American-Eurasian J. Agric. & Environ. Sci., 2 (4): 430-436, 2007
ISSN 1818-6769

Conservation Priority of the Threatened Plants in the Lower Tersakan Valley (A5 Amasya - Turkey) and Its Floristic Diversity

Ferhat Celep and Musa Dogan

Department of Biological Sciences, Middle East Technical University, 06531, Ankara, Turkey

Abstract: The natural flora of lower Tersakan Valley, located in Amasya province (A5) in northern Turkey, was studied between 2001 and 2004. During the floristic surveys, 457 taxa of 301 genera belonging to 74 families were recorded and 54 of these determined to be threatened according to IUCN Red List Categories. The types of the threat categories of these taxa are as follows: 1 taxon Critically Endangered, 3 taxa, Endangered, 1 taxon Vulnerable, 5 taxa Near Threatened and 44 taxa Least Concern. A total of 50 of the taxa (10.94%) determined in the research area are endemic. The distribution of taxa according to phytogeographic regions is as follows: Irano-Turanian elements 77 (16.8%), Euro-Siberian elements 39 (8.5%), Mediterranean elements 35 (7.6%), widespread and unknown 306 (66.9%). Four vegetation types can be recognized in the study area: *Degraded forest, maquis, steppe* and *riparian* vegetation. Unfortunately, this rich plant diversity faces various threats such as habitat destruction, urbanization, environmental contamination and cultivation. Urgent actions are needed for conservation of the lower Tersakan Valley's plant biodiversity and vegetation types.

Key words: Conservation . lower Tersakan valley . Threatened habitats . Turkey

INTRODUCTION

Turkey has rather interesting flora. In the country, nearly one in every three plants in Turkey is endemic, an astonishingly high percentage for a mainland country. The exceptional diversity in Turkey's flora is the collective results of extent of a variety of climates, topographical diversity with marked changes in ecological factors over a short distance, geological and geomorphic variation, a range of aquatic environments such as seas, lakes and rivers, altitude variations from sea level to 5000 m. There are a number of major mountain ranges in Anatolia that constitute effective barriers and these have further encouraged a greater diversity of species particularly in the inner ecosystems due to isolation [1, 2].

Amasya (A5 *sensu* [3]) is a small city and located in the northern Turkey. The region has an area of 5690 km^2 and altitude ranges between 370 and 2135 m. Amasya consists of a number of mountains, plains, lakes, rivers, streams, valleys and plateaus. For these reasons, the area shows very interesting geographic, edaphic, geologic and climatic diversity.

In addition, *meadows, wetlands, forests, maquis, steppes, riparian* and different vegetation types appearing in vertical belts are also important. An estimated over 1000 species of vascular plants are found in Amasya, almost 200 of which are endemic [3, 4]. These figures make this region one of the richest and interesting botanical area among the territories of Northern Turkey.

Main research area, lower Tersakan Valley, is situated in the northern part of the city center and it appears to be a transitional zone between Central Anatolia steppes and the North Anatolia. Moreover, it is a transitional zone between Euro-Siberian and Irano-Turanian phytogeographic regions. Such transitional zones have interesting properties, due to the mixing of oceanic and continental climates. This situation is clearly reflected in the flora and vegetation of the study area. In certain places of the region Mediterranean climate is seen and Mediterranean enclaves are widespread in the study area [5].

This research has a great importance for a better understanding of human impact on the floristic changes caused by the land use policies in the region and certainly it has some advantages for sustainability. In addition, the factors affecting survival of the threatened plant species are explained along with the sustainable use of plant diversity, some conservation priorities and strategies are also suggested.

Study area: Main research area, lower Tersakan Valley, is located in the northern part of Amasya

Corresponding Author: Dr. Ferhat Celep, Department of Biological Sciences, Middle East Technical University, 06531, Ankara, Turkey

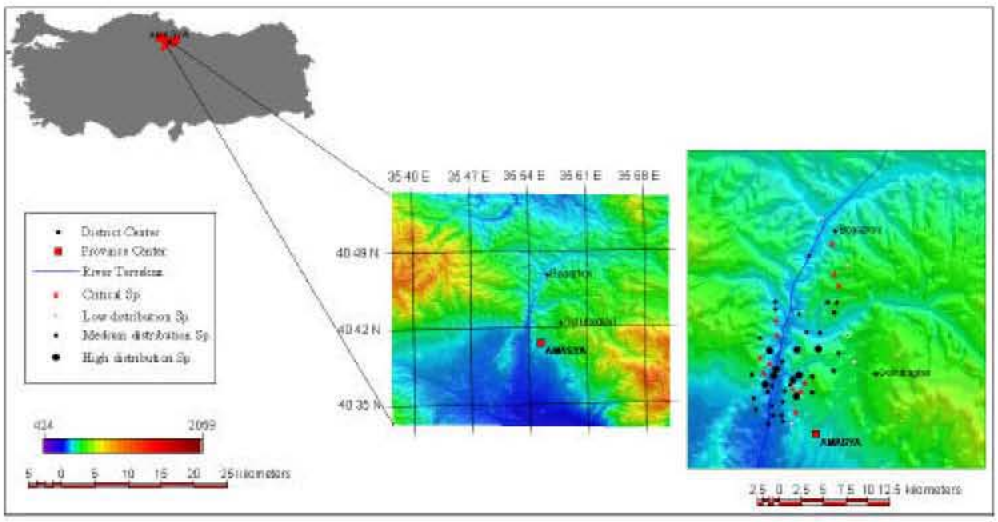

Fig. 1: Location of the study area, the distribution of 54 threatened plant populations according to their rarity

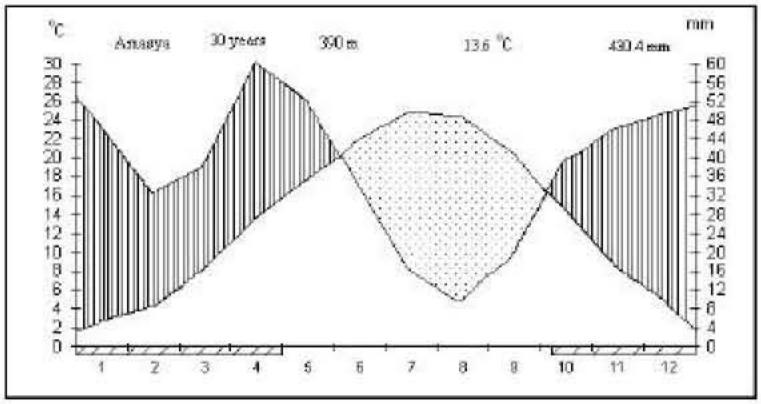

Fig. 2: Ombrothermic diagram of Amasya

province and lies approximately at 40°39' 24''-40°43' 55'' north latitudes and 35°50' 03''-35°46' 24'' east longitudes. Altitude of the study area varies between 390 m and 1130 m and it appears to be generally mountainous. Tersakan river is placed in the centre of the valley and flows from north to south drection, towards Yesilirmak river. In addition, the study area lies on the ancient silk road (Fig. 1).

The climate of the research area is based on the data obtained from the meteorology station in Amasya. The dominant bioclimate is characterized as a semi-arid Mediterranean climate. The Mediterranean climate is experienced by hot and dry summers followed by cold and wet winters [6]. Rainfall is lower from the north to the south of the valley [7]. The mean annual average temperature is 13.6°C and precipitation is 430.4 mm. It can be seen that heavy rainfall is received in November to April, while the dry period extends from the beginning of June until the end of October. The most of precipitation occurs in the Spring and Winter. The ombrothermic diagram shows the months with dry and rainy period (Fig. 2).

The geological structure of the researh area mostly consists of calcareous rock which precipitate, on the paleosoic old basic rocks [8]. There are five large soil groups in the study area: brown forest soil, chesnut colour, brown soil, alluvial and colluvial soil [9].

MATERIALS AND METHODS

Field observations were conducted and plant species were gathered to depict the flora of the area and make an inventory of plants before habitat degradation in 2001 and 2004. Efforts were made to collect both flowering and fruiting specimens. The specimens were prepared according to established herbarium techniques. The Flora of Turkey [3, 10, 11] and other related floras [12, 13] were utilized in the

identification of the specimens. Experts were consulted in some controversial cases. The authorities are cited using Authors of Plant Names [14].

Threatened categories are proposed for endemic and rare taxa in the study area according to IUCN risk categories [15, 16]. The distribution of threatened plant populations was also mapped (Fig. 1). The following abbreviations are used; EN, Endangered; VU, Vulnerable; CR, Critically endangered; LC, Least concern; NT, Near threatened.

RESULT AND DISCUSSION

During the floristic study, about 1000 vascular plant specimens were collected from lower Tersakan Valley and its vicinity, 325 species (457 taxa) in 301 genera, belonging to 74 families were established. Four taxa belong to Gymnospermae, while the other 453 were in Angiospermae [4].

A total of 54 threatened plant species, belonging to 43 genera in 17 families, were found. The distribution of the threat categories of these taxa is as follows: 1 taxon CR, 3 taxa, EN, 1 taxon VU, 5 taxa NT and 44 taxa LC (Fig. 3). The largest families are Asteraceae, Fabaceae, Lamiaceae, Boraginaceae, Brassicaceae and Scrophulariaceae, together comprising about 60% of the total threatened species (Fig. 4). More than 35% of the threatened species belong to 8 genera, including *Alyssum*, *Minuartia*, *Astragalus*, *Onobrychis*, *Centaurea*, *Scorzonera*, *Onosma* and *Asperula*.

Of the total threatened species in the valley, about 77.8% is distributed between 400-650 m, 14.8% between 650-850 m and 7.4% above 850 m, reflecting that most of the threatened species in the valley could not survive in a wider vertical range with stronger adaptation. Urbanization and cultivation activities have been concentrated at the lower part of the valley; therefore, human activities are directly effect on the threatened plant species and urgent conservation measures are needed for the sustainability of threatened species.

Of the total threatened species, 64.8% grows in *steppe*, 16.6% grows in *maquis* and the remaining 1.8% grows in *riparian* habitats. 16.7% of them were found in more than two kinds of habitats. This shows that the *steppe* is the main habitat for threatened plants and therefore protection of the *steppe* seems to be the most important vegetation for saving these species. The threatened flora of the study area with threatened species, their conservation status, vegetation types and elevation ranges are given in Table 1.

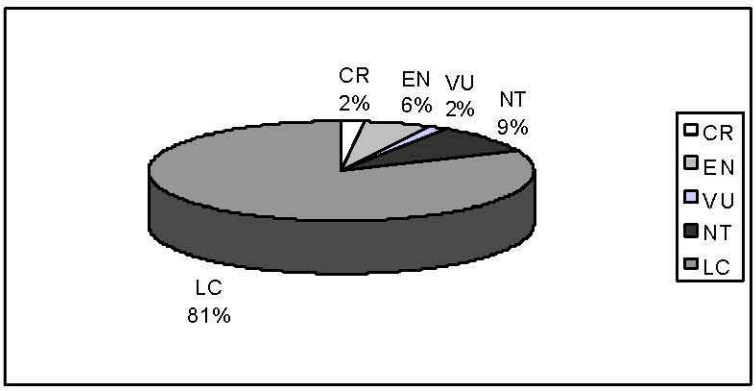

Fig. 3: Distribution of the threatened species according to IUCN Red List categories

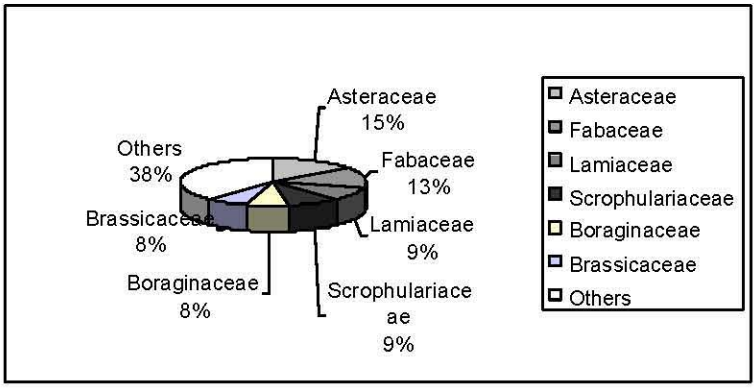

Fig. 4: The richest families according to threatened species

Table 1: The threatened flora of the study area, its IUCN red data list categories, vegetation types and elevational range

Species name	Conservation status	Vegetation types	Elevational range (m)
Endemic species			
Delphinium venulosum Boiss.	LC	Steppe	400-650
Consolida thirkeana (Boiss.) Schröd	LC	Steppe	400-650
Alyssum blepharocarpum Dudley & Hub.-Mor.	NT	Steppe	400-650
Alyssum praecox Boiss. et Bal. var. *praecox* Boiss.	LC	Steppe	400-650
Draba rigida Willd. var. *rigida*	LC	Maquis (on rocks)	400-650
Erysimum amasianum Hausskn. et Bornm.	EN (Bl a,b and B2 a,b)	Steppe	400-650
Minuartia erythrosepala (Boiss.) Hand.-Mazz.var.*cappadocica* (Boiss.) McNeill	LC	Steppe (on rocks)	400-650
Minuartia corymbulosa (Boiss& Bal.) McNeil. var. *Corymbulosa*	NT	Steppe (on rocks)	400-650
Saponaria prostrata Willd. subsp. *Prostrata*	LC	Steppe	400-650
Haplophyllum armenum Spach	LC	Steppe	400-650
Astragalus dipsaceus Bunge	LC	Steppe	400-650
Astragalus leucothrix Freyn & Bornm.	LC	Steppe	400-650
Astragalus lycius Boiss.	NT	Steppe	400-650
Astragalus squalidus Boiss. & Noe	LC	Steppe	650-850
Hedysarum pogonocarpum Boiss.	LC	Steppe	400-650
Onobrychis bornmuelleri Freyn	EN (Bl a,b and B2 a,b)	Steppe	400-650
Onobrychis cappadocica Boiss.	LC	Steppe	650-850
Heracleum platytaenium Boiss.	LC	Maquis (on rocks)	+850
Inula anatolica Boiss.	LC	Steppe (on rocks)	400-650
Anthemis sintenisii Freyn	LC	Steppe	400-650
Tripleurospermum rosellum (Boiss& Orph.) Hayek var. *album* E. Hossain	VU (Bl a,b and B2 a,b)	Steppe	400-650
Jurinea pontica Hausskn. et Freyn ex Hausskn.	LC	Steppe	650-850
Centaurea consanguinea DC.	LC	Steppe	+850
Scorzonera acuminata Boiss.	LC	Steppe, Degraded forest	400-650
Scorzonera amasiana Hausskn. & Bornm.	CR (Bl a,b and B2 a,b)	Steppe (on rocks)	50-850
Campanula saxonorum Gandoger	LC	Steppe	400-650
Asyneuma limonifolium (L.) Janchen subsp. *Pestalozzae* (Boiss.) Damboldt	LC	Maquis, Degraded forest	400-650
Vincetoxicum fuscatum (Hornem.) Reichb. Fil. subsp. *Boissieri* (Kusn.) Browicz	LC	Maquis, Steppe	400-650
Convolvulus assyricus Griseb.	LC	Maquis, Steppe	400-650
Paracaryum ancyritanum Boiss.	LC	Steppe	400-650
Echium orientale L.	LC	Steppe	400-650
Onosma bornmuelleri Hausskn.	LC	Steppe	400-650
Onosma stenolobum Hausskn. ex H.Riedl	LC	Steppe	400-650
Verbascum myrianthum Boiss.	EN (Bl a,b and B2 a,b)	Maquis	650-850
Scrophularia libanotica Boiss. subsp. *libanotica* var. *pontica* R. Mill	LC	Riparian	400-650
Linaria corifolia Desf.	LC	Steppe	400-650
Digitalis lamarckii Ivan.	LC	Steppe, Degraded forest	+850
Scutellaria salviifolia Bentham	LC	Steppe	400-650
Phlomis armeniaca Willd.	LC	Steppe, Maquis	400-650
Lamium ponticum Boiss. et Bal. ex Boiss.	LC	Steppe	400-650
Sideritis amasiaca Bornm.	NT	Maquis	650-850
Salvia cyanescens Boiss. & Ball.	LC	Steppe	400-650
Asperula pestalozzae Boiss.	LC	Steppe (on rocks)	400-650
Asperula suavis Fisch. et Mey.	LC	Maquis	650-850
Galium fissurense Ehrend. et Schönb.-Tem.	LC	Maquis	400-650
Arum euxinum R. Mill	LC	Maquis, Degraded forest	+850
Allium cappadocicum Boiss	LC	Maquis	400-650
Bellevalia gracilis Feinbrun	LC	Steppe	400-650
Hyacinthella micrantha (Boiss.) Chouard	NT	Maquis	400-650
Iris galatica Siehe	LC	Steppe, Maquis	400-650
Crocus ancyrensis (Herbert) Maw	LC	Maquis, Steppe	400-650
Non Endemic-Rare species *Centaurea urvillei* DC. subsp. *steppeposa* Wagenitz	LC	Maquis	400-650
Astragalus densifolius Lam. subsp. *amasiensis* (Freyn) Aytaç	LC	Steppe	650-850
Veronica multifida L.	LC	Steppe	400-650

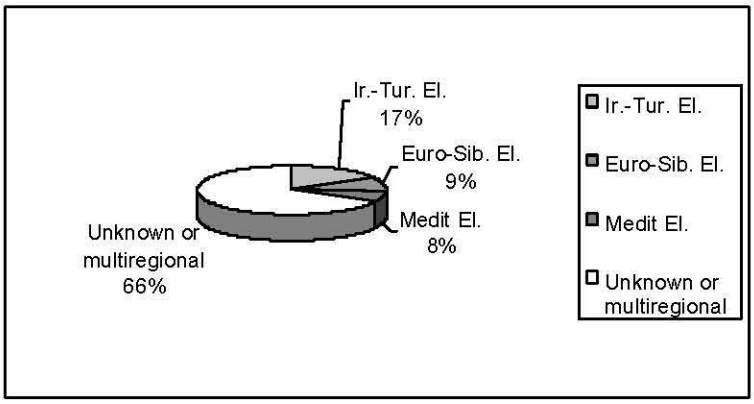

Fig. 5: Phytogeographic distribution of the taxa in the study area

According to the latest IUCN risk categories and the field observations, *Scorzonera amasiana* Hausskn. & Bornm. is Critically endangered [CR (Bl a,b and B2 a,b): extent of occurrence less than 100 km^2; area of occupancy less than 10 km^2 ; known to exist at only a single location; inferred decline in the area, extent and/or quality of habitat]. *Verbascum myrianthum* Boiss., *Onobrychis bornmuelleri* Freyn and *Erysimum amasianum* Hausskn. et Bornm. are Endangered [EN (Bl a,b and B2 a,b): extent of occurrence less than 5000 km^2, area of occupancy less than 500 km^2, known at no more than five locations; inferred decline in the area, extent and/or quality of habitat]. *Tripleurospermum rosellum* (Boiss & Orph.) Hayek var. *album* E. Hossain is Vulnerable [VU (Bl a,b and B2 a,b): Extent of occurrence less than 20,000 km^2; area of occupancy less than 2000 km^2, known at no more than 10 locations; inferred decline in the area, extent and/or quality of habitat]. *Hyacinthella micrantha* (Boiss.) Chouard, *Sideritis amasiaca* Bornm., *Astragalus lycius* Boiss., *Minuartia corymbulosa* (Boiss& Bal.) McNeil var. *corymbulosa* and *Alyssum blepharocarpum* Dudley & Hub.-Mor. are Near Threatened (NT) and remaining Least Concern (LC) [16].

The vegetation of the lower Tersakan valley is rather variable. Four main vegetation types can be distinguished in the study area as a result of this research: *Degraded forest, maquis, steppe* and *riparian* vegetation. Vegetation is stratified from the bottom of the valley to the slopes. Altitude, direction, topography, temperature and precipitation play an important role in stratification.

Degraded forest vegetation is especially widespread in the northern-exposed slopes of the area and includes *Quercus pubescens* Willd., *Carpinus orientalis* Miller and *Juniperus oxycedrus* L forests formed as a result of the destruction of *Pinus brutia* Ten forest. *Maquis vegetation* is found in the area as Mediterranean enclaves because of the destruction of *Pinus brutia* ten forest. *Maquis vegetation* usually occurs on south-facing slopes of the area and lower part of the valley. *Steppe vegetation*, most widespread, embodies perennial herbaceous and semi-woody dwarf plants dominating the south facing slopes, under severe urbanization and cultivation pressure. *Riparian vegetation*, only in the Tersakan River bank, including herbaceous or woody plants such as *Populus alba* L., *Salix triandra* L. subsp. *bornmuelleri* (Hausskn.) A. Skv. The characteristic species of vegetation types, their phytogeographic regions and elevation range are given in Table 2.

The distribution of taxa according to phytogeographical regions is as follows: Irano-Turanian elements 77 (16.8%), Euro-Siberian elements 39 (8.5%), Mediterranean elements 35 (7.6%), unknown or multiregional 306 (66.9%) (Fig. 5). Irano-Turanian and Mediterranean elements were generally distributed in open and steppe areas, whereas Euro-Siberian elements were found in humid shadowy areas, around damp springs and in meadows.

The first five families with the highest number of taxa are Asteraceae (56 spp.) (12.2%), Fabaceae (42 spp.) (9.2%), Lamiaceae (35 spp.) (7.6%), Brassicaceae (33 spp.) (7.2%) and Poaceae (33 spp.) (7.2%). Five of the richest genera are *Astragalus* L. (7 spp.), *Alyssum* L. (7 spp.), *Vicia* L. (6 spp.), *Salvia* L. (6 spp.) and *Centaurea* L. (5spp.).

Natural ecosystems degrade and decline rapidly as human populations increase. Due to the rapid population increase in Turkey within the last few decades many natural habitats have been fragmented, reduced in size, degraded or destroyed [17]. Similarly, the destruction of habitat through human encroachment is the principal cause of the loss of the area's biodiversity [18]. Habitat loss, clearing of the natural vegetation for urbanization, cultivation and pollution are the main causes of threats in the study area.

Table 2: The characteristic species of vegetation types, their phytogeographic regions and elevational ranges

Main vegetation types	Elevational range (m)	Characteristic species	Phytogeographic element
Degraded forest	450-900	*Pinus brutia* Ten	Unknown or multiregional
		Quercus pubescens Willd.	Unknown or multiregional
		Quercus robur L.	Euro-Siberian El.
		Carpinus orientalis Miller	Unknown or multiregional
		Juniperus oxycedrus L.	Unknown or multiregional
Maquis	450-650 (800)	*Phillyrea latifolia* L.	Mediterranean El.
		Cistus creticus L.	Mediterranean El.
		Jasminum fruticans L.	Mediterranean El.
		Pistacia terebinthus L.	Mediterranean El.
		Quercus cerris L.	Mediterranean El.
		Rhamnus oleoides L.	Mediterranean El.
		Paliurus spina-christii Miller	Unknown or multiregional
		Colutea cilicica Boiss & Ball.	Unknown or multiregional
Steppe	450-900	*Astragalus microcephalus* Willd.	Irano-Turanian El.
		Acantholimon acerosum (Willd.) Boiss.	Irano-Turanian El.
		Stipa ehrenbergiana Trin. & Rupr.	Irano-Turanian El.
		Thymus sipyleus Boiss.	Unknown or multiregional
		Centaurea solstitialis L.	Unknown or multiregional
		Xeranthemum annum L.	Unknown or multiregional
		Chardinia orientalis (L.) O. Kuntze	Irano-Turanian El.
		Onosma sericeum Willd.	Irano-Turanian El.
		Teucrium polium L.	Unknown or multiregional
		Teucrium chamaedrys L.	Irano-Turanian El.
		Verbascum orientale (L.) All.	Mediterranean El.
		Globullaria trichosantha Fish. & Mey.	Unknown or multiregional
		Pennisetum orientale L. C. M. Richard	Irano-Turanian El.
		Chrysopogon gryllus (L.) Tri.	Unknown or multiregional
		Convolvulus assyriacus Griseb.	Irano-Turanian El.
(on rocks)	400-700	*Onosma alba-roseum* Fisch. & Mey.	Unknown or multiregional
		Sedum album L.	Unknown or multiregional
		Sedum hispanicum L.	Unknown or multiregional
		Paronychia kurdica Boiss.	Unknown or multiregional
		Minuartia erythrosepala Hand.-Mazz.	Irano-Turanian El.
Riparian	390-450	*Elaeagnus angustufolia* L.	Unknown or multiregional
		Salix triandra L. subsp. *bornmuelleri* A.Skv.	Irano-Turanian El.
		Mentha longifolia (L.) Hudson	Euro-Siberian El.
		Plantago lanceolata L.	Unknown or multiregional
		Lythrum salicaria L.	Euro-Siberian El.
		Epilobium montanum L.	Euro-Siberian El.
		Polygonium lapathifolium L.	Unknown or multiregional
		Reseda luteola L.	Unknown or multiregional
		Sambucus ebulus L.	Euro-Siberian El.
		Conium maculatum L.	Unknown or multiregional
		Schonoplectus lacustris (L.) Palla	Unknown or multiregional
		Dipsacus laciniatus L.	Unknown or multiregional
		Phragmites australis (Cav.) Trin. ex Steudel.	Unknown or multiregional
		Cyperus longus L.	Unknown or multiregional

Because of the rapidly growing human population in the city center and the nearby lowlands, recently, the area has been declared as a residential area by the municipality. Afterwards, construction activities have been gradually increased. Nowadays, majority of the valley basin is occupied by construction companies, especially; lower part of the valley is almost degraded. Consequently, in near future, plant diversity will decline and threatened species will disappear in the area.

Another factor affects biodiversity in the area is the presence of factories which are situated at the upper part of the Tersakan River. From time to time, these factories release some toxic waste into the river. This detrimental situation gives rise to the decline of both floral and faunal diversity in the area.

CONCLUSIONS

As a result of this study, it can be expected that gradually the important floristic changes will take place in the area due to the habitat destruction. Urbanization is one of the leading causes of species extinction. Many human activities promote biotic homogenization, but urbanization is one of the most homogenizing activities of all [19, 20]. Consequently, in near future, plant diversity will decline and threatened species will disappear in the area if necessary conservation measures are not taken. Although in recent years local government authorities have made some efforts to preserve biodiversity, but much work remains to be done. The area needs to be legally protected with protection of the small population and vegetation, besides the area is urgently modeled and managed by means of using the Geographical Information System (GIS) images. In addition, several other measures need to be considered such as a search for the threatened species in surrounding areas, rehabilitation or restoration of damaged habitats, transferring the species in surrounding protected areas and cultivation in botanical gardens.

ACKNOWLEDGEMENTS

We thank to Prof. Dr. Zeki Kaya, Prof. Dr. H. Resit Akçakaya and Prof. Liangdong Guo, for providing useful discussions and their constructive critics about the manuscript, to Research Asisstant Banu Kaya for drawing map. This project supported by the Gazi University Scientific Research Project Unit.

REFERENCES

1. Davis, P.H. and I.C. Hedge, 1971. Distribution patterns in Anatolia with particular reference to endemism. Plant life of South-West Asia, pp: 15-27.
2. Davis, P.H. and I.C. Hedge, 1975. Flora of Turkey: Past, present and future. Candollea, 30: 331-351.
3. Davis, P.H. *et al*., 1965-1985. Flora of Turkey and the East Aegean, Islands 1-9. Edinburgh University Press, Edinburgh, UK.
4. Celep, F., Z. Aytaç and F. Karaer, 2006. Plant Diversity and Distribution in the Lower Tersakan Valley. Flora Mediterranean, 16: 295-332
5. Karaer, F. and M. Kilinç, 2001. The Flora of Kelkit Valley, Tr. J. Bot., 25: 195-238.
6. Akman, Y., 1990. Iklim ve Biyoiklim. Palme Yayinlari Da, No. 103, Ankara, Turkey.
7. Anonymus, 1984. Ortalama Ekstrem Sicaklik ve Yagis Degerleri Bülteni, Meteoroloji Isleri Genel Müdürlügü Yayini, Ankara, Turkey.
8. Eser, S., 1983. Merzifon Depresyonu ve Çevresinin Jeomorfolojik Etüdü, Istanbul Üniversitesi Edebiyat Fakültesi, Yayin No: 3100, Istanbul.
9. KHGM, 2002. National Digital Soil Data Base of Turkey. The Ministry of agriculture and Rural affair of Turkey. The General Directorate of Rural Services, Ankara.
10. Davis, P.H., R. Mill and K. Tan, 1988. Flora of Turkey and the East Aegean Islands 10 (Suppl.). Edinburgh University Press, Edinburgh, UK.
11. Güner, A., N. Özhatay, T. Ekim and K.H.C. Baser, 2000. Flora of Turkey and the East Aegean Islands. Edinburgh University Press, 11(Suppl.), Edinburgh, UK.
12. Townsend, C.C. and G. Evan, 1968-1980. Flora of Iraq, Baghdad, Iraq, pp: 1-9.
13. Tutin, G.T. *et al*., 1964-1980. Flora Europaea vols. I-V, Univ. Press, Cambridge.
14. Brummit, R.K. and C.E. Powel, 1992. Authors of Plant Names. Royal Botanic. Gardens, Kew, London.
15. Ekim, T., M. Koyuncu, M. Vural, H. Duman, Z. Aytaç and N. Adigüzel, 2000. Turkiye Bitkileri Kirmizi Kitabi (Egrelti ve Tohumlu Bitkiler), Red Data Book of Turkish Plants (Pteridophyta and Spermatophyta). Turkish Association for the Conservation of Nature-Van Centennial University, Ankara, Turkey.
16. IUCN, 2001. IUCN Red List Categories and Criteria: Version 3.1. Prepared by the IUCN Species Survival Commision. IUCN, Gland, Switzerland, Ii + 30 pp.
17. Kaya, Z. and D.J. Raynal, 2001. Biodiversity and conservation of Turkish forests. Biological Conservation, 97: 131-141.
18. López-Pujol, J., F.M. Zhang and S. Ge, 2006. Plant biodiversity in China: Richly varied, endangered and in need of conservation. Biodiversity and Conservation DOI 10.1007/s10531-005-3015-2.
19. Czech, B., P.R. Krausman and P.K. Devers, 2000. Economic associations among causes of species endangerment in the United States. BioSci., 50: 593-601.
20. McKinney, M.L., 2006. Urbanization as a major cause of biotic homogenization. Biological Conservation, 127: 247-260.