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RESEARCH ARTICLE

Comparative Morphological Investigation of *Sideritis* Species I: S. *bilgerana* P.H. Davis & *S. hispida* P.H. Davis

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Comparative Morphological Investigation of Sideritis Species I: S. bilgerana P.H. Davis & S. hispida P.H. Davis
Summary

S. bilgerana P.H. Davis and S. hispida P.H. Davis, which have been used as folk medicine and herbal tea in infusion forms, are very similar in terms of morphological characteristics and are frequently confused. The aim of this paper is to provide a better understanding of the morphology, habitat and distribution of these two close local endemic Sideritis species. The morphological features of various organs of both S. bilgerana and S. hispida, such as stem, leaf, bract, and flower, are described and illustrated in detail. Diagnostic differentiations between these closely related species are given comparatively. In addition, in this study, habitat and distribution of S. bilgerana and S. hispida are evaluated and their conservation status discussed.

Key Words: *Labiatae, Sideritis, S. bilgerana, S. hispida, morphology, endemic, Turkey.*
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Sideritis Türleri Üzerinde Karşılaştırmalı Morfolojik Araştırma I: S. bilgerana P.H. Davis & S. hispida P.H. Davis
Özet

S. bilgerana P.H. Davis ve S. hispida P.H. Davis, infüzyonları halk ilacı olarak kullanılan ve bitkisel çay halinde tüketilen, morfolojik özellikleri bakımından oldukça yakın iki türdür ve sıklıkla karıştırılır. Bu makalenin amacı, bu iki yakın lokal endemik Sideritis türünün morfolojik özelliklerinin, habitat ve yayılışlarının daha iyi anlaşılmasını sağlamaktır. S. bilgerana ve S. hispida'nın gövde, yaprak, brakte ve çiçek gibi farklı organlarının morfolojik özellikleri açıklanmış ve orijinal fotoğraflar ve çizimlerle detaylı olarak gösterilmiştir. Bu iki yakın türün teşhisinde önemli olan farklılıklar karşılaştırmalı olarak verilmiştir. Ayrıca bu çalışmada, S. bilgerana ve S. hispida'nın habitat ve yayılışları değerlendirilmiş ve koruma statüleri tartışılmıştır.

Anahtar Kelimeler: *Labiatae, Sideritis, S. bilgerana, S. hispida, morfoloji, endemik, Türkiye*

INTRODUCTION

Many species of the genus *Sideritis* L. (Labiatae) have been known since the times of Dioscorides and used in folk medicine as herbal tea to treat different illnesses[1]. In Anatolia, 1-5% infusions of *Sideritis* species are also used as traditional medicine, especially for their tonic, diuretic, carminative and appetizing properties against stomachache and common cold and as herbal tea[2-5].

This genus, including more than 150 species world-wide, is distributed mainly in Turkey[6] and Spain[7]. There are 53 taxa, including 39 species, 12 subspecies and 2 varietes, of *Sideritis* in Turkey. Thirty-nine of these are endemic to Turkey and the rate of endemism is 74%[6-10]. Huber-Morath[6] formally divided the genus *Sideritis* into two sections on the basis of morphological characteristics: section Hesiodia Bentham, which includes 5 taxa; and section Empedoclia (Rafin), with 48 taxa, a taxanomically difficult section, which usually has no particular element since it grows in transitional areas between two phytogeographical regions in Turkey. *S. bilgerana* P.H. Davis and *S. hispida* P.H. Davis, belonging to section Empedoclia, are regarded as closely related species with similar taxonomic

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features in the Flora of Turkey[6], and their descriptions need to be revised.

As a part of the revision of Turkish *Sideritis*, we report herein detailed morphological characteristics of two close local endemic *Sideritis* species, *S. bilgerana* and *S. hispida*. In addition to full descriptions and illustrations, distributions and habitats of both species are given. Conservation status of the plants are also discussed according to new IUCN criteria [11].

MATERIALS and METHODS

Plant materials were gathered at flowering time in Southern Anatolia and the voucher specimens have been situated at the Herbarium of the Faculty of Pharmacy, Hacettepe University, Ankara, Turkey (HUEF) and the Herbarium of Gazi University, Ankara, Turkey (GAZI). Morphological features were identified from fresh samples and herbarium materials. Measurements were made on herbarium materials. Taxonomical descriptions of the plants were carried out according to Flora of Turkey[6] and also confirmed by the herbarium samples of the examined species in the HUEF, GAZI, ANK, AEF, HUB. A map is provided (Fig. 1) showing the distribution of both species based on the localities where we found specimens, herbaria records and the citations of Huber-Morath[6].

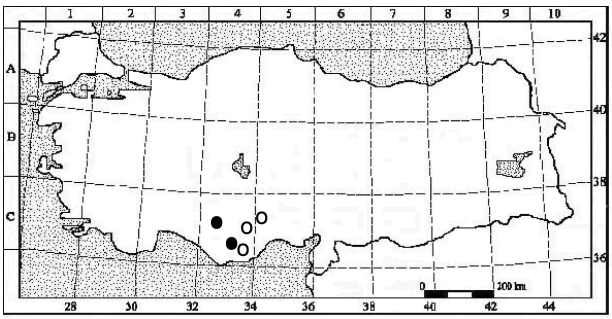

Figure 1. Distribution of *Sideritis bilgerana* and *Sideritis hispida*.
o *S. bilgerana* • *S. hispida*

RESULTS

1. S. bilgerana P.H. Davis

Type: [Turkey C4] Konya: Ermenek, 1300-1400 m, chalky slopes, 13 viii 1949, P.H. Davis 16160 (holo. K!, iso. B, E!, W, Hb. Hub.-Mor.)

Perennial, herbaceous, woody at base. Stem erect, 25-110 cm, simple or rarely branched, densely long adpressed tomentose below, ± glabrescent or short erect glandular and eglandular above. Leaves densely long adpressed eglandular and sparsely tiny glandular on both sides; lower leaves with 1(-1.5) cm petiole, lamina eliptic to linear, 2-7 x 0.4-0.9 cm, acute, entire, attenuate at base; middle cauline leaves sessile, lamina linear, linear-lanceolate, sometimes falcate, 3-8.5 x 0.3-1 cm, acute, with 0.5-1(-2) mm yellowish spiny tip, entire, ± amplexicaul at base; upper leaves sessile, lamina linear-lanceolate, sometimes falcate, 1.5-3.5 x 0.4-0.5 cm, with 0.5-1 (-1.5) mm yellowish spiny tip, entire, ± amplexicaul at base; cauline leaves crowded and longer than internodes below, shorter than internodes above. Internodes 2-7.5 cm, shorter below. Inflorescence simple or branched. Verticillasters 2-8, 6-flowered, (1-)3-5(-7.5) cm distant. Bracts orbicular, orbicular-reniform, ciliate, outer short glandular and eglandular, along the midrib long adpressed eglandular, inner short glandular and eglandular, reticulately nerved; lower bracts 1.3-1.9 x 1-1.9 cm with 3-6 mm acumen; middle bracts 0.9-1.4(-1.6) x 1.3-1.5 cm with 1-5(-6) mm acumen, upper bracts 0.9-1.3 x 0.8-1 cm with 2-4 mm acumen (Figs. 2, 3). Calyx (6-)8-10 mm; tube 4-7 mm, outer densely glandular, throat with a uniform ring of long eglandular hairs; teeth lanceolate, 2-3.5 x 1-1.5 mm, with glabrous yellowish mucro 1-1.5 mm, outer long adpressed eglandular and short erect glandular and eglandular, inner sparsely eglandular and glandular. Corolla yellow, 10-13 mm, longer than calyx; upper part of tube and lobes densely adpressed eglandular outside; upper lip sparsely short eglandular inside; interruptedly hairy under filaments, upper lobe with brown striae inside (Figs. 2, 4). Nutlet, ovate, triangular, 2-2.5 mm, brown.

Fl: 6-8.

Habitat: Chalky slopes, open *Pinus nigra* forest, *Quercus* macchie, steppe, 200-1400 m.

Phytogeographic region: Endemic to Karaman province and its surroundings East Mediterranean element.

Examined specimens: C4 İçel: Mut to Karaman, 930-

Figure 2. Habitat and floral part of *S. bilgerana* (photo. Hayri DUMAN).

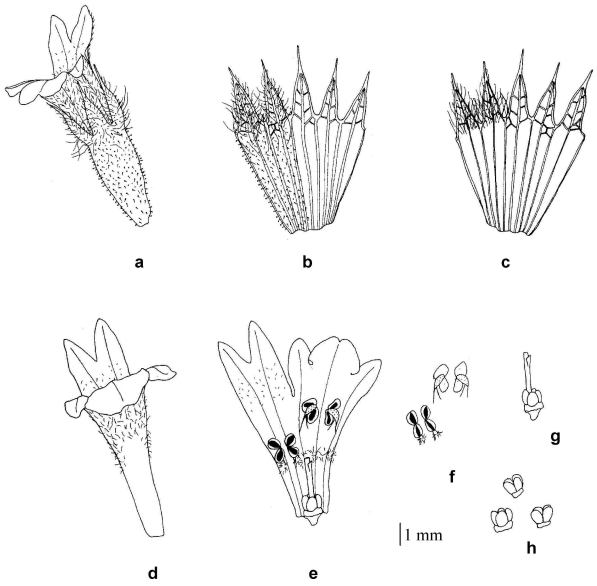

Figure 4. Floral parts of *S. bilgerana*.

a. general appearance, **b.** calyx outer side, **c.** calyx inner side, **d.** corolla outer side, **e.** corolla inner side, **f.** stamens, **g.** gynaecium, **h.** ovary.

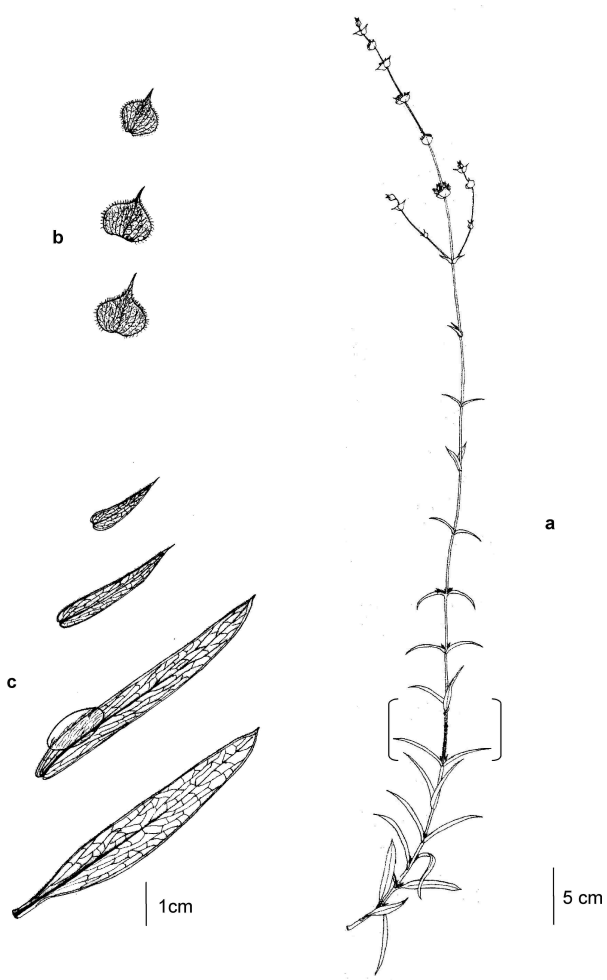

Figure 3. *S. bilgerana*, a. gross appearance, b. bracts, c. leaves.

1110 m, 14.7.2000, open *P. brutia* and *P. nigra* forest, F.P. Şahin, H. Duman (HUEF 00257!), H. Duman 8370 (GAZI!), Mut to Ermenek, 40. km, 550-600 m, 14.7.2000, open *P. brutia* forest, F.P. Şahin, H. Duman (HUEF 00259!), H. Duman 8375 (GAZI!), Mut, Palantepe, 240 m, 25.8.1992, M. Vural 6077, M. Koyuncu, M. Ekici, (GAZI!) (HUB 24377!), Mut, Çamlıca village, 500 m, 20.7.1977, M. Vural 1979 (GAZI!) (ANK 35500!) (KNYA 479!), between Mut-Ermenek, 12.6.1970, M. Pamukçuoğlu-Quezel, H. Peşmen (HUB 22070!), Mut to Ermenek, Suçatı village, dry slopes, 200 m, 24.7.1981, M. Koyuncu, F. İzgü, (AEF 11702!), **Karaman:** Karaman to Mut, 1120 m, 17.8.1994, steppe, M. Vural 7105, N. Akyalçın, A. Dönmez (GAZI!), Ermenek, 1250 m, bushy calcareous-soil, 19.7.1998, A. Güner 12660 (GAZI!), Ermenek to Gülnar, Görmeli village, 830 m, 16.7.2000, open *P. brutia* forest, marn, F.P. Şahin, H. Duman (HUEF 00265!), H. Duman 8388 (GAZI!), Ermenek, calcareous rocks, 1300-1400, P.H. Davis, 13.8.1949, (ANK 35498!), Ermenek, Kuruseki, macchie, 1200 m, M. Vural, 10.8.1979, (ANK 35499!), Ermenek, Göksu valley, 600 m, 15.6.1982, N. Tanker, M. Koyuncu, F. İlisulu, T. Özcan, (AEF 12272!), Ermenek to Gülnar, 6 km, 800 m, 17.61982, M. Koyuncu, N. Tanker, F. İlisulu, T. Özcan, (AEF 12271!), **C5 Konya:** Ereğli,

Kıraman village, 1300 m, 23.7.1995, steppe, Z. Aytaç 7224, N. Adıgüzel (GAZI!).

Conservation status: This species could be categorized "Vulnerable" (criterion B1 a, B2 a) for its known extent of occurrence, which is not more than 20,000 km^2; area of occupancy estimated to be less than 2,000 km^2 and fewer than 10 fragmented locations known.

Etymology: The specific name commemorates Prof. Dr. Kamil Bilger (Karamanoğlu) who was founder of AEF (Herbarium of Ankara University Faculty of Pharmacy) and the first professor at the Department of Pharmaceutical Botany, Faculty of Pharmacy, Ankara University.

2. *S. hispida* P.H. Davis

Type: [Turkey C4] Konya: d. Bozkır, Bozkır vadisi, open steppe calc. Slopes, [1100 m] 7 ix 1949, P.H. Davis 16617 (holo. K!, iso E!, G, W).

Perennial, herbaceous, woody at base. Stem erect, 35-90 cm, simple or rarely branched, with densely long erect hispid eglandular hairs to 3 mm and densely short glandular below, ± glabrescent and with densely glandular hairs above. Leaves sparsely long eglandular and short glandular hairs on both sides, reticulately nerved; lower leaves sessile or with 0.5-1 cm petiole, lamina elliptic-oblanceolate, 4.5-5 x 0.7-1.1 cm, acute-mucronate, mucro yellowish spiny c. 1 mm, serrate, serrulate-crenate, attenuate at base; middle cauline leaves sessile, lamina linear-lanceolate to lanceolate, 1.7-6.8 x 0.7-1.2 cm, acute, 0.5-2.5 mm yellowish spiny mucronate, entire or finely serrate, obtuse at base, truncate or ± cordate; upper leaves sessile, broadly lanceolate, 3-3.7 x 0.8-1.3 cm, 0.1-2 mm yellowish spiny mucronate, entire, amplexicaul at base; cauline leaves crowded and longer than internodes below, shorter than internodes above. Internodes 2-6 cm, shorter below. Inflorescence simple or branched. Verticillasters 2-8(-10), 6-flowered, internodes (1-)4-5(-6.5) cm distant. Bracts ciliate, outer glabrescent or sparsely short glandular, sparsely eglandular along the midrib, inner glabrescent or sparsely short eglandular and glandular, reticulately nerved, entire; lower bracts cordate, orbicular-reniform, 2-3.1 x 1.3-2 cm incl. acumen 8-16 mm; middle bracts orbicular-cordate, orbicular-reniform, 1.5-2.3 x 1.8-2.6 cm incl. spiny acumen 4-12 mm; upper bracts orbicular-reniform, 1.4-1.8 x 1.2-1.6 cm incl. spiny acumen 5-6 mm (Figs. 5, 6). Calyx 10-12 mm; tube 6.5-8.5 mm, outer densely

Figure 5. Habitat and floral part of *S. hispida* (photo. Hayri DUMAN).

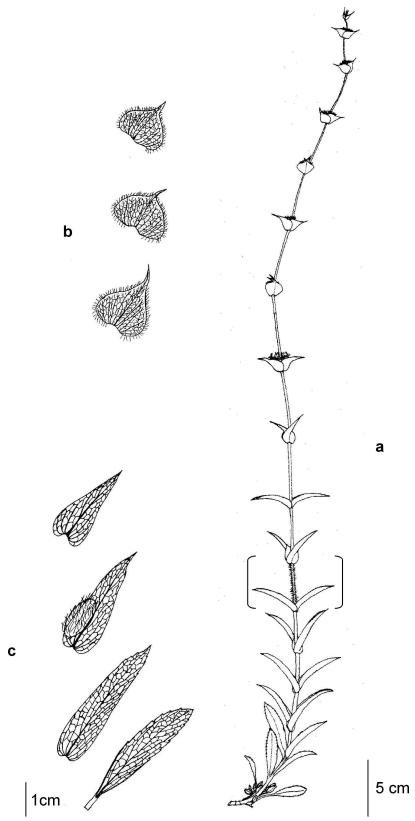

Figure 6. *S. hispida*, **a.** gross appearance, **b.** bracts, **c.** leaves

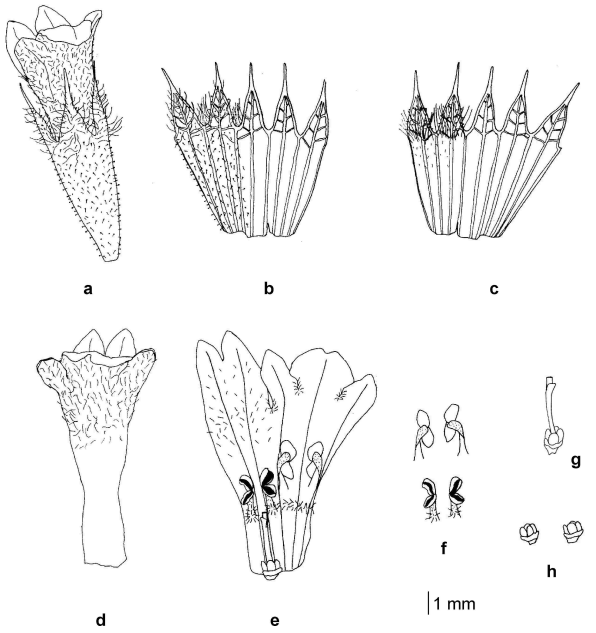

Figure 7. Floral parts of *S. hispida*.

a. general appearance, **b.** calyx outer side, **c.** calyx inner side, **d.** corolla outer side, **e.** corolla inner side, **f.** stamens, **g.** gynaecium, **h.** ovary.

glandular, throat with a uniform ring of long eglandular hairs; teeth lanceolate, 3-4 x 1-1.5 mm, with 1-2 mm glabrescent yellowish mucro, outer sparsely long eglandular and short glandular, inner sparsely eglandular and glandular. Corolla yellow, 11-14 mm, longer than calyx; upper part of tube and lobes densely adpressed eglandular outside; upper lip sparsely short eglandular inside, lower lip sinus eglandular inside; interruptedly hairy under filaments, upper lobe with brown striae inside (Figs. 5, 7). Nutlet, ovate, 3-4 mm, triangular, tiny tuberculous, light brown.

Fl: 7-9

Habitat: Calcareous slopes, steppe, 950-1450 m.

Phytogeographic region: Endemic to South of Konya and Karaman provinces. East Mediterranean element.

Examined specimens: C4 Konya: Hadim, Hadim to Çumra, 2. km, 1450 m, 17.7.2000, open *Quercus* scrub, schistose soil, F.P. Şahin, H. Duman (HUEF 00270!), H. Duman 8395 (GAZI!), between Hadim-Konya, Çiçek village, 1100 m, 28.8.1992, open *Juniperus* forest, M. Vural 6201, M. Koyuncu, M. Ekici (GAZI!) (HUB 24373!), Çumra to Hadim, 30 km to Hadim, 1250-1400 m, 8.8.1994, open *Q. libani* scrubs, H. Duman 5572, Z. Aytaç, A. Duran (GAZI!), Hadim, Eyişte stream, 1100 m, 28.8.1992, M. Vural 6193, N. Akyalçın, A. Dönmez (GAZI!), Bozkır valley, open steppe, 1100 m, P.H. Davis, 7.9.1949, (ANK 35501!) **Karaman:** Bucakkışla, Bayır village, 950 m, 23.8.1994, M. Vural 7182, N. Adıgüzel, A. Dönmez (GAZI!).

Conservation status: This species could be categorized "Vulnerable" (criterion B1 a, B2 a) for its known extent of occurrence which is not more than 20,000 km2; area of occupancy estimated to be less than 2,000 km2 and fewer than 10 fragmented locations known.

Etymology: The specific name is derived from the Latin; hispid meaning erect, firm, stiff eglandular hairs referring to the stem indumentum.

DISCUSSION

S. bilgerana and *S. hispida* are regarded as closely related species in the Flora of Turkey[6]. During our studies, we observed that some herbarium specimens were not identified correctly. In order to provide clarification and prevent such misidentifications, in this study we report detailed morphological characteristics of both species. Diagnostic differentiations between these closely related *Sideritis* species provided in this study are given comparatively in Table 1.

Morphological characteristics of these two species are limited in the Flora of Turkey[6]. There is no previous information about nutlets, internodes, or inflorescence, and no details regarding the stem, leaves, bracts, calyx and corolla. These characteristics are provided in detail and enlightened in this study. With the additional information revealed in this study, the description of *S. bilgerana* and *S. hispida* has been widened.

Our findings were also compared with the Flora of Turkey[6]. Stems of *S. bilgerana* in our samples were 25-110 cm, versus 30-60 cm in the Flora of Turkey. Stem of *S. hispida* was reported with hispid hairs to 2 mm, but according to our findings, they are longer (to 3 mm). Additionally, stems of both species are

Table 1. Comparison of different morphological features of *S. bilgerana* and *S. hispida*

	S. bilgerana	*S. hispida*
Stem	25-110 cm, densely long adpressed tomentose below, ± glabrescent or short erect glandular and eglandular above	35-90 cm, densely long erect hispid below, ± glabrescent and with densely glandular hairs above densely
Leaves	densely long adpressed eglandular and sparsely short glandular	sparsely long eglandular and short glandular along vessels
	lower cauline leaves elliptic to linear, 2-7 x 0.4-0.9 cm, acute, entire	lower cauline leaves elliptic-oblanceolate, 4.5-5 x 0.7-11 cm, acute-mucronate, serrate, serrulate-crenate
	middle cauline leaves linear, linear-lanceolate, sometimes falcate, 3-8.5 x 0.3-1 cm, with a 0.5-1(-2) mm spiny tip, entire, ± amplexicaul at base	middle cauline leaves linear-lanceolate to lanceolate, 1.7-6.8 x 0.7-1.2 cm, with a 0.5-2.5 mm spiny tip, entire or finely serrate, obtuse, truncate or ± cordate at base
	upper cauline leaves linear-lanceolate, sometimes falcate, 1.5-3.5 x 0.4-0.5 cm	upper cauline leaves broadly lanceolate, 3-3.7 x 0.8-1.3 cm
Bracts	lower bracts orbicular, orbicular-reniform, 1.3-1.9 x 1-1.9 cm incl. 3-6 mm acumen	lower bracts cordate, orbicular-reniform, 2-3.1 x 1.3-2 cm incl. 8-16 mm acumen
	middle bracts orbicular, orbicular-reniform 0.9-1.4 (-1.6) x 1.3-1.5 cm incl. 1-5(-6) mm acumen	middle bracts orbicular-cordate, orbicular-reniform, 1.5-2.3 x 1.8-2.6 cm incl. 4-12 mm acumen
	upper bracts orbicular, orbicular-reniform 0.9-1.3 x 0.8-1 cm incl. 2-4 mm acumen	upper bracts orbicular-reniform 1.4-1.8 x 1.2-1.6 cm incl. 5-6 mm acumen
Calyx	(6-)8-10 mm; teeth 2-3.5 x 1-1.5 mm, outer side long adpressed eglandular; tube 4-7 mm, inner side glabrescent	10-12 mm; teeth 3-4 x 1-1.5 mm, outer side sparsely long erect eglandular; tube 6.5-8.5 mm, tube upper part tiny erect eglandular inside
Corolla	10-13 mm	11-14 mm, lower lip sinus eglandular inside
Nutlet	2-2.5 mm, brown	3-4 mm, tiny tuberculous, light brown

(to 3 mm). Additionally, stems of both species are erect, which is not mentioned in the Flora of Turkey.

In the Flora of Turkey, only middle cauline leaves and middle bracts were described in brief. In this study, we have provided full descriptions including shape, size and indumentum of upper and lower leaves and bracts in addition to middle cauline leaves and middle bracts (Figs. 2, 3, 5, 6). As indicated in Table 1, detailed morphological features of upper and lower leaves and bracts seem to be very useful diagnostic tools for differentiating these closely related species. Furthermore, in this research, we found some additional diagnostic features of middle cauline leaves, which were not explained in the Flora of Turkey. According to our findings, middle cauline leaves of *S. bilgerana* are sometimes falcate, ± amplexicaul at base and of *S. hispida* are obtuse, truncate or ± cordate at base. In both species, middle cauline leaves are sessile. In addition, in our study, middle cauline leaves of *S. bilgerana* and *S. hispida* measured 3-8.5 x 0.3-1 cm and 1.7-6.8 x 0.7-1.2 cm, respectively, versus 1-6 x 0.2-0.6 cm and 2-8 x 0.4-1.2 cm, respectively, in the Flora of Turkey. According to Huber-Morath[6], middle bracts of *S. bilgerana* and *S. hispida* are 0.8-2.5 x 1-2 cm and 1.5-2 x 1-1.7 cm, respectively. Our samples showed that middle bracts of these species are 0.9-1.4(-1.6) x 1.3-1.5 cm and 1.5-2.3 x 1.8-2.6 cm, respectively. Moreover, our results indicated that bracts of *S. bilgerana* and *S. hispida* are distinctly ciliate. This feature has not been reported previously in the Flora of Turkey, although it is of diagnostic value in the genus *Sideritis*.

Internodes, inflorescence, and nutlets of both *Sideritis* species are described in this study for the first time. Morphological differences observed between *S. bilgerana* and *S. hispida* in the shape, size, surface sculpturing and color of nutlets can also be used as taxonomic

characteristics in determining the species.

Although our findings of calyx and corolla generally agree with the description in the Flora of Turkey, hair properties are reported here in detail. Calyx teeth length of both species is also reported in this study for the first time (Figs. 4, 7).

According to Huber-Morath[6], *S. bilgerana* and *S. hispida* grow between 650-1400 m and 1100-1350 m, respectively. During our field and herbarium studies, we found that *S. bilgerana* and *S. hispida* grow between 200-1400 m and 950-1450 m, respectively.

In the Red Data Book of Turkish Plants[12], *S. bilgerana* and *S. hispida* were defined as "Vulnerable [VU]" and "Lower Risk conservation dependent [LR (cd)]", respectively. According to the new IUCN Red List Category[11], species are classified based on the "extent of occurrence, area of occupancy, and number of locations or subpopulations". According to these criteria, *S. bilgerana* would again be regarded as "Vulnerable [VU]". *S. hispida* could also be evaluated as "Vulnerable", since its extent of occurrence is not more than 20,000 km^2, area of occupancy is estimated to be less than 2,000 km^2, and fewer than 10 fragmented locations are known.

Acknowledgement

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