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PREFACE

This study presents a new insight for regional revisions of geophyte diversity, as well as taxonomic remarks on some critical petaloid geophytes in Turkey, including a new verification, a new synonym, new approaches for confusing taxa and new IUCN threat categories for endemic and rare plants. In order to determine and/or verify the petaloid monocotyledonous (geophytic) flora in Bolu province, located within A3 and A4 grid squares in Turkey, 829 plant specimens were collected and examined in 2012 and 2014. In all, 127 taxa belonging to 12 families and 43 genera have been detected. The previously doubted existence of a taxon, *Gagea liotardii*, was confirmed for Turkey. The taxonomic status of the two confusing taxa, *Ophrys apifera* and *Ophrys oestriifera* subsp. *oestriifera*, were re-evaluated. The proposed amendment of IUCN's threatened categories of four endemic taxa and one rare taxon is also given. Of all the collected specimens, four taxa for the A3 grid square, one taxon for the Black Sea region and 17 taxa for Bolu province were assessed as new records. The number of endemic taxa found in the research area was 19 and the endemism rate was 14.96%. 22 taxa recorded in previous studies were verified as having no distribution in the research area, and it is suggested that they should be removed from the floristic list of Bolu province; 18 records were confirmed as doubtful and/or no recollected taxa and 33 synonymized records with the addition of a new synonym, *Crocus bolensis* syn. nov. have been listed.

May, 2015

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Petaloid Monocotyledonous Flora of Bolu Province, Including Annotations on Critical Petaloid Geophytes of Turkey

INTRODUCTION

Anatolia is one of the most significant geophyte centers in the world, having around 100 seedless vascular geophytes, 1000-1200 dicotyledonous geophytes, 200-250 non-petaloid monocotyledonous geophytes and around 1000 petaloid monocotyledonous geophytes. Geophytes have been used in perfumery and the drug industry as well as in ornamental and food plants since ancient times. Due to their commercial properties, Turkish geophytes have attracted the interests of foreign researchers and merchants since the 16th century. The first European adventure of the natural flower bulbs started with the exhibition of our tulips gathered from Anatolia in a botanic garden in Holland in 1554 (Hessayon, 1995; King, 2005). Market of bulbous plants started with the export of bulbs of snowdrops (*Galanthus elwesii* Hook. f.) and tulips (*Tulipa humilis* Herb.) which were collected in the Taurus Mountains by Austrian Franz Schlosser, who lived in İzmir in 1885 (Alp, 2006; Demir, 2009). However, Turkish businessmen started to export wild flower bulbs in 1960's. The collection of excessive amounts of natural flower

bulbs from Turkish flora between 1960 and 1990 led to destructions in the population of many species, and even caused some of them to become extinct. As a consequence, some laws were passed in order to protect these plants and avoid excessive gathering after the 1990's and their export was restricted by quota (Ekim et. al., 1991). In this connection, Turkish geophytes including 17-21 species have been commercially exported each year (T.C. Başbakanlık Dış Ticaret Müsteşarlığı, 2012) and estimated annual net profit return was around three million U.S. dollars on this controlled gathering and/or breeding. However, although Turkey has a rich floristic structure, rise in import up to five million U.S. dollars in the recent years seems to be thought-provoking. Besides, geophytes for horticultural, food source and/or folkloric uses, have excessively been collected and consumed by the local people or foreign collectors. Thus, the future of wild species are still under threat. Moreover, although Turkey has abundance of geophytes, any publication has not been published covering the whole geophytes of Turkey. Therefore, the recent population conditions of mainly endemic and/or rare taxa should be detected, and also updated reports should be prepared to ensure the conservation of plant species. Referring to the previous studies conducted on geophytes in Turkey, the oldest report was prepared by Malyer (1983) on Liliaceae and Iridaceae families of Karacadağ (Şanlıurfa) where the chorological and ecological features of the local plants were studied. The most important work on geophytes was made by Baytop and Mathew (1984) and approximately 500 petaloid geophytes were introduced with their morphological features and economical importance. In the other remarkable study, taxonomic and ecological properties of some of Turkish geophytes were investigated by Ekim et al. (1991). Among the regional studies, the most extensive local study on geophytes was performed by Eker et al. (2008). Within this report, 102 geophyte taxa were determined from Şanlıurfa province, and also threatened categories of endemic and/or rare plants as well as their population density were exhibited.

Apart from these detailed studies mentioned above, there are some inventorial and floristic works on geophytes conducted by several researchers. For example, autumn geophytes in the city center of Muğla province by Mammadov and Sahrañç (2003), some geophyte taxa in Denizli province by Çelik et al. (2004), Amaryllidaceae and Iridaceae families of Murat Mountain (Uşak-Kütahya) by Zilci (2007), Liliaceae family of Türkmen Mountain (Kütahya-Eskişehir) by Kısa (2009), monocotyledonous geophytes of Sof Mountain (Gaziantep) by Özuslu and İskender (2009), monocotyledonous geophytes of Çermik (Diyarbakır) by Kupik (2009), geophytes of Euxine and Colchic regions by Duman (2010), geophytes of Yazılıkaya (Eskişehir) by Çıngay et. al. (2012), some geophytes of Hatay province by Kayıkçı et. al. (2012) and some geophytes of Kilis province by Şekeroğlu et. al. (2013) were studied, respectively.

Bolu province, covering 1.0% of area in Turkey, includes 8.276 km² area with eight counties (city centre, Dörtdivan, Gerede, Göynük, Kırıscık, Mengen, Mudurnu and Yeniçağa), and is located between 40° 06'–41° 01' N and 30° 32'–32° 36' E in west Black Sea region (Figure 1). Average altitude is 1000 m above sea level while the center province altitude is around 725 m. Mountains cover more than half of Bolu province with 56% ratio. Mountain heights increase from north to south and west to east. The highest points of these mountains are Köroğlu hill with 2499 m, Çele hill with 1980 m, and Naldöken hill with 1911 m, respectively (Anonymous, 2013).



Figure 1. The geographic location of the research area.

Considering temperature and rainfall data of Bolu, two different climatic regions have been seen in Bolu, either semi arid-moist climate according to the De Martonne method or Mediterranean climate according to Emberger drought index (Akman, 2011). There is more rainfall in winter season, in spite of less rainfall in summer season in Bolu. Regarding the last decade's rainfall data, annual mean temperature in Bolu was 11.5°C. Similarly, mean maximum temperature was 29.5°C in August and mean minimum temperature was noted as 1.6°C in February. According to the temperature averages depending on the seasons, it was measured as 10.2°C in

spring, 20.9°C in summer, 12.2°C in autumn and 2.6°C in winter. When taken into account the distribution of rainfalls, they were as follows: 159.9 mm in spring, 111.3 mm in summer, 120.6 mm in autumn and 166.5 mm in winter, and total annual mean rainfall is 558.3 mm. Depending on these data, the rainfall regime of Bolu city is classified as the 1st Lower Type of East Mediterranean rainfall regime (Akman, 2011). Annual mean relative humidity is 72%. The highest humidity is 82% in January while the lowest is observed as 63.3% in August (Figure 2).

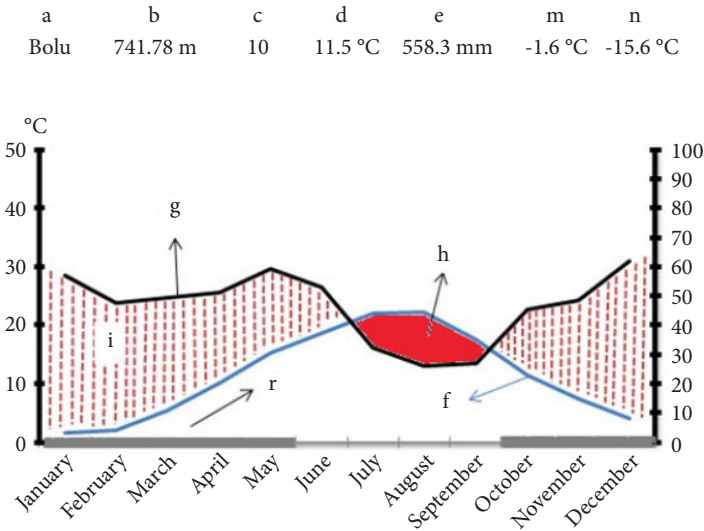


Figure 2. Climatic diagram of Bolu Province (for the last 10 years). Explanations: a- Meteorological Station, b- Altitude of Meteorological Station, c- Data Collection Period (last ten years), d- Mean Annual Temperature, e- Mean Annual Precipitation, f- Temperature, g- Precipitation, h- Dry Season, i- Humid Season, m- Minimum Temperature of Coldest Month, n- Absolute Minimum Temperature, and r- Possible Freezing Months.



According to literature studies, any report has not been directly performed on geophytes in the province of Bolu. However, some floristic and vegetational studies have been conducted between 1979 and 2013. Floristic studies are as follows: Gerede and Aktaş Forests by Akman and Ketenoğlu (1979b), Bolu and Semen Mountains by Akman and Yurdakulol (1981a; 1981b), Yedigöller Natural Park by Ekim and İlarıslan (1982), campus flora of Abant İzzet Baysal University by Turgut (1996), Gökçeler Mountain by Uluğ (1999), Lake Abant by Türker and Güner (2003), Lake Yeniçağa by Sümer (2002), Lake Gölcük by İkinci and Güner (2007), Karakiriş Mountain by Aksoy (2009), Lake Sünnet by İkinci (2011), Kartalkaya by Sungurlu (2011), Lake Sülüklü by Kanoğlu (2011), Taşlıyayla and Kızık surrounding by Tunçkol (2012) were studied. The vegetational studies are as follows: Köroğlu Mountains by Akman and Ketenoğlu (1978), Bolu and Semen Mountains by Akman et al. (1983a; 1983b), Gerede-Aktaş forest by Ketenoğlu (1983) and Mudurnu surroundings by Akman and İlarıslan (1983) were studied.

The main aim of this study is to prepare the species inventory list of petaloid monocotyledonous geophytes in Bolu province with its counties which have not been studied as yet, as well as to contribute for solving of some taxonomic problems in the Flora of Turkey. However, it is note worthy to mention that the present study is not only a floristic study but also a local revisional work about petaloid geophytes in Bolu province. For this aim, cross-checking of some doubtful records from Bolu province have been verified. Also, it was tried to examine the herbarium materials of ungathered records in our study as far as possible. In addition to preparation of inventory list of taxa, habitat features and intensity of populations have been observed. The results obtained in this study are not only regarding local floristic structure but also closely related to the flora of Turkey and the World flora.