

Taxonomical notes on *Stachys* sect. *Eriostomum* (Lamiaceae) in Turkey

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Abstract: As a part of a revisional study of *Stachys* L. sect. *Eriostomum* (Hoffmanns. & Link) Dumort. (Lamiaceae), 4 taxa [*S. tymphaea* Hausskn., *S. thracica* Davidov, *S. cretica* L. subsp. *cretica*, and *S. cretica* L. subsp. *salviifolia* (Ten.) Rech.f.] were recorded for the first time from Turkey. *S. cretica* subsp. *trapezuntica* Rech.f., which was described based on 3 syntypes [Bourgeau 695; Sintenis 3432 (designated here as the lectotype); Handel-Mazzetti 324] near Trabzon, had not been collected again since 1907. It was found in 2 syntype localities from Trabzon in 2010 during this study, for the first time in 103 years. For 2 taxa, the categories of other authors were accepted, as opposed to those in *Flora of Turkey*: *S. germanica* L. subsp. *bithynica* (Boiss.) R.Bhattacharjee (a subspecies) was replaced with *S. bithynica* Boiss. as a species, and *S. balansae* Boiss. & Kotschy subsp. *carduchorum* R.Bhattacharjee (a subspecies) was replaced with *S. carduchorum* (R.Bhattacharjee) Rech.f. as a species. In one taxon, the category of Haussknecht was accepted: *S. tymphaea* Hausskn. The status of *S. libanotica* Benth. var. *minor* Boiss. was changed to *S. minor* (Boiss.) Akçiçek & Dirmenci **comb. et stat. nov.** One species (*S. ehrenbergii* Boiss.) was removed from the flora of Turkey because it was mistakenly reported to grow in Turkey. Descriptions, diagnostic characters, detailed illustrations, distribution maps, and taxonomic comments for these taxa are presented. A phylogenetic analysis using the ITS of the nuclear ribosomal DNA of the examined taxa further confirmed the rearrangements suggested.

Key words: ITS, phylogenetics, Lamiaceae, *Eriostomum*, *Stachys*, taxonomy

Türkiye *Stachys* cinsi *Eriostomum* (Lamiaceae) seksiyonu üzerine taksonomik notlar

Özet: Bu çalışma kapsamında dört taksonun Türkiye için yeni kayıt [*S. tymphaea* Hausskn., *S. thracica* Davidov, *S. cretica* L. subsp. *cretica* ve *S. cretica* L. subsp. *salviifolia* (Ten.) Rech.f.] olduğu tespit edilmiştir. *S. cretica* L. subsp. *trapezuntica* Rech.f. Trabzon yakınlarındaki 3 sintip örneğine [Bourgeau 695; Sintenis 3432 (lektotip olarak belirlenmiştir); Handel-Mazzetti 324] dayalı olarak tanımlanmıştır. O tarihten bugüne kadar ilk kez 2010 yılında (103 yıl sonra) Trabzon yakınlarındaki 2 sintip lokalitesinden toplanmıştır. 2 takson için Türkiye florasındaki otörlerin değil, diğer otörlerin kategorisi kabul edilmiştir [*S. germanica* L. subsp. *bithynica* (Boiss.) R.Bhattacharjee alttür olarak değil, *S. bithynica* Boiss. tür olarak; *S. balansae* Boiss. & Kotschy subsp. *carduchorum* R.Bhattacharjee alttür kategorisinde değil, *S. carduchorum* (R.Bhattacharjee) Rech.f. tür olarak]. Bir taksonda C.H. Haussknecht'in kategorisi kabul edilmiştir; *S. tymphaea* Hausskn. *S. libanotica* Benth. var. *minor* Boiss. taksonunun statüsü, *S. minor* (Boiss.) Akçiçek & Dirmenci **comb. et stat. nov.** olarak değiştirilmiştir. Bir türün ülkemizde yetişmediği tespit edilerek (*S. ehrenbergii* Boiss.) Türkiye Florası'ndan çıkartılmıştır. Taksonların betimi, ayırt edici özellikleri, detaylı resimleri, dağılım haritaları ve taksonomik yorumlar verilmiştir. İncelenen örnekleri kapsayan çekirdek ribozomal ITS DNA dizilerine dayalı bir filogenetik analiz önerilen yeni düzenlemeleri desteklemiştir.

Anahtar sözcükler: ITS filogenetiği, Lamiaceae, *Eriostomum*, *Stachys*, taksonomi

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Introduction

Stachys L. is among the largest genera of the Labiatae and it contains about 300 species worldwide. It is a genus of annual or perennial herbs or small shrubs. Species of the genus are concentrated in the warm temperate regions of the Mediterranean and south-western Asia, with secondary centres in North America, South America, and southern Africa. Native species are absent from Australia and New Zealand. The Asiatic centre contains 2 phylogeographical regions (Mediterranean and Irano-Turanian). The European centre is Mediterranean and Euro-Siberian. There are 2 main centres of diversity as assessed by the number of species. The first is confined to southern and eastern Anatolia, Caucasia, north-western Iran, and northern Iraq, and the other to the Balkan Peninsula (Bhattacharjee, 1980). *Stachys* was revised by Bhattacharjee for the flora of Turkey (1982). Since then, 18 new species have been described from Turkey. *Stachys* has 90 species (115 taxa) belonging to 15 sections and 2 subgenera in Turkey. Of the 115 taxa, 54 (47%) are endemic to Turkey (Bhattacharjee, 1982; Davis et al., 1988; Sümbül, 1990; Gemici & Leblebici, 1998; Duman, 2000; Dinç & Doğan, 2006; İlçim et al., 2008; Akçiçek, 2010; Yıldırım, 2010; Yılmaz et al., 2010; Martin et al., 2011; Özhatay et al., 2011). The endemic taxa are mostly eastern Mediterranean elements.

The section *Eriostomum* (Hoffmanns. & Link) Dumort. comprises 23 species (34 taxa) in Turkey. This section is widely distributed in Europe, Asia, and part of western Africa, and it is well separated from the other sections of *Stachys*. It is made up of species that are very similar to one another, but they show great morphological variability both on an individual and on a populational level (Falciani, 1997). The section is divided into 3 subsections. Of these, subsect. *Spectabiles* R.Bhattacharjee is mainly oriental and Irano-Turanian, while subsect. *Creticae* R.Bhattacharjee and subsect. *Germanicae* R.Bhattacharjee grow widely throughout Europe and Asia (Bhattacharjee, 1974, 1980).

Utilisation of ITS sequence comparison in plants has been effective (Baldwin et al., 1995; Álvarez &

Wendel, 2003), and it has also been confirmed for Lamiaceae by multiple reports (e.g., Steane et al., 1999; Prather et al., 2002; Bräuchler et al., 2010; Dirmenci et al., 2010). In this study, ITS phylogeny was used along with morphological analyses to assess the taxonomic positions of the taxa mentioned above. Phylogenetic analysis confirmed the new arrangements suggested by morphological revision. A comprehensive revision involving the morphology and ITS phylogeny of *Stachys* sect. *Eriostomum* (not yet published) further confirmed these results.

Materials and methods

Plant materials

During the field studies for the revision of *Stachys* sect. *Eriostomum* in Turkey, interesting *Stachys* specimens were collected from different regions of Turkey. After a thorough examination of all *Stachys* specimens in several herbaria (ANK, BM, BULU, E, EDTU, EGE, G, GAZI, HUB, ISTE, ISTE, ISTO, K, KATO, KNYA, SU, W, and WU) and consultation of the relevant literature (Boissier, 1879; Arcangeli, 1882; Colmeiro, 1888; Stoianoff & Stefanoff, 1925; Fiori, 1926; Hayek & Markgraf, 1931; Palhinha, 1939; Savulescu, 1961; Halacsy, 1968; Ball, 1972; Bhattacharjee, 1982; Davis et al., 1988; Jordanov, 1989; Baden, 1991; Duman, 2000; Dönmez, 2002; Daşkın et al., 2009; Dirmenci, 2010), it was concluded that the specimens belonged to *S. tymphaea* Hausskn., *S. thracica* Davidov, *S. cretica* L. subsp. *cretica*, and *S. cretica* L. subsp. *salviifolia* (Ten.) Rech.f., previously unknown in Turkey. *S. cretica* L. subsp. *trapezuntica* Rech.f., *S. carduchorum* (R.Bhattacharjee) Rech.f., and *S. minor* (Boiss.) Akçiçek & Dirmenci were also collected during the field trips for the same revision.

Genomic DNA isolation, PCR, and sequencing

Total genomic DNA isolation was performed using the DNeasy Plant Kit (QIAGEN GmbH, Hilden, Germany). PCR was run using the ITS primers found in the literature (White et al., 1990; Sang et al., 1995) with the following protocol on a Techne TC-5000 Thermal Cycler (Techne, Staffordshire, UK): 5 min at 95 °C for initial denaturation; 35 cycles of 30 s at

94 °C for denaturation, 30 s at 50 °C for annealing, and 1 min at 72 °C for extension; and a 10-min final extension at 72 °C. The same primers were used for both amplification and sequencing, conducted at RefGen Inc. (Ankara, Turkey) using an ABI 3130XL genetic analyser (Applied Biosystems, Foster City, CA, USA) with a BigDye Cycle Sequencing Kit (Applied Biosystems). ITS sequences were generated from 2 independent sequencing reactions for each of the triplicates for each taxon. If no sequence difference was observed within the triplicates of a taxon, only one representative sequence was included in the phylogenetic analysis. The vouchers used for genomic DNA extraction were as follows: *Stachys tymphaea* (Akçiçek 4598, GAZI), *Stachys germanica* L. subsp. *heldreichii* (Boiss.) Hayek (Akçiçek 4629, ISTE), *Stachys bithynica* Boiss. (Akçiçek 4780, ISTE), *S. thracica* (Akçiçek 4599, GAZI), *S. carduchorum* (Akçiçek 5335, ISTE), *S. minor* (Akçiçek 5319, ISTE), *S. balansae* Boiss. & Kotschy (Dirmenci 3547, ISTE), *Stachys vuralii* Yıldız, Dirmenci & Akçiçek (Yıldız 16353, GAZI), *Stachys byzantina* K.Koch (Akçiçek 4158, GAZI), *Stachys thirkei* K.Koch (Akçiçek 5212, GAZI), and *Stachys tmolea* Boiss. (Akçiçek 4642, ISTE). ITS sequences for *S. cretica* subsp. *cretica*, subsp. *salviifolia*, and subsp. *trapezuntica* could not be obtained despite multiple attempts and multiple approaches that are still ongoing; they will probably be achieved along with the completion of the revision of sect. *Eriostomum* being conducted by the authors of this study.

Phylogenetic analysis

Alignment of the ITS sequences was done using BioEdit (Hall, 1999). The phylogenetic tree was inferred with the neighbour-joining method (Saitou & Nei, 1987) and constructed with MEGA4 software (Tamura et al., 2007). ITS sequences of all of the *Stachys* taxa were obtained in this study and their accession numbers were shown in a tree along with the ITS sequences of *Sideritis* species and *Phlomis lychnitis* L., which were taken from the NCBI GenBank. Since some *Sideritis* species are very close to those of *Stachys* and vice versa, *Phlomis lychnitis* was used as a second outgroup.

Results and discussion

Subsect. *Germanicae* R.Bhattacharjee

Stachys bithynica Boiss., Diagn. Pl. Orient. 5: 28 (1844) (Figure 1).

≡ *Stachys germanica* var. *bithynica* (Boiss.) Boiss., Fl. Orient. 4: 720 (1879).

≡ *Stachys germanica* subsp. *bithynica* (Boiss.) R.Bhattacharjee, Notes Roy. Bot. Gard. Edinburgh 33: 276 (1974).

Perennial herb with basal sterile rosettes. Flowering stems erect or ascending, (20-)25-50 cm, simple or rarely branched, densely lanate villous,

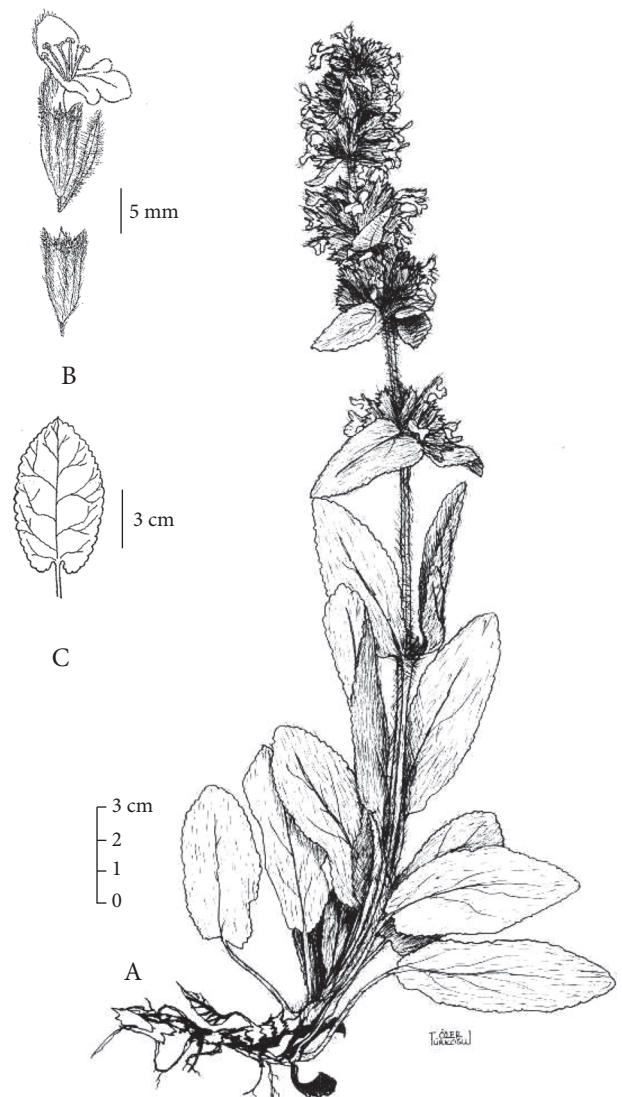


Figure 1. *Stachys bithynica*: A) habit, B) calyx and corolla, C) leaf.

mixed with short or long glandular hairs or sessile glands. Basal leaves oblong-ovate or ovate, 40-70 × 20-40 mm, margin crenate to crenate-serrate, apex acute or sometimes obtuse, cordate at base, petiole 3-6 cm. Cauline leaves 2-5-paired, oblong-ovate or ovate, 40-105 × (18-)20-55 mm, gradually becoming smaller above, margin crenate-serrate to serrate, apex acute to subacute or sometimes obtuse, cordate at base, petiole 0.5-5.5 cm, uppermost subsessile. Both leaves densely sericeous-tomentose above, densely adpressed floccose-white-tomentose beneath, mixed with short or long glandular hairs or sessile glands on both surfaces. Floral leaves ovate to ovate-lanceolate, the upper cuneate, the lower cordate at base, sessile; as long as or longer than verticillasters; entire to crenate-serrate, glandular hairy. Verticillasters 2-7, the lower (1-4) remote, distant to 6 cm, the upper (2-6) approximate, 10-30-flowered. Bracteoles numerous, lanceolate to linear, (3-)8-14 mm, herbaceous, tip not spinescent, as long as or shorter than calyx, densely tomentose-villous. Pedicels 1-5 mm. Calyx subbilabiate, subcampanulate, 8-15 mm, densely tomentose-villous, mouth with dense hairy ring; teeth subequal, ovate-triangular 1/3-1/4 × tube, slightly recurved in fruit, with glandular hairs and sessile glands, tip spinescent, mucro 0.5 mm. Corolla 12-16 mm, rose-pink, tube subincluded, limb bilabiate; upper lip entire, lower lip 3-lobed, middle lobe much larger than 2 lateral lobes, upper lip densely sericeous-tomentose on outside, hairs usually exceeding the lip; style not exceeding the upper lip, glabrous, 2-branched, branches equal, stamens 4, included in corolla, anther cells dithecous, thecae divaricate, filaments hairy. Nutlets obovoid, faintly trigonous, 2-2.5 × 1.5-2 mm, slightly winged near base, glabrous, tuberculate, blackish-brown at maturity. *Fl.* 6-8. *Limestone gullies, moist or dry rocky slopes, 1500-2500 m.*

Type: [Turkey] A2(A) Bursa: in regione alpina Olympi Bithyni (Uludağ) supra valem Kirkbounar (Kirkpınar mevkii), vi. 1842, *Boissier* (holo. G!).

Specimens examined:

Turkey: A2 Bursa: Uludağ, 1960 m, 11.07.2008, *Akçiçek* 5215 & *Dirmenci* (Hb. Akçiçek); *ibid.*, 1600-2200 m, 06.09.2007, *Akçiçek* 4780 & *Dirmenci* (ISTE); *ibid.*, 11.08.1949, *A.Berk* (ISTE 63612); *ibid.*, 2200 m, 13.09.1947, *P.H.Davis* 14834 (ANK, E, K); *ibid.*, 2500

m, 17.08.1932, *Kotte* 445 (ANK); *ibid.*, Juli 1874, *T.Pichler* 47 (W); *ibid.*, 2240 m, 09.08.1951, *Demiriz* 896 (G); *ibid.*, 1900 m, 13.09.1947, *P.H.Davis* 14809 (E); A3 Bolu: Abant, Sığırlık yaylası, ca. 1350 m, 15.07.1978, *Akman* 9628 (ANK); A4 Kastamonu: Ilgaz dağı, Kızılgöller yaylası, ca. 1950 m, 27.07.1982, *Akman*, *E.Yurdakulol* & *M.Demirörs* 12342 (ANK); between Tosya and Yapraklı, Kirişciğir, 1750 m, 15.07.1977, *M.Kılınç* 6918 (ANK); N. side of Ilgaz mountain, 2200 m, 28.07.1962, *P.H.Davis* 38446, *Coode* & *Yaltırık* (E, K); Bolu: Köroğlu mountain, ca. 2300 m, 24.08.1975, *Akman* 3082 (ANK); Aladağ on Kartalkaya hill, 2100-2200 m, *P.H.Davis* 37346 & *Coode* (K); A5 Kastamonu: Tosya, mt. Bellona, 09.07.1892, *Sintenis* 4569 (W); Samsun: above Ladik, Ak Dağ, 1500 m, 15.07.1890, *Bornmüller* 2873 (G); Amasya: In regione alpina montis Ak-dagh, 1600-1900 m, 18.06.1899, *Bornmüller* 665 (BM, G, K, W); B6 Kayseri: Pınarbaşı, Çukuryurt village, Hınzır mountain, 1900 m, 14.07.1981, *Çelik* 1873 (ANK); Sarız, Yalak, Binboğa Dağları, 2400 m, 07.08.2007, *A.Duran* 7667, *Yavuz* & *Dinç*. C3 Isparta: Dedegöl Da., 1600 m, 03.07.1965, *Sorger* 65-43-106 (E, K, W); Isparta: Davros Dag, 1830 m, 08.1843, *Heldreich* 1174 (BM, G, W).

S. bithynica was first treated as a distinct species (*S. bithynica* Boiss., *Diagn. Pl. Orient.* 5: 28, 1844), later as a variety [*S. germanica* L. var. *bithynica* (Boiss.) Boiss., *Fl. Or.* 4: 720, 1879], and finally as subspecies [*S. germanica* L. subsp. *bithynica* (Boiss.) R.Bhattacharjee, *Notes Roy. Bot. Gard. Edinburgh* 33: 276, 1974]. We accept the category of Boissier, not the one in *Flora of Turkey* of R.Bhattacharjee.

S. bithynica is related to *S. balansae* and *S. tymphaea*. This species shows an affinity with the eastern species *S. balansae*, but it can be distinguished from *S. balansae* by the following features: cauline leaves oblong-ovate or ovate (not narrowly oblong to oblong-lanceolate) and densely sericeous-tomentose above, densely adpressed floccose white-tomentose beneath, glandular (not sericeous-pilose above, softly villous beneath, eglandular) (Figure 1).

S. bithynica is usually distributed in northern or rarely in south-western Anatolia (Figure 2). A morphological comparison of *S. bithynica*, *S. germanica* subsp. *heldreichii* and *S. tymphaea* is given in the Table.

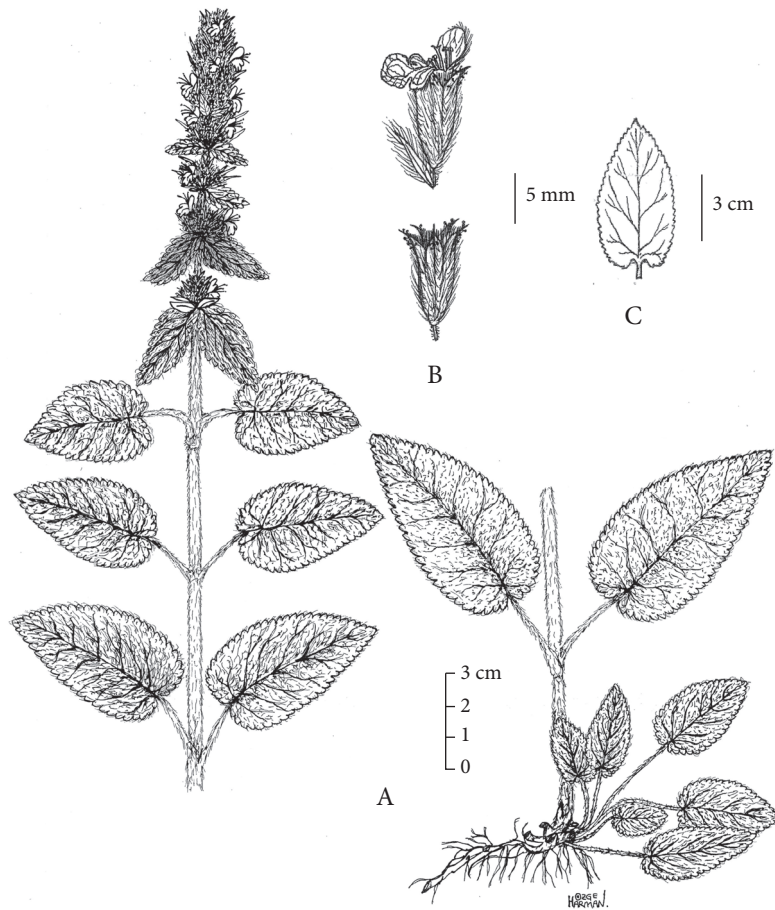


Figure 2. *Stachys tymphaea*: A- habit, B- calyx and corolla, C- leaf.

Table. Morphological comparison of *Stachys germanica* subsp. *heldreichii*, *S. bithynica*, and *S. tymphaea*.

Characters	<i>S. germanica</i> subsp. <i>heldreichii</i>	<i>S. bithynica</i>	<i>S. tymphaea</i>
Flowering stems	60-150 cm eglandular	(20-)25-50 cm glandular	(40-)50-90(-115) cm eglandular
Cauline leaves	6-8-paired, oblong-ovate or broadly ovate crenate to crenate- dentate subacute or obtuse eglandular	2-5-paired, oblong-ovate or ovate crenate-serrate to serrate acute to obtuse glandular	4-8-paired, ovate or ovate-lanceolate crenate to crenate-serrate acute eglandular
Petiole	(0.5-)2-10(-19) cm	0.5-5.5 cm	subsessile to 8(-9.5) cm
Pedicel	subsessile to 1 mm	1-5 mm	subsessile to 2.5 mm
Calyx teeth	unequal, triangular-lanceolate, erect in fruit, eglandular	subequal, ovate-triangular, slightly recurved in fruit, glandular	subequal, ovate-lanceolate, strongly recurved in fruit, glandular
Corolla	12-14 mm	12-16 mm	8-13 mm
Style branches	subequal	equal	equal to unequal
Nutlets	1.7-2 × 1-1.2 mm	2-2.5 × 1.5-2 mm	2 × 1.2(-1.5) mm

Stachys tymphaea Hausskn., Mitt. Geogr. Ges. (Thüringen) Jena 5 (Mitt. 2): 70 (1887) (Figure 2).

= *Stachys reinertii* Heldr., Exsicc. (Herb. Graec. Norm.) 743 (1857).

= *Stachys germanica* var. *reinertii* (Heldr. ex Murb.) Nyman, Consp. Fl. Eur., Suppl. 2: 251 (1889).

= *Stachys reinertii* Heldr. ex Murb., Acta Univ. Lund. 27(5): 62 (1891).

= *Stachys germanica* subsp. *tymphaea* (Hausskn.) R.Bhattacharjee, Notes Roy. Bot. Gard. Edinburgh 33: 276 (1974).

Perennial herb, usually with basal sterile rosettes. Flowering stems erect, (40-)50-90(-115) cm, usually branched above, rarely simple, densely adpressed tomentose-villous to sparsely villous with eglandular hairs. Basal leaves oblong-ovate or ovate, 25-130 × 15-35 mm, margin distinctly crenate-serrate, apex acute to subobtuse, cordate at base, petiole (2-)3-9 cm. Cauline leaves 4-8-paired on each stem, ovate or ovate-lanceolate, 2-13.5 × 0.6-5 cm, gradually becoming smaller above, crenate to crenate-serrate, apex acute, cordate at base, petiole 1-8(-9.5) cm, uppermost shortly petioled to subsessile. Both leaves sericeous-tomentose above, floccose-tomentose beneath. Floral leaves ovate-lanceolate to lanceolate, sessile, as long as or longer than verticillasters, entire to crenate-serrate, eglandular. Verticillasters (2-) 3-11(-14), usually lower [1-4(-8)] remote, 1-6 cm distant, upper (3-8) congested, rarely all congested, 12-45-flowered. Bracteoles numerous, lanceolate to linear, 5-10 mm, herbaceous, tip not spinescent. Pedicels subsessile to 2.5 mm. Calyx subbilabiate, subcampanulate, 6-11 mm, densely tomentose-villous, mouth with dense hairy ring; teeth subequal ovate, abruptly acuminate or ovate-lanceolate. c. 1/3 × tube, strongly recurved in fruit, with glandular hairs, tip spinescent, mucro 1 mm. Corolla 8-13 mm, pinkish-purple, tube subincluded, limb bilabiate, upper lip entire, lower lip 3-lobed, middle lobe much larger than 2 lateral lobes, upper lip densely sericeous-tomentose on outside, hairs usually exceeding the lip; style not exceeding the upper lip, usually glabrous, rarely hairy, 2-branched, branches equal to unequal; stamens 4, included in corolla, anther dithecous, thecae divaricate, filaments hairy. Nutlets obovoid, rounded at apex, faintly trigonous, 2 × 1.2(-1.5) mm, slightly winged near base, glabrous, blackish-brown

at maturity. 2n=30. Fl. ♂ Fr. 6-8. Forest openings, dry meadows, 8-600 m.

Type: "C.Haussknecht. Iter Graecum 1885. *Stachys tymphaea*, Pindus Tymphaeus: in jure alpino Zygos in scist. serpentin. dieb. Jul 17" (JE).

Specimens examined:

Albania: Tomor Range. (Abbas Ali) Rubbly, c. 5800 ft, 13.08.1935, *Alston & Sandwith* 2461 (BM); Ostrovic Range, 6000 ft, 04.07.1933, *Alston & Sandwith* 2061 (BM).

Bosnia and Herzegovina: Crna Gora, Cetinje, Levcen, 1100 m, 26.07.1984, *M.F. & S.G. Gardner* 2364 (BM, E).

Bulgaria: Slavyanka: Gotsev hill, Uşinki, 07.1973, *M.Kulova & Koeva* 86095 (SU); Alibotuş, Hambar hill, Varovik, 1200 m, 20.07.1983, *D.Stoyanov* 92402 (SU); Hambar Dere, 25.07.1969, *Petrova* 86094 (SU); *ibid.*, 21.07.1971, *Ancev* 86093 (SU); Black Sea shore, 14.07.1969, *St.Kojuharov* 86089 (SU); Murova forest, Gotsev hill, 14.07.1969, *St.Kojuharov* 86091 (SU).

Germany: Oberstes Tal der Schariska, 1800-2200 m, 04.08.1936, *D.Fritz Lemperg* 386 (E); Mittelfranken: Jura-Abhänge bei Hartmannshof. Bodenunterlage: Weisser Jura. Meereshöhe: c. 250 m, Anfang 08.1905, *J.Meister* 1069 (E).

Greece: Samarica: Smolika, 6700 ft, Macedonia, 30.06.1937, *Balls & Gourlay* B-3419 (E); Malakasi: in mle Sina, 13.07.1896, *Haussknecht* 950 (E); *Agropha* (*Dolopia veterum*): montis Ghavellu Pindi supra Sermeniko, 4500'-5500', 30.06.1885, *Heldreich* 138/91 (E); Macedonia orientalis: Boz Dagh prope Serrai (Seres) 1200 m, 14.07.1936, *K.H.Rechinger* 11030 (BM); Pindus Tymphaeus: in summi montis Zygos supra Metzovo, 4500'-5000', 20.07.1885, *Heldreich s.n.* (E).

Hungary: Suskulin, Heveulesfuvdo, 24.06.1905, *Crawford* 84 (E).

Italy: Holy-Reg. Abruzzi, Prov. L'Aquila, 24 km from Sulmona, 440 m, 20.07.1985, *Jury, Watson, D.A.Webb & M.B.Wyse Jacks.* 6619 (BM, E); Basilicata, Potenza: 16.5 km SE of Lagonegro, 700 m, 10.07.1983, *Akeroyd, Jury, F.J.Rumsey & M.J.A.Simpson* 3393 (BM); Marche, Macerata, Monti Sibillini, c. 15 km SE of Visso, 1550 m, 1985, *Jury, Watson, D.A.Webb & M.B.Wyse Jacks.* 6486 (BM, E); Montis Morrone, Aprutii, 21.07.1856, *E.Huet & A.Huet* 411 (E);

Aprutium. Prov. L'Aquila: Gioia de' Marsi vecchio, 1300 m, 19.06.1926, *A.Fiori* 2944 (BM).

Turkey: A1 Kırklareli: 22 km from Kırklareli to Dereköy, 550 m, 31.05.2007, *Akçiçek* 4591 & *Dirmenci* (Hb. Akçiçek); 3 km from Şükrüpaşa village to Karadere village, 600 m, 31.05.2007, *Akçiçek* 4597 & *Dirmenci* (Hb. Akçiçek); İğneada-Limanköy road junction, 8 m, 31.05.2007, *Akçiçek* 4598 & *Dirmenci* (Hb. Akçiçek); 6 km from Dereköy to Bulgaria frontier, 550 m, 28.07.2007, *Yıldız* 16517 & *Dirmenci* (Hb. Akçiçek); Saray, Güngörmez village, 150 m, 01.08.2007, *Yıldız* 16527 & *Dirmenci* (Hb. Akçiçek); Kofcaz, 500 m, 01.08.2007, *Yıldız* 16611 (Hb. Akçiçek); Saray, 3 km from Beyceler village to Sinekli village, 150 m, 02.08.2007; *Yıldız* 16533 (Hb. Akçiçek).

For *S. tymphaea*, the category of Haussknecht has been accepted, not that of R.Bhattacharjee [*S. germanica* L. subsp. *tymphaea* (Hausskn.) R.Bhattacharjee is not in a subspecies category; *S. tymphaea* Hausskn. is a species]. This species is distributed in Albania, Bosnia and Herzegovina, Bulgaria, Germany, Greece, Hungary, Italy, Macedonia, and Turkey (Baden, 1991). The subspecies was not previously recorded in Turkey. It is found in the Istranca Mountains of Kırklareli Province. It resembles subsp. *bithynica*. A morphological comparison of *S. bithynica* and *S. tymphaea* is given in the Table.

Stachys thracica Davidov, Spis. Bulg. Akad. Nauk. 12: 109 (1915) (Figure 3).

Perennial herb, with basal sterile rosettes, many stemmed from base. Flowering stems erect or ascending, (30-)50-90(-100) cm, simple or sparsely branched above, adpressed tomentose with eglandular hairs. Basal leaves oblong or oblong-lanceolate to lanceolate, 30-90 × 10-35 mm, margin crenulate or crenate, apex obtuse to acute, cordate at base, petiole 2-11 cm. Cauline leaves 2-6 paired, oblong or oblong-lanceolate to lanceolate, 2-8 × 1-3.5 cm, gradually becoming smaller above, margin crenulate, apex obtuse to acute, subcordate at base, petiole subsessile or petiolate to 13 cm. All leaves rugose on upper surface, green, scarcely tomentose above and densely adpressed greyish - soft tomentose beneath. Floral leaves as long as or longer than verticillasters; the lower broadly ovate-triangular, acute; the upper orbicular, apex spinescent acuminate, margin entire to crenulate-

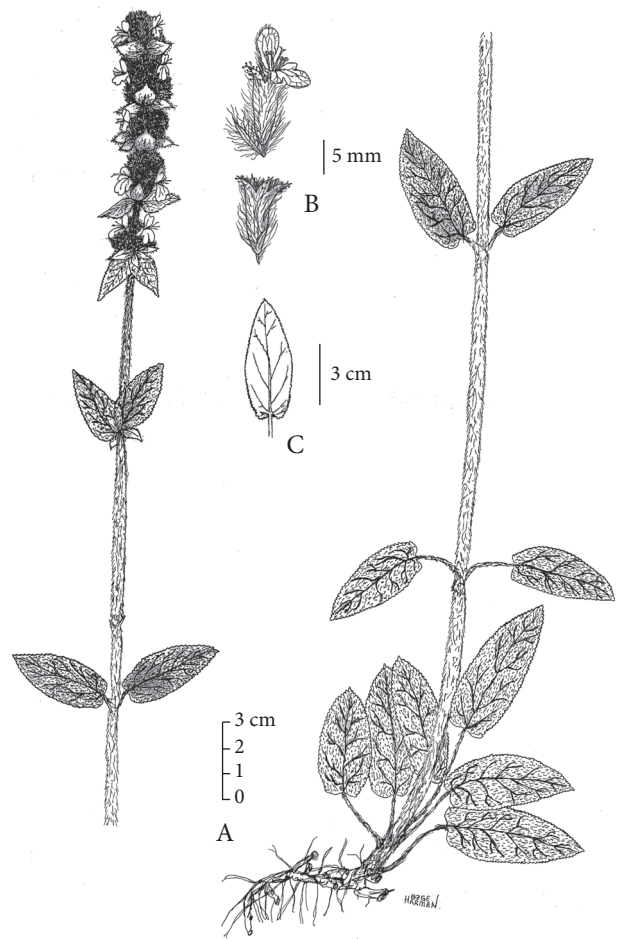


Figure 3. *Stachys thracica*: A- habit, B- calyx and corolla, C- leaf.

serrulate; with glandular hairs. Verticillasters 2-8(-9), usually the lower (1-3) remote, distant to 6 cm, the upper (2-5) congested, rarely all congested, 12-30 flowered. Bracteoles numerous, lanceolate or linear, 5-10 mm, herbaceous, tip not spinescent, shorter than calyx, glandular hairy. Pedicels 1-1.5 mm. Calyx subbilabiate, subcampanulate, 8-15 mm, white lanate-villous, mouth with dense hairy ring; teeth subequal, ovate-lanceolate to lanceolate, c. 1/3 × tube, recurved in fruit, glandular hairy, tip spinescent, mucro c. 1 mm. Corolla 10-12(-16) mm, purple, tube subincluded, bilabiate, upper lip entire, lower lip 3-lobed, middle lobe much larger than 2 lateral lobes, upper lip densely sericeous-tomentose on outside, hairs usually exceeding the lip. Style not exceeding the upper lip, glabrous, 2-branched, branches subequal. Stamens 4, included, thecae divaricate, filaments with hairs from base to middle. Nutlets obovoid, faintly

trigonous, 2.5 × 2 mm, slightly winged near base, glabrous, blackish-brown at maturity. 2*n*=30. Fl. & Fr. 5-9. Forest openings, 8-560 m.

Type: Turkey. Istanbul: In pascuis circa Constantinopolem ad stationem Bijuk Han. 11.V.1913, *B.Davidov* (SOM – 62599).

Specimens examined:

Bulgaria: Ahtopol-Vasiliko, Micurin, 24.07.1963, *D.Yordanov*, 62193 (SU); Istranca Mountains: Kosti village, 05.05.1963, *V.Stefanov* 62437 (SU); *ibid.*, 25.05.1997, *Koeva* 99062 (SU); Keryazov valley, Black Sea coast, 21.05.1972, *Koeva* 86083 (SU); between Primorsko and Yasnapoliana villages, 20.08.1977, *Koeva* 86077 (SU); Brodilovo village-Micurinski, 21.05.1972, *Koeva* 86078 (SU); 5 km south of Ahtopol village, 21.05.1972, *Koeva* 86079 (SU); M. Strandza: Resovo, 21.05.1972, *Koeva* 86080 (SU); between Zvedets and Kruşevets villages, 22.06.1972, *Koeva* 86081 (SU); M. Strandza: inter pagos Losenez et Velika, 20.05.1972, *Koeva* 86082 (SU); Burgaz, Belika village, 20.05.1972, *Koeva* 86084 (SU); Burgaz, Izgrev village, 25.05.1972, *Koeva* 86086 (SU); between Primorsko and Kigen villages, 02.08.1974, *Koeva* 86085 (SU); Primorsko village, 01.08.1973, *Koeva* 86087 (SU); between Trionski and Bilgari villages, 07.07.1979, *Koeva* 86364 (SU); between Kondolovo and Izgrev villages, 19.05.1979, *St.Kojuharov* 91090 (SU); Brodilovo village, 21.05.1972, *Koeva* 102252 (SU); 19.05.1979, *St.Kojuharov* 102391 (SU); Southern coastal area of the Black Sea, 6.5 km SSW of Sinemorets, 60 m, 09.06.1998, *D.Uzunov* & *Vitek* 98-650 (W).

Turkey: A1(E) Kırklareli: 24 km from Kırklareli to Demirköy, Kapaklı village, 560 m, 31.05.2007, *Akçiçek* 4592 & *Dirmenci* (Hb. Akçiçek); 22 km from Kırklareli to Dereköy, 550 m, 31.05.2007, *Akçiçek* 4569 & *Dirmenci* (Hb. Akçiçek); İğneada-Limanköy road junction, 8 m, 31.05.2007, *Akçiçek* 4599 & *Dirmenci* (Hb. Akçiçek); 2 km from Dereköy to Demirköy, 550 m, 02.08.2007, *Yıldız* 16522 & *Dirmenci* (Hb. Akçiçek); 6 km from Armutveren to Sarpdere, 380 m, 21.06.2009, *Akçiçek* 5291 & *Dirmenci*; (Hb. Akçiçek) 22 km from Kıyıköy to Demirköy, 150 m, 21.06.2009, *Akçiçek* 5299 & *Dirmenci* (Hb. Akçiçek); Demirköy, Sarpdere village, 350 m, 21.06.2009, *Akçiçek* 5298 & *Dirmenci* (Hb. Akçiçek); Tekirdağ: 2 km from Saray to Kıyıköy, E, 165 m, 21.06.2009, *Akçiçek* 5294 & *Dirmenci* (Hb. Akçiçek). A2 (E) İstanbul: On the

way from Karamandere to Karacaköy, 28.07.1967, *A.Baytop* & *G.Atila* (ISTE 11617); Yeniköy, 19.06.1984, *K.H.Rechinger* 60753 (W); Bahçeköy, 08.06.1902, *Aznavour s.n.* (G); Çatalca, 19.05.2002, 80 m, *İ.Genç* 1278 (ISTE 82136).

The type specimen of *S. thracica* was collected from İstanbul in 1913 by Davidov (SOM-62599). The species was not included in the account of *Stachys* in *Flora of Turkey* (Bhattacharjee, 1982), although it is a type specimen known from Turkey. During our herbarium and literature studies in the University of Sofia, it was determined that the specimens collected by us from Kırklareli are *S. thracica*. Our field and herbarium studies showed that the species grows from Istranca Mountains to İstanbul. *S. thracica* is morphologically similar to *S. germanica*, but it differs from *S. germanica* by the following feature: floral leaves broadly ovate-triangular to orbicular (not ovate-lanceolate to lanceolate).

Stachys carduchorum (R.Bhattacharjee) Rech.f., in Fl. Iran. 150: 363 (1982) (Figure 4).

= *Stachys balansae* subsp. *carduchorum* R.Bhattacharjee, Notes Roy. Bot. Gard. Edinburgh 33: 277 (1974).

Perennial herb with basal sterile rosettes. Flowering stems 40-65 cm, simple, rarely branched, erect, patent white-villous with sessile glands. Basal leaves ovate-oblong, margin, distinctly crenate-dentate, apex obtuse to acute, cordate at base, petiole 3-8 cm. Cauline leaves ovate to broadly elliptic, 3-10 × 1-5 cm, gradually becoming smaller above, margin distinctly crenate to serrate, apex rotund or obtuse to acute, cordate to subcordate at base, membranous when dry, green on both surfaces, distinctly reticulate-veined, subsessile or petiolate to 7 cm. All leaves glabrescent or sparsely (rarely densely) pilose on both surfaces. Floral leaves ovate to ovate-lanceolate, rarely lanceolate, apex acute, margin sharply serrate to entire, sessile, as long as or longer than verticillasters. Verticillasters 2-8, usually the lower (1-5) remote, 1.5-9 cm distant, the upper (2-4) congested, rarely remote throughout, 10-20 flowered. Bracteoles numerous, lanceolate to linear or filiform, 5-13 mm, herbaceous, tip not spinescent, with shortly glandular hairs. Pedicels 1-4 mm. Calyx subbilabiate, subcampanulate, 8-11 mm, densely sericeous, mouth with hairy ring; teeth subequal, ovate-lanceolate, c.

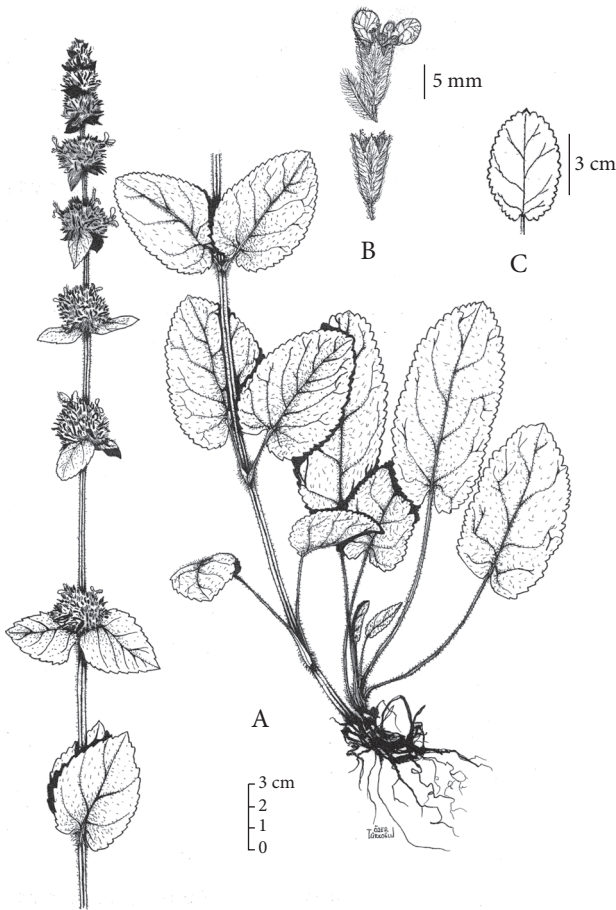


Figure 4. *Stachys carduchorum*: A- habit, B- calyx and corolla, C- leaf.

1/3 × tube, erect to slightly recurved in fruit, with shortly glandular hairs, tip spinescent, mucro 0.2-0.5 mm. Corolla purplish-pink, 13-15 mm, tube subincluded, bilabiate, upper lip emarginate, lower lip 3-lobed, middle lobe much larger than 2 lateral lobes, upper lip densely sericeous tomentose on outside, hairs usually exceeding the lip. Style not exceeding the upper lip, 2-branched, branches equal. Stamens 4, included, thecae divaricate, filaments with hairs from base to middle. Nutlets obovoid, faintly trigonous, 2.5-3 × 1.8-2 mm, slightly winged near base, glabrous, blackish-brown at maturity. *Fl.* 7-9. *Limestone ravines, streamsides, rocky slopes, 1750-3100 m.*

Type: [Turkey] C9 Hakkari: Cilo Da., in gorge between Cilo yayla and Diz deresi, 2438 m, 10.viii.1954, *P.H.Davis* 24265 & *Q.Polunin* (holo. E! iso. ANK! BM! K!).

Specimens examined:

Turkey: B9 Bitlis: Karz Dağ, above Kotum, 6500 ft, 28.06.1954, *P.H.Davis* 22230 & *Q.Polunin* (K); *ibid.*, 2200 m, 24.08.1954, *P.H.Davis* 24593 & *Q.Polunin* (ANK, BM, G, K); Van: Çatak, Kavuşşahap mountain, Karapet pass, 2750 m, 24.07.2009, *Akçiçek* 5335 & *Dirmenci* (ISTE); *ibid.*, 3100 m, 23.07.1954, *P.H.Davis* 23214 & *Q.Polunin* (ANK, BM, K); *ibid.*, 22.07.1954, *P.H.Davis* 23032 & *Q.Polunin* (BM, K); Artos Da., above Gevaş, 3000 m, 02.09.1956, *McNeill* 751 (K); Bitlis / Van: 10 km SE of Belli, 9000 ft, 08.07.1954, *P.H.Davis* 22571 & *Q.Polunin* (K). C9 Hakkari: Cilo Da, Cilo Yaylası, Diz deresi, ca. 2438 m, 10.08.1954, *P.H.Davis* 24265 & *Q.Polunin* (Isotypes: ANK, BM, K); Cilo Tepe, ca. 3100 m, 08.08.1954, *P.H.Davis* 24076 & *Q.Polunin* (ANK, BM, K). C10 Hakkari: Sat Dagi, near Varegöz, 1750-1900 m, 30.06.1966, *P.H.Davis* 45733 (K).

For *S. carduchorum*, the category of K.H. Rechinger was accepted, not that in *Flora of Turkey* of R. Bhattacharjee [*S. balansae* subsp. *carduchorum* R.Bhattacharjee is not in a subspecies category; *S. carduchorum* (R.Bhattacharjee) Rech.f. is a species]. This species is distributed in northern Iraq and south-eastern Anatolia (Bitlis, Hakkari, Van) (Rechinger, 1982). It resembles *S. balansae*, but it can be distinguished from subsp. *balansae* by the following features: cauline leaves ovate to broadly elliptic (not narrowly oblong to oblong-lanceolate), glabrescent or sparsely pilose on both surfaces (not sericeous-pilose above, softly villous below); nutlets obovoid, 2.5-3 × 1.8-2 mm (not rounded, 1.8-2.2 × 1.5-2 mm).

Stachys minor (Boiss.) Akçiçek & Dirmenci comb. et stat. nov. (Figure 5).

≡ *Stachys libanotica* Benth. var. *minor* Boiss. *Fl. Orient.* 4: 718 (1879).

Perennial herb, usually with basal sterile rosettes. Flowering stems erect, simple rarely sparsely branched middle, 25-90 cm, often reddish or red-angled, setulose. Leaves oblong to elliptic, 4-14 × 1-4.5 cm, margin crenate or crenate-serrate, apex obtuse to acute, asymmetric and rounded at base, villous on both surfaces, subsessile or petiolate to 8.5 cm. Floral leaves lanceolate to rhomboid-lanceolate, subsessile to sessile, as long as or longer than

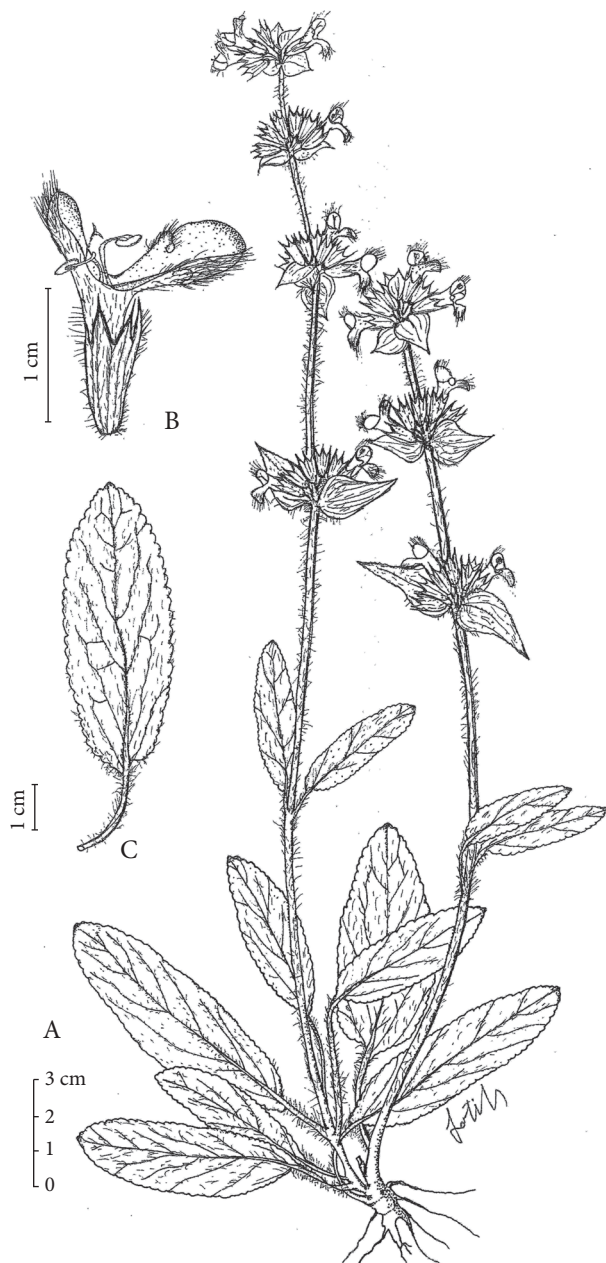


Figure 5. *Stachys minor*: A- habit, B- calyx and corolla, C- leaf.

verticillasters. Verticillasters 3-11, remote, 1-9 cm apart, 6-13 flowered. Bracteoles broadly lanceolate to linear or linear-subulate, 6-15 mm, herbaceous, tip spinescent. Pedicels 1.5-4 mm. Calyx subbilabiate, subcampanulate, 8-14 mm, villous or glabrescent, mouth with hairy ring, prominently veined in fruit; teeth subequal, ovate to ovate-lanceolate or triangular, $1/2-1/3 \times$ tube, recurved in fruit, margin with glandular hairs, tip spinescent, mucro c. 1-1.5

mm. Corolla rose, 15-18 mm, tube subincluded, bilabiate, upper lip entire, lower lip 3-lobed, middle lobe much larger than 2 lateral lobes, upper lip densely sericeous-tomentose on outside, hairs usually exceeding the lip. Style not exceeding the upper lip, 2-branched, branches equal. Stamens 4, included, thecae divaricate, filaments with hairs from base to middle. Nutlets obovoid, faintly trigonous, $2-3 \times 1.8-2.2$ mm, slightly winged near base, blackish-brown at maturity. $2n=30$. Fl. 5-6. *Pinus brutia* forest, forest openings, 500-550 m.

Type: [Turkey, C5 Hatay] in sylvaticis regionis inferioris montis Cassii Syriae borealis (Akra Da.) Boissier s.n. (holo. G!).

Specimens examined:

S. minor: Turkey: C5 Mersin: 13 km from Mezitli to Kuzucubelen, Cemilli village, 550 m, 15.05.2009, Akçiçek 5273 & Dirmenci (Hb. Akçiçek). C6 Hatay: 2 km from Yayladağı to Yeditepe village, 500 m, 20.07.2009, Akçiçek 5319 & Dirmenci (Hb. Akçiçek); ibid., 10.06.2010, Akçiçek 5488 & T.Özcan (Hb. Akçiçek).

S. libanotica: Syria: Hennor Mt. 4000 ft. 1863, B.T.Lowne (E); Ad margines vinetorum Raschaya, 4500 ped. 25.06.1855, Kotschy 160 (G); Anadi el Harir, 03.07.1811, Gaillardot 2117 (G); Ad Kafrum prope Bischerre in alpinis, 1822, Ehrenberg 333 (G); Mons Hermon, 1896, L.Fonck (G); Antilibani, misicris ad Rasiheya, 1200 m, 24.06.1897, Bornmüller 1344 (G).

In *Flora of Turkey*, Bhattacharjee stated that this taxon was not seen. The specimens of the taxon were collected from Hatay, which has the type locality (Yayladağı, Akra Mountain), and Mersin (Kuzucubelen, Cemilli village). As a result of careful examinations, it was realised that this should be recognised as a different taxon by changing its status [*S. libanotica* Benth. var. *minor* Boiss. is not in a variety category; *Stachys minor* (Boiss.) Akçiçek & Dirmenci **comb. et stat. nov.** is a species]. It differs from *S. libanotica* in its shorter calyx tube and calyx teeth with shorter mucros. It is also related to *S. sericantha*, but it can be distinguished from *S. sericantha* by the following features: calyx villous or glabrescent; teeth ovate to ovate-lanceolate or triangular, $1/2-1/3 \times$ tube. *S. minor* is geographically intermediate between *S. sericantha* (Antalya, Turkey) and *S. libanotica* (western Syria). *S. minor* grows

in the forest areas of the southern slopes of Akra Mountain, which is located in Mersin and Hatay. Akra Mountain continues descending towards Syria. It is likely that *Stachys minor* can be seen on the Syrian side of the mountain. Thus, it is doubtful whether or not it is endemic to Turkey.

Stachys ehrenbergii Boiss., Fl. Orient. 4: 721 (1879).

= *Stachys germanica* var. *ehrenbergii* (Boiss.) Briq., Lab. Alp. Mar.: 233 (1893).

= *Leonurus mollis* Ehrenb. ex Boiss., Fl. Orient. 4: 721 (1879).

Lectotype (designated here): [Lebanon] circa Cedretum et in summis Djord Arasch, *Kotschy* 307 (lectotype: G! isolectotypes: BM! K!).

Specimens examined:

S. ehrenbergii: Syria: Lebanon, Djebel Makhmal, 2900 m, 20.07.1936, *A.Bertschinger* 1486 (G); Libani borealis in cedreto supra Bischerre, 1925 m, 03.07.1910, *Bornmüller* 12277 (BM, E, G, W); Hermon: Duvdavan ridge, 2000-2100 m, 28.08.1985, *A.Liston*, *Y.Lev-Avi* 7-85-405/1 (G); Libani in regione alpina jugi Sanin, 2300-2500 m, 20.07.1897, *Bornmüller* 1345 (G, W).

S. balansae (wrongly determined as *S. ehrenbergii*): Turkey: C6 Kahramanmaraş: Ahır dağı, 1830-2135 m, 07.1907, *Haradjian* 1663 (G).

S. ehrenbergii was described based on 4 syntypes from Lebanon by Boissier. It is known only from Lebanon and western Syria. In 1907, another *Stachys* specimen was collected as *S. ehrenbergii* from southern Anatolia (C6: Kahramanmaraş: Ahır Mountain, 1830-2135 m, Haradjian 1663) by Haradjian. This taxon has never been collected by any other researcher in Turkey to date. However, in the field studies at Ahır Mountain in Kahramanmaraş and in neighbouring mountain ranges (Berit Mountain, Koç Mountain, Engizek Mountain) conducted in 2007 and 2008, no specimens of *S. ehrenbergii* could be found. After careful examinations of the specimen (Haradj. 1663) from Ahır Mountain in Kahramanmaraş collected by Haradjian and examination of the type specimen of *S. ehrenbergii* in G and W herbaria, we decided that Haradjian's specimens were the same as *Stachys balansae*. Thus, it was decided that *S. ehrenbergii* does not grow in Turkey.

Subsect. *Creticae* R.Bhattacharjee

S. cretica L., Sp. Pl. 581 (1753).

= *Eriostomum creticum* (L.) Hoffmanns. & Link, Fl. Portug. 1: 105 (1809).

Perennial herb with basal sterile rosettes, usually many stemmed from base. Flowering stems 20-100(-170) cm, erect, rarely ascending, simple or branched, adpressed greyish-tomentose to tomentose-villous or adpressed white-lanate, rarely puberulent, eglandular. Cauline leaves oblong-lanceolate to lanceolate or oblong-spathulate, rarely oblong-ovate or oblong-elliptic, 1-12 × 0.3-3.5 cm, margin crenulate, apex obtuse, sometimes acute, attenuate to cuneate or rarely rounded to subcordate at base, sparsely green-tomentose to tomentose-villous or rarely adpressed white-lanate above, densely grey-tomentose to tomentose-villous or lanate below, sessile to subsessile or petiolate to 9 cm. Floral leaves usually oblong-lanceolate to lanceolate or rarely ovate-lanceolate to ovate, subsessile or sessile, as long as or longer than verticillasters. Verticillasters 3-13(-18), remote throughout or the lower remote, the upper approximate, rarely congested or approximate throughout, distant to 10(-15) cm, 10-30(-35) flowered. Bracteoles lanceolate to linear-lanceolate or linear-subulate, 3-13(-23) mm, tip usually softly spinescent. Pedicels 0.5-3(-7) mm. Calyx subbilabiate, subcampanulate, 7-17 mm, tomentose-villous to villous or white lanate-villous, usually mixed with short glandular hair and/or sessile glands, mouth with hairy ring; teeth subequal or rarely unequal, ovate to ovate-lanceolate or triangular-lanceolate to triangular, rarely triangular-subulate, 1/4-1 × tube, erect or recurved in fruit, eglandular or glandular hairy, tip spinescent, mucro 0.6-3 mm. Corolla rose-pink or purplish-pink, rarely white, 8-18 mm, tube subincluded, bilabiate, upper lip entire, sometimes emarginate, lower lip 3-lobed, middle lobe much larger than 2 lateral lobes, upper lip densely sericeous-tomentose on outside, hairs usually exceeding the lip. Style not exceeding the upper lip, 2-branched, branches equal to unequal. Stamens 4, included, thecae divaricate, filaments with hairs from base to middle. Nutlets obovoid, slightly or distinctly winged near base, faintly trigonous, 2-3 × 1.2-2 mm, blackish-brown at maturity.

1. Verticillasters mostly approximate; cauline leaves rounded or subcordate at base
 2. Calyx lanate-villous; teeth triangular-subulate, as long as or slightly less than calyx tube, slightly recurved in fruit, eglandular, mucro 2-3 mm.....a. subsp. **cassia**
 2. Calyx tomentose-villous to villous; teeth ovate to ovate-lanceolate, 1/3 × tube, recurved in fruit, glandular hairy, mucro 1-2 mm.....e. subsp. **bulgarica**
1. Verticillasters remote throughout or approximate above; cauline leaves cuneate to attenuate, rarely rounded at base
 3. Calyx teeth ovate to ovate-lanceolate; cauline leaves broadly oblong-lanceolate to oblong-spathulate or oblong-elliptic, rarely oblong-ovate
 4. Calyx teeth recurved in fruit; cauline leaves broadly oblong-lanceolate to oblong-spathulate
 5. Flowering stems adpressed white-lanate or adpressed white-tomentose; calyx teeth eglandular; style branches unequal.....d. subsp. **trapezuntica**
 5. Flowering stems sparsely tomentose-villous; calyx teeth with glandular hairs; style branches subequal.....i. subsp. **smyrnaea**
 4. Calyx teeth erect or slightly recurved in fruit; cauline leaves oblong-elliptic or oblong-ovate
 6. Cauline leaves oblong-elliptic, at least 3 times as long as wide, usually cuneate or rounded at base.....f. subsp. **cretica**
 6. Cauline leaves oblong-ovate, less than 2-3 times as long as wide, subcordate at base..... g. subsp. **salviifolia**
 3. Calyx teeth triangular-lanceolate to triangular or triangular-subulate; cauline leaves narrowly oblong-lanceolate to lanceolate or oblong-spathulate
 7. Flowering stems usually paniculately branched
 8. Flowering stems adpressed greyish-tomentose; verticillasters congested above, remote below; calyx teeth widely recurved in fruit, mucro 1 mm..
.....b. subsp. **garana**
 8. Flowering stems adpressed, short, white-lanate; verticillasters remote throughout; calyx teeth erect or slightly recurved in fruit, mucro c. 2 mm
.....j. subsp. **mersinaea**
 7. Flowering stems usually simple or rarely branched
 9. Verticillasters 4-10(-16.5) cm distant throughout; flowering stems adpressed white lanate-villous to tomentose-villous or puberulent
 10. Calyx teeth erect or slightly recurved in fruit; corolla purplish-pink.....h. subsp. **vacillans**
 10. Calyx teeth recurved in fruit; corolla white...l. subsp. **kutahyensis**
 9. Verticillasters 1-4(-8) cm distant throughout; flowering stems shortly adpressed-tomentose
 11. Calyx lanate-villous or tomentose-villous, tube hidden under dense indumentum; teeth erect or slightly recurved in fruit, eglandular..... k. subsp. **anatolica**
 11. Calyx villous, tube not hidden under dense indumentum; teeth recurved in fruit, glandular-hairy.....c. subsp. **lesbiaca**

Stachys cretica is an extremely widespread and polymorphic taxon. It has a wide distribution through southern Europe, the Mediterranean area, Anatolia, Crimea, northern Iraq, western Iran, and Caucasia. *S. cretica* is highly variable with respect to hair density, calyx shape, tube/teeth proportion, length of calyx mucro, and leaf width/length proportion. Due to these numerous variations, it splits into 13 subspecies, 12 of which grow in Turkey and 4 of which are endemic to Turkey. Hence, the *S. cretica* group has an endemism rate of 33%. As one outcome of a revision study conducted by us (unpublished), *S. cretica* L. subsp. *kutahyensis* Akçiçek was described for the first time (Akçiçek, 2010), while *S. cretica* subsp. *cretica* and *S. cretica* subsp. *salviifolia* are reported for the first time from Turkey in this report. A dichotomous key covering all of the subspecies mentioned is given above.

subsp. *trapezuntica* Rech.f., Ann. Naturhist. Mus. Wien 48: 172 (1937) (Figure 6).

Lectotype (designated here): [Turkey] A7 Trabzon: Dschevlik (Maçka) to Hamsiköy, 23.08.1890, *Sintenis* 3432 (lectotype: G! isolectotype: W!).

Specimens examined:

A7 Trabzon: 4 km from Maçka to Hamsiköy, 400 m, 07.07.2010, Akçiçek 5489 & E.Erdoğan (Hb. Akçiçek); 5 km from Akçaabat to Ginik, Kalanema dere valley, Helvacı district, 80 m, 06.07.2010, Akçiçek 5490 & E.Erdoğan (Hb. Akçiçek).

Endemic. Subsp. *trapezuntica*, which was described based on 3 syntypes (Bourgeau 695, 08.08.1862; *Sintenis* 3432, 23.08.1890; *Handel-Mazzetti* 324, 09.07.1907) near Trabzon, was not collected again after 1907. It was found in 2 syntype localities from Trabzon in 2010, for the first time in 103 years.

Subsp. *trapezuntica* resembles *S. thirkei* in habit. It can be distinguished from other subspecies by the following features: flowering stems adpressed white-lanate or adpressed white-tomentose; cauline leaves broadly oblong-lanceolate or oblong-spathulate; calyx teeth ovate and eglandular.

subsp. *cretica* (Figure 7).

Lectotype [designated by Turland (in Jarvis et al., 2001)]: “*Stachys folio obscure virenti, fl. Roseo*” in Walther, Design. Pl.: t. 19. 1735. - Epitype [designated by Turland (in Jarvis et al., 2001)]: [Greece] Kriti: in dumosis m. Lassithi, Jun 1899, *Baldacci s.n.* (BM).

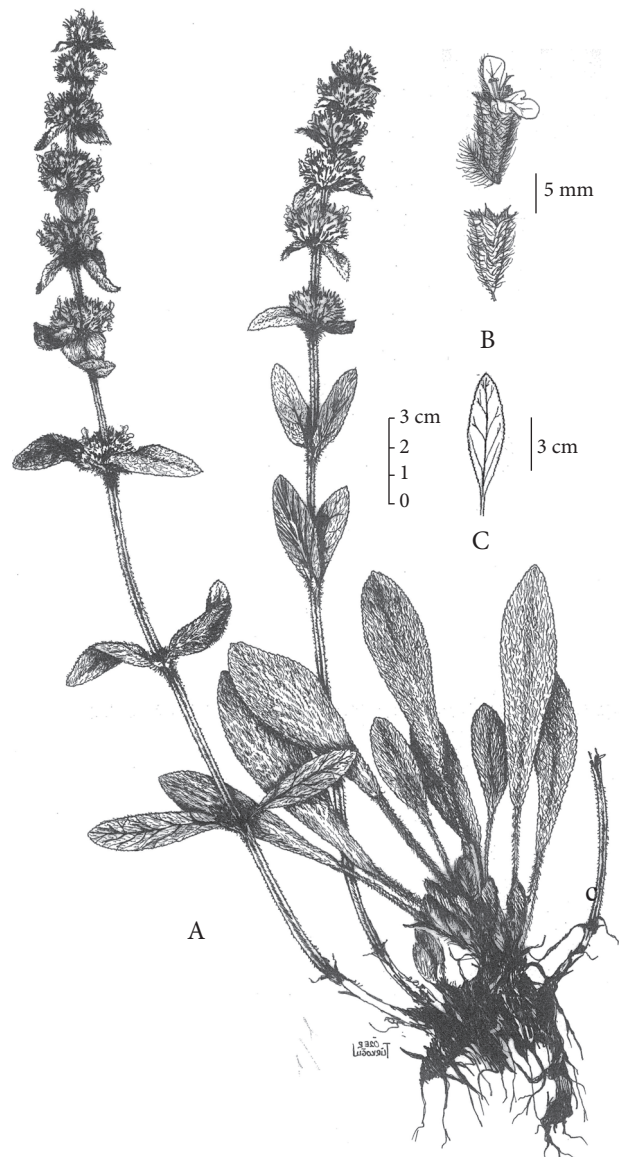


Figure 6. *Stachys cretica* subsp. *trapezuntica*: A- habit, B- calyx and corolla, C- leaf.

Fl. 6-7. *Quercus* forests, rocky slopes, 50-260 m. $2n=30$.

Specimens examined:

Cyprus: 15 km SW of Nicosia, 280 m, 25.04.1979, J.R.Edmondson 2931 & M.A.S.McClintock (E); Perapedhi, 3500 ft, 12.07.1940, P.H.Davis 1832K (E); Chrysorogiatissa, 11.05.1941, P.H.Davis 3412K (E); Kombos village, 06.06.1935, 12.05.1941, P.H.Davis 3398K (E).

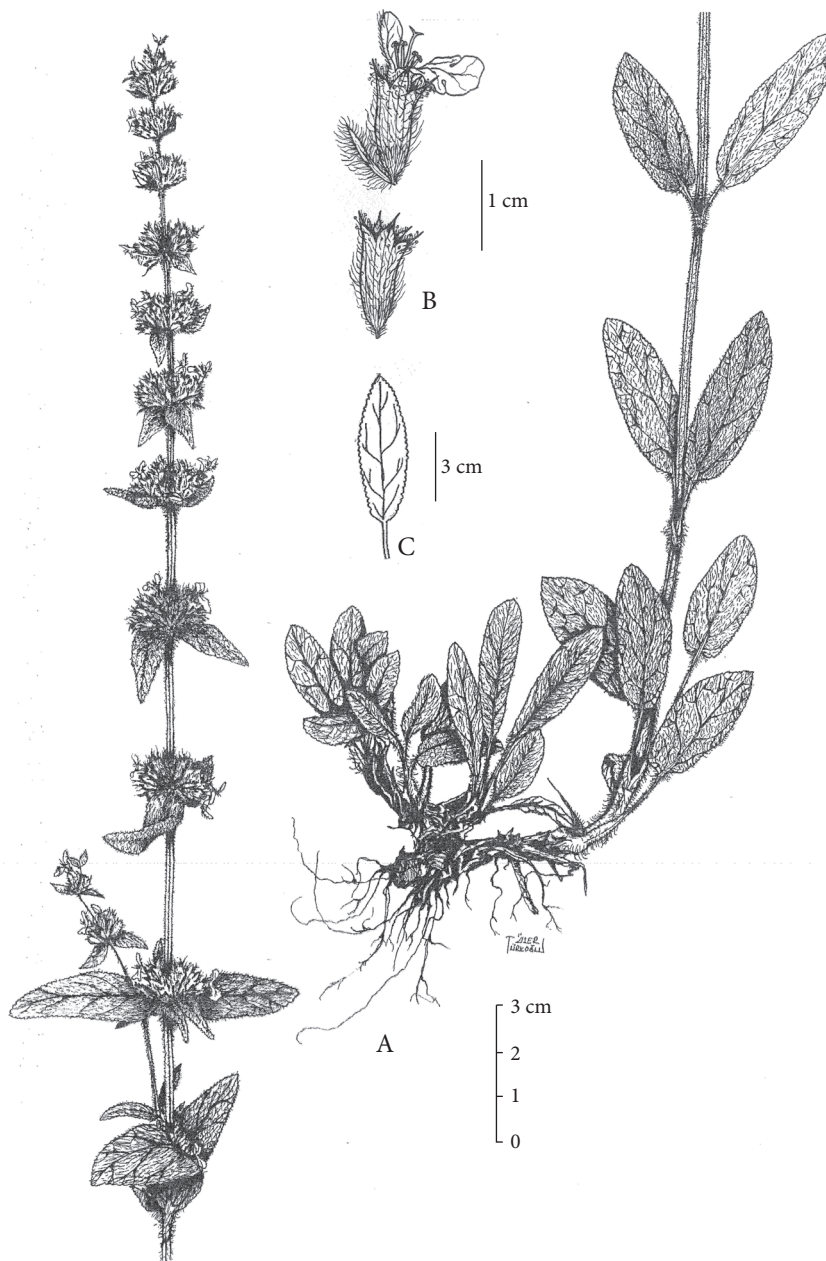


Figure 7. *Stachys cretica* subsp. *cretica*: A- habit, B- calyx and corolla, C- leaf.

Greece: In colle Lycabetto Atticae, 17 Mai, *T.G.Orphanides* 185 (E); Kalkidiki, 520-550 m, 18.06.1973, *H.M.Burdet* & *A.Charpin* 10214 (E); Island of Corfu (Corcyra), near Rovinia. Summer 1967, *J.C.R.McCubbin* 87 (E); Seriphos (Aegean Island), 21.06.1961, *E.Gathorne-Hardy* 70/1961 (E); Attica: In colle Lycabetto prope Athenas, 10.5.1891, *Heldreich* 1168 (E); Ep. Ierapetra: in faucibus inter Christos et Metaxochori, 500 m, 27.10.1966, *Greuter*

7805 (E); Crete, Kissamos, 24.05.1884, *Reverchon* 138; Crete, La Canea, 04.06.1883, *Everchon s.n.* (E); Kreta, Rhetimno, 350-450 m, 10.06.1983, *Podlech* 38265 (G); Kreta, Iraklion: Dikti-Gebirge, 600 m, 07.06.1983, *Podlech* 38192 (G); Euboea in montibus Xiron Oros prope Hagia Anna, 700 m, 02.06.1960, *K.H.Rechinger* 16883 (G); Euboea meridionalis: Montes Ocha, 300-600 m, 22.05.1955, *K.H.Rechinger* 16958 (G); Creta, Apokorono, 22.06.1942, *K.H.Rechinger* 13962 (G).

Turkey: A1 Edirne: 23 km from Keşan to Gelibolu, Korudağı ramp, 50 m, 29.05.2007, *Akçiçek* 4543, *Dirmenci* (Hb. Akçiçek); Kırklareli: Pınarhisar, Poyralı village, 260 m, 16.06.2010, *Akçiçek* 5498 (Hb. Akçiçek).

Subsp. *cretica* is distributed in Crimea, Cyprus, central and southern Greece, and Turkey (Rechinger, 1937). It was not previously recorded in Turkey. This species was found in Kırklareli and Edirne provinces. It differs from the other subspecies in having oblong-elliptic, at least 3 times as long as wide, and cuneate or rounded at base cauline leaves.

subsp. *salviifolia* (Ten.) Rech.f., Ann. Naturhist. Mus. Wien 48: 170 (1937) (Figure 8).

≡ *Stachys salviifolia* Ten., Fl. Napol.: 34 (1811).

≡ *Eriostomum salviifolium* (Ten.) C.Presl, Fl. Sicul.: 37 (1826).

= *Stachys germanica* var. *boissieri* Briq., Lab. Alp. Mar.: 222 (1893).

≡ *S. germanica* subsp. *salviifolia* (Ten.) Gams in G.Hegi, III. Fl. Mitt.-Eur. 5(4): 2427 (1927).

Quercus forests, 200 m.

Type: (Herb. Tenore, NAP).

Specimens examined:

Crimea: Karasubasar. In regione deserta et inculta 01.VII.1900, *Callier* 707 (E).

Croatia: Dalmaticum, Spalato-Salona, 16.06.1886, *Bornmüller* 1696 (E); Basilicata, Potenza: 3 km from Lauria, 700 m, *J.R.Akeroyd*, *S.L.Jury*, *F.J.Rumsey* & *M.J.Simpson* 3393 (E).

Greece: Island of Corfu (Corcyra), near Rovinia. Summer 1967, *J.C.R. McCubbin* 88 (E); Ex regione collina Insulae Corcyra, 1877, *Ball* 2695 (E); Ipiros, Ioannina, Metsovon, 1000 m, 16.06.1982, *I.Hagemann*, *H.Scholz*, *W.Schwarz* 39 (E).

Italy: Ex rupibus Calcarea Umbriae. Juxta Narni, April 1848, *Ball s.n.* (E).

Turkey: A1 Kırklareli: Pınarhisar, Poyralı village, 200 m, 31.05.2007, *Akçiçek* 4600 & *Dirmenci* (Hb. Akçiçek).

Subsp. *salviifolia* is distributed in the central Mediterranean region (Albania, Croatia, Greece, and Italy), Crimea, and Turkey. The subspecies is



Figure 8. *Stachys cretica* subsp. *salviifolia*: A- habit, B- calyx and corolla, C- leaf.

reported for the first time from Thrace (Turkey). It is rare and is found in a narrow area in the Istranca Mountains of Kırklareli Province. It differs from the other subspecies in having oblong-ovate, less than 2-3 times as long as wide, and subcordate at base cauline leaves.

Phylogenetic analysis

Despite numerous attempts, we were not able to obtain ITS sequences of *Stachys cretica* subsp. *cretica*, subsp. *salviifolia*, and subsp. *trapezuntica*. Detailed analyses revealed an approximately 6-11 long G (guanine) sequence followed by a similar length C (cytosine) sequence, possibly inhibiting the sequencing reaction for most of the *Stachys* taxa. While our attempts are ongoing to resolve this problem, we were able to conduct a phylogenetic analysis including *S. carduchorum*, *S. balansae*, *S. tymphaea*, *S. bithynica*, *S. thracica*, and *S. minor*, along with some other *Stachys* taxa as ingroups and *Sideritis* and *Phlomis lychnitis* taxa as outgroups. The phylogenetic analyses clearly showed that *S. carduchorum* was not the closest relative to *S. balansae*, as should have been the case if the *S. balansae* subsp. *carduchorum* assessment was true (Figure 9). The tree also supported the new status of *S. tymphaea* and *S. bithynica* as species instead of subspecies, since they are clearly separated both from each other and from the other subspecies (*Stachys germanica* subsp. *heldreichii*). Hence, ITS analysis strongly confirmed the suggested

rearrangements of *S. carduchorum*, *S. tymphaea*, and *S. bithynica*. *S. thracica* and *S. minor* were also distinctly separated from the other taxa, but to be able to phylogenetically confirm their new arrangements, a comprehensive analysis including all *Stachys* taxa needs to be conducted.

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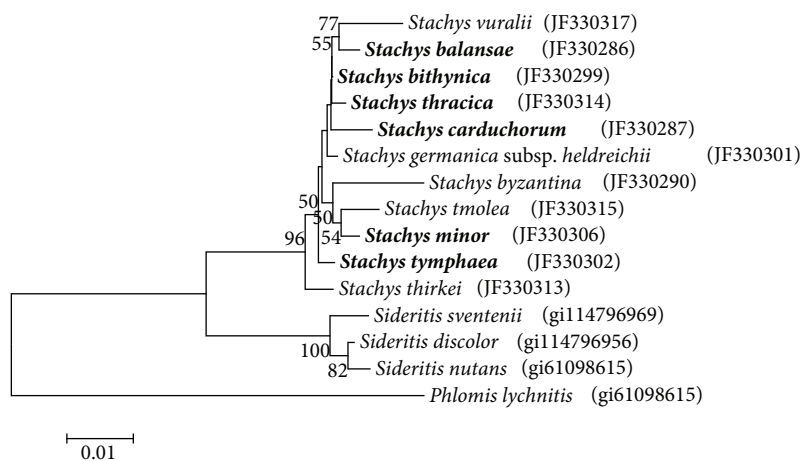


Figure 9. Phylogenetic analysis of *Stachys carduchorum*, *Stachys balansae*, *Stachys tymphaea*, *Stachys bithynica*, *Stachys thracica*, and *Stachys minor* (bold). The alignment of the sequences was generated using the CLUSTAL W algorithm (Thompson et al., 1994) of the BioEdit program (Hall, 1999). The phylogenetic history was inferred using the neighbour-joining method (Saitou & Nei, 1987). The percentages (less than 50% is not shown) of replicate trees in which the associated taxa clustered together in the bootstrap test (500 replicates) are shown next to the branches (Felsenstein, 1985). The tree is drawn to scale, with branch lengths in the same units as those of the phylogenetic distances used to infer the tree. There were a total of 477 positions in the final dataset. Phylogenetic analyses were conducted in MEGA4 (Tamura et al., 2007). Accession numbers of the ITS sequences obtained from the NCBI GenBank are shown in parentheses (accession numbers starting with JF were obtained through this study).

References

- Akçiçek E (2010). A new subspecies of *Stachys cretica* (section *Eriostomum*, Lamiaceae) from Turkey. *Turkish Journal of Botany* 34: 131-136.
- Álvarez I & Wendel JF (2003). Ribosomal ITS sequences and plant phylogenetic inference. *Molecular Phylogenetics and Evolution* 29: 417-434.
- Arcangeli G (1882). *Compendio Della Flora Italiana*, pp. 550-553. Turin: Ermanno Loescher.
- Baden C (1991). *Stachys* L. In: Strid A & Tan K (eds.), *Mountain Flora of Greece*, Vol. 2, pp. 97-107. Edinburgh: Edinburgh University Press.
- Baldwin BG, Sanderson MJ, Porter JM, Wojciechowski MF, Campbell CS & Donoghue MJ (1995). The ITS region of nuclear ribosomal DNA: a valuable source of evidence on angiosperm phylogeny. *Annals of the Missouri Botanical Garden* 82: 247-277.
- Ball PW (1972). *Stachys* L. In: Tutin TG, Heywood VH, Burges NA, Moore DM, Valentine DH, Walters SM & Webb DA (eds.) *Flora Europaea*, Vol. 3, pp. 151-157. Cambridge: Cambridge University Press.
- Bhattacharjee R (1974). Taxonomic studies in *Stachys* I: New species and infra-specific taxa from Turkey. *Notes from the Royal Botanic Garden, Edinburgh* 33: 275-292.
- Bhattacharjee R (1980). Taxonomic studies in *Stachys* II: A new infrageneric classification of *Stachys* L. *Notes from the Royal Botanic Garden, Edinburgh* 38: 65-96.
- Bhattacharjee R (1982). *Stachys*. In: Davis PH (ed.) *Flora of Turkey and the East Aegean Islands*, Vol. 7, pp. 199-262. Edinburgh: Edinburgh University Press.
- Boissier E (1879). *Flora Orientalis*, Vol. 4, pp. 714-752. Geneva & Basel: H. Georg.
- Bräuchler C, Meimberg H & Heubl G (2010). Molecular phylogeny of Menthinae (Lamiaceae, Nepetoideae, Mentheae) - Taxonomy, biogeography and conflicts. *Molecular Phylogenetics and Evolution* 55: 501-523.
- Colmeiro M (1888). *Las Plantas De La Peninsula Hispano-Lusitana* 4, pp. 403-412. Madrid: Imprenta de la Viuda e Hija de Fuentenebro.
- Daşkın R, Yılmaz Ö & Kaynak G (2009). *Stachys ketenoglui* sp. nov. (sect. *Infrarosularis*) (Labiatae/Lamiaceae) from south Anatolia, Turkey. *Nordic Journal of Botany* 27: 238-242.
- Davis PH, Mill RR & Tan K (eds.) (1988). *Flora of Turkey and East Aegean Islands* (Suppl. 1), Vol. 10, pp. 204-206. Edinburgh: Edinburgh University Press.
- Dinç M & Doğan HH (2006). *Stachys yildirimlii* (Lamiaceae), a new species from south Anatolia, Turkey. *Annales Botanici Fennici* 43: 143-147.
- Dirmenci T, Dündar E, Deniz G, Arabacı T, Martin E & Jamzad Z (2010). Morphological, karyological and phylogenetic evaluation of *Cyclotrichium*: a piece in the tribe Mentheae puzzle. *Turkish Journal of Botany* 34: 159-170.
- Dönmez AA (2002). *Perilla*: a new genus for Turkey. *Turkish Journal of Botany* 26: 281-283.
- Duman H (2000). *Stachys* L. In: Güner A, Özhatay N, Ekim T & Başer KHC (eds.) *Flora of Turkey and the East Aegean Islands* (Suppl. 2), Vol. 11, pp. 204-206. Edinburgh: Edinburgh University Press.
- Falciani L (1997). Systematic revision of *Stachys* Sect. *Eriostomum* (Hoffmanns. & Link) Dumort. in Italy. *Lagascalia* 19: 187-238.
- Felsenstein J (1985). Confidence limits on phylogenies: an approach using the bootstrap. *Evolution* 39: 783-791.
- Fiori A (1926). *Nuova Flora Analitica D'Italia*, Vol. 2, pp. 427-440. Florence: Tipografia di M. Ricci.
- Gemici Y & Leblebici E (1998). A new species from southern Anatolia: *Stachys cydni* Kotschy ex Gemici and Leblebici. *Turkish Journal of Botany* 22: 359-362.
- Halacsy ED (1968). *Conspectus Florae Graecae*, Vol. 2, pp. 514-531. Codicote, UK: Wheldon & Wesley.
- Hall TA (1999). BioEdit: a user-friendly biological sequence alignment editor and analyses program for Windows 95/98/NT. *Nucleic Acids Symposium Series* 41: 95-98.
- Hayek A & Markgraf F (1931). *Prodromus Florae Peninsulae Balcanicae*, 2, pp. 280-301. Berlin: Verlag des Repertoriums.
- İlçim A, Çenet M & Dadandı MY (2008). *Stachys marashica* (Lamiaceae), a new species from Turkey. *Annales Botanici Fennici* 45: 151-155.
- Jarvis CE, Cafferty S & Forrest LL (2001). Typification of Linnaean plant names in Lamiaceae (Labiatae). *Taxon* 50: 507-523.
- Jordanov D (1989). *Flora Reipublicae Popularis Bulgaricae*, 9, pp. 388-416. Sofia: Academiae Scientiarum Bulgaricae.
- Martin E, Çetin Ö, Akçiçek E & Dirmenci T (2011). New chromosome counts of genus *Stachys* (Lamiaceae) from Turkey. *Turkish Journal of Botany* 35: 671-680.
- Özhatay FN, Kültür Ş & Gürdal MB (2011). Check-list of additional taxa to the supplement Flora of Turkey V. *Turkish Journal of Botany* 35: 589-624.
- Palhinha RT (1939). *Flora De Portugal*, 2, pp. 617-618. Lisbon: Gravadores-Impressores.
- Prather LA, Monfils AK, Posto AL & Williams RA (2002). Monophyly and phylogeny of *Monarda* (Lamiaceae): evidence from the internal transcribed spacer (ITS) region of nuclear ribosomal DNA. *Systematic Botany* 27: 127-137.
- Rechinger KH (1937). Revision des Formenkreises der *Stachys cretica*. In: Keissler K (ed.) *Annalen Naturhistorischen Museums in Wien*, Vol. 48, pp. 167-178. Vienna: Natural History Museum.
- Rechinger KH (1982). *Stachys* L. In: Rechinger KH (ed.) *Flora Iranica*, Vol. 150, pp. 354-396. Graz: Akademische Druck-u. Verlagsanstalt.

- Saitou N & Nei M (1987). The neighbor-joining method: a new method for reconstructing phylogenetic trees. *Molecular Biology and Evolution* 4: 406-425.
- Sang T, Crawford DJ & Stuessy TF (1995). Documentation of reticulate evolution in peonies (*Paeonia*) using internal transcribed spacer sequences of nuclear ribosomal DNA: implications for biogeography and concerted evolution. *Proceedings of the National Academic of Sciences USA Sci* 92: 6813-6817.
- Savulescu T (1961). *Flora Reipublicae Popularis Romanicae*, 8, pp. 208-235. Bucharest: Editio Academiae Reipublicae Popularis Romanicae.
- Steane DA, Scotland RW, Mabberley DJ & Olmstead RG (1999). Molecular systematics of *Clerodendrum* (Lamiaceae): ITS sequences and total evidence. *American Journal of Botany* 86: 98-107.
- Stoianoff N & Stefanoff B (1925). *Flore De La Bulgarie*, pp. 943-949. Sofia: Dürzhavna Pechatnitsa.
- Sümbül H (1990). Two new species from South Anatolia. *Turkish Journal of Botany* 22: 359-362.
- Tamura K, Dudley J, Nei M & Kumar S (2007). MEGA4: Molecular evolutionary genetics analysis (MEGA) software version 4.0. *Molecular Biology and Evolution* 24: 1596-1599.
- Thompson JD, Higgins DG & Gibson TJ (1994). CLUSTAL W: improving the sensitivity of progressive multiple sequence alignment through sequence weighting, position-specific gap penalties and weight matrix choice. *Nucleic Acids Research* 22: 4673-4680.
- White T, Bruns T, Lee S & Taylor J (1990). Amplification and direct sequencing of fungal ribosomal RNA genes for phylogenetics. In: Innis M, Gelfand D, Sninsky J & White T (eds.) *PCR Protocols: A Guide to Methods and Applications*, pp. 315-322. San Francisco: Academic Press.
- Yıldırım Ş (2010). Some new taxa, records and taxonomic treatments from Turkey. *OT Sistemik Botanik Dergisi* 17: 1-114
- Yılmaz Ö, Daşkın R & Kaynak G (2010). *Stachys pseudobombycina* sp. nov. (Lamiaceae) from south Anatolia. *Nordic Journal of Botany* 28: 341-343