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Research Article

Vegetation Mosaic around the Second Center of Tourism Development in the Uludağ Mountain, Bursa, Turkey*

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Abstract: The vegetation mosaic around the Second Center of Tourism Development in Uludağ (Bursa) was determined by aerial photographs and Geographical Information Systems (GIS) techniques. The vegetation characteristic of the area is composed of dwarf shrub formation *(Vaccinium myrtillus–Juniperus communis–comm.* and *Juniperus communis–comm.)*. In addition, a database related to the vegetation mosaic of the area was prepared.

Key Words: Vegetation mapping, GIS techniques.

Uludağ (Bursa) İkinci Turizm Gelişim Merkezi Çevresinin Vejetasyon Mozaiği

Özet: Uludağ (Bursa) İkinci Turizm Gelişim Merkezinin vejetasyon mozaiği hava fotoğrafları ve Coğrafi Bilgi Sistemleri (CBS) teknikleri kullanılarak hazırlanmıştır. Bölgede bodur çalı formasyonu *(Vaccinium myrtillus–Juniperus communis ve Juniperus communis)* vejetasyon mozağinin karakteristiğini oluşturmaktadır. Ayrıca, bölgenin vejetasyon mozaiği ile ilgili bir veri tabanı hazırlanmıştır.

Anahtar Sözcükler: Vejetasyon haritalama, CBS.

Introduction

Uludağ Mountain contains one of the important winter sports center in Turkey. The tourism center of winter sports (the First Center of Tourism Development, abbreviated as FCTD) is located within the boundaries of Uludağ National Park. A vegetation map of this area, including hotels and ski lift was prepared in an earlier study (1). The Tourism Ministry of the Turkish Republic declared the area at the eastern part of the FCTD to be the Second Center of Tourism Development (SCTD) in 1986. The mountain has a rich biological diversity and is home to many endemics. It has been reported that there is a total of 104 endemic plant species growing in this area (2).

Geographical Information Systems (GIS) techniques have been in use in many different disciplines, including forestry, land–use, and city and area planning, over the past two decades (3). There are different publications on botanical applications concerning the use of these techniques (4, 5). These techniques are usually used to map the vegetation of an area and to observe the changes taking place over time. A vegetation map of the Innoko (Alaska) Wildlife Refuge has been prepared with Landsat MSS data (4). The vegetation mosaic of South Florida's

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National Parks and Protection Areas has been determined, and a digital database prepared (5). Increases in anthropogenic activity lead to changes in natural plant vegetation. Changes in vegetation mosaic can be observed by GIS techniques.

The aim of this study was to map the vegetation and to prepare a digital database vegetation characteristics around the SCTD on Uludağ Mountain. The study is based on a vegetation study of a larger part of the National Park (6). Details concerning the climate, geology and characteristics of vegetation types are given that study.

Material and Methods

Material

Aerial photographs belonging to Uludağ National Park with a scale of 1/10000 and the maps with a scale of 1/2500 produced from the aerial photos were the main materials.

Methods

1. Obtaining and Digitizing of the Aerial Photographs

The Aerial Mapping Service of the Turkish Republic took the aerial photographs with a scale of 1/10000 using planes equipped with special instruments in August, 1992. The longitudinal overlapping of the photographs is 60–90%, and latitudinal overlapping is 30%. Three black–and–white photographs were printed at the Aerial Mapping Service laboratories. Photographs were digitized orthophotographically by the same institution.

2. Determining of the Plant Communities

Determination of plant species and plant communities in the research area were based on results obtained in a previous study by Rehder et al. (6). The main differential species of the plant communities and vegetation types above the timberland of Uludağ have been listed in an earlier vegetation map study by Güleryüz et al. (1). "Flora of Turkey and the East Aegean Islands" is referred to for the names of taxa cited in the text (7).

3. Marking of the Plant Communities on the Maps

The maps produced by the Aerial Mapping Service of the Turkish Republic include contours, rivers, hill points, rocks, water resources, buildings, under waterlines, altitudes values (at certain points), plant community boundaries, destroyed areas and roads. The maps

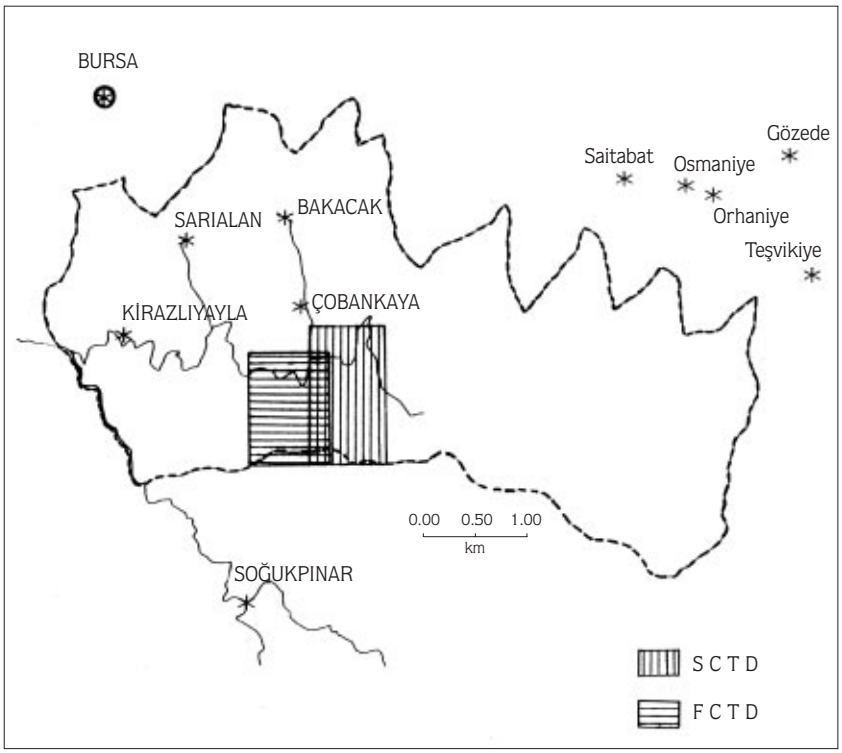

Figure 1. The location of the Winter Sports Center (FCTD and SCTD) and vicinity in Uludağ National Park.

produced from the aerial photographs include about 25 square km of Uludağ National Park, and this total research area was divided into 20 sections with a scale of 1/2500.

With the above sections of the map, the boundaries of the plant communities were checked by field study in July, 1993. Plant communities were marked on the maps with different symbols, and their boundaries were confirmed by this fieldwork.

4. Analyzing and editing the Results on the Computer

The characteristics of the plant species (cover, frequency, density) in the grassland and the changes on the cover can be traced with large–scale aerial photographs (8). In our study, areas of 200 square meters and larger were marked on the maps. This is fairly high resolution. Vegetation and other geographic data were analyzed according to GIS techniques (3), which improve the accuracy and efficiency of environmental assessments, especially large–scale assessment (9). This technique allows us to record plant community boundaries, prepare feature attribute tables (vegetation type, cover, list of species, abundance degree etc.), calculate areas (ha, m^2, km^2 etc.) and edit attribute tables. In the GIS techniques, the term "coverage" represents the geographical layers of the real world. Each of these layers (for example, hydrology, topography, streams, utilities and parcels) is coverage. In our study, the boundaries of plant communities, contours, streams etc. of every section (scale 1/2500) were transferred to computer from digitizer (ALTEK^{TM}). Each of these coverages was separately filed on computer (Hewlett–Packard Workstation Apollo Series 700^{TM}). Feature attribute tables relating to each coverage were created with ARC/INFO^{TM} software (ESRI, 1992) with geographical data. End–map compositions with a scale of 1/12 500 scale were prepared.

Results and Discussion

The location of the FCTD and the SCTD and their immediate surroundings are shown in Figure 1.

The area surrounding the SCTD was calculated by GIS techniques. This area is about 600 ha, and between 1700–2100 m in altitude (Figure 2). The construction of the hotels and other facilities on this area started in the summer of 1996.

We determined that 11 plant communities and 5 vegetation types are distributed on the SCTD and its vicinity. The boundaries of plant communities and vegetation types are shown in Figure 3 and Figure 4. Forest (*Abies bornmuelleriana*–comm.), dwarf shrub *(Vaccinium myrtillus–Juniperus communis*–comm. and *Juniperus communis*–comm.), meadows and mats *(Nardus stricta*–comm., *Agrostis canina*–comm., *Plantago holosteum*–comm., *Plantago atrata*–comm.), hard cushion (*Festuca cyllenica*–comm., *Festuca punctoria*–comm. and *Acantholimon ulicinum*–comm.) and ruderal vegetation *(Verbascum olympicum*–comm.) form the vegetation mosaic around the SCTD. The vegetation mosaic of the research area is represented characteristically by dwarf shrub (Figure 3). This vegetation type is dominant, with a cover of 68.74% (411.03 ha). Meadow and mat formation is the second vegetation type, covering the largest area, and *N. stricta* is dominant in this type. *Abies bornmuelleriana*–comm. is widespread on the north side around the SCTD and also the upper boundary of the tree line on Uludağ Mountain. Hard cushion formation is scarce in the mapped area, being widespread only in the higher altitudes outside of the map. Ruderal formation is composed of *Verbascum olympicum*–comm., and is found especially on roadsides.

It has been reported that there are environmental problems caused by improper use, and the ruderal formation is dominant on disturbed lands and roadsides around the FCTD (1). Therefore, the land must be treated more carefully while new hotels and other facilities are constructed around the SCTD. In addition, the SCTD is also close to the Kırkpınarlar locality where there are important water sources. A sensitive environmental evaluation and land–use planning must be prepared for this area. GIS techniques help improve the accuracy and efficiency of environmental assessments, especially large–scale assessment (9). The determination and mapping of the vegetation reserve are important processes in environmental assessments. It is known that the documentation of existing vegetation reserve could be important for analyses of graded changes of the environment in the future (10). With this study, we determined the mosaic of the existing vegetation reserve around the Second Center of Tourism Development in 1993. In addition, a database concerning this area was prepared in a computer environment. We hope that these data will serve as a basis for various investigations in this area in the future.

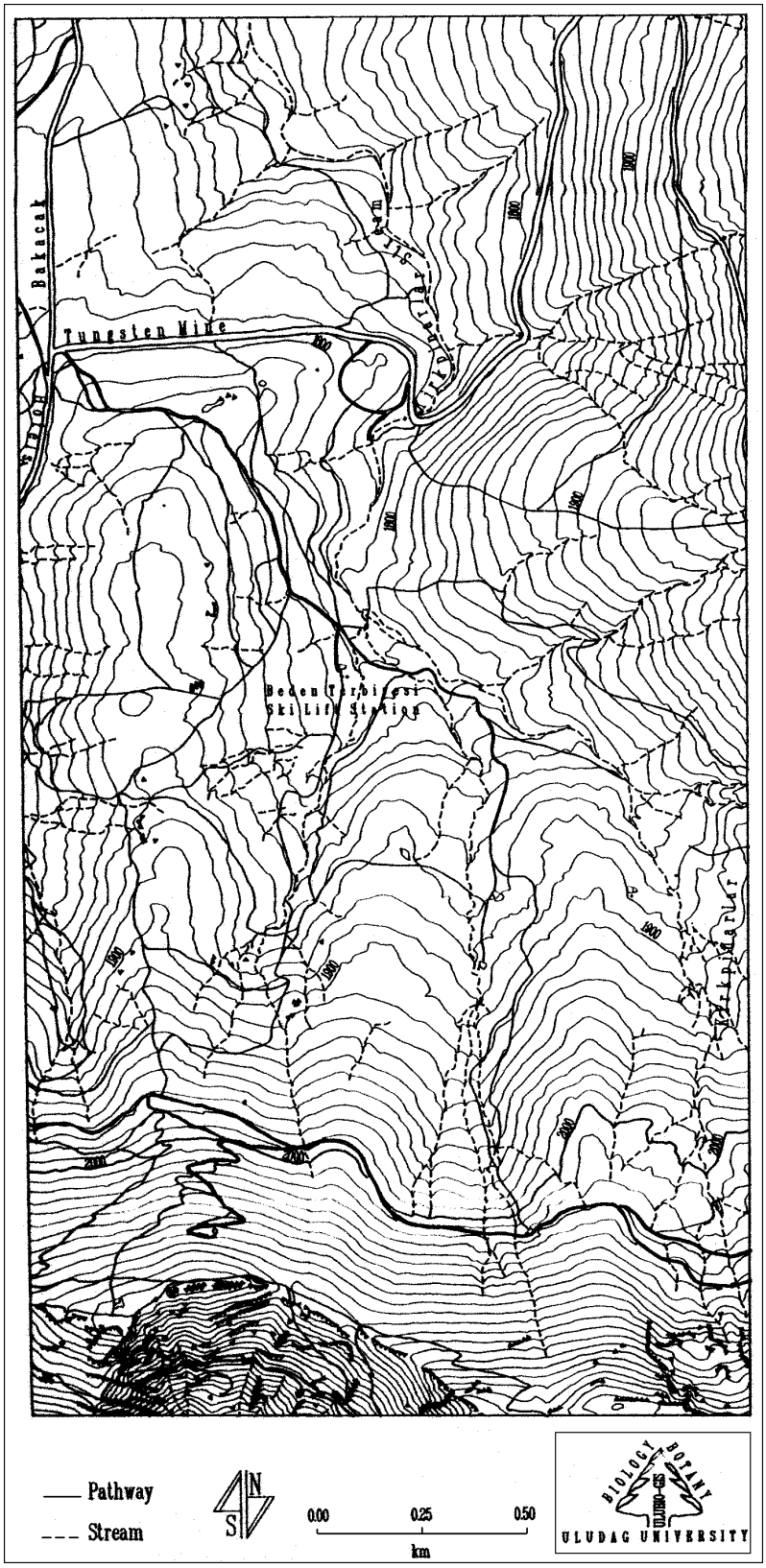

Figure 2. Geographical map of the Second Center of Tourism Development.

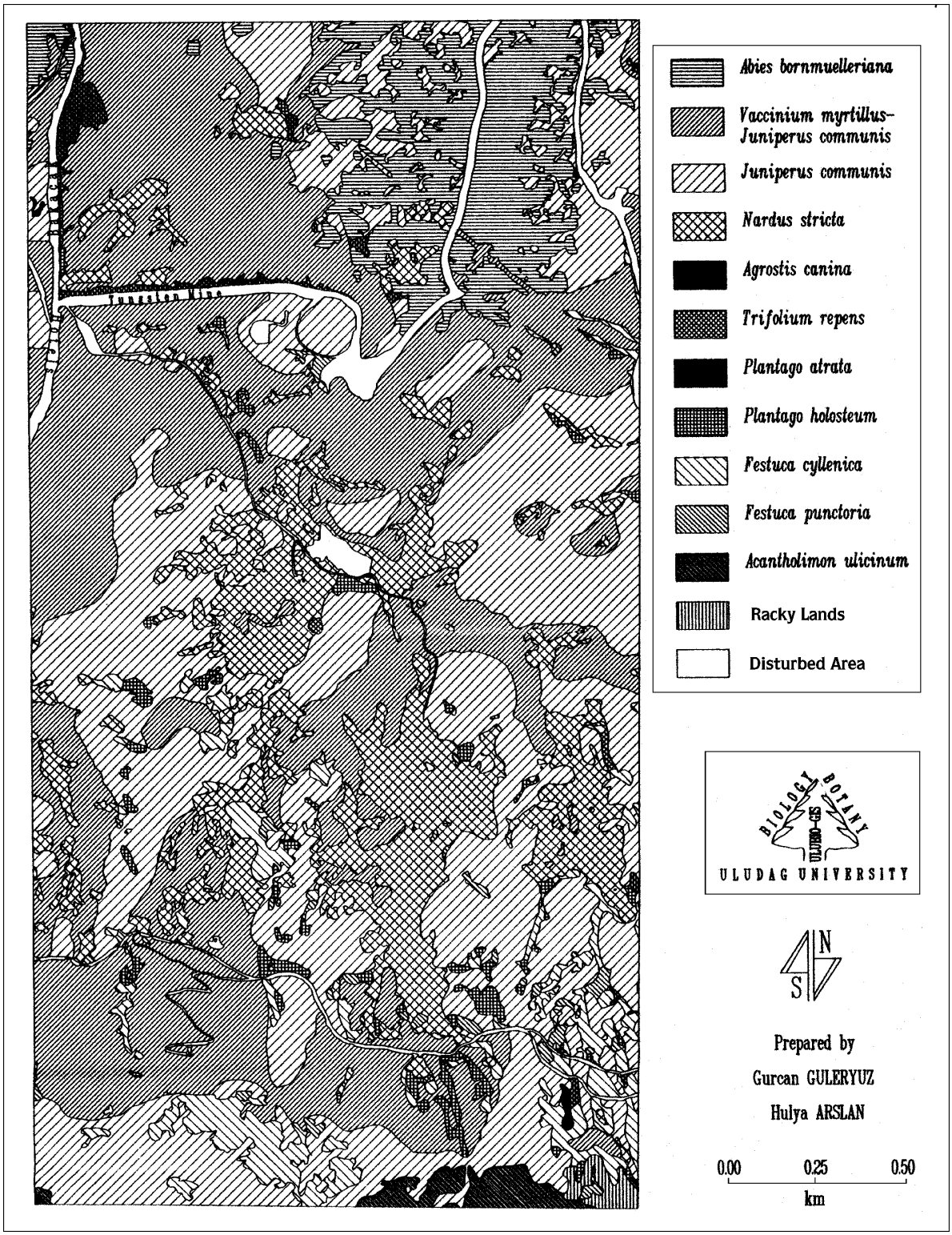

Figure 3. Map of plant communities around the Second Center of Tourism Development.

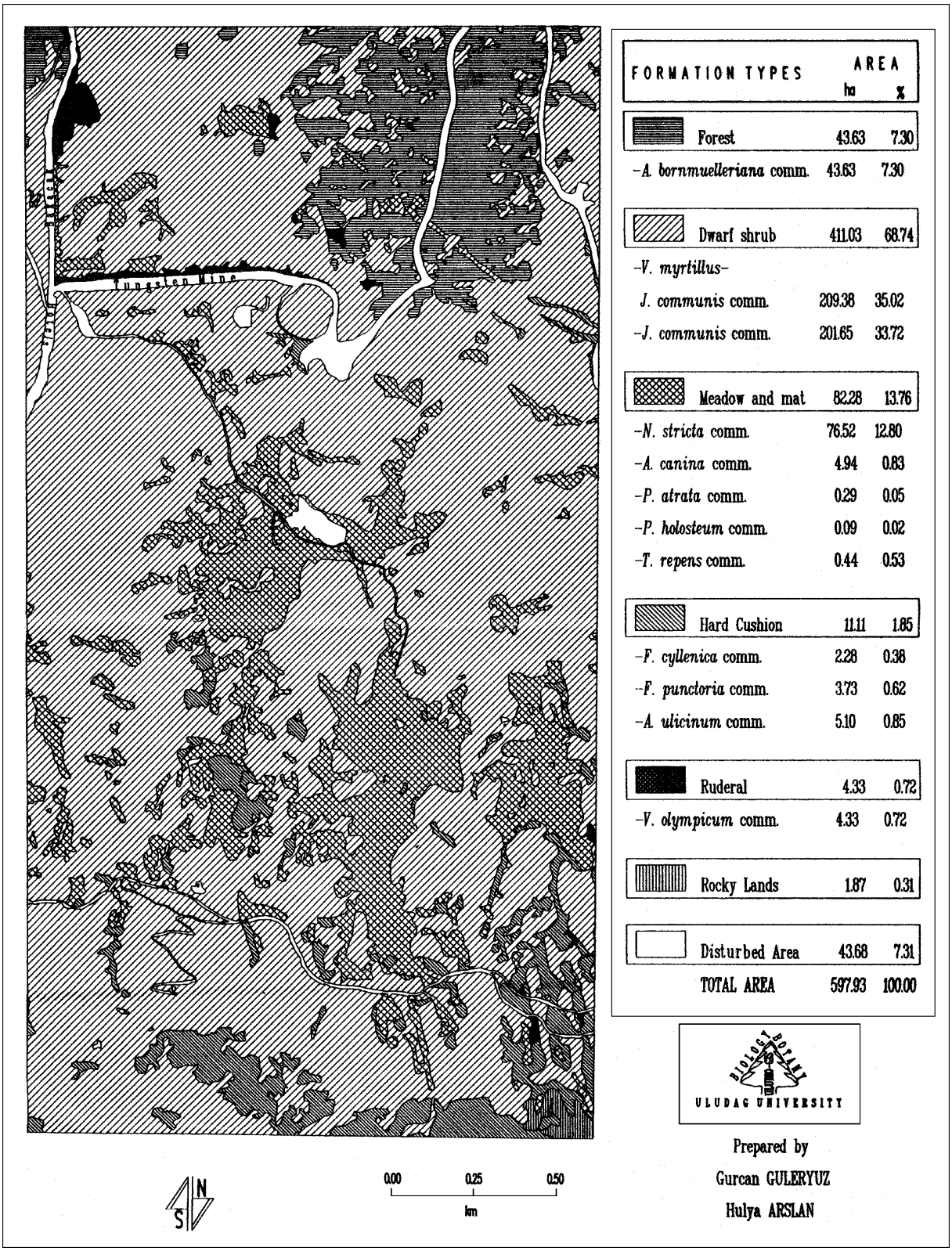

Figure 4. Map of vegetation types around the Second Center of Tourism Development.

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