

Morphological characteristics of two endemic subspecies of *Clinopodium troodi* (Post) Govaerts (Lamiaceae) growing in Turkey

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ABSTRACT

A group of Lamiaceae that has caused confusion over its generic boundaries are those species belonging to the complex surrounding the genera *Satureja*, *Calamintha*, *Micromeria*, *Clinopodium* and *Acinos*. In the current study, morphological and taxonomical characteristics of two endemic subspecies of *Clinopodium troodi* (Post) Govaerts subsp. *vardaranum* (Leblebici) Govaerts and *Clinopodium troodi* (Post) Govaerts subsp. *grandiflorum* (Hartvig and Å.Strid) Govaerts were studied for the first time using stereoscopic microscopy and

detailed descriptions and illustrations of general appearance of plants and their leaf, bract, flower, calyx, corolla and fruit shapes were described and illustrated. At the same time, the variation borders of subspecies in Flora of Turkey was expanded and a identification key prepared. According to Flora of Turkey, status of a sample collecting from Denizli of *C. troodi* is doubtful and here its real status was determined as subsp. *grandiflorum*.

Keywords: *Clinopodium troodi*, Lamiaceae, Morphology, Taxonomy

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INTRODUCTION

Turkey is regarded as an important centre of biodiversity for the Lamiaceae. In Turkey, the family is represented by 45 genera, 546 species and a total of 731 taxa (1). The genus *Clinopodium* L. is also a member of Lamiaceae family. Recently some *Satureja* L., *Micromeria* Benthams, section *Pseudomelissa* Benthams species and all species of *Calamintha* Miller and *Acinos* Miller have been transferred to *Clinopodium* by Govaerts (2), Harley and Granda (3), Harley *et al.* (4), Brauchler *et al.* (5), Ryding (6-7) and Dirmenci *et al.* (8). Thus, the number of species belong to genus *Clinopodium* has reached about to 100. They are mostly distributed in the New World and temperate Eurasia, but a few in Africa, tropical Asia and Indo-Malaysia (4).

The genus *Clinopodium* had only 2 species in the first revision of *Clinopodium* was made by Davis and Leblebici (9) for the "Flora of Turkey". Recently two considerable contributions on the taxonomy of *Clinopodium* have been made (10-11).

After the above mentioned taxonomic studies, the number of accepted taxa in Turkey has reached to 38.

All species of the genus *Acinos* including *Acinos troodi* (Post) Leblebici subsp. *grandiflorus* Hartvig and Strid and *Acinos troodi* (Post) Leblebici subsp. *vardaranus* Leblebici have been transferred into the genus *Clinopodium* and they have been included in the synonymy of *Clinopodium* by Harley *et al.* (4). After the last taxonomic rearrangement into *Clinopodium*, the accepted names in Turkey are as follows: *C. troodi* (Post) Govaerts subsp. *grandiflorum* (Hartvig and Å.Strid) Govaerts (Syn. *Acinos troodi* (Post) Leblebici subsp. *grandiflorus* Hartvig and Strid) and *C. troodi* (Post) Govaerts subsp. *vardaranum* (Leblebici) Govaerts (Syn. *Acinos troodi* (Post) Leblebici subsp. *vardaranus* Leblebici). These subspecies are endemic plants in Turkey and East Mediterranean elements (9, 12).

C. troodi subsp. *grandiflorum* is locally known as “sultan fesleğeni” and *C. troodi* subsp. *vardaranum* is locally known as “vardar fesleğeni” in the regions where they grow (13). *Clinopodium* species have used for medicinal purposes in the literatures. For example, the decoction of *C. suaveolens* (Sm.) Kuntze is used in Northern Greece as sedative and in others as an anti-inflammatory (14). Internally, *C. acinos* (L.) Kuntze is used in melancholy, for shortness of breath and for improving digestion. Externally, oil was once used to treat bruises, toothache, sciatica and neuralgia (15). *C. alpinum* (L.) Kuntze is employed in folk medicine having beneficial effects on coughs and gastrointestinal disorders in Spain (16). *C. graveolens* (M. Bieb.) Kuntze is used as herbal tea against influenza in Denizli, Kütahya, Balıkesir of Turkey (17).

Morphological and anatomical studies are played an important role in systematics. In previous publications, the compositions of essential oils of these subspecies (18), leaf anatomic structures (19) and pollen features (20) were reported by us but morphological properties had not been studied yet.

In this study, distinguishing traits of two endemic subspecies of *Clinopodium troodi* have been investigated for the first time. A comparative study with different populations and herbarium materials constituted the basis of our observations. According to Flora of Turkey (9), status of a sample collecting from Denizli of *C. troodi* is doubtful and more material is needed to settle its status. The aim of this paper is also to present morphological characters of the two subspecies, to discuss their taxonomic values and to determine real status of Denizli samples.

MATERIAL AND METHODS

Clinopodium troodi subsp. *vardaranum* was collected from vary localities of Muğla province while subsp. *grandiflorum* was collected from different localities of Muğla and Denizli province. Some of them were brought as herbarium material and they are kept in the Herbarium of the faculty of Pharmacy of Anadolu (ESSE). Furthermore herbarium materials in ANK, EGE and ISTE were also examined.

Descriptions of species are based on living material. All measurements were made directly from herbarium specimens. Measurement were made a lot sample for description of each specimen. General views, stem, calyx, corolla, nutlet, leaves, bract and bracteol of subspecies had been drawn. Drawing of plant parts had made by illustration (drawing) tube of a wild M5 A stereomicroscope.

RESULTS

Clinopodium troodi (Post) Govaerts subsp. *vardaranum* (Leblebici) Govaerts (Figs. 1-2)

Perennial 2.5-16 cm. **Stems** decumbent, glandular and eglandular, 0.1 mm or shorter, puberulent, sparsely crispate-haired. **Leaves** green, seldom purple, from orbiculate to ovate-lanceolate, 2-8.5 x 2-9 mm, petiole to 1.5-7 mm, apex rotundate to acute-acuminate, margin entire or shallowly serrate towards to apex, base obtus rotundate, cuneate, rare truncate, veins prominent beneath, with 2-3 pairs of lateral veins, both of surface usually scabros or sparsely crispate-haired, dense glandular. **Floral leaves** ovate, lanceolate to elliptic, 3-7 x 1-6 mm, petiole to 0.5-7 mm, apex apiculate-acuminate, margin entire or shallowly serrate towards to apex, base cuneate, the venation like leaves, with 1-3 pairs of lateral veins, trichomes like leaves. **Bracteoles** subulate, 0.7-2 mm, ciliate. **Verticillasters** 1-4, forming a head in the axils of floral leaves, 2-10 flowered, distance between verticillasters up to 2 cm, flowers projecting beyond floral leaves, petiole 0.5-3.5 mm. **Calyx** green, seldom green-purple, 7-9.5 mm, 13-ribbed, sub-bilabiate, tube slightly curved and weakly gibbous at the base, throat bearded, five toothed, lower teeth two, 2.5-3.5 mm, subulate, upper teeth three, 1.5-2.5 mm, triangular-subulate, ciliate, glandular and eglandular, 0.1 mm or shorter puberulous-haired, densely glandular. **Corolla** yellowish-violet, but yellowish-white in calyx and purple spots on middle lobe and margin of lower lip, half of corolla in exserted of calyx, 12-20 mm, bilabiate, corolla tube like a narrow funnel, 1 mm wide toward to base, 4 mm wide in the upper, upper lip 2-lobed, 3-3.5 x 3-4.5 mm, lobes

obtus, lower lip 3-lobed, 3.5-4.5 x 5-6.8 mm, lobes rotundate, the middle lobe is longer than laterals, glandular and eglandular, indumentum dense and long in calyx outside, with parallel 2-row long-thick haired in lower lip, 2-row short-thin haired between stamens in upper lip. **Stamens** 4, didynamous, filaments white, 1.5-2.2 mm in upper pair, 3-6 mm in lower pair; anthers purple-white, 1-2 mm and 0.8-1.8 (-2) mm respectively. **Ovary** 0.4-0.5 mm, style white, purple in the apex, 12-20 mm, branched unequal, short lobe subulate, erect, 0.5 mm, long lobe large and recurved 0.8 mm. **Nutlets** brown, reticulate, 1.8-2 x 0.7-1 mm, obovoid-oblong, trigonous, apex obtus.

Flowering time : July-August

Habitat : Rocky slopes on serpentine

Altitude : 1700-2200 m.

Distribution : South-West Anatolia

Pyhtocography : East Medit. (mt.) element

Climate : Mediterranean

Red data category : EN (Endangered)

Endemic (9, 21)

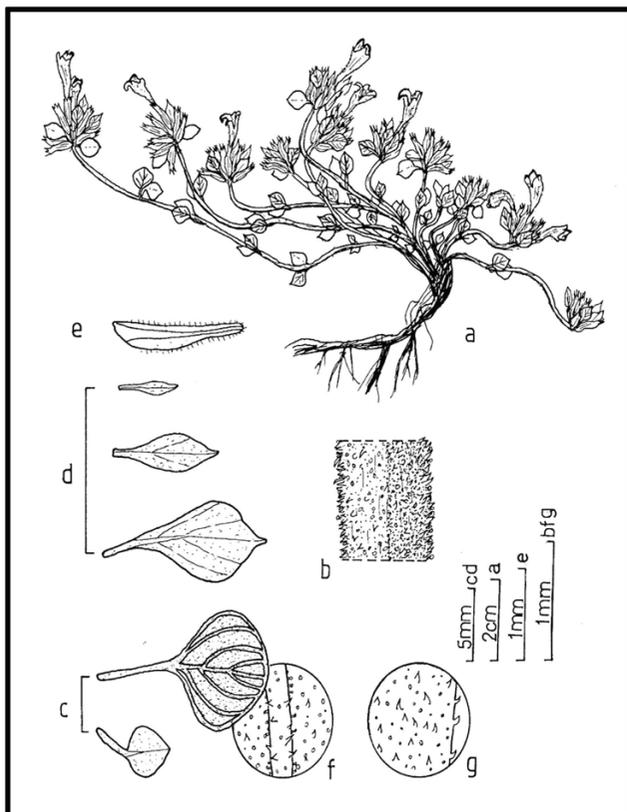


Fig. 1. *C. troodi* subsp. *vardaranum*, a-habit b-indumentum of stem c-leaves d-bracts brakteole f-g-trichomes in lower and upper surface of leaves

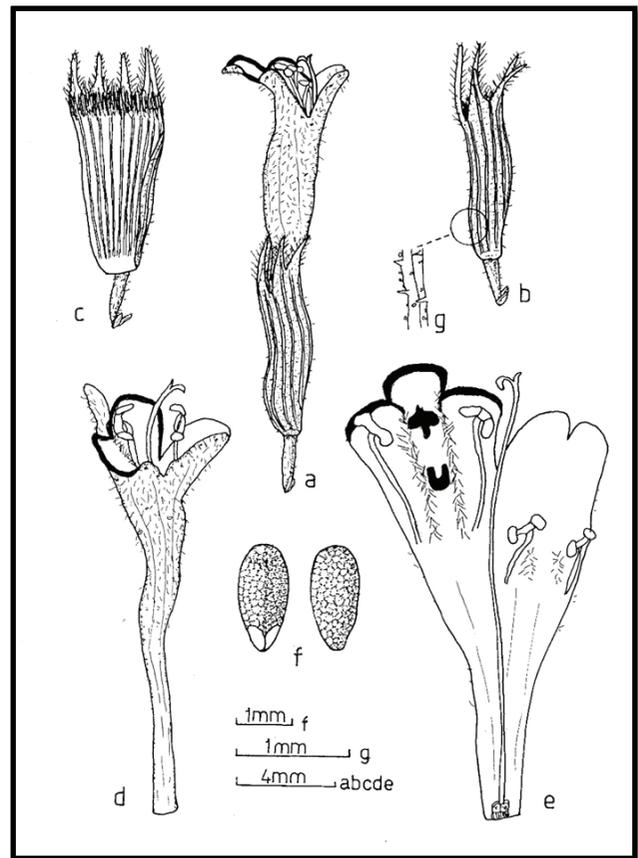


Fig. 2. *C. troodi* subsp. *vardaranum*, a-flower b-c- calyx d-e-corolla f-nutlets g-trichomes of calyx

***Clinopodium troodi* (Post) Govaerts subsp. *grandiflorum* (Hartvig & Å.Strid) Govaerts (Figs. 3-4)**

Perennial 4-35 cm. **Stems** compact, decumbent, glandular and eglandular, 0.1-0.8 (-1) mm patent-haired. **Leaves** green, seldom purple, from orbiculate to ovate-lanceolate, 3-11 x 3-9 mm, petiole to 3-9 mm, ciliate, apex rotundate to acute-acuminate, margin entire or shallowly serrate towards to apex, base obtus-rotundate or cuneate, rare truncate, veins prominent beneath, with 2-3 pairs of lateral veins, both of surface short and long patent-haired and densely glandular. **Floral leaves** ovate-lanceolate to elliptic, 3.5-10 x 1.5-8 mm, petiole to 3-5 mm, ciliate, apex acute, acute-apiculate, margine entire, the venation like leaves, with 1-3 pairs of lateral veins, trichomes like leaves. **Bracteoles** subulate, 1-2 mm, ciliate. **Verticillasters** (1-) 2-4 (-6), forming a head in the axils of the floral leaves, 2-10 flowered, distance between verticillasters 2.5-5.8 mm, flowers exceeded floral leaves, petiole 0.5-4 mm, **Calyx** green, seldom green-purple, 7-10.5 mm, 13-ribbed, sub-bilabiate, tube slightly curved and weakly gibbous at the

base, throat bearded, five toothed, lower teeth two, 3-3.5 mm, subulate, upper teeth three, 1.8-2.5 mm, triangular-subulate, ciliate, glandular and eglandular, long patent-slightly crispate haired at the base, shorter above, densely glandular. **Corolla** yellowish-violet, but yellowish-white in calyx and purple spots on the middle and margin of lower lip, half of corolla in exserted of calyx, 12-21 mm, bilabiate, corolla tube like a narrow funnel, 1 mm wide toward to base, 4 mm wide in the upper, upper lip 2-lobed, 2-3.5 x 2.5-5 mm, lobes obtus, lower lip 3-lobed, 3.5-6 x 4.2-7.5 mm, lobes obtus-rotundate, the middle lobe is longer and widener than laterals, glandular and eglandular, indumentum dense and long in calyx outside, with parallel 2-row long-thick-haired in lower lip, 2-row short-thin haired between stamens in upper lip. **Stamens** 4, didynamous, filaments white, 2-2.5 mm in upper pair, 4-5.5 mm in lower pair; anthers purple-white, 1.5 mm and 1.5-1.8 mm respectively. **Ovary** 0.5 mm, style white, purple in the apex, 12-19 mm, branched unequal, short lobe subulate, erect, 0.5 mm, long lobe large and recurved 0.8 mm. **Nutlets** brown, reticulate, 1.8-2 x 0.7-1 mm, obovoid-oblong, trigonous, apex obtus.

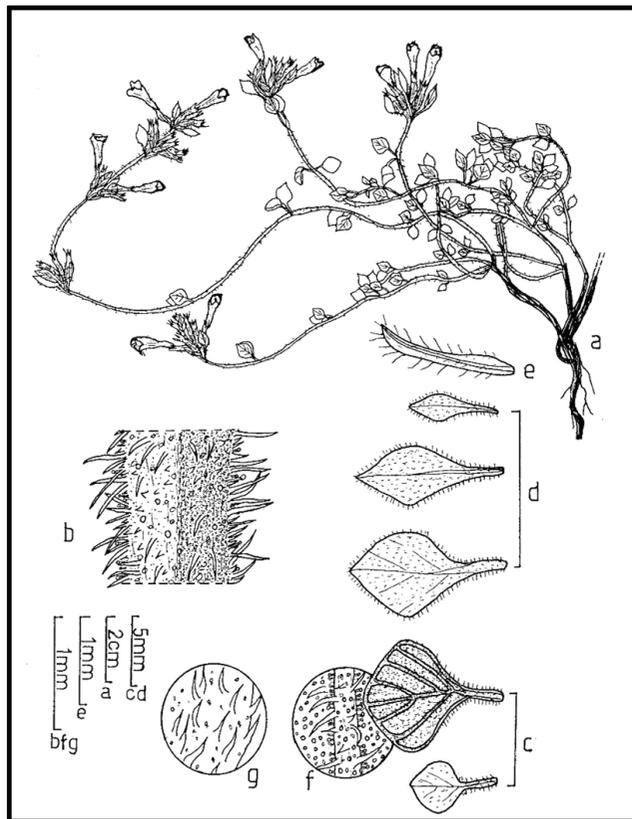


Fig. 3. *C. troodi* subsp. *grandiflorum*, a-habit b-indumentum of stem c-leaves d- bracts e-brakteole f-g-trichomes in lower and upper surface of leaves

Flowering time : July-August
Habitat : Rocky slopes on serpentine, on limestone
Altitude : 1700-2000 m.
Distribution : South-west Anatolia
Pyhtocography : East Medit. element
Climate : Mediterranean
Red data category: EN (Endangered)
Endemic (9, 21)

DISCUSSION

C. troodi is an endemic species which grows on serpentine, limestone and rocky slopes at an altitude of 1700-2200 m. Plant is easily separated from the other *Clinopodium* species with decumbent or procumbent stem, slightly curved and weakly gibbous calyx tube and prominent veins on lower surface of leaves (9, 17). Results of the study show that there are some morphological variations in *C. troodi*, which is represented by two subspecies (subsp. *vardaranum* and subsp. *grandiflorum*) in Turkey. However, many characters are present in all of them.

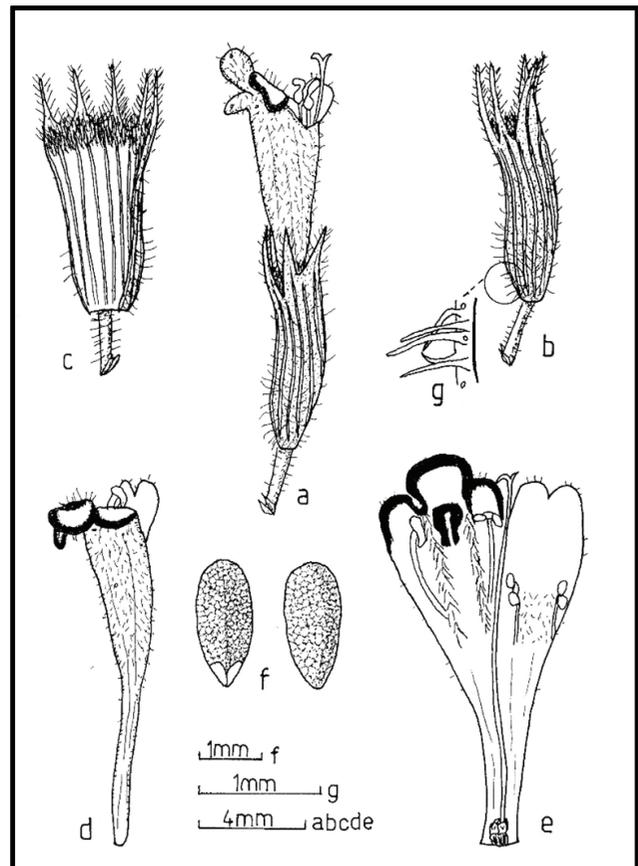


Fig. 4. *C. troodi* subsp. *grandiflorum*, a-flower b-c-calyx d-e-corolla f-nutlets g-trichomes of calyx

Morphological and taxonomical properties of subspecies of *C. troodi* were summarized in Table according to our findings and the results were with Flora of Turkey compared. According to Table, the stem structure, hair length-hair structure and distance between verticillasters are significant diagnostic character to distinguish the subspecies. That is; in subsp. *vardaranum*, flowering stems are 2.5-16 cm, hairs to 0.1 mm, puberulent, sparsely crispate-haired and distance between verticillasters to 2 cm. In subsp. *grandiflorum*, flowering stems are 3.5-35 cm, hairs to 0.1-0.8 mm, patent-haired and distance between verticillasters to 5.8 cm. This status is given in the separation key for the subspecies. In addition, measurements of plant, leaves, calyx and corolla lengths in subspecies were found higher than Flora of Turkey. According to result of this study, the variations borders of subspecies were expanded. Furthermore, the distance between verticillasters, properties and lengths of petiol, floral leaves, upper-lower teeth of calyx, upper-lower lip of corolla, stamen, pistil and nutlet are reported here in detail for the first time. The others features were in accordance with the published data. Some morphological variations were also determined in the length of trichomes, number of verticillasters and flower in investigated populations of subsp. *grandiflorum*. That is; the hairs in Muğla-Çal mountain

samples (0.8-1 mm) is longer than in Denizli-Bozdağ samples (0.5 mm) as the verticil (1-6) and flower numbers (2-10) in Denizli-Bozdağ are more than in Muğla-Çal mountain (1-4 verticil, 2-6 flower). According to Flora of Turkey, status of a sample collecting from Denizli of *C. troodi* had determined to be doubtful (9). We collected a lot samples from this locality and determined its real status as subsp. *grandiflorum*.

Identification key for the subspecies

Stem, leaves and calyx indumentum 0.1 mm or shorter, flowering stems 2.5-16 cm, verticil distance to 2 cm.....
.....*C. troodi* subsp. *vardaranum*

Stem, leaves and calyx indumentum 0.1-0.8 (-1) mm, flowering stems 4-35 cm, verticil distance to 5.8 cm.....
.....*C. troodi* subsp. *grandiflorum*

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Table To compare of morphological features in subspecies of *C. troodi*

	subsp. <i>vardaranum</i>	Flora of Turkey	subsp. <i>grandiflorum</i>	Flora of Turkey
Stem	decumbent 2.5-16 cm	decumbent 3-10 cm	decumbent or procumbent 4-35 cm	procumbent to 30 cm
Indumentum	sparsely crispate haired or puberulent 0.1 mm or shorter	sparsely crispate haired, puberulent -	patent 0.1-0.8 (-1) mm	Patent -
Leaves	2-8.5 x 2-9 mm	3-8 x 3-5 mm	3-11 x 3-9 mm	7-10 x 6-8.5mm
Petiol	1.5-7 mm	-	3-9 mm	-
Floral leaves	3-7 x 1-6 mm	-	3.5-10 x 1.5-8mm	-
Verticil number	1-4	1-3	(1-) 2-4 (-6)	2-3
Verticil distance	to 2 cm	-	0.25-5.8 cm	-
Calyx	7-9.5 mm	8-9.5 mm	7-10.5 mm	7.5-9.5 mm
C. upper teeth	1.5-2.5 mm	-	1.8-2.5 mm	-
C. lower teeth	2.5-3.5 mm	-	3-3.5 mm	-
Corolla	yellowish-violet	violet	yellowish-violet	pale bluish-violet
Corolla upper lip	12-20 mm	12-16 (-18) mm	12-21 mm	6-19 mm
lower lip	3-3.5 x 3-4.5 mm 3.5-4.5 x 5-6.8 mm	-	2-3.5 x 2.5-5 mm 3.5-6 x 4.2-7.5 mm	-
Nutlet	brown 1.8-2 x 0.7-1 mm	-	brown 1.8-2 x 0.7-1 mm	-

Türkiye’de yetişen *Clinopodium troodi* (Post) Govaerts (Lamiaceae) nin iki endemik alttürünün morfolojik özellikleri

ÖZ

Lamiaceae’nin bir grubu olan *Satureja*, *Calamintha*, *Micromeria*, *Clinopodium* ve *Acinos* cinsleri genel sınırlarında bir karışıklığa neden olan türlere sahiptir. Bu çalışmada, *Clinopodium troodi* (Post) Govaerts nin iki endemik alttürü olan subsp. *vardaranum* (Leblebici) Govaerts ve subsp. *grandiflorum* (Hartvig and Å.Strid) Govaerts’ un morfolojik ve taksonomik özellikleri

stereomikroskop kullanılarak deskripsiyonları ayrıntılı olarak tanımlanmış, bitkilerin genel görünümleri, yaprak, brakte, çiçek, kaliks, korolla ve meyvelerin şekilleri çizilerek gösterilmiştir. Aynı zamanda, Türkiye Flora’sındaki alttürlerin varyasyon sınırları genişletilmiş ve bir ayırım anahtarı hazırlanmıştır. Türkiye Flora’sına göre, *C. troodi* nin Denizli’den toplanan şüpheli örneklerinin durumu yapılan çalışmayla subsp. *grandiflorum* olarak belirlenmiştir.

Anahtar kelimeler: *Clinopodium troodi*, Lamiaceae, Morfoloji, Taksonomi

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Appendix

Examined specimens for *C. troodi* subsp. *vardaranum*: C2 MUĞLA: Köyceğiz, Sandras Da. Gökçeova locality, 1800 m, 12.7.1992, A.Kaya İ. Kaya, ESSE 10503!, Çiçekova locality, 1850 m, 12.7.1992, A.Kaya, İ.Kaya, ESSE 10504!, Beşparmak locality, 1900-2000 m, 12.7.1992, A.Kaya, İ.Kaya, ESSE 10505!, 9.8.1993, A. Kaya, İ.Kaya, ESSE 10507!, Dikencik locality, 1800 m, 12.7.1992, A.Kaya, İ.Kaya, ESSE 10506!, Sandras Da. West of summit, 1970 m. 7.7.1984, P.Hartvig, A.Strid, Ö.Seçmen, EGE 27978!, Dikencik locality, 1000-1700 m, 3.8.1978, Ö.Seçmen EGE16962!, Gökçeova, 1700 m, on limestone rocky, 22.7.1947, Davis, EGE 32514!, Gökçeova, 1700 m., on serpentine rocky, *Pinus nigra* subsp. *pallariana* forest, 22.7.1947, Davis, ANK 13499! **isotype**. Top

of Beşparmak, 1900 m, 12.7.1978, N.Özhatay, E.Özhatay, ISTE 40482!, Sandras Da. Above Böceli, 1700 m, 12.7.1978, N.Özhatay, E.Özhatay, ISTE 40543!, Köyceğiz, after 11 km from Ağla, çiçek baba tepesi road, 1650 m, 31.8.1991, K.Alpınar, H. 't Hart, ISTE 63380!.

Examined specimens for *C. troodi* subsp. *grandiflorum*: C2 MUĞLA: Fethiye, Çal Da., 1700-1800 m, 13.7.1992, A.Kaya, İ.Kaya ESSE 10500!, Çal Da. S. side, 1900-2000 m, Rocky slopes facing W. Open *Pinus nigra* woodland near timberline, limestone, 9.7.1984, P. Hartvig, Ö. Seçmen, EGE 31467! **isotype C2 DENİZLİ:** Acıpayam, Bozdağ, 1750-1920 m, 14.7.1992, A.Kaya, İ.Kaya ESSE 10501!, Acıpayam, Bozdağ, 1900 m, 8.8.1993, A.Kaya, İ.Kaya, ESSE 10502!.