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Full Length Research Paper

Distribution and conservation significance of endemic plants in the Düzce province

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When considering the conservation status of endemic plants, their traits must be taken in land use systems, since endemics population ranges and sizes, and durability of natural habitats. In this paper, we present the global assessment of the conservation status of the endemic plants from the Düzce province, by applying IUCN criteria and categories, together with the distribution patterns of these species according to land using and its threatened. Also, we focused on which endemic species is distributed and where the populations are more spread and threatened in planning by plotting them in land use maps of Düzce province. The recent studies of flora in Düzce province shows richness in endemic species by a local and regional flora researches which biological diversity is reflected on land use map. The endemic plant lists of Düzce, which were obtained in field studies conducted between 2003 and 2009 in Düzce province, were plotted on the maps produced by employing geographic information systems (GIS). Distribution in land use of determining endemic species, which were specified as critical, endangered and vulnerable endemic species among them, were shown on the land use maps. Eventually, the natural habitats for these species were specified as usage areas with land use and landscape management planning by planning them into conservation management.

Key words: International union for conservation of nature, endemic plants, conservation status, geographic information systems, land use, landscape plan, Düzce, Turkey.

INTRODUCTION

Floristic studies are one of the basic underlies in exposing the natural resources of an area. The regional and local flora studies in our country are used in preserving the nature, detecting the biological diversity and forming nature management plans. Therefore, floristic explorations are carried out in the studies like EIA (environmental impact assessment) carried out in terms of using nature regionally and locally. However, in some Europan countries like Germany and Holland, floristic and faunistic studies putting forward the present condition of the natural resources related to the region are conducted; and in terms of the area, vegetation, biotopes, etc. studies are regularly carried out in the landscape plans having legal status. In the process of taking decisions about land usages, the landscape plans, so, the floristic studies in these plans and their results are taken into consideration. This situation is needed in using the natural resources in a maintainable frame (Cowling et al., 2003; Makhzoumi and Pungetti, 1999; Uzun, 2003; Uzun and Yilmaz, 2009; Uzun et al., 2010). Landscape plan, which is defined as the prudential active actions for landscapes to be improved, maintained and formed, has recently been on the agenda by Europe landscape agreement, and it has been emphasised in different platforms. In the agreement, preserving the landscapes is defined as the actions that are done to preserve the important and characteristic treats, which are confirmed by the heritage value that stems from the natural forming of the landscape and/or human activities, and to maintain it. In this sense, preserving the landscapes involving endemic species is a universally promised issue (ELC, 2003).

Düzce province is located in a floristically important junction point containing different ecosystems with its seaside, high mountains, wetlands, running waters and agriculture lands. The provincial borders of Düzce involve

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almost the entire project of Büyük Melen that will provide İstanbul with potable water. There are important industrial areas and facilities between İstanbul and Düzce. The industrial development in Düzce, which started in 1976, has accelerated in recent years. Even though the Düzce plain has first class agricultural lands, a considerable part of the plain is covered with residences and industrial facilities. The influent running waters of Büyük Melen river are Asarsuyu, Küçük Melen, Uğursuyu and Aksu. The last three running waters composes Büyük Melen river by joining around Efteni lake, which is the most important wetland of the province. Efteni lake is an important ecological nodal point that collects the main running waters of the province and transmits them to Black Sea. There are aquatic plants in Efteni Lake (such as *Nuphar lutea* (L.) Sm, *Nymphaea alba* L., *Trapa natans* L.) and marshy plants at the edge of the lake (such as *Carex vesicaria* L., *Eleocharis quinqueflora* (Hartmann) O. Schwarz, *Schoenoplectus litoralis* (Schrader) Palla, *Juncus effusus* L., *Typha latifolia* L., *Phragmites australis* (Cav.)Trin. ex Steudel). There are meadows near the lake and, beyond the meadows, there are maquis (*Arbutus andrachne* L., *Phillyrea latifolia* L., *Pistacia terebinthus* L. ssp. *palaestina* (Boiss.) Engler, *Erica arborea* L., *Cistus creticus* L. and beyond the maquis, there are forests to the northern slope of Elmacik Mountain, there is a mixed forest (*Fagus orientalis* Lipsky, *Quercus petraea* Liebl. ssp. *iberica* (Steven ex Bieb.) Krassiln, *Acer platanoides* L., *Carpinus betulus* L., *Castanea sativa* Miller, *Tilia argentea* Desf. ex DC., *Ulmus glabra* Hudson, *Fraxinus excelcior* L. ssp. *excelcior* and *Cerasus avium* (L.) Moench).

In the other regions, *Pinus sylvestris* L. var. *hamata* Steven and *Abies nordmanniana* (Stev) Spach. ssp. *bornmuelleriana* (Mattf.) Coode and Cullen make up mixed and pure stands. On the tops of the hills, alpine zones are present (Aksoy, 2006, 2007). Czeczott (1939) collected some plants from Elmacik Mountain in 1925. According to the Flora of Turkey Kühne has visited and collected plant specimens from this area (Davis, 1965 to 88). In addition, some floristic studies have been carried out in Düzce (Akman and Yurdakulol, 1981; Aksoy, 2001; Güner, 2000; Doğan, 2000; İkinci, 2000; Özkan Yilmaz, 1996; Pazarcikçi, 1998; Uçar, 2003) but no regular floristic research has been performed in the Düzce region since 2001 (Aksoy, 2006, 2007). After, some floristic and vegetation studies have been carried out in Düzce (Aksoy, 2006; Güneş Özkan, 2009; Koca, 2003) and regional endemic plants of DUOF herbaria. Therefore, the objectives of these studies were to:

1). Emphasising the importance of the floristic studies, which are the main parts of the natural resource explorations.
2). Determining the endemic plants list of the Düzce Region and categorize the endemic plants according to IUCN Red Data Categories IUCN (2000).
3). Putting forward the areal distribution of the species detected in Düzce province.
4). Offering some suggestions to nature protection experts by determining in which land use the species having importance according to the IUCN categories are.

MATERIALS AND METHODS

Düzce is situated on Melen River Basin in the Western Black Sea Region of Anatolia (Turkey). It is located in the north of the Elmacik Mountain range and the south of Kaplandede Mountain. Düzce region is in the A3 grid square by considering categorization of Davis (1965 to 1988). It is under the influences of Euro-Siberian, Mediterranean and Irano-Turanian phytogeographic regions (Figure 1). Düzce province shows a transitory character between the Mediterranean climate with a very cold, less rainy winter and oceanic climate. Because of the geographical conditions, Elmacik Mountain is totally closed to the dry southern wind and opens to the northern winds, causing a high degree of humidity in the region (Düzce Meteorological Station, pers. comm.). The nearest station is in Düzce, which is in the northeast of the region at an altitude of about 146 m. According to the meteorological data obtained between 1960 and 2002 (42 years) in Düzce, the mean annual temperature is 13°C. The mean annual precipitation in Düzce is 839,5 mm. The total land area of Düzce Province is 259.300 ha whose 62% is forest, 9% is non irrigated, 9% is irrigated, shrub is 1% and pasture (Figure 2) (Environmental Status Report of Düzce Province, 2009).
The method of the study is conducted in 8 respective phases:

1). Between 2003 to 2009, herbaceous, ligneous, tubercular, etc. herb species were collected from especially southern side of Düzce province.
2). During the plants being collected, the altitude, aerial view point, UTM coordinates, etc. of each of the species were recorded.
3). During this process going on, the diagnosis of these collected plant species were conducted in ISTO, GAZI and DUOF herbaria, whose construction was finished.
4). Among the species whose diagnosis was conducted in Düzce provincial borders, according to IUCN classification system; critical, endangered, vulnerable, about to be threatened and least concerned species were classified.
5). These species, whose lists were formed, were transferred into maps numerically on Düzce provincial map in ArcGIS 9.3 environment, one of the GIS programmers'). Endemic plants of Düzce, which were obtained in field studies conducted between 2003 to 2009 and regional endemic plants of DUOF Herbaria in Düzce province, were plotted on the maps produced by employing geographic information systems (GIS). Small boxes on the geometrically registered stand map were digitalized. Then, positional databases for these digitalized boxes were produced. Arc GIS 9.3 software was used in digitalization.
6). The land use status of Düzce province is mapped according to 7 classes by making use of the land maps taken from the Ministry of Agriculture and Rural Affairs in MARA (2008) (forestry, shrub, nonirrigated arable land, irrigated arable land, hazelnut, pasture and settlement).
7). The superposing of the endemic species, spotted with overlay analysis in ArcGIS 9.3 program and land using was done.
8). Finally, some suggestions were offered in terms of nature protection studies by considering that superposing map.

RESULTS

Recent flora and vegetation investigations of Düzce

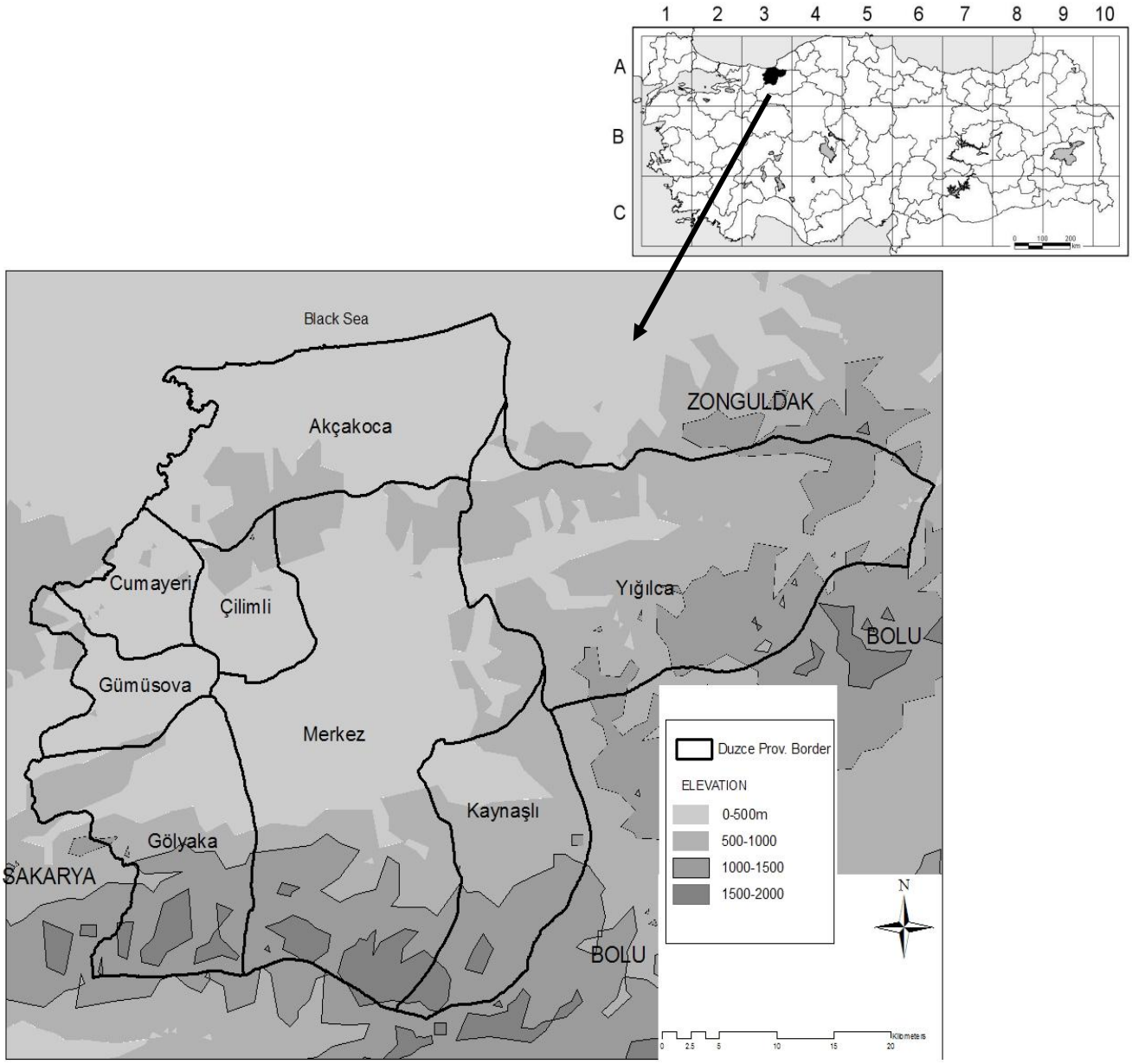

Figure 1. Elevations and location of Düzce Province (produced by GCM 1997).

region (the vegetation of Elmacik Mountain (Düzce) (Aksoy, 2006), flora and ethnobotany of the Akcakoca District (Kocak, 2003), *Cephalaria duzceënsis* (Dipsacaceae), a new species from the western Black Sea region, Turkey (Aksoy et al., 2007), *Centaurea yaltirikii* sp. nov. (Asteraceae, *C*. sect. Pseudoseridia) from Turkey (Aksoy et al., 2008) and the flora of Hasanlar Dam Lake and Its surroundings (Günes Özkan, 2009), the number of total vascular plant is reached to more than one thousand taxa. There are 71 endemic taxas in Düzce Region and the endemism ratio is approximately 7% (Aksoy et al., 2010). The latest conservation status of 71 endemic vascular plants of Düzce Region, eight species (*Silene sangaria* Coode et Cullen, *Centaurea kilaea* Boiss*., Centaurea yaltirikii* N. Aksoy, H. Duman and A. Efe*, Cephalaria duzceënsis* N. Aksoy and R.S. Göktürk*, Festuca rubra* L. ssp. *pseudorivularis* Markgr-Dannenb*, Lythrum anatolicum* Leblebici and Seçmen*, Lamium purpureum* L. var. *aznavourii* Gand. ex Aznav.*, Verbascum degenii* Hal.) are categorized as Critically Endangered, one species (*Cirsium boluënse* P.H. Davis and Parris) Endangered, two species (*Lathyrus undulatus* Boiss*., Seseli resinosum* Freyn and Sint.). Vulnerable and sixty as lower risk (47 as Least Concern and 13 as Near Threatened) when subjected to the IUCN Red List criteria (Aksoy et al., 2010) (Table 1).

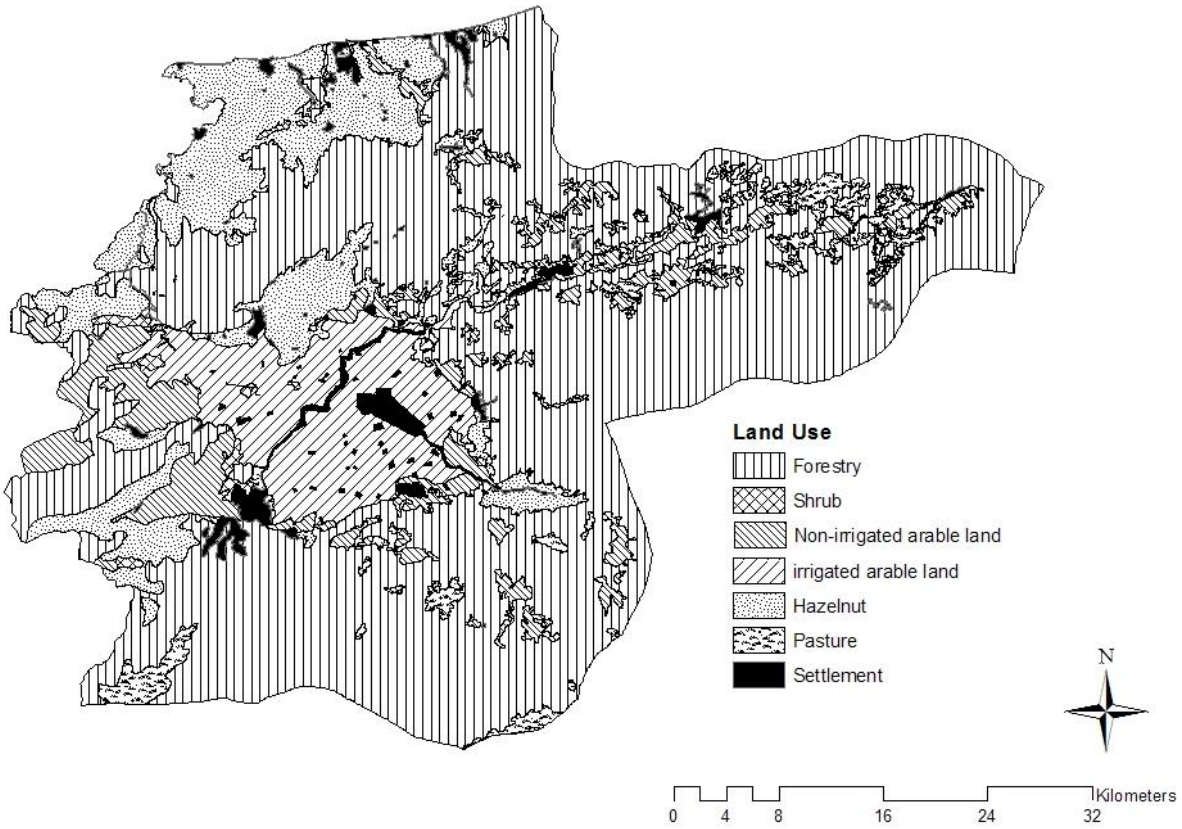

Figure 2. Land use map of Düzce Province (MARA, 2008).

Table 1. The number of endemic plants of Düzce in IUCN categories.

IUCN categories	Endangered (EN)	Critic (CR)	Vulnerable (VU)	Near threatened (NT)	Least concern (LC)
Number of Taxa	1	8	2	13	47

The flora of Turkey (Davis, 1965 to 1988; Güner et al., 2000) and Red Data Book of Turkish Plant (Ekim et al., 2000) were the main source used to check endemic plant specimens. The lejant of endemic species in maps were categorized according to IUCN Red Data Categories (IUCN, 2000). These abbreviations are as follows:

CR, critically endangered; EN, endangered; VU, vulnerable; NT, near threatened; LC, least concern; plants included in this list were deposited in the herbarium of the Forest Faculty of Düzce University (DUOF) (Table 1) (Figure 3):

1) *Centaurea yaltirikii*; 2) *Cephalaria duzceënsis*; 3) *Festuca rubra* subsp. *Pseudorivularis*; 4) *Lamium purpureum* var. *Aznavourii*; 5) *Lythrum anatolicum,* 6) *Verbascum degenii*; 7) *Centaurea kilaea;* 8) *Silene sangaria,* 9) *Cirsium boluënse,* 10) *Lathyrus undulatus*; 11) *Seseli resinosum*; 12) *Alyssum blepharocarpum*; 13) *Alyssum virgatum*; 14) *Carduus nutans* subsp. *falcato-incurvus*; 15) *Fritillaria bithynica*; 16) *Ferulago thirkeana*; 17) *Ornithogalum alpigenum*; 18) *Scorzonera pygmaea* subsp. *Nutans*; 19) *Stenotaenia macrocarpa*; 20) *Thlaspi jaubertii*; 21) *Verbascum bithynicum*; 22) *Dianthus cibrarius*; 23) *Verbascum cheiranthifolium* var. *asperulum*; 24) *Veronica fuhsii*; 25) *Corydalis wendelboi* subsp. *congesta*; 26) *Abies nordmanniananina* subsp. *bornmuelleriana*; 27) *Allium huber-morathii*; 28) *Allium olympicum*; 29) *Alyssum pseudo-mouradicum*; 30) *Anthemis aciphylla* var. *discoidea*; 31) *Arum euxinum*; 32) *Asperula lilaciflora* subsp. *phrygia*; 33) *Astrantia maxima* subsp. *haradjianii*; 34) *Campanula latiloba* subsp. *latiloba*; 35) *Campanula lyrata* subsp. *lyrata*; 36) *Cicerbita variabilis*; 37) *Crataegus* x *bornmuelleri*; 38) *Dactylorhiza bithynica*; 39) *Delphinium fissum* subsp. *anatolicum*; 40) *Dianthus anatolicus*; 41) *Dianthus carmelitarum*; 42) *Dianthus leucophaeus* var. *leucophaeus*; 43) *Dianthus lydus*; 44) *Epipactis bithynica*;

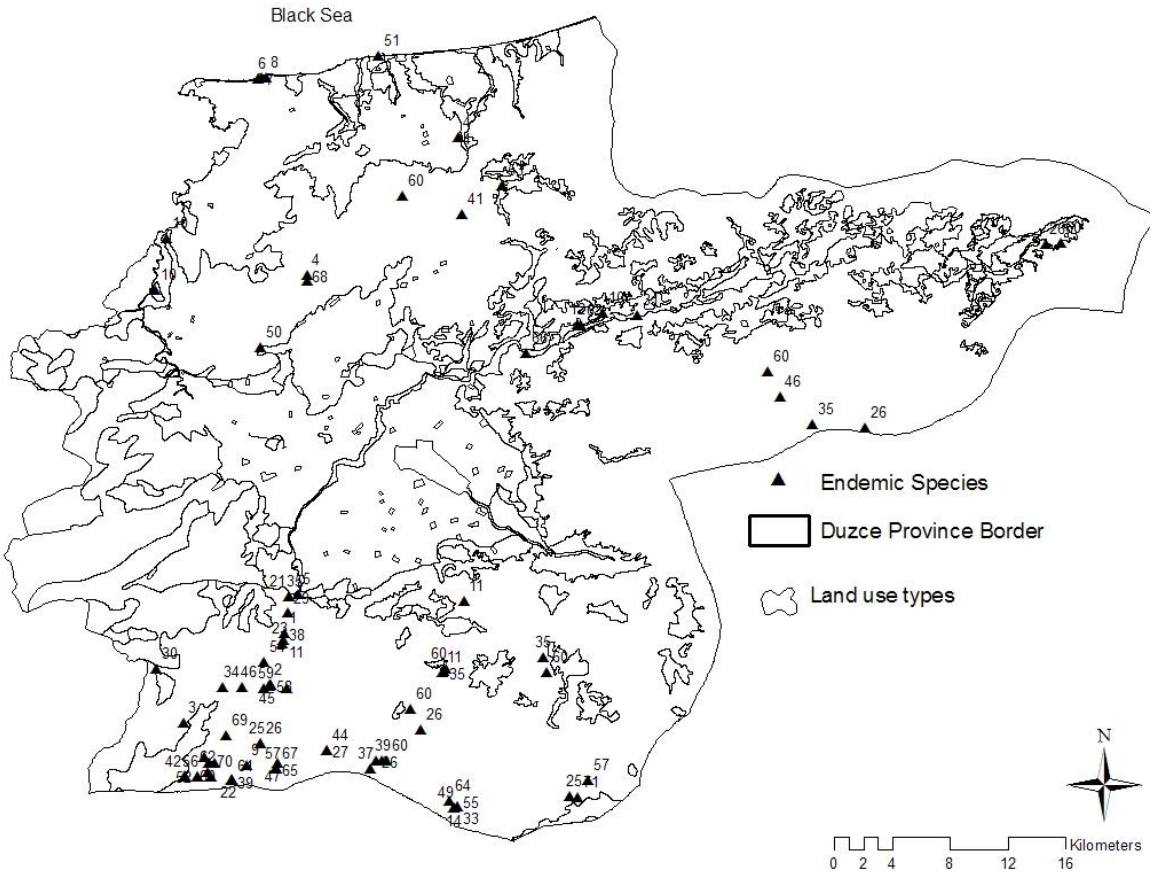

Figure 3. Distribution map of endemic plant species in Düzce Province.

45) *Euphorbia falcata* subsp. *macrostegia*; 46) *Galium fissurense*; 47) *Helichrysum arenarium* subsp. *aucheri*; 48) *Hieracium artabirense*; 49) *Jurinea alpigena*; 50) *Knautia degenii*; 51) *Lamium ponticum*; 52) *Lathyrus tukhtensis*; 53) *Linaria iconia*; 54) *Lonicera caucasica* subsp. *orientalis*; 55) *Marrubium globosum* subsp. *globosum*; 56) *Minuartia anatolica* var. *anatolica*; 57) *Muscari aucheri*; 58) *Nonea pulla* subsp. *monticola*; 59) *Onosma bornmuelleri*; 60) *Phlomis russeliana*; 61) *Sempervivum armenum* var. *armenum*; 62) *Sideritis dichotoma*; 63) *Stachys cretica* subsp. *anatolica*; 64) *Stachys iberica* subsp. *iberica* var. *densipilosa*; 65) *Taraxacum turcicum*; 66) *Tragopogon aureus*; 67) *Trifolium barbulatum*; 68) *Trifolium caudatum*; 69) *Trifolium pannonicum* subsp. *elongatum*; 70) *Asyneuma rigidum* subsp. *Sibthorpianum* and 71) *Crocus bicolor* subsp. *pulchricolor.*

The conservation status of 71 endemic plants of Düzce Province in Western Black Sea Region of Turkey is reviewed according to land use systems of Düzce. Field survey reports, recovery plants, herbaria holdings and observations have been utilized to assess each taxon's current range, status and their distribution in land use of Düzce Province are discussed. Distribution in land use of determining 71 endemic species and their distribution in Düzce province (Figure 3), which were specified as critical (*Silene sangaria* Coode et Cullen, *Centaurea kilaea* Boiss., *Centaurea yaltirikii* N. Aksoy, H. Duman and A. Efe, *Cephalaria duzceënsis* N. Aksoy and R. S. Göktürk, *Festuca rubra* L. ssp. *pseudorivularis* Markgr-Dannenb, *Lythrum anatolicum* Leblebici and Seçmen, *Lamium purpureum* L. var. *aznavourii* Gand. ex Aznav., *Verbascum degenii* Hal.), endangered (*Cirsium boluënse* P. H. Davis and Parris), vulnerable (*Lathyrus undulatus* Boiss., *Seseli resinosum* Freyn and Sint.) (Figure 4) and sixty as Lower Risk (47 as Least Concern and 13 as Near Threatened) when subjected to the IUCN Red List criteria (Figure 5) endemic species among them, were shown on the land use maps.

Distribution localities in land use of determining 71 endemic species and their distribution in Düzce province, which are plotted 82 as forest, 6 hazel nut, 4 non irrigated, 1 irrigated, 8 pasture and there is no shrub areas of (Table 2) endemic species distribution localities among them, were shown on the land use maps (Figure 6). The natural habitats of endemic species in forest are under the threat of forestry activities, road and dam constructions, in hazel nut are clear cutting to understory flora and hedges of nut tree farming, in non irrigated are

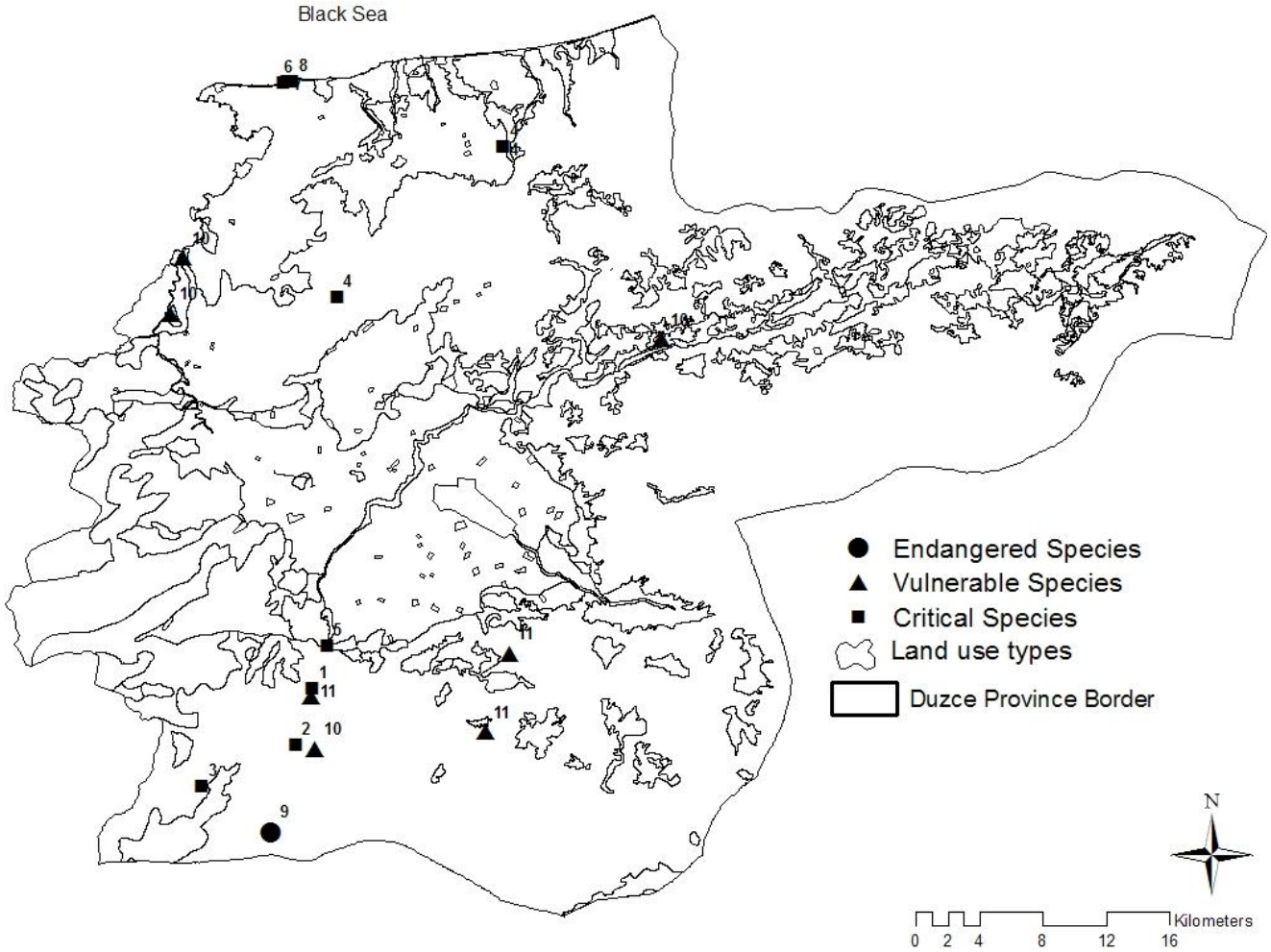

Figure 4. Distribution map of endangered, vulnerable and critical endemic plant species in Düzce Province.

urbanization and road construction, in irrigated are agricultural activities and road construction, in pasture are animal grazing, agricultural activity and urbanization, there is no locality of endemic species in shrub because the natural are of shrub in Düzce province are destroyed by forestry and agricultural activities. Another criteria in evaluating land usages and endemic species together is related to the ability of the species to renew themselves. Especially the endemic species away from human usages like settlement, agriculture, pasture are more able to renew themselves when human and natural disturbances are included (Altan et al., 2004). In this context, raising public awareness about usage of the lands in the districts near human usages is required for nature protection.

DISCUSSION

In the management of a region's natural resources, the region's floristic, faunal composition is quite important. In this context, the fact that such studies are being carried out around the university is a great advantage for Düzce. However, it is required that such kind of studies should be conducted in the context of landscape plans systematically like in some of the European countries and landscape management models should be formed by evaluating the natural resources together with the cultural resources of the region. Makhzouni and Pungetti (1999) confirms that judgement, too. Their conservation management plans must be planned according to endemic plant species distribution and currently threatened categories in land use systems. The densification of endemic species distribution plotting in area such as forestry must be separated into strictly protected zones. Forming biotopes, in which the endemic species exist, along with buffer zones around them and offering that to the deciders in a landscape management model will provide success in maintaining endemic species. Otherwise, determining the borders and spheres of influence of the human activities carried out in the region like forest activities, dams, etc. will not be possible. At the present

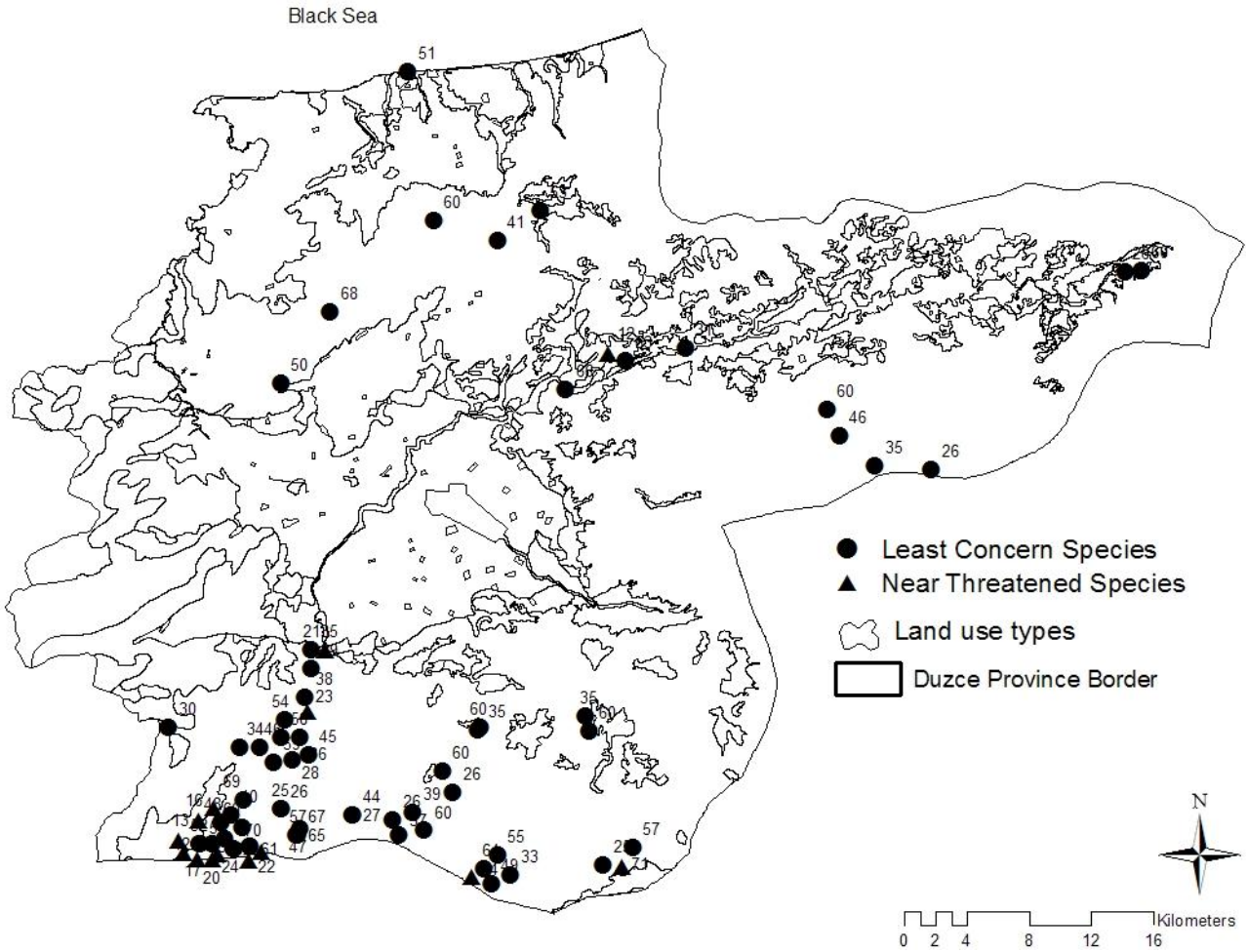

Figure 5. Distribution map of near threatened and least concern endemic plant species in Düzce Province.

Table 2. Distribution numbers points of endemic plant species in land use of Düzce Province.

Endemic plant species and land use	Endangered (EN)	Critic (CR)	Vulnerable (VU)	Near threatened (NT)	Least concern (LC)
Forest	1	4	6	13	58
Hazel nut	-	5	-	-	1
Non irrigated	-	1	-	-	3
Irrigated	-	-	-	-	1
Shrub	-	-	-	-	-
Pasture	-	-	-	3	3

situation, it was detected that the interactions between the ecotourism potential in Uğursuyu and Aksu Watersheds located in southern part of the study area and some land usage decisions like hydro electric power plants, water rent areas, material mines; the processes about landscape's functional structure like erosion, water process, also the present situation about administration are generally negative and, wrong land usage decisions affect the natural resources negatively.

In this context, it was found that landscape plans in local and regional dimension are highly needed (Uzun and Gültekin, 2010). In the context of that landscape plan, zoning studies should be conducted to preserve the related species by carrying out detailed studies about the elements of natural landscape and cultural landscape in the areas where endemic species are condensed in

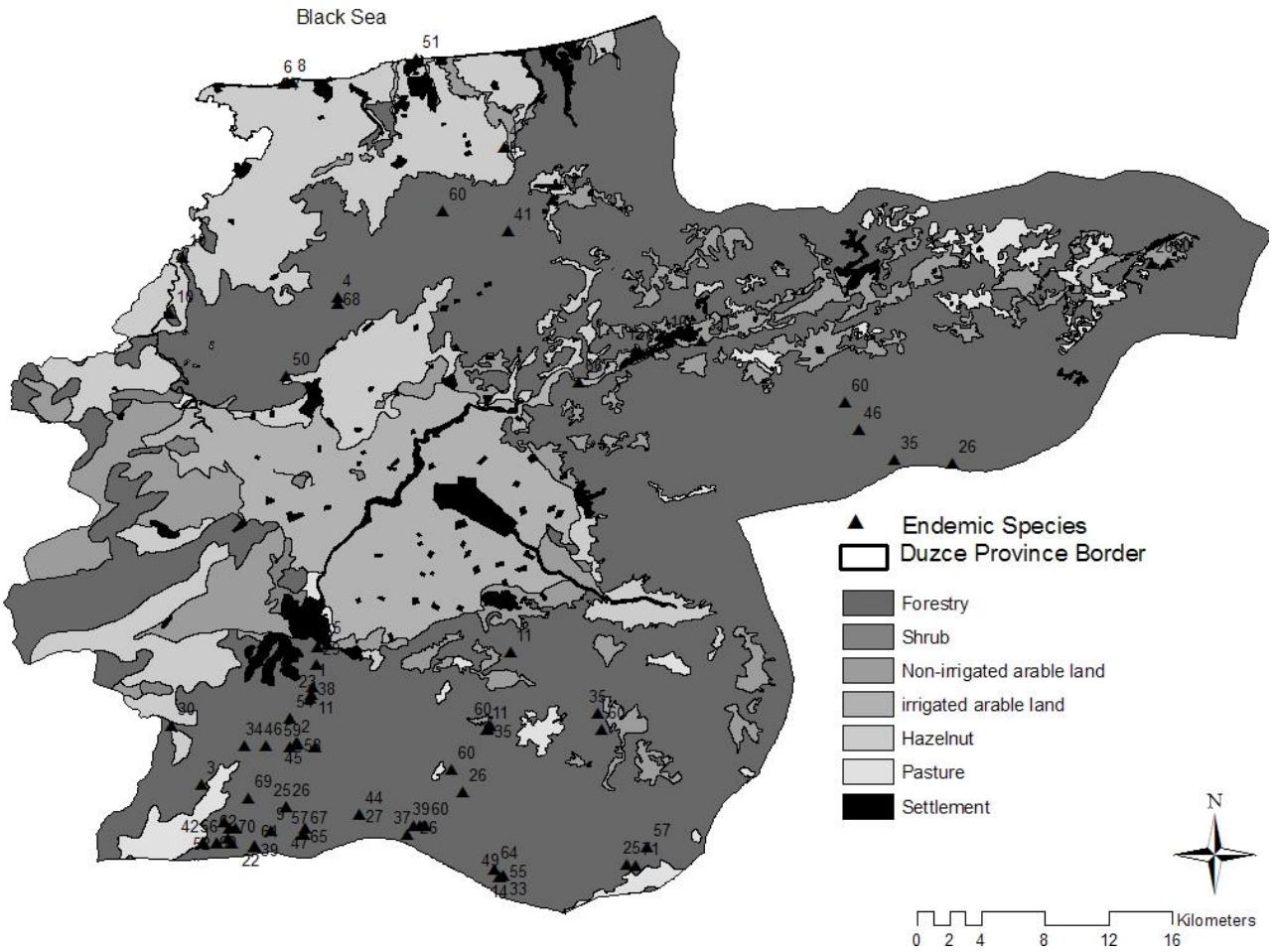

Figure 6. Distribution map of endemic plant species and land use in Düzce Province.

southwest and northeast of the study area. In those zoning studies, the parts forming the core zone should have a strong protective function to be used for scientific purposes. In the buffer zone, some usages in protection usage balance and some ecotourism activities like forest secondary product productions, botanic tourism, nature walks will be taking place. In the maintainable usage zone, human activities will be able to go on in accordance with the principle of maintainability. As a result, floristic studies are the most important part of nature protection, but, the important issue is that all the parts in the context of nature protection should be actualized as a whole under the title of landscape plan. Also, all the studies should be parallel to the universal decisions in Europe scale like Natura 2000, Europe Habitat directive, Europe landscape agreement.

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