


Updated Distribution and Future Concerns of *Crocus balansae*

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Abstract

Crocus balansae J.Gay ex Maw (Iridaceae) is a rare petaloid monocotyledon with fragmented habitats, under heavy anthropogenic pressure and climatic threat. Within the scope of this study, several herbariums were visited and previously collected specimens identified as *C. balansae* were examined morphologically. Field surveys were carried out to all addresses in the herbarium records, including some unidentifiable specimens, and to areas where populations are likely to be found. As a result of this study, it was determined that *Crocus balansae* populations are distributed in a narrower area than previously thought and the distribution area of *C. balansae* in Western Anatolia was updated. The challenges in accurate identification of *Crocus balansae* and the possible causes of misidentified plants were discussed. Field studies and observations revealed that some populations differ slightly morphologically from one another and that urbanization has caused the extinction of some populations. It was found that the type locality population had vanished as a result of the urbanization issue, making it impossible to compare samples from the type locality with populations that were later found using the techniques available today. The morphologically closest population to the species description is suggested in this paper.

Keywords: Anthropogenic pressure, Conservation, *Crocus*, Iridaceae, Urbanization.

1. Introduction

The Iridaceae family is poorly understood phylogenetically in terms of its systematic relationships; different authors have different ideas about genus boundaries, species relationships, and phylogenetic relationships [1]. 28 genera and over 995 species that belong to the subfamily Crocoideae make up more than half of this family [2]. With over 235 species, the genus *Crocus* L. (Iridaceae) of the subfamily Crocoideae is widely distributed, ranging from Poland to China, while the majority of its species are located in Turkey and the Balkans. Turkey is home to more than half of these species. The genus *Crocus* was divided into 2 sections and 16 series by Mathew [3]. However, Harpke et al. [4] showed that only 8 of these series are monophyletic, while the rest are polyphyletic.

A revision of the genus is needed, as several infrageneric and even intraspecific units have been shown to be para- or polyphyletic, and although more than 50 new species have been described recently [5] [6] [7], in most cases they are not assigned to existing taxonomic groups. Moreover, the relationship of the various species and infrageneric groups is still unclear.

In summary, *Crocus* is a genus with unresolved infrageneric issues, rich in neo-endemic species and currently in the middle of a speciation explosion [8]. However, while scientists continue to study the genus taxonomically, many local endemic crocus species are threatened with extinction due to anthropogenic impacts.

The study's main subject, *Crocus balansae* J.Gay ex Maw, is a corm geophyte that thrives under forests and at an elevation of 650–700 meters. Other species in the genus often grow in alpine meadows or forest clearings [9]. One of the genus' most gravely threatened species is *Crocus balansae*. The primary significant risks to this taxon are overgrazing, newly constructed highways, its limited distribution range, residing in fragmented habitats, and the low number of individuals per unit area. İzmir and Manisa are home to the species' known populations.

The purpose of this study is to assess the present condition of *C. balansae* populations and ascertain if any additional populations exist that have not yet been detected.

2. Materials and Methods

Istanbul University Faculty of Pharmacy Herbarium (ISTE), Istanbul University Faculty of Science Herbarium (ISTF), Ege University Faculty of Science Herbarium (EGE), Ankara University Faculty of Science Herbarium (ANK), Ankara University Faculty of Pharmacy Herbarium (AEF), Hacettepe University Herbarium (HUB) were visited and previously collected *C. balansae* specimens and closely related species were examined. Manisa and its surroundings, İzmir and its surroundings, Denizli and its surroundings, Aydın Dilek peninsula, Balıkesir and its surroundings were studied together with the type locality of *Crocus balansae* taxon and samples from a total of 6 populations were collected. During the field study, herbarium samples were collected for future morphological and molecular studies. Field studies were carried out in March and April in 2022-2023. The specimens are kept in Istanbul University Science Faculty Herbarium (ISTF). Identifications were made using Maw [10], Bowles [11], Mathew [3] and [12].

2. Results and Discussion

It was found that the distribution of the *Crocus balansae* species reaches up to 1200 meters in altitude. The plant can be found in alpine meadows, woodland understory, and clearings of juniper and oak (Figure 1). It turned out that the plants in Manisa-Soma and İzmir-Karaburun, two of the populations of *Crocus balansae* that have been documented, were misidentified previously.

C. olivieri J.Gay from Soma (Manisa) was identified as *C. balansae*, which is distributed together with *C. chrysanthus* Herb. and *C. flavus* Weston in Soma, Manisa. Most probably, these plants were erroneously identified as *C. balansae* due to the colorations on the outer tepals of the plants in this population, but although it is rare, such colorations can be observed in *C. olivieri*.

The plants in Karaburun, İzmir were also examined and similarly identified as *C. olivieri*. In the light of the information obtained as a result of the field studies, it was determined that *C. balansae* is distributed in a narrower area than previously thought. Address information of *C. balansae* plants collected from other locations is given in Table 1.

Table 1. The specimens collected during the field work in this study.

ISTF No.	Lokasyon	Habitat	Tarih
41782	Manisa: Soma	<i>Quercus</i> sp. clearings, 865 m	03.03.2022
41459	Manisa: Spil Dağı	<i>Juniperus</i> , <i>Pinus</i> , stony clearings, 1196 m	06.04.2022
41554	Aydın: Dilek yarımadası	<i>Pinus nigra</i> forest, 733 m	22.02.2023
41556	İzmir: Bornova, Çiçekli	<i>Pinus brutia</i> forest, 466 m	23.02.2023
41557	İzmir: Kayadibi	<i>Quercus</i> sp. clearings, stony places, 490 m	23.02.2023
41898	İzmir: Selçuk, Şirince	-	03.2023

With the collected specimens, the distribution of *C. balansae* taxon in Western Anatolia was updated (Figure 2).



Figure 1. *Crocus balansae* (a) in its habitat on Spil mountain distributing with *C. chrysanthus* and (b) habitus.

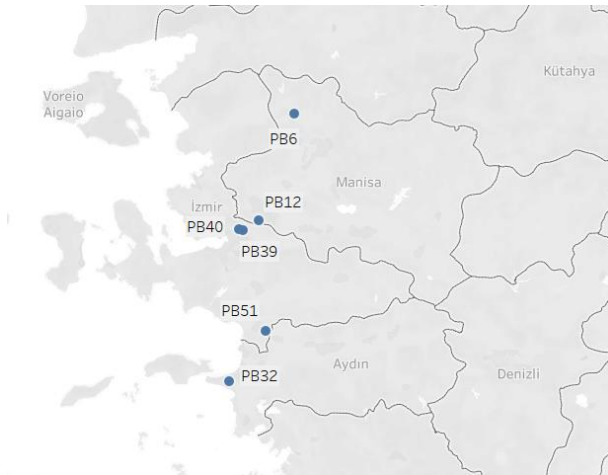


Figure 2. Current distribution map of *Crocus balansae* according to the field studies carried out within the scope of the study.

A problem often encountered during herbarium and field studies is that *C. olivieri* plants are often misidentified as *C. balansae*. Because closely related species share similar morphological traits at first look and because colors and patterns in herbarium specimens fade over time, it can be challenging to correctly identify these plants, especially for non-specialists.

Fieldwork and herbarium specimen observations demonstrated that some populations morphologically differed significantly for their classification as distinct species. Similarly, the populations reported by Mathew [12] on the islands of Kos and Samos are most likely distinct species. Urbanization appears to be the cause of the disappearance of some populations that were mentioned in the literature and herbariums. All the areas where the type specimen was located were surveyed during the field studies [Turkey, İzmir, Uncultivated hills near Smyrne, approximately 4 km SE of Koukouloudja, Bornova, 4 km SE of Altındag (Kokluca, Koukouloudja), 13 iii 1854, B. Balansa 34 (lectotype / lectotypus / lectotype: K 000802442!) [13]. Due to extensive development of cities, the location where the type specimen was discovered ended up being entirely destroyed. Under this circumstance, it is no longer possible to use contemporary methods to compare the specimens from where the type specimen was obtained with other populations. Moreover, many useful features that were once comparable in herbarium specimens have also diminished over time.

Crocus balansae has been described in various ways by Maw [10], Bowles [11], Mathew [3], Mathew [12] and Erol and Çiftçi [13]. Upon analyzing these descriptions, two things become evident:

- 1) Stigma arms having (8-)12-16 segments
- 2) Presence of distinct patterns on the back of outer tepals

Given that these two traits must coexist for the studied populations to be referred to as *C. balansae*, it is evident that Spil Mountain (Manisa) is home to the population that best fits the common description traits of *C. balansae* among the studied populations.

The plant's distribution area suggests that it is a component of the Eastern Mediterranean. The eastern Mediterranean region experiences hot, dry summers followed by warm, wet winters due to a regional climate impacted by many climatic systems that is vulnerable to atmospheric changes [14]. This region is also seeing the effects of climate change, which is a globally significant issue. Increases in average annual temperatures, drops in average annual precipitation, floods, droughts, and fires are all effects of climate change. Living things have been observed to have altered and homogenized in their community structure in response to climate change, more likely to migrate to higher elevations, and have undergone some degree of adaptation [15]. Plants are "sedentary" organisms, thus it makes sense to look into the biology of pollination and protection, as these processes are crucial to the development of adaptive individuals. As a result, *C. balansae* is the subject of an ongoing model pollination study in crocuses (I.U. BAP 37723).

Determining whether there is gene exchange between populations of plants with fragmented habitats, if not, whether this is a physical barrier due to geographical distance or a pollination barrier, identifying the population with the highest genetic diversity and determining which population should be protected as a priority is an important issue for the future of *C. balansae*, which is under both anthropogenic pressure and climatic threat. Studies on this subject are also ongoing.

3. Conclusion

Road expansion and human influences are threatening the Spil Mountain populations, which were found to be the ones that most closely matched the original description of *C. balansae*, even though they are located within the national park boundaries. Therefore, taking action for its conservation is extremely important for the transmission of this species to future generations.

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Author's Contributions

Almila Çiftçi: Drafted and wrote the manuscript, performed the experiment and result analysis.

Ethics

There are no ethical issues after the publication of this manuscript.

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