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A new species of *Micromeria* (Lamiaceae) from Köyceğiz (Muğla, southwest of Turkey)

Hayri DUMAN[1], Tuncay DİRMENCİ[2,*]

[1]Department of Biology, College of Arts and Sciences, Gazi University, Ankara, Turkey

[2]Department of Biology Education, Necatibey Education Faculty, Balıkesir University, Balıkesir, Turkey.

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Abstract: A new species, *Micromeria aybalae* H.Duman & Dirmenci (Lamiaceae), *Micromeria* Benth. sect. *Micromeria*, is described from Muğla Province in southwestern Turkey. A description, taxonomic note, distribution map, habitat, and nrDNA ITS and cpDNA *trn*L-F based phylogeny are presented. The differences between the new species and its allies, *Micromeria cremnophila* Boiss. & Heldr. s.l. and *M. hispida* Benth., are discussed, and an identification key is provided for the Turkish *Micromeria*.

Key words: Labiatae, Muğla, phylogeny, Sandras Mountain, *Micromeria*, Turkey

1. Introduction

The genus *Micromeria* Benth. belongs to the family Lamiaceae, subfamily Nepetoideae, tribe Mentheae, and subtribe Menthinae (Harley et al., 2004). *Micromeria* Benth. s.str. is currently circumscribed as monophyletic and is represented by nearly 70 species in the world (Govaerts, 1999; Brauchler et al., 2008b; Puppo and Meimberg, 2015a, 2015b). The genus is distributed from the Macaronesian-Mediterranean region to southern Africa, India, and China (Bräuchler et al., 2008b).

Micromeria s.l., a taxonomically complex genus, was divided into six sections as sect. *Micromeria*, sect. *Pseudomelissa* Benth., sect. *Cymularia* Boiss., sect. *Pinoelentia* P.Perez, sect. *Xenopoma* (Willd.) Benth., and sect. *Hesperothymus* Benth. by Morales (1993). In recent studies some changes were made to the taxonomic border of the genus *Micromeria*, as listed below. The species of sections *Xenopoma* and *Hesperothymus* pro parte distributed in southeastern Africa were transferred to the genus *Killickia* Bräuchler, Heubl & Doroszenko by Bräuchler et al. (2008a), and to *Clinopodium* by Cantino and Wagstaff (1998), Govaerts (1999), and Harley and Granda (2000); the species of section *Pseudomelissa* were transferred to *Clinopodium* by Bräuchler et al. (2005) and by Ryding (2006).

In *Flora of Turkey* (Davis, 1982), *Micromeria* s.l. is represented by 14 species (22 taxa), 12 of which are endemic and grouped into three sections: sect. *Micromeria* (7 species, 12 taxa), sect. *Pseudomelissa* (6 species, 9 taxa), and sect. *Cymularia* (1 species). After the latest taxonomic evaluations performed by Bräuchler et al. (2005), the species of section *Pseudomelissa* were transferred to *Clinopodium*. Finally, *Micromeria* is represented in Turkey by 8 species and 13 taxa, 8 of which are endemic (Arabacı et al., 2010; Dirmenci, 2012).

In 2015, the first author collected some unusual specimens belonging to *Micromeria* sect. *Micromeria* in southwestern Turkey (Figure 1). These specimens were clearly different from other known *Micromeria* species growing in Turkey, Greece, and Cyprus. After taxonomic studies it was concluded that the collected specimens represented an undescribed species close to *Micromeria cremnophila* Boiss. & Heldr. and *M. hispida* Boiss. & Heldr. ex Benth. It is being described as a new species here.

The main purposes of this study are: 1) to identify a new species, 2) to discuss the morphological and micromorphological differences between the new species and its allies, 3) to discuss the phylogenetic relationships of the new species with other *Micromeria* species, 4) to determine the phylogenetic position of the other Turkish *Micromeria* species, 5) to evaluate the condition of Turkish *Micromeria* species according to recent studies, and 6) to make a new identification key consisting of the new species and other species in Turkey.

2. Materials and methods

2.1. Plant material

The plant materials of the new species were collected by the first author during the GEF-5 project, carried out in the Köyceğiz district of Muğla Province in November

* Correspondence: dirmenci@balikesir.edu.tr

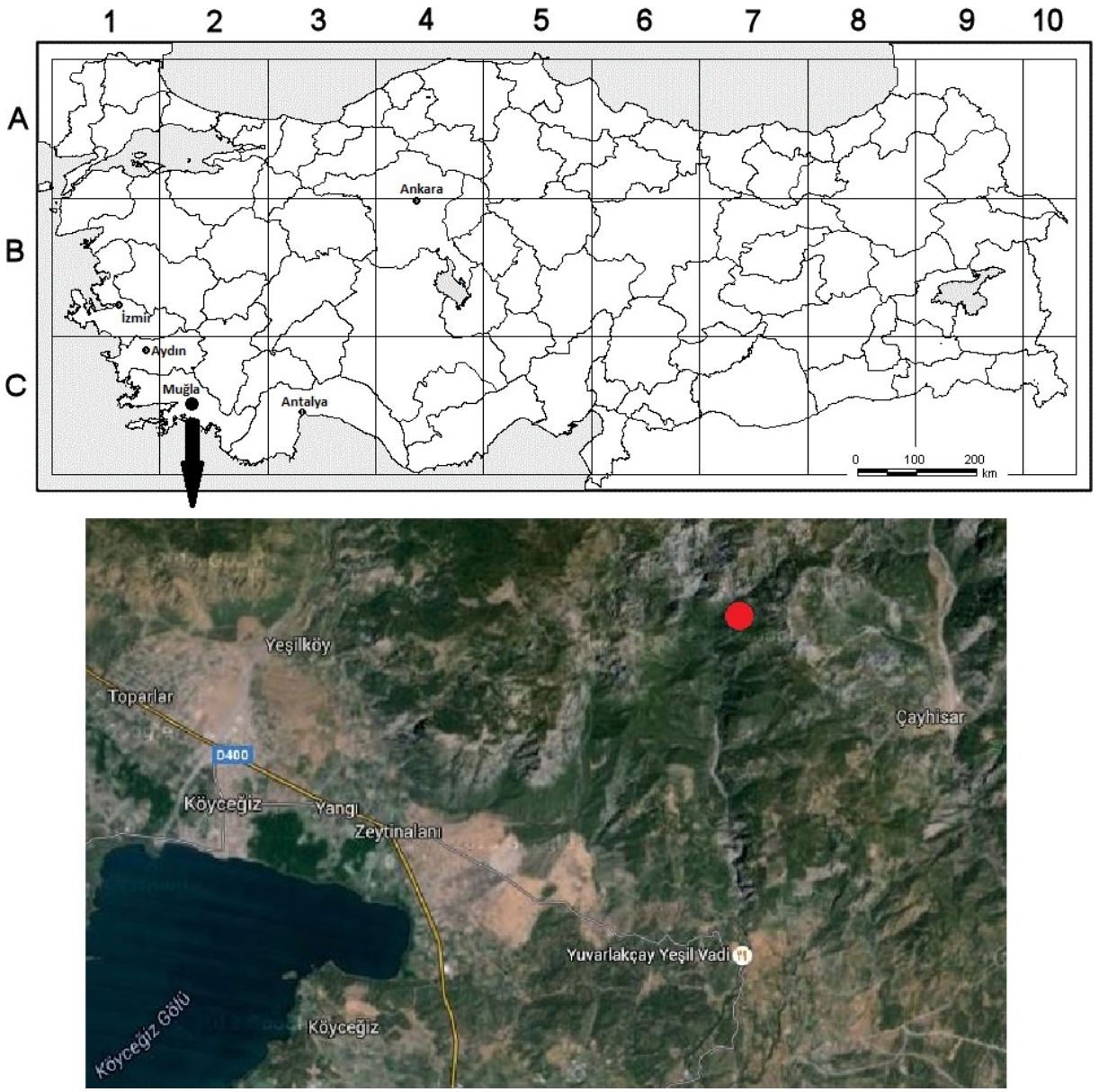

Figure 1. Distribution map of *Micromeria aybalae*.

2015 (Figure 1). These specimens were identified using the relevant literature (Ball and Getlifle, 1972; Baden, 1990; Davis, 1982; http://www.cretanflora.com) and compared to other known *Micromeria* species (Appendix 1) using specimens found in the following herbaria (acronyms according to Index Herbarium 2016): ANK, B, BM, E, EGE, G, GAZI, GOET, HUB, ISTF, ISTE, K, LE, MA, W, and WU (http://sweetgum.nybg.org/science/ih/).

2.2. Micromorphological studies

Trichome morphology of *Micromeria cremnophila*, *M. aybalae*, and *M. hispida* was studied using tabletop scanning electron microscopy (SEM) in the Basic Sciences Research and Applied Center of Balıkesir University. Average samples were chosen for micromorphology of stems and leaves. Trichomes were investigated and photographed using a NeoScope JCM. They were fixed on aluminum stubs using double-sided adhesive. The SEM micrographs were taken with a NeoScope JCM-5000 at an accelerating voltage of 10 kV.

2.3. Genomic DNA isolation

About 0.2 g of dried leaf tissue was used for DNA isolation. Some of the specimens were collected from their natural distribution areas. These fresh leaves were dried in silica gel. In addition, some leaves from some species were taken

from herbarium materials. Samples dried in silica gel and herbarium materials were squashed using a mortar and pestle with liquid nitrogen. The GeneJET Plant Genomic DNA Purification Mini Kit (Thermo Scientific, Lithuania) was used for DNA extraction following the manufacturer's protocol. Information on the investigated samples, GenBank numbers, and voucher numbers are provided in Appendix 2 (samples used in our molecular studies are marked with an asterisk). The quality of DNA extraction was confirmed by electrophoresis on a 1% agarose gel.

2.4. PCR amplification

The internal transcribed spacer (ITS) region of the nuclear ribosomal DNA (nrDNA) sequences and the *trn*L-F region of the chloroplast DNA (cpDNA) were used for molecular analysis of the *Micromeria* species. Polymerase chain reaction (PCR) amplifications of the ITS nrDNA were performed using ITS5A (5'-CCTTATCATTTAGAGGAAGGAG-3') (Stanford et al., 2000) and ITS4 (5'-TCCTCCGCTTATTGATATGC-3') (White et al., 1990) primers. The *trn*L-*trn*F (trnLeu-trnPhe) cpDNA amplifications were performed using *trn*L-c (forward) CGAAATCGGTAGACGCTACG (Taberlet et al., 1991) and *trn*L-f (reverse) ATTTGAACTGGTGACACGAG (Taberlet et al., 1991) primers. The total volume of each PCR tube was 25 µL, comprising 2.5 µL of CoralLoad PCR Buffer (QIAGEN, Germany), 3.0 µL of Q-solution (QIAGEN), 0.25 µL of Taq DNA polymerase (QIAGEN), 1.25 µL of 5 µM ITS5A (1.25 µL of 5 µM *trn*L-c), 1.0 µL of 5 µM ITS4 (1.25 µL of 5 µM *trn*L-f) (Sigma-Aldrich, Germany), and 0.4 µL of 20 µM dNTP solution (QIAGEN), and it was autoclaved in deionized water. During the PCR amplification, a thermal cycler machine (Techne-Prime, USA) was used for the routine amplification. Initial denaturation was performed for 5 min at 95 °C. The following 35 cycles were carried out: 1 min at 94 °C for denaturation, 1 min at 51 °C (59 °C for *tnr*L-F) for annealing, and 2 min at 72 °C for extension. A final extension cycle (5 min at 72 °C) followed. PCR products were checked by electrophoresis in 1% agarose gel.

2.5. Data analysis and editing of the ITS nrDNA and trnL-F cpDNA data

PCR products were sent to Genoks (Gene Research and Biotechnology Company, Ankara, Turkey) to be sequenced. The sequenced DNA was edited using Sequencher, version 4.9 (Gene Code Corporation, Ann Arbor, MI, USA). Clustal W (Larkin et al., 2007) was used for alignment. Some nucleotides from the 5' end of ITS1 (rpl32) and the 3' end of ITS2 (trnL-trnF) were cut to avoid doubtful base callings and redundant gaps. Finally, sequences of 660–672 nucleotides in length were produced from nrITS regions and 850–870 nucleotides in length from *trn*L-*trn*F cpDNA regions for the taxa studied. Polymorphic sequence regions of the *Micromeria* species were determined. A maximum parsimony tree was obtained using PAUP* (Swofford, 2002).

3. Results

Micromeria aybalae H.Duman & Dirmenci **sp. nov.** (Figures 2A–2E, 3A–3C, 4A–4I)

Type: Turkey. C2 Muğla: Köyceğiz, Sandras Mountain, west of Çayhisar village, calcareous rocks, 980–1000 m a.s.l., 4.11.2015. *H.Duman* 10395 (holotype GAZI!, isotypes ANK!, HUB!, ISTE!).

3.1. Diagnosis

Micromeria aybalae is similar to *Micromeria cremnophila* s.l. and *M. hispida*. It differs from *M. cremnophila* s.l. in the following aspects: stems prostrate to procumbent, slender, fragile (not ascending to erect and woody rootstock) and pilose with minutely glandular papillate (not puberulent, short hispid, or scabrid); leaves revolute only at apex (not revolute); calyx 4–4.5 mm and pilose with minutely glandular papillate (not 2–3 mm and puberulent to scabrid-pubescent); teeth 1.25–1.75 mm and 1/3–1/2 of tube (not 0.3–0.5 mm and 1/5–1/4 of tube), ciliate (not ciliate); corolla 5–6 mm (not 3–4 mm), pinkish-white (not purplish-pink). It differs from *M. hispida* in its herbaceous appearance: herbs only woody at base; stems prostrate to procumbent, branched, pilose with minutely glandular papillate (not dwarf shrub, procumbent to ascending, often branched, patent-pubescent to hispid); verticillasters 2-flowered (not 1–6-flowered); calyx pilose with minutely glandular papillate (not hispid); teeth 1/3–1/2 of tube (not 3/4 of tube); corolla pinkish-white (not purple).

3.2. Description

Perennial herbs. Stems numerous, prostrate to procumbent, 5–15 cm long, slender, brittle, pilose with minutely glandular papillate thoroughly, sometimes ±hispid at the base. Leaves ovate, 4–8 × 2.5–4.5 mm, slightly revolute towards the apex, pilose with minutely glandular papillate on both surfaces, subsessile, petioles up to 0.5 mm long, attenuate to rounded at base, acute to obtuse at apex, veins invisible. Inflorescence lax, 2-flowered, to 6 × 2 cm, raceme or paniculate; cymules distinctly pedunculate. Bracts similar to leaves, 2–5 × 1.5–3 mm, ovate, shortly petiolate to subsessile; bracteoles 2, 1–1.5 mm long, linear, shorter than pedicel, pedicel 3–5 mm long. Calyx tubular, 4–4.5 mm long, subbilabiate, pilose with minutely glandular papillate, veins 15, visible, pilose at throat; teeth linear-lanceolate, 1.25–1.75 mm long, 1/3–1/2 of the tube, ±equal or lower ones slightly longer than upper ones, ciliate. Corolla 5–6 mm long, pinkish-white, exserted from corolla, minutely glandular papillate; upper lip emarginate, lower lip divided into 3 lobes; hairy inside of upper lip and mouth. Style slightly exserted from corolla, unequally 2-lobed. Stamens 4, included in corolla, filaments hairy at

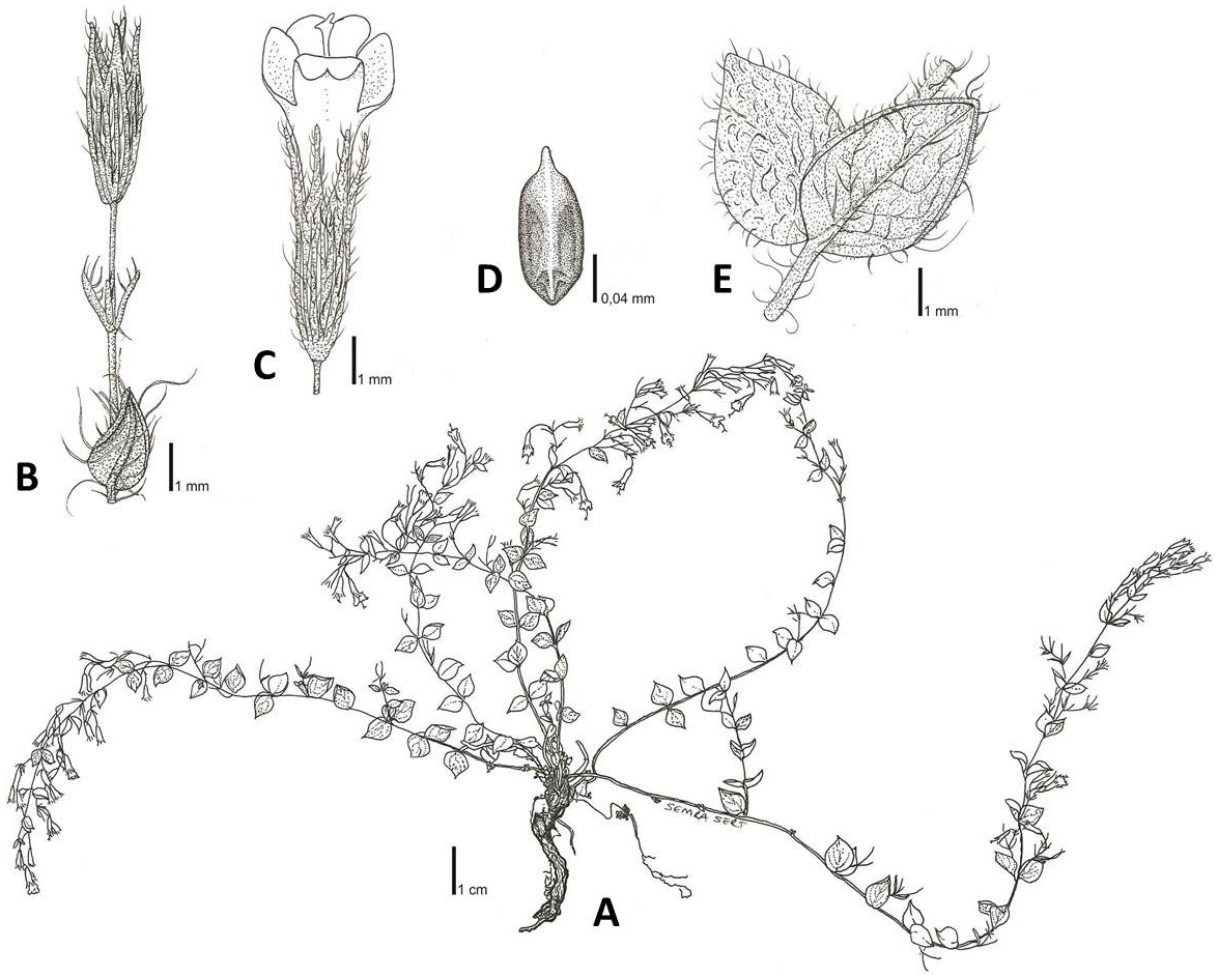

Figure 2. *Micromeria aybalae*: A- habit, B- calyx, C- flower, D- nutlet, E- leaves.

Figure 3. *Micromeria aybalae*: A, B- flowers and leaves, C- habit (photos from Dr Hayri Duman).

base. Nutlets oblong, c. 1.5 mm long, acuminate, mucro 0.3–0.4 mm, brown.

3.3. Habitat, geographical distribution, and conservation status

The species was found as growing only on Sandras Mountain, one of the highest mountains in southwestern Turkey, located in the northeastern part of the Köyceğiz district of Muğla Province (Figure 1). The bedrock of Sandras Mountain mainly comprises serpentine and limestone (Doğan, 2011). This geomorphological characteristic is responsible for the high number of endemic species. Sandras Mountain presents about 118 endemic plants, 25 of which (including *M. aybalae*) grow only there (Pirhan et al., 2014), and 4 of which are under

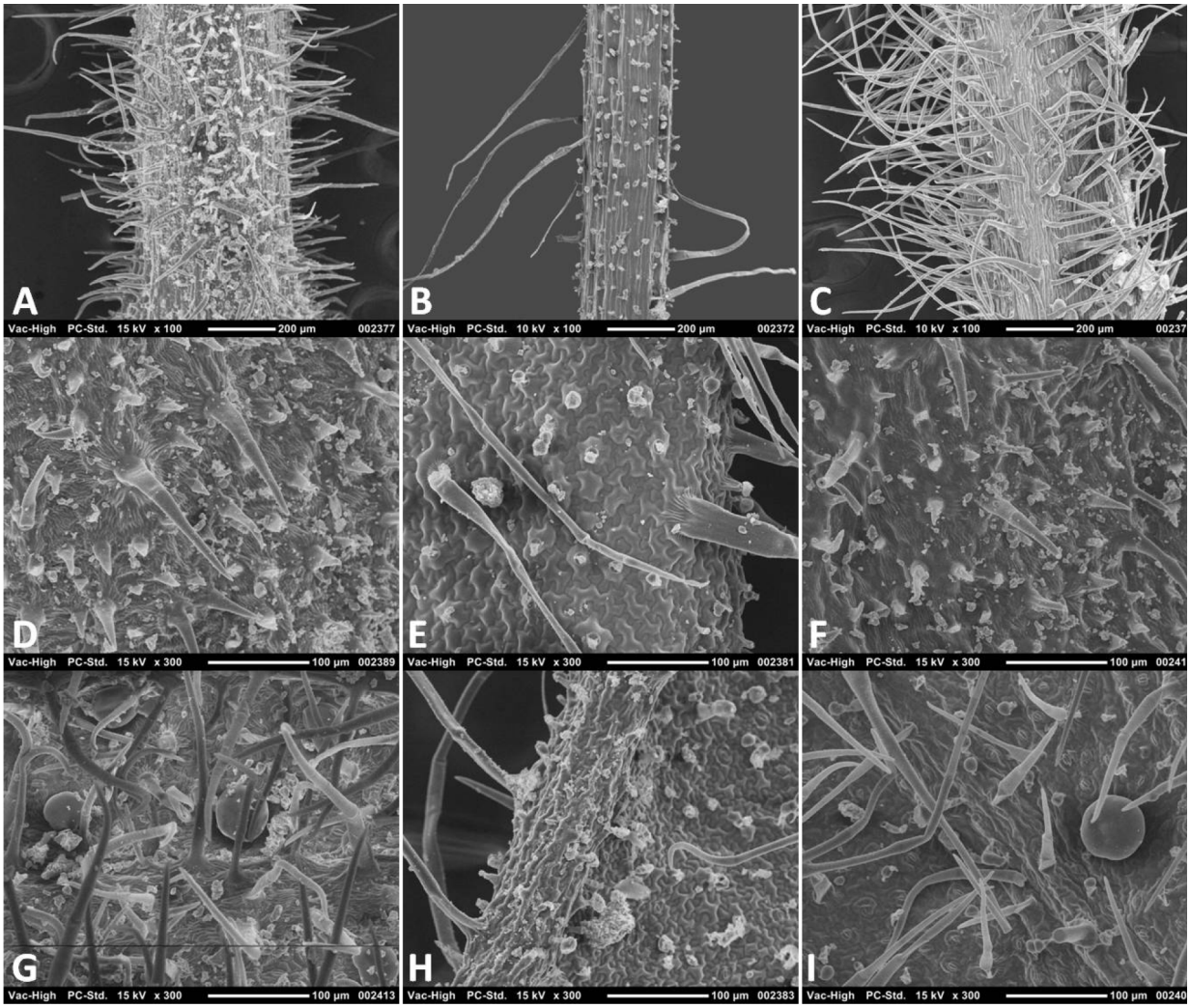

Figure 4. SEM photographs of *Micromeria cremnophila* (A, D, G), *M. aybalae* (B, E, H), and *M. hispida* (C, F, I).

threat on the European and global scale (Özhatay et al., 2003). Phytogeographically, Sandras Mountain is under the influence of the Eastern Mediterranean.

Micromeria aybalae was collected at an altitude of 1000 m in the northwest of Çayhisar village, on the limestone bedrock of black pine forest clearances. The species growing in the same area together with the new species are *Phagnalon rupestre* (L.) DC subsp. *graecum* Batt (Asteraceae), *Inula heterolepis* Boiss. (Asteraceae), *Micromeria myrtifolia* Boiss. & Hohen. (Lamiaceae), *Teucrium montbretii* Benth. subsp. *pamphylicum* P.H.Davis (Lamiaceae), and *Ptilostemon chamaepeuce* (L.) Less. (Asteraceae). *Micromeria aybalae* is known only from the type locality. The new species is endemic and an element of the East Mediterranean. The distribution area of the species is less than 10 km^2. Its population in the type locality is considerably poor. The number of individuals is about 200. Moreover, its habitat is subject to rain erosion. Because the region is too hot, forest fires are often observed. As a result, the species' habitat may be destroyed, and its present distribution area might get narrower in the future. It should, therefore, be regarded as Critically Endangered (CR) under the B2abi-v, C1-2ai-ii, D criteria (IUCN, 2014).

3.4. Etymology

Micromeria aybalae is a name given in dedication to the first author's daughter.

4. Discussion

According to the latest studies, the genus *Micromeria* is represented by 9 species in Turkey (Bräuchler et al., 2008a; Arabacı et al., 2010; Dirmenci, 2012). The identification key for all the species occurring in Turkey is provided below.

Key to the species of *Micromeria* present in Turkey

1. Annual herb, corolla resupinate (Sect. *Cymularia*) ..... **M. cymuligera**

1. Subshrub or perennial herbs, corolla not resupinate (Sect. *Micromeria*) ..... **2.**

2. Flowering stems with resting buds at base; leaves imbricated ..... **M. cristata**

2. Flowering stems lacking resting buds at base; leaves seldom overlapping ..... **3.**

3. Flowers crowded in tight verticillasters, without conspicuous pedicels ..... **4.**

3. Flowers in lax verticillasters, peduncles and pedicels conspicuous ..... **5.**

4. Verticillasters hemispherical, cymules inconspicuously pedunculated; calyx teeth divergent, 1/5–1/4 as long as calyx; throat bearded ..... **M. myrtifolia**

4. Verticillasters obconical, cymules shortly pedunculated; calyx teeth porrect, 2/5–1/2 as long as calyx; throat glabrous ..... **M. juliana**

5. Cymules subumbellate; calyx conspicuously hispid-plumose ..... **M. nervosa**

5. Cymules dichasial; calyx pubescent, scabrid or pilose ..... **6.**

6. Calyx 2–3 mm; corolla 3–4 mm ..... **M. cremnophila**

6. Calyx 3–5 mm; corolla 5–9 mm ..... **7.**

7. Perennial herbs, leaves flat or slightly revolute at apex, calyx pilose ..... **M. aybalae**

7. Suffruticose, leaves revolute, calyx scabrid-pubescent, shortly pubescence to hispidulous ..... **8.**

8. Calyx subbilabiate to 1/5, scabrid-pubescent; teeth lanceolate, erect to subpatent (NE of Turkey) **... M. elliptica**

8. Calyx subbilabiate to 1/3–2/5, shortly pubescence to hispidulous; teeth subulate, curved (W and S of Turkey) ..... **M. graeca subsp. graeca**

Micromeria aybalae is geographically isolated and morphologically clearly different from other *Micromeria* species growing in Turkey, Greece, and Cyprus. On the other hand, *Micromeria aybalae* has some morphological similarities with *Micromeria cremnophila* s.l. and *M. hispida* in sect. *Micromeria* (Figures 2–4). As seen as Figure 4, it can be easily distinguished from allied species morphologically and micromorphologically. It differs from *M. cremnophila* s.l. in the following aspects: stems pilose with minutely glandular papillate (not puberulent, short hispid, or scabrid) (Figures 4A and 4B), leaves pilose on both surfaces (not scabridulous and hispidulous) (Figures 4D, 4E, 4G, and 4H), calyx 4–4.5 mm and pilose with minutely glandular papillate (not 2–3 mm and puberulent to scabrid-pubescent), corolla 5–6 mm (not 3–4 mm) (Figures 2A–2E and Figures 3A–3C). It differs from *M. hispida* in appearance; herbs only woody at base, stems prostrate to procumbent, branched and pilose with minutely glandular papillate (not dwarf shrub, procumbent to ascending, often branched and patent-pubescent to hispid) (Figures 4B and 4C), leaves pilose on both surfaces (not patent pubescent to pilose) (Figures 4E, 4F, 4H, and 4I), verticillasters 2-flowered (not 1–6-flowered), calyx pilose with minutely glandular papillate (not hispid); teeth 1/3–1/2 of tube (not 3/4 of tube), and corolla pinkish-white (not purple) (Figures 2A–2E and Figures 3A–3C). Detailed differences between *Micromeria aybalae* and related species are presented in the diagnosis and in the key.

Micromeria aybalae is close to *M. chionistrae* Meikle, which is endemic to Cyprus, and *M. microphylla* (d'Urv.) Benth., a widespread species from the Mediterranean basin. It is distinguished from *M. chionistrae* by its perennial herbs (not subshrub and cushion-forming), verticillasters 2-flowered (not 3–8-flowered), calyx 4–4.5 mm (not 2.5–3 mm), and corolla 5–6 mm (not 3.5–4 mm). It can be distinguished from *M. microphylla* by its perennial herbs (not subshrub), verticillasters 2-flowered (not 1–7-flowered), calyx 4–4.5 mm (not 2–2.5 mm), corolla 5–6 mm (not ca. 4 mm).

According to our molecular and GenBank data results, and as seen in Figures 5 and 6, the genus *Micromeria* s.str. is a monophyletic genus when all the *Micromeria* clades are considered regarding the nrITS data (Figure 5) and the cp*trn*L-F data (Figure 6). On the other hand, in classical sectional classification, some of the section *Pineolentia* members are together with section *Micromeria* members (from the Canary Islands). This can be easily seen from the cp*trn*L-F phylogenetic tree (Figure 6). According to the data of Bräuchler et al. (2010), section *Pineolentia* and section *Micromeria* have the same clade, and this shows that they have a common ancestor. The data of Puppo et al. (2014, 2015) contributed to sections *Pineolentia* and *Micromeria*. *M. pineolens* shares the same clade with the Canary Islands section *Micromeria* specimens. Likewise, section *Cymularia* and Madagascarian *Micromeria* species do not belong to the section *Micromeria* clade according to Bräuchler et al. (2010). *M. cymuligera* (from section *Cymularia*) is closer to the Madagascarian group. This species (*M. cymuligera*) is known to grow only in Turkey, and the collected specimens are not as sufficient as mentioned before by Bräuchler et al. (2010). Our phylogenetic data and results confirm the results of Bräuchler et al. (2005, 2010).

In *Flora of Turkey*, the genus *Micromeria* is divided into three sections: *Cymularia, Pseudomelissa*, and *Micromeria*. Bräuchler et al. (2006) transferred the section *Pseudomelissa* to *Clinopodium* s.l. In this study, three Turkish species (*M. mollis*, *M. carica*, and *M. dolichodonta*) belonging to sect. *Pseudomelissa* (Davis, 1982) that differ from the other sections with larger, flat at the margin, and entire to weakly crenate leaves were also molecularly

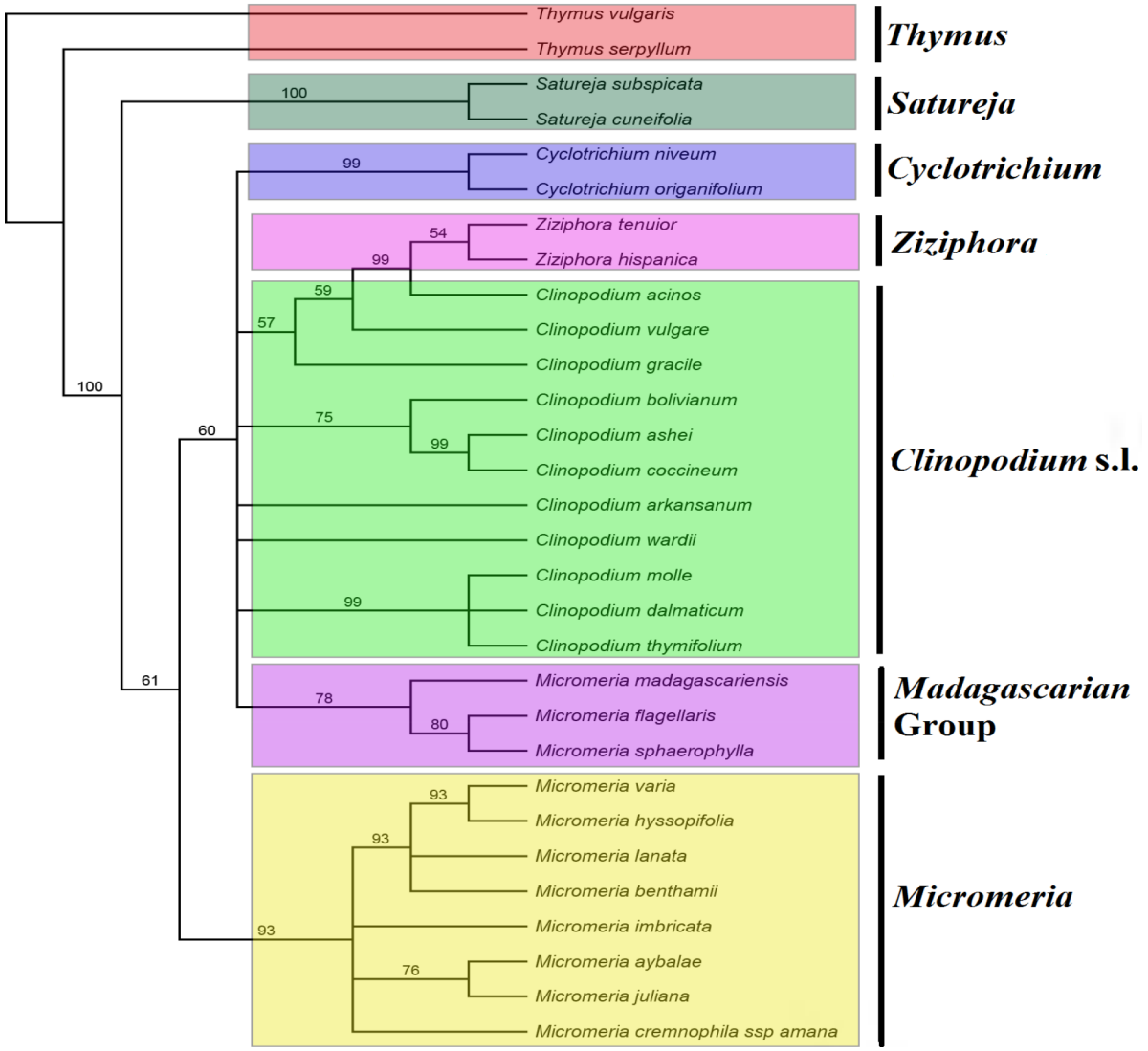

Figure 5. Maximum likelihood tree of *Micromeria* and related genera with bootstrap values (based on ITS data).

examined, and it was observed that these species belong to *Clinopodium* s.l. (Figures 5 and 6). The findings were consistent with the results of Bräuchler et al. (2005, 2010).

Sect. *Cymularia*, which is a monotypic section, is characterized by being annual, morphologically with ovate-acuminate bracteoles and resupinate corolla. According to Brauchler et al. (2010), *Micromeria cymuligera* is closer to *Mentha* and *Cyclotrichum* than to *Micromeria*. In addition, our *trn*L-F data obtained from this study also showed this close relationship (Figure 6).

Sect. *Micromeria*, which contains the new species *Micromeria aybalae*, differs from the other two sections by a prominent vein at the leaves' margins, and mostly revolute and entire leaves. According to our nrDNA data (Figure 5, bootstrap value: 93) and cpDNA data (Figure 6, bootstrap value: 98), *M. aybalae* is included in Sect. *Micromeria*-real *Micromeria*. It is seen in Figure 5 that *Micromeria aybalae* has a close relationship with *M. juliana* in the ITS region (bootstrap value: 76).

Finally, morphological differentiation was also supported using two different DNA regions. With this new species, the *Micromeria* species numbers in Turkey have increased to 9 species and 14 taxa, 9 of which are endemic to Turkey.

Acknowledgments

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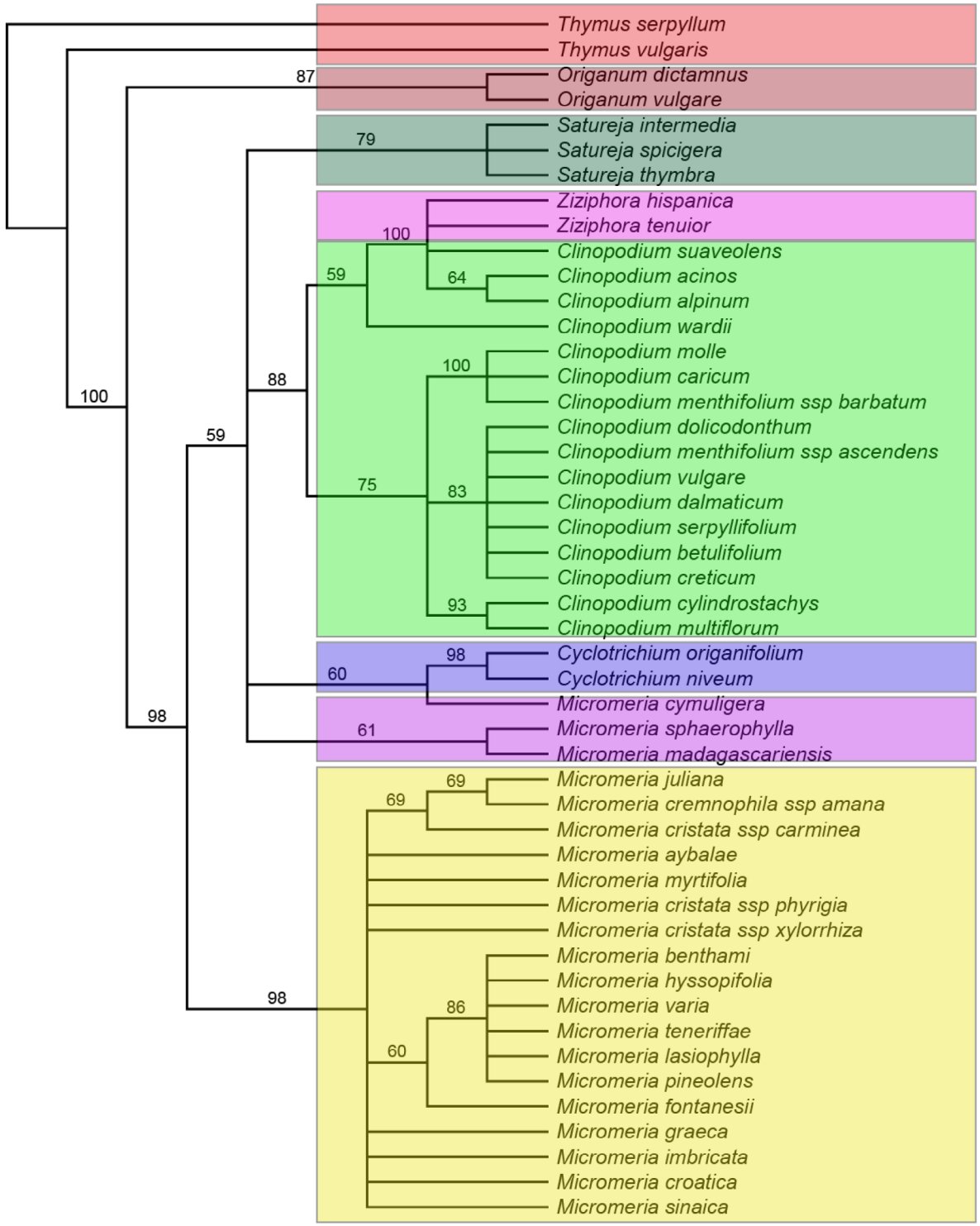

Figure 6. Maximum likelihood tree of *Micromeria* and related genera with bootstrap values (based on trnL-F data).

the specimens: ANK, B, BM, E, EGE, G, GAZI, GOET, HUB, ISTE, ISTF, K, LE, W, and WU. We also thank Infrastructure Action under the FP6 (SYNTHESYS Project GB-TAF 3087), FP7 (SYNTHESYS Project ES-TAF 264) "Structuring the European Research Area" Program, the Council of Higher Education of Turkey (YÖK), and the Basic Sciences Research and Applied Center of Balıkesir University.

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Appendix 1. Examined specimens.

***Micromeria cremnophila* subsp. *amana*:** Type. (Turkey) **C6** Adana: Mons Amanus, mont de Düldül, 1500–2000 m a.s.l., 07.1911, Haradjian 3887 (E W); **B5** Kayseri: Tomarza, Toklar, around Aslandaş village, 1700–1800 m a.s.l., 14.07.1989, M.Koyuncu 7198 (AEF); Bakırdağ, Kisge, at west foot of Bakır Da., 1300 m a.s.l., 27.06.1952, P.H.Davis 19217 (ANK, E, EGE, K, BM); Adana: Feke, Göksu gorge, below Himmetli village, 700–800 m, P.H.Davis 19870 (E, K, BM); Feke: between Suphandere and Belanköy, in gorge, 900 m a.s.l., 02.07.1952, P.H.Davis 19542 (BM); ibid., P.H.Davis 19565 (K, BM); ibid., P.H.Davis 19546 (ANK, K); **C5** Adana: Pozantı, Alpu village, Karınca mountain, 1650 m a.s.l., 07.07.2007, T.Dirmenci 3450 & E.Akçiçek (GAZI); 20 km from Saimbeyli to Feke, 800–900 m a.s.l., 11.07.2006, T.Dirmenci 3237 (GAZI); 10 km from Saimbeyli to Tufanbeyli, 1200 m a.s.l., 11.07.2007, T.Dirmenci 3462 & E.Akçiçek (GAZI); **C6** Osmaniye: Bahçe, montis amanus, regione de Düldül, 7000 ft., 07.1908, Haradjian 2407 (K); Düldül mountain, near Haruniye, 700 m a.s.l., 26.07.1949, P.H.Davis 16377 (ANK, K); Düldül mountain, Başkonuş plateau, 1800 m a.s.l., 14.08.2014, T.Dirmenci 4254, T.Arabacı & T.Yazıcı (GAZI); Kahramanmaraş: Engizek Dağı, Aksu village, 1000–1100 m a.s.l., 05.07.1986, H.Duman 2083 (GAZI); **subsp. *anatolica*:** Type: (Turkey) **B9** Van: 5 km north of Çatak, in crevices of boulders, 25.07.1954, P.H.Davis 23258 & O.Polunin (holo. E, iso K, BM, ANK); **B6** Kayseri: Akkışla, above Ganişeyh, Hınzır mountain, 1900 m a.s.l., 22.07.1980, N.Çelik 1459 (AEF); Yalak, Binboğa mountain, 1750–2200 m a.s.l., 20.07.1992, Z.Aytaç & H.Duman 5367 (GAZI); Kahramanmaraş: Göksun, between Yeşilköy and Kınıkkoz village, 1400–1600 m a.s.l., 13.06.1978, B.Yıldız 2092 (HUB); Sivas: Gürün, Gökpınar village, 1500 m a.s.l., 21.07.1987, M.Koyuncu (AEF-14434); Malatya: Darende, 1070 m a.s.l., 19.06.1954, P.H.Davis 21852 (E, K, BM); 50 km SE of Darende, 1200 m a.s.l., 05.08.1956, McNeill 440 (K); Malatya: Darende, ca. 1070 m a.s.l., 19.06.1954, P.H.Davis 21852 (ANK); between Malatya and Darende, 1 km east of Develi village, 4795 ft., 10.08.2007, T.Dirmenci 3504 & T.Arabacı (GAZI); **B7** Elazığ: Harput, around castle, 17.07.1990, K.Alpınar (ISTE-62187); Erzincan: between Kemaliye and Sarıkonaklar, 1100–1200 m a.s.l., 08.06.1989, M.Koyuncu 8859 (AEF); Erzincan: between Kemaliye and Divriği, old road, the entrance of Bülent Ecevit tunnel, 15.06.2016, T.Dirmenci 4564 & A.Kahraman (GAZI). Tunceli: Munzur Da., Aksu De., above Ovacık, 1800 m a.s.l., P.H.Davis 31480 (E); **B8** Muş: 15 km from Muş to Tatvan, 26.06.1983, T.Ekim 7773 (GAZI); Van: Atatürk forest, around DSİ and Radar, 2000 m a.s.l., 23.06.1988, Z.Aytaç 2330 (GAZI); **B9** Van: Gürpınar, south of Hamurkesen village, 1900 m a.s.l., 15.07.2003, M.Ünal 8595 (VANF); **C4** Konya: Ereğli, around Çakıllar village, 1900 m a.s.l., 20.07.1995, Z.Aytaç 7169 & N.Adıgüzel (GAZI); **C10** Hakkari: Cilo Da., Diz De., 1760 m a.s.l., 06.08.1954, P.H.Davis 23996 (E, K, BM).

Micromeria hispida: In rupestribus pr. Kainurio Chorio, (Eparhiae Mirabello) Cretae, 21.04.1846, Heldreich 1422 (isotypes: K WU P-photo); Crete: Selinaris, dans la gorge traverse par la route Iraklion-Agios Nikolaos, a proximate du monatere d'Agios Georgios, fin Avril, 1997, G.Van Buggenhout 18344 (G); Crete, Hierapetra, Felsgerölle des aphendi Kavusi, 02.08.1904, Dörfler 1054 (G-Boiss.).

Micromeria microphylla: Malta: "In collibus aridis insulae Melitae copiosissime", d'Urville (Lectotype: P-photo); Karpathos, in fissuris rupium calc. ad Vrondi adversus Pigadia, 17.06.1935, K.H.Rechinger 8249 (G-Boiss.).

Micromeria chionistrae: Cyprus, Phini 1000 m a.s.l., in cracks of bare rock, 06.06.1939, Kennedy 1495 (holotype: K).

Appendix 2. GenBank information.

	GenBank Accession Numbers	
	ITS	trnL-trnF
Thymus vulgaris L.	AY506646	GU381636
Thhymus serpyllum L.	EU796890	AY570502
Satureja subspicata Bartl. ex Vis.	EU823288	-------
Satureja cuneifolia Ten.	EU823290	-------
Satureja intermedia C.A.Mey.	-------	GU381622
Satureja spicigera (K.Koch) Boiss.	-------	GU381623
Satureja tymbra L.	-------	JQ669068
Cyclotrichium niveum (Boiss.) Manden. & Scheng.	GU381397	GU381525
Cyclotrichium origanifolium (Labill.) Manden. & Scheng.	GU381399	GU381527
Ziziphora tenuior L.	KP278588	GU381507
Ziziphora hispanica L.	KP278578	GU381503
Origanum dictamnus L.	-------	GU381643
Origanum vulgare L.	-------	AY506614
Clinopodium acinos (L.) Kuntze	JQ669074	GU381498
Clinopodium vulgare L.	DQ667324	AY506593
Clinopodium gracile (Benth.) Kuntze	JQ669082	-------
Clinopodium bolivianum (Benth.) Kuntze	DQ017564	-------
Clinopodium ashei (Weath.) Small	DQ667237	-------
Clinopodium coccineum (Nutt. ex Hook) Kuntze)	AY943485	-------
Clinopodium arkansanum (Benth.) Kuntze	JQ669080	-------
Clinoopodium wardii (C.Marquand & Airy Shaw) Bräuchler	GU381392	GU381516
Clinopodium dalmaticum (Benth.) Bräuchler & Heubl	JQ669118	JQ669055
Clinopodium thymifolium (Scop) Kuntze	JQ669121	-------
Clinopodium suaveolens (Sm.) Kuntze)	-------	GU381499
Clinopodium alpinum (L.) Kuntze	-------	AY840180
Clinopodium serpyllifolium (M.Bieb.) Kuntze	-------	GU381535
Clinopodium serpyllifolium (M.Bieb.) Kuntze	-------	GU381536
Clinopodium betulifolium (Boiss. & Balansa) Kuntze	-------	GU381532
Clinopodium creticum (L.) Kuntze	-------	GU381533
Clinopodium cylindrostachys (Epling & Játiva) Govaerts	-------	GU381605
Clinopodium multiflorum (Ruiz & Pav.) Kuntze	-------	GU381602
Micromeria madagascariensis Baker	GU381374	GU381481
Micromeria flagellaris Baker	GU381375	-------
Micromeria sphaerophylla Baker	GU381376	GU381487
Micromeria varia Benth.	GU381447	AY840203
Micromeria hyssopifolia Webb & Berthel.	AY227142	AY506612
Micromeria lanata (C.Sm. ex Link) Benth.	JQ669120	-------
Micromeria benthamii Webb & Berthel.	GU381446	AY840183
Micromeria imbricata (Forssk.) C.Chr.	KF805105	AY840193
Micromeria cymuligera Boiss. & Hausskn.	-------	GU381523

Appendix 2. (Continued).

Micromeria teneriffae (Poir.) Benth. ex G.Don	-------	AY840206
Micromeria lasiophylla Webb & Berthel.	-------	AY840205
Micromeria pineolens Svent.	-------	AY840182
Micromeria fontanesii Pomel	-------	AY840195
Micromeria graeca (L.) Benth. ex Rchb.	-------	AY840198
Micromeria croatica (Pers.) Schott	-------	GU381624
Micromeria sinaica Benth.	-------	AY840200
Micromeria cremnophila Boiss. & Heldr. subsp. *amana* (Rech.f.) P.H.Davis*	KY020411	KX381823
Micromeria cristata (Hampe) Griseb. subsp. *phyrigia* P.H.Davis*	-------	KX381824
Micromeria cristata subsp. *carminea* (P.H.Davis) P.H.Davis*	-------	KX381825
Micromeria cristata subsp. *xylorrhiza* (Boiss. & Heldr. ex Benth.) P.H.Davis*	-------	KX381826
Clinopodium serpyllifolium subsp *barbatum* (P.H.Davis) Bräuchler*	-------	KY038988
Micromeria aybalae H.Duman & Dirmenci*	KX381815	KX381818
Micromeria juliana (L.) Benth. ex Rchb.*	KX381816	KX381821
Micromeria myrtifolia Boiss. & Hohen.*	-------	KX381822
Clinopodium molle (Benth.) Kuntze*	KX381814	KX381819
Clinopodium caricum (P.H.Davis) Bräuchler & Heubl*	-------	KX381817
Clinopodium dolicodonthum (P.H.Davis) Bräuchler & Heubl**	-------	KX381820

*: Isolated in this study.