Peninsula (including Trakya Part). With respect to its flora it is divided as follows: first part is the Colchis region which extends from Ordu towards east; second part is the Euxin region located from Ordu to Istranca Mountains and to Bulgaria, and also drier than the Colchis region (ATALAY, 1990).

The survey area (Ayıkaya region) is located in the Ayıkaya Forest Subdistrict Headquarters belonging to Bolu Forest Conservancy and Forest Enterprise Directorate. The overall area is approximately 1,400 ha. It is nearly 45 km away from Bolu.

### Climate

Bolu has a transition climate from North Anatolia to Central Anatolia. It also has a precipitation regime of Blacksea transition type and maximum rainfall is during the spring time.

### Soil characteristics

The magmatic deep rocks which make the core of Bolu massif are gathered in the name Bolu Granitoid.

Over much of the area, the bedrock is sedimentary sandstone. The major soil group of the area is known as non-calcerous brown forest soil.

Based on soil analysis one may say that the soil type is clayey loam at altitudes of 1,200-1,300 m and sandy loams are common at other altitudes. The results of physical analysis revealed mid-depth soils in all plots. The drainage conditions at 1,500-1,700 m altitude are good and moderate at other altitudes. The humus type was mull.

The soil reaction has an important role in order to provide suitable nutrients for plant growth. The results of analysis show that the pH value had increased from 4.6 to 7.1 (mean pH = 5.97) in the research area.

### Vegetation

The research area is found in the Euro-Siberian phytogeographic region which extends from Iceland, covers the whole Blacksea coasts till Kamçatya. The Euro-Siberian phytogeographic region is divided into 3 provinces: Balkan Province in the inner parts of Trakya, Euxine Province in the middle and West Blacksea, Colchis Province in the East (KÜÇÜK, 1992). The research area is in the Euxine Province.

According to the forest management plan of the region, the main trees in the research area are as follows: *Pinus nigra* Arnold. (Crimean pine), *P. sylvestris* L. (Scots pine), *Abies bornmülleriana* Mattf. (Bornmullerian fir), *Fagus orientalis* Lipsky. (Oriental beech), *Carpinus betulus* L. (Hornbeam), *Populus tremula* L. (Trembling aspen), *Alnus glutinosa* (L.) Gaertn. (Alder), *Quercus* sp. (Oak species), *Acer* spp. (maple species), *Ulmus* spp. (Elm species), *Fraxinus* spp. (Ash species). Beside these trees, the other shrubs and herbs also present. These are: *Euphorbia amygdaloides* L. var. *amygdaloides*, *Hedera helix* L. (Bind wood), *Urtica dioica* L. (Nettle), *Fragaria vesca* L. (Strawberry), *Rhododendron ponticum* subsp. *ponticum.*, *Tamarix* spp. (Tamariks), *Corylus* spp. (Hazelnut), *Pteridium* spp. (Fern), *Rubus* spp. (Blackberry or Raspberry), *Paliurus* spp. (Black thorn), *Mentha* spp. (Mint), *Equisetum* spp. (Horsetail), *Gramineae*.

## Material and Methods

### Material

The research area (Ayıkaya region) is located in the A3 grid square. The fields were visited in spring and autumn. Totally 1,742 herbaceous and woody plant specimens were collected and recorded into the vegetation unit tables with their data and sample plot numbers. In addition, the specimens were dried in a suitable manner and then labelled. From each plant specimens, 2 or 3 identical sets were prepared. The identification of the plant was done by using the publications of DAVIS, GÖKMEN and KAYACIK as well as herbaria, i.e., İSTO and ANK. All taxa are listed according to alphabetical order of their family name. All specimens were collected from "A3 Bolu: Bolu, Ayıkaya on the road to Yedigöller". The identical sets of plant specimens were put together into the herbarium of West Blacksea Forestry Research Institute and the herbarium of Abant İzzet Baysal University (AIBU).

### Methods

#### Determination of plots

The fundamental principle of Plant Sociology is to investigate and characterize the plant communities in a determined area. The study areas have homogenous site factors (the changes of slope or aspect are not present in a sample area). And the natural structure of vegetation has to be protected.

The minimum size of sample plots changes with respect to the plant community and expands according to the length of the plants and species richness of the community (AKSOY, 1978). ELLENBERG (1956) suggests that 200-500 m<sup>2</sup> land for the tree storey and 50-200 m<sup>2</sup> for herb storey are enough for investigations carried in the forests. Regular geometric shapes from the studied area are suitable to ease the investigations.

First of all, the forest management plan of the Ayıkaya region and the site class and stand maps were examined beside the counter-lined map of 1:25000. In the light of these preliminary examinations, the oriental beech was determined as a dominant species in the study area. The areas with the

minimum and maximum values of its altitude levels were obtained. Also the areas where the other species come into contact with the oriental beech were determined. According to these observations the Güzören Catchment area was accepted as a study area. These examinations were supported during the field observations. Also, it was noticed that a large part of the catchment area is rocky and very steep, such areas not being used for the establishment of sample plots.

There were some variations in the vegetation between the lowest and highest altitudes according to field observations. In the stands one of the factors affecting the subflora is the stand density and the other is the elevation difference. In line with the project's purpose and content, a large part of the Güzören Catchment area (except from its rocky parts), where the oriental beech and Uludağ fir are dominant, was taken into investigation. The altitude difference was chosen as the basic criterion. Hence, the lowest altitude and the highest altitude were determined as 700 m and 1,740 m, respectively. Steps of 100 m were set up between these altitudes. In these elevation steps (totally 11), 5 sample plots located on the same contour line and have a distance of 25-50 m from each other were settled. The size of sample plots (400 sq.m, 20 x 20 m) was chosen based on the "minimum area method" which was applied to 3 different elevations between 700 m and 1,100 m.

The bark of trees found on the borderline of sample plots was signed at their breast height and their sample plot numbers were recorded.

50 sample plots were established between 800-1740 m elevations. According to the field observations and the growth conditions of Uludağ fir and oriental beech, the shaded north, northeast and northwest-facing slopes were observed in the selected sample plots.

The identified plant species collected from the sample plots were recorded into the vegetation unit tables according to the presence in overstorey, middle and lower storey, understorey and herb storey.

Following the identification of plant species, their dominance and sociability values were determined and these values

were also recorded in these tables. The Braun-Blanquet method has principally used in these determinations. This method was used and suggested by SELÇUK (1965), YALTIRIK (1966), ÇEPEL (1966), AKSOY (1978) and ANŞİN (1979).

The dominance and sociability values were determined according to the Braun-Blanquet method (1964).

### Results

In the study area, the sample plots where the Uludağ fir and oriental beech are dominant were considered in a floristic way. As a result 122 taxa were determined in the sample plots.

In our research, the Uludağ fir was found between 800 and 1,740 m. The height of beech trees attains 30 m and even more at altitudes over 1,000 m and decreases at 1,500 m.

In the investigation carried in the Bolu Mountains and also in the Yedigöller part, brown forest soils and mull type humus were determined by AKMAN et al. (1983).

The species having high presence and dominance values at altitudes between 800 and 1,740 m are *Abies nordmanniana* subsp. *bornmulleriana*, *Fagus orientalis* and *Rubus hirtus* and this fact is shown clearly in the table prepared to discuss the presence of species in our sample plots with respect to altitude. It can be noticed that some species form a group at altitudes from 720 to 940 m. These species are listed below (order from the most frequent to the least one): *Festuca drymeja*, *Rhododendron ponticum* subsp. *ponticum*, *Lathyrus laxiflorus* subsp. *laxiflorus*, *Carpinus betulus*, *Cyclamencoum myosotis arvensis*, *Trachystemon orientalis*, *Galium paschale*, *Pteridium aquilinum*, *Mycelis muralis*, *Quercus petraea*, *Diplotaxis muralis*, *Vicia crocea*, *Hedera helix*, *Pinus sylvestris*, *Asperula involucrata*.

In our research, the altitudes of the fields where the *Rhododendron ponticum* subsp. *ponticum* is added to the dense composition changes between 720-940 m and 1,020-1,540 m. At these elevations, the oriental beech, the bornmuellerian fir, the hornbeam, the elm, the European oak and the bird cherry are

found in the upper and understoreys of sample plots.

In the community composition, *Carpinus betulus*, *Ulmus glabra* and *Tilia rubra* are found in the ratios of 25.5%, 12.7 %, and 3.6%, respectively. In the studies carried on the Örümcek Forests, these species are very scattered in the composition.

### Conclusions

The purpose of our research was to determine the floristic composition of oriental beech-Uludağ fir stands and to examine the changes only in one region. Therefore, the following researches have to be carried out in a region where the Uludağ fir was dominant, and discussions have to be made by comparing the obtained results. In addition some discussions related to the site factors have to be present in the conclusion.

The conclusions of this research work are as follows:

- 1,742 plant specimens have been collected in study area and 122 taxa belonging to 45 families have been determined.

- Many of taxa were included in Spermatophyte (90.16 %) and Angiospermae (88.52%) taxa.

- The endemism ratio is 2.45% in study area. These taxa are *Arum euxinum*, *Abies nordmanniana* subsp. *bornmulleriana*, *Astrantia maxima* subsp. *Haradjianii*.

- The rates of the species belonging to the Euro-Siberians and pluri-regional are 35.24% (43) and 36.06% (44), respectively.

- The bedrock in the study area is sedimentary sandstone; brown forest soils are dominant.

\* Our study area is situated in the Euxine region and the *Fagus orientalis* association was described. The probable distinctive and characteristic species of the association are *Fagus orientalis*, *Abies nordmanniana* subsp. *bornmulleriana* and *Rubus hirtus*. But, in the Colchic region, *Picea orientalis* which is the representative species of this region is also characteristic.

\* Other species within the association having high presence and dominance values are *Cardamine bulbifera*, *Calamintha grandiflora*, *Galium odoratum*, *Cardamine*

*gracea*, *Euphorbia amygdaloides*, *Festuca drymeja*, *Rhododendron ponticum* subsp. *Ponticum*, *Daphne pontica*, *Dryopteris filix-mas*, *Lathyrus laxiflorus* subsp. *Laxiflorus*, *Sanicula europaea*, *Lathyrus aureus*, *Cirsium arvense* subsp. *vestitum*, *Geranium robertianum*, *Polygonatum orientale*, *Melica uniflora*, and *Oxalis acetosella*.

\* *Rhododendron* spp., *Rubus* spp., *Festuca drymeja*, *Vaccinium arctostaphylos*, *Galium odoratum* species usually are present under the oriental beech and Uludağ fir forests.

\* *Rhododendron* spp. prefer very humid north hillsides of Blacksea region like beech. In the study area, this species was found very dense between 720-940 m and 1,020-1,540 m altitudes.

\* Scots pines join the stands on south-facing slopes and change their appearance.

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