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REASSESSMENT OF IUCN THREAT CATEGORY FOR LOCAL ENDEMIC *CAMPANULA DAMBOLDTIANA* FROM ANKARA, TURKEY

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ABSTRACT. In this study, threat category of local endemic plant species *Campanula damboldtiana* was reassessed according to IUCN Red List Categories and Criteria. *C. damboldtiana* prefers special habitat type with marly-gypsaceous soils. The assessment based on new field data such as current population size, distribution areas and the main threats to this taxon. Field studies were carried out during the vegetation periods between 2017 and 2018. In addition to those parameters, soil samples were taken from each location and physical and chemical analyses were performed including pH, EC, gypsum, texture, $CaCO_3$ parameters. Also, bioclimatic interpretations were made with the climatic data of the locations. With a recently discovered population, *C. damboldtiana* has three populations known from Ankara. The estimated total number of mature individuals was 8982. The area of occupancy and the extent of occurrence were calculated as 16 km^2 and 16 km^2, respectively. Considering our findings of *C. damboldtiana*, the IUCN threat category was reassessed as Critically Endangered (CR) as indicated in Red Data Book of Turkish Plants.

1. INTRODUCTION

In its geographical zone, Turkey is one of the richest countries in endemic plants. The narrowly distributed endemics live mainly in certain mountains and mountain chains and in certain habitats [1]. However, Turkey is very rich in endemic plants, some of these species that have very special habitat needs and restricted distribution areas, are faced with serious threats by anthropogenic drivers of global changes. According to recent studies, there are 11466 natural plant taxa, that 3649 of them are endemic (31.82%) throughout Turkey [2]. One of the major factors causing

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biodiversity erosion is habitat fragmentation, when the habitat is destroyed, patches of habitat remain. These habitat fragments are often isolated as differentiated or degraded areas [3]. *Campanula damboldtiana* P.H. Davis & Sorger is one of the local endemic taxon located in Ankara province. It belongs to Campanulaceae family and it is a perennial species with marly-gypsaceous soil preference. Flowering and fruiting periods occur between June and August. The species was first introduced to the scientific world by P.H. Davis and Sorger in 1979 and its type specimen was collected by Steppenhang at 16 km east of Ayaş, Aysantıbeli, which is located within the borders of Ankara province.

It was described as perennial herb with many stems. Roots cylindrical, thick, twisted. Flowering stems 5.5-22 cm. ascending, rigid. denselv retrorsely strigose with numerous leaves. Basal leaves absent. Cauline leaves oblong-linear, sessile, rigid, median ones 12-25 \ 2-4 mm. acute, patent or deflexed, densely antrorsely strigose, lower and upper decreasing in size. Inflorescence racemose or narrowly subpaniculate. 1.5-15 x 1-2 cm. upright. Corolla infundibular-campanulate. c. 12\ 12 mm, lilac-blue, adpressed pubescent outside, divided to 1/3, lobes ovate, acute, spreading (Figure 1). This species certainly belongs to Sect. *Dictyocalyx* (Fed.) Damboldt because of its inflated and reticulately-veined appendages in fruit; it is related to *Campanula stricta* L. [4,5].

The species was known from only two populations in Ankara: Ayaş, Aysantıbeli; Kahramankazan, Orhaniye locations [4,5], but a new location was discovered from Sincan district between Mülk and İncirlik villages during the fieldworks. Consequently, it has three populations known from Ankara province (Table 1). Additionaly, *C. damboldtiana* appears in the list of Bern Convention Appendix-I under title of "Strictly protected flora species" [6]. The threat category of *C. damboldtiana* is defined as Critically Endangered (CR) in Red Data Book of Turkish Plants [7].

FIGURE 1. *Campanula damboldtiana.*

TABLE 1. Locations of *C. damboldtiana.*

1	A4 Ankara: 16 km east of Ayaş, Ankara-Ayaş road 50th km, Aysantıbeli, 1180-1210 m
2	A4 Ankara: Sincan, between Mülk-İncirlik villages, 940-1000 m
3	A4 Ankara: North of Kahramankazan – Orhaniye village, Çaltepesi, 1070-1210 m

Because the species is rare, endemic and threatened, it needs to be protected. Therefore, the population size, distribution area, IUCN threat categories of this edaphic endemic species are determined. Physical and chemical analyses of soil

samples including pH, EC, gypsum, texture, $CaCO_3$are performed and bioclimatic interpretation is done using the climatic data of the locations.

2. Materials and Methods

2.1 Field studies and re-evaluation of IUCN Categories

The distribution areas of *C. damboldtiana* were determined by reviewing of literatures and visiting of the major herbaria of Ankara (ANK, GAZI, HUB). For the potential distribution areas, potential habitats around the known distribution areas were visited in the years between 2017 and 2018. By creating minimum convex polygon on Google Earth with GPS coordinates of locations, distribution areas were calculated. For determination of population sizes, small populations were counted one by one and for large populations it was estimated by extracting the mean of mature individuals in 25 m^2 of sampling areas with 10m gaps.

The threat category of each species re-evaluated in the light of the data obtained according to IUCN Red List Criteria [8] such as area of occupancy (AOO), extent of occurrence (EOO), number of mature individuals, number of locations and the main threats to the taxon. AOO and EOO values were calculated by using GeoCAT (Geospatial Conservation Assessment Tool program) [9] IUCN mapping program considering "Guidelines for Using the IUCN Red List Categories and Criteria" version 14 (Table 2) [10].

Table 2. Summary of some criteria in IUCN Red List threatened categories.

Threatened Categories	**Extent of occurrence (km^2)**	**Area of occupancy (km^2)**	**Number of mature individuals**	**Number of locations**
CR (Critically Endangered)	<100	<10	<250	=1
EN (Endangered)	<5.000	<500	<2.500	≤5
VU (Vulnerable)	<20.000	<2.000	<10.000	≤10

2.2 Bioclimatic Data

Climatic data of all locations obtained from General Directorate of Meteorology and their bioclimatic interpretations were made considering Emberger and Gaussen Methods [11]. There were two different meteorological observation stations covering the study areas (Table 3)

TABLE 3. Information of meteorological observation stations used in climate analysis of the study areas.

Station name	**Observation duration**	**Station altitude**	**Covered locations**
Etimesgut Airport	22 years	806 m	A4 Ankara: North of Kahramankazan – Orhaniye village, Çaltepesi, 1070-1210 m A4 Ankara: Sincan, between Mülk-Incirlik villages, 940-1000 m
Ayaş	15 years	910 m	A4 Ankara: 16 km east of Ayaş, Ankara-Ayaş road 50^{th} km, Aysantıbeli, 1180-1210 m

2.3 Soil Data

Within the scope of the study, soil samples were taken from each location of *C. dambodtiana* by considering 3 different heights as bottom, middle and top. Soil samples were dried and prepared as 2 kg each and sent to BIOTAR soil analysis laboratory for physical and chemical analyses. As physical parameter, texture analysis; as chemical parameters pH, EC (electrical conductivity), $CaCO_3$ and gypsum analyses were performed.

3. Results and Discussion

3.1 Field studies and re-evaluation of IUCN Categories

C. damboldtiana is known from three populations including Ayaş, Kahramankazan and Sincan in Ankara province (Figure 2). It has 8982 mature individuals in total. The AOO was calculated as 16 km^2 and the EOO was calculated as 16 km^2 (Figure 3). The main threats are urbanisation, agricultural and mining activities. The IUCN threat category was found as CR [8] (Table 4).

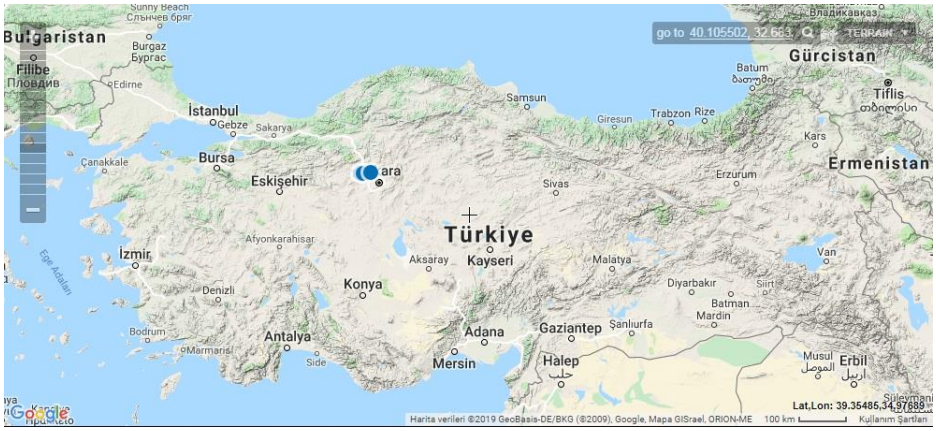

FIGURE 2. Location of three populations of *C. damboldtiana*.

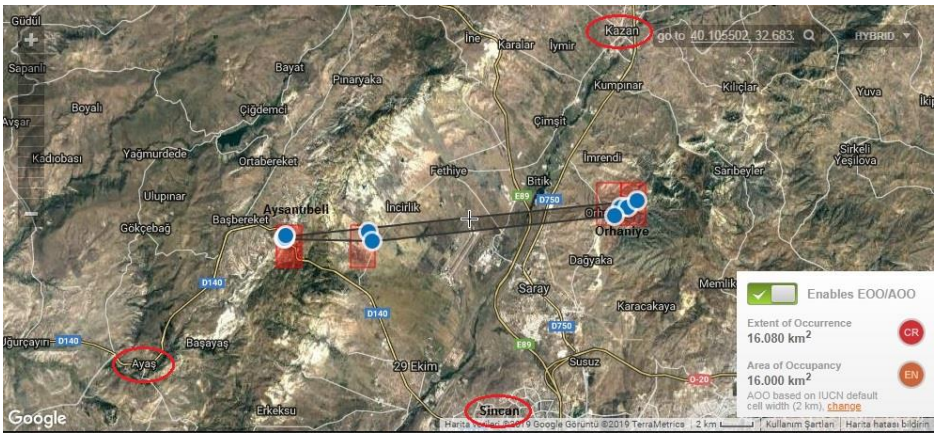

FIGURE 3. Area of occupancy and extent of occurrence of *C. damboldtiana.*

TABLE 4. Field data of *C. damboldtiana.*

Locations	**Number of mature individuals**	**Area**	**Threat factors**
A4 Ankara: North of Kahramankazan – Orhaniye village, Çaltepesi, 1070-1210 m	5610	≈28 ha	Mining activities (to obtain clay)
A4 Ankara: 16 km east of Ayaş, Ankara-Ayaş road 50th km, Aysantıbeli, 1180-1210 m	330	≈5 ha	Expansion of agricultural areas
A4 Ankara: Sincan, between Mülk-İncirlik villages, 940-1000 m	3042	≈18 ha	Expansion of agricultural areas, Proximity to urban areas, Soda Ash and Sodium Bicarbonate factory
Total	**8982**	**≈51ha**	

3.2 Bioclimatic Analysis

Bioclimatic analysis of the study areas was performed according to Emberger method (Table 5).

TABLE 5. Bioclimatic analysis of the study areas [12].

Stations / **Parameters**	**Etimesgut Airport** Kahramankazan and Sincan	**Ayaş** Aysantıbeli
P (mm)	381.9	427.1
M (°C)	31.7	29.4
M (°C)	-3.1	-2.9
Q	38.19	46.19
PE (mm)	65.5	58
S	3	1.97
Rainfall regime	Eastern Mediterranean Type 2	Eastern Mediterranean Type 2
Bioclimatic layers	Semi-arid "lower", very cold in winter, Mediterranean	Semi-arid "upper", cold in winter, Mediterranean

P: Mean total annual rainfall (mm),
M: Mean max.temperature of the warmest month (°C),
m: Mean min. temperature of the coldest month (°C)
Q: Rainfall-temperature coefficient
PE: Summer rainfal total (mm)
S: Drought index

Type of rainfall regime are characterized by Eastern Mediterranean Type 2 for all locationsof C.*damboldtiana*. In this regime type, spring is the rainy season and summer is the driest season [11].

Ombrothermic diagrams of the study areas were created according to Gaussen method [13] (Figure 4, 5).

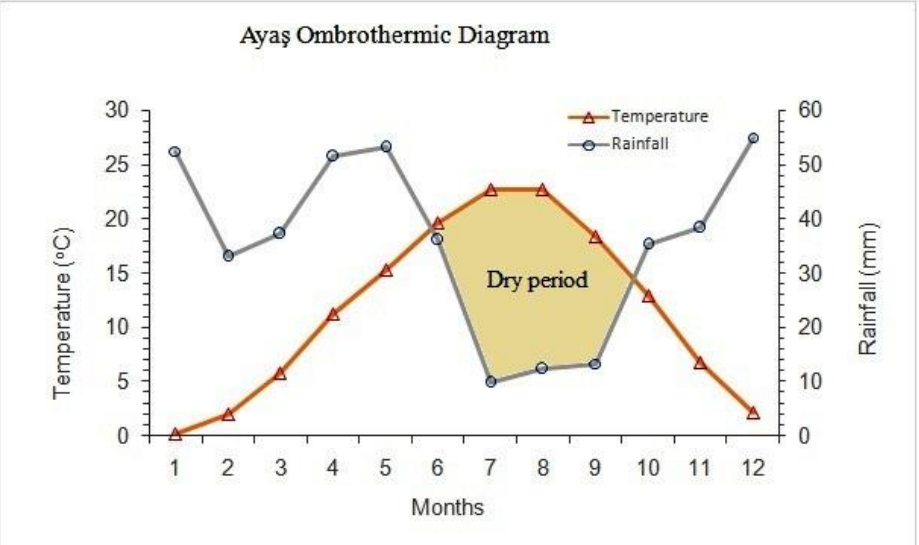

FIGURE 4. Ayaş (Aysantıbeli) ombrothermic diagram.

The dry periods, determined in the ombrothermic diagrams, starts with June and lasts at the beginning of October in Ayaş, Sincan and Kahramankazan.

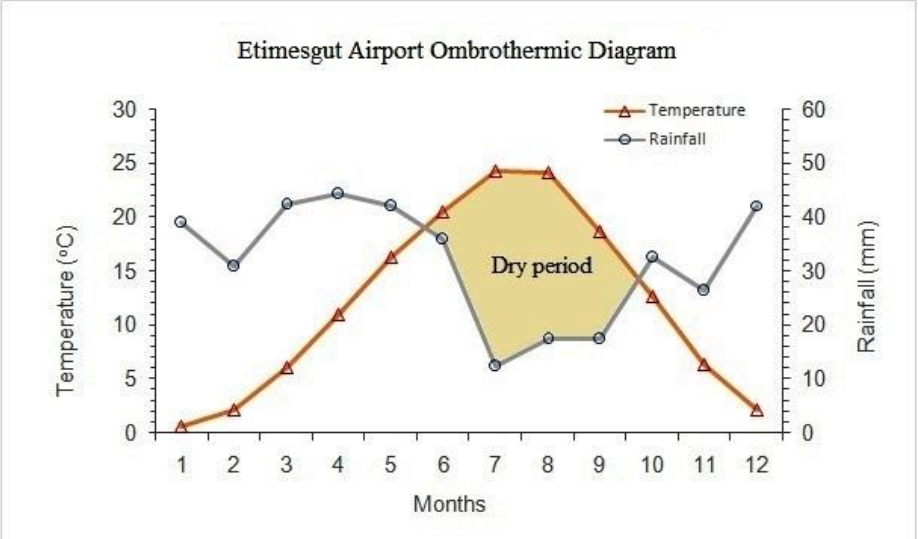

FIGURE 5. Etimesgut Airport (Kahramankazan and Sincan) ombrothermic diagram.

3.3 Soil Parameters Analysis

EC, pH, $CaCO_3$, gypsum and texture analyses were performed on soil samples taken from all locations (Table 6).

TABLE 6. Results of physical and chemical parameter analyses of soil samples.

Soil sample no	**pH (saturated soil paste)**	**EC (dS/m)**	**Salt (%)**	**$CaCO_3$ (%)**	**Gypsum (%)**	**Texture**
1 (Ayaş)	Slightly alkaline 7.89	0.540	Non-saline 0.0329	Strongly calcareous 43.85	0.135	Clay
2 (Sincan)	Slightly alkaline 7.85	0.440	Non-saline 0.0199	Strongly calcareous 45.28	0.101	Clay loam
3 (Kahramankazan)	Slightly alkaline 7.82	0.430	Non-saline 0.0113	Strongly calcareous 72.60	0.056	Loam

4. Conclusion

According to the results of climatic analysis, all of the study areas are under the influence of "semi-arid Mediterranean climate". In various type of "semi-arid Mediterranean climate", secondary steppe vegetation of anthropogenic origin is being dominant. In fact, all study areas have secondary steppe vegetation. This vegetation is sometimes covered with tree or shrub formations. However, the steppe vegetation without trees is the majority [11].

Considering the results of chemical analysis of soil samples, it can be inferred that all three locations have "non-saline, slightly alkaline and strongly calcareous" soils. Although there are slight differences between the locations in terms of texture, the clay content is dominant. Since all of them have predominantly calcareous-clay soil, they can be described as marly soil. In addition, according to the literature [14], since the gypsum contents are less than 2% in all samples, they cannot be classified as gypsum soils. However, all the soil samples contain gypsum in small quantities.

After the field studies and the examination of the data gathered from them, the EOO (Extent of occurrence), AOO (Area of occupancy), number of mature individuals (population size) and number of locations were determined. IUCN Red List Categories of each species were reassessed and all the results were summarized in Table 7.

TABLE 7. Results of IUCN Red List Criteria gathered from the field studies.

EOO (km^2)	**AOO (km^2)**	**Number of mature individuals**	**Number of locations**	**Categories in Red Data Book of Turkish Plants**	**Reassessed IUCN Red List Categories**
16	16	8982	3	CR	CR

For *C. damboldtiana* threat category did not change, it was reassessed as CR as before [CR B1ab (ii,iii)]. Even though the number of mature individuals seems relatively high, because of EOO size and the anthropogenic threat factors like urbanisation, agricultural and mining activities, it is better to keep the status in CR for this species.

To protect *C. damboldtiana,* there are some protection activities performed by Republic of Turkey Ministry of Agriculture and Forestry Ninth Regional Directorate of Nature Protection and Natural Parks, such as sending the seeds to gene banks and placing informative sign-boards to the locations.

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