



A taxonomic revision of the genus *Stachys* (Lamiaceae: Lamioideae) in Iran

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Stachys is a large and taxonomically complex genus of Lamiaceae (Lamioideae: Stachydeae). On the basis of morphological examination and field investigation, we revised the genus *Stachys* in Iran. We examined about 3500 specimens from various herbaria and produced a key for identification of all taxa found in Iran. The following are provided for each taxon: a description along with the complete synonymy, notes on nomenclature and relationships within the genus, geographical distribution, habitat, IUCN conservation status assessment and selected materials examined. The following taxa are reported here as new for Iran: *S. atherocalyx*, *S. kotschyi*, *S. melampyroides* and *S. recta* subsp. *subcrenata*. Several taxa are placed in synonymy for the first time here: *S. persica* is a synonym of *S. alpina*, *S. koelzii* is a synonym of *S. aucheri*, *S. ballotiformis* is a synonym of *S. kurdica* subsp. *kurdica*, and *S. setifera* subsp. *daenensis* and *S. setifera* subsp. *iranica* are synonyms of *S. setifera*. Two taxa are reduced to the rank of subspecies: *S. kurdica* subsp. *asterocalyx* and *S. pilifera* subsp. *ixodes*. According to the present revision, the genus contains 32 species, nine subspecies and two hybrids in Iran with 17 endemic taxa. © 2012 The Linnean Society of London, *Botanical Journal of the Linnean Society*, 2012, 170, 573–617.

ADDITIONAL KEYWORDS: conservation status – determination key – geographical distribution – systematic revision – taxonomic description.

INTRODUCTION

Stachys L., with about 300 species worldwide (Harley *et al.*, 2004), is the largest genus of subfamily Lamioideae and among the largest genera of Lamiaceae. The genus consists of annual and perennial creeping to ascending herbs or cushion-like subshrubs. The highest number of taxa known in the genus is reported mainly from the Mediterranean and Irano-Turanian regions (Bhattacharjee, 1980). There are about 115 *Stachys* spp. in south-west (SW) Asia (Hedge, 1986) representing no fewer than 20 of the 23

currently recognized sections (excluding *Betonica* L.). Of these areas, Turkey and Iran alone harbour about 60 and 34 species, respectively. Both countries thus constitute major centres of diversity on a global scale (Table 1). Species of the genus are primarily elements of mountainous steppes [e.g. *S. annua* (L.) L.], but some species prefer humid habitats such as forests (e.g. *S. sylvatica* L.) or river banks (e.g. *S. setifera* C.A.Mey.). Some are edaphically and microclimatically specialized chasmophytes (found in rock crevices), and as a consequence are often narrowly distributed endemics (e.g. *S. kermanshahensis* Rech.f.).

Due to their high content of secondary compounds, several species are widely used in traditional

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Table 1. Species number of *Stachys* in selected geographical areas

	Total no. of species	No. of endemic species	Reference(s)
North America	28–32	22–25	Turner (1994)
Central America and Mexico	38	38	Turner (1994)
South America	12	7	Pool (2007)
Australia	0	0	–
North Africa	20	7	Harvey & Demissew (1994)
South Africa	41	40	Codd (1985)
Europe	81 (including <i>Betonica</i>)	26	Ball (1972)
Former Soviet Union (USSR)	50	11–12	Czerepanov (2007), Knorring (1954)
Turkey	72 (including <i>Betonica</i>)	25	Bhattacharjee (1982)
Middle East (<i>Flora Palestina</i> and <i>Flora of Iraq</i>)	11	3	Feinbrun-Dothan (1978)
<i>Flora Iranica</i>	47	25	Rechinger (1982)
China	18	13	Li & Hedge (1994)

medicine, e.g. as tea (e.g. *S. lavandulifolia* Vahl and *S. pilifera* Benth.). In Iran, some species are endangered due to human land disturbance (e.g. *S. persepolitana* Boiss.), whereas some are becoming more widespread because of resistance to grazing (e.g. *S. acerosa* Boiss.).

The taxonomy of the genus has been subject to only a few comprehensive treatments, which are, however, complemented by a growing number of more regionally focused studies. When first described (Linnaeus, 1753) the genus included only eight species, most of them occurring in Europe. For the next 80 years advances in the taxonomy of *Stachys* were gradual and not extensive. Dumortier (1827) was the first to recognize infrageneric groups (three unranked groups) in *Stachys*. Reichenbach (1830), Bentham (1834), Boissier (1879) and Briquet (1896) made important contributions to the subgeneric classification of *Stachys* (Table 2) based mainly on growth habit (annual versus perennial), number of flowers in verticillasters, calyx shape, corolla colour, size of bracteoles and stem type (herbaceous versus woody). As an important taxonomic treatment on the genus which is still in use, Bentham (1834) considered *Betonica* as a subgenus under *Stachys* and divided the genus into nine sections. The most inclusive revision of *Stachys* was undertaken by Bhattacharjee (1980), who presented a taxonomic revision of the genus in the Old World and assigned types to the formerly described sections of the genus. Some new sections have also been introduced elsewhere (Koeva-Todorovska, 1978; Krestovskaya, 2003, 2006, 2007). Moreover, several taxonomic and morphological studies have been conducted on the genus focusing on certain geographical regions (Table 1), such as North America (Nelson, 1981), Mexico and Central America (Turner, 1994) and southern Africa (Mulli-

gan, Munro & McNeill, 1983; Codd, 1985; Basset & Munro, 1986; Mulligan & Munro, 1989), tropical East Africa (Demissew & Harley, 1992), Europe (Ball, 1972), Turkey (Bhattacharjee, 1982) and the Iranian Highlands (Rechinger, 1982).

Recent molecular phylogenetic studies (Scheen *et al.*, 2010; Bendiksby *et al.*, 2011) proposed *Stachys* as a member of tribe Stachydeae, and some other genera including *Sideritis* L., *Prasium* L., *Phlomidosema* Vved. were nested in *Stachys sensu lato* (*s.l.*) (Scheen *et al.*, 2010). Contrary to some previous taxonomic revisions of the genus, these studies have shown that *Betonica* is not closely related to *Stachys*. However, only limited Old World *Stachys* spp. have been included in the molecular phylogenetic studies so far. Even based on this reduced sampling, monophyly of several sections (*sensu* Bhattacharjee, 1980, 1982; Rechinger, 1982) was questioned and the need to identify possible synapomorphies for more naturally circumscribed units/sections was emphasized. Micromorphological studies (Krestovskaya & Vasiljeva, 1997, 1998; Salmaki *et al.*, 2008a, 2009a; Salmaki, Zarre & Jamzad, 2008b) gave further hints to the current circumscription of most sections not being natural. Therefore, a reliable subgeneric classification awaits further morphological and phylogenetic investigations covering the whole range of morphological variation and employing additional suitable molecular markers. For this reason we do not apply any subgeneric classification for the species treated here. Our preliminary results including a reasonable number of taxa and several plastid and nuclear ribosomal DNA markers show that both delimitation of genera in Stachydeae and the subgeneric classification of *Stachys* need substantial changes (Y. Salmaki *et al.*, unpubl. data). The arrangement of species in the present taxonomic

Table 2. Summarized taxonomic history of *Stachys*

	Dumortier (1827)	Reichenbach (1830)	Bentham (1834)	Boissier (1879)	Knorring (1954)	Bhattacharjee (1980)
No. of recognized species	18	102	84	50	154	
No. of recognized subgenera	-	-	-	-	-	2 (<i>Stachys</i> and <i>Betonica</i>)
No. of recognized sections	3 sections	3 informal groups	9 sections including 2 sections of <i>Betonica</i>	3 sections	3 sections	21 sections (including 2 sections in subgenus <i>Betonica</i>)
Geographical area of the taxonomic revision	Worldwide	Worldwide	Worldwide	Area of <i>Flora Orientalis</i>	USSR	Old World
Significant morphological features*	No. of flowers in each verticillaster and length of the bracteoles	Annual or perennial habit, calyx shape and corolla colour	Annual or perennial habit, many- or few-flowered verticillasters, bracteoles in each verticillaster	Annual or perennial habit, many- or few-flowered verticillasters, conspicuous or inconspicuous bracteoles, herbaceous versus suffruticose habit and presence or absence of basal rosettes	Annual or perennial habit, calyx shape and corolla colour	Presence or absence of pedicel, many- or few-flowered verticillasters, herbaceous versus suffruticose habit and presence or absence of basal rosettes

*Characters used in delimitation of subgeneric taxa.

treatment is alphabetical as the results of our unpublished phylogenetic study do not confirm the current sectional concept in *Stachys*, which is purely based on overall morphological similarity and hence subject to extreme convergence.

As in general, for Iran there is no consensus yet on the circumscription of *Stachys* (in a wide or narrow sense), the subgeneric classification system to be used or the number of species, subspecies and hybrids to be recognized. Furthermore, the distribution of each *Stachys* sp. in Iran has not fully been investigated. According to Rechinger (1982) there are 34 species and four hybrids of *Stachys* in Iran covering 12 sections, reflecting major morphological lineages. There are, however, several taxonomic problems that could not be referred to in the mentioned treatment. Furthermore, the treatment of Lamiaceae for the 'Farsi Flora of Iran' (M. Assadi *et al.*, unpubl. data) is far from completion. The aim of the present synopsis is to provide a reliable updated key for species identification in Iran and an updated description of the species and to present information on typification, accepted names, synonyms, delimitation of taxonomically difficult species and distribution of the species. This study is a first contribution to an international collaborative effort towards a comprehensive morphological and phylogenetic investigation of *Stachys* on a global scale.

MATERIALS AND METHODS

The revision presented here is based on fieldwork and examination of > 3500 herbarium specimens, including types (for 36 names) from various European and Iranian herbaria, i.e. B, E, G, G-BOIS, G-DC, K, FUMH, HUB, LE, M, MSB, TARI, TUH, W and WU. Although our main focus has been on Iranian species, this study considers materials from neighbouring and other countries for species with wider distribution ranges. About 400 of the specimens represent our own collections deposited in TUH, with duplicates in MSB and TARI. All measurements were taken directly from herbarium material. Information that could not be clearly observed on dried material (e.g. flower colour or the shape of cross-sections of the basal leaf) was recorded in the field. We carefully examined and measured samples to obtain data on many morphological character traits and tried to include the range of morphological variation. Leaf anatomy is also described for all species in the area. For this purpose the fresh cauline leaves of the second or third nodes of the stem were fixed in the field with FAA (formalin-acetic acid-alcohol), or removed from herbarium material. Handmade cross-sections were prepared from the median part of the petiole and the median part of the lamina. Staining and microscopic methods

follow Salmaki *et al.* (2011). For detailed description of indumentum, hairs on different organs were studied using scanning electron microscopy as described by Salmaki *et al.* (2009a).

TAXONOMIC TREATMENT

STACHYS L., SP. PL. 580 (1753).

Type: S. sylvatica L. (designated by Press, J.R. in Jarvis 1992: 570), *typ. cons. prop.*

Zietenia Gled., Syst. Pl. Stamin. Situ: 185 (1764). *Type: Zietenia orientalis* Gled., Mém. Acad. Roy. Sci. Hist. (Berlin): pp. 3 (1766).

Trixago Haller, Hist. Stirp. Indigenar. Inch. 101 (1768). *Type: Trixago arvensis* (L.) Hoffmanns. & Link, Fl. Portug. 1: 102 (1809).

Tetrahitum Hoffmanns. & Link, Fl. Portug. 1: 103 (1809). *Type: Tetrahitum hirtum* Hoffmanns. & Link, Fl. Portug. 1: 104 (1809).

Eriostomum Hoffmanns. & Link, Fl. Portug. 1: 105 (1809). *Type: E. alpinum* (L.) Hoffmanns. & Link ex Steud., Nomencl. Bot. 1: 806 (1821), nom. inval.

Trixella Fourr. In: Ann. Soc. Linn. Lyon N. S. 17: 135 (1869). *Type: Trixella arvensis* (L.) Fourr., Ann. Soc. Linn. Lyon N.S., 17: 135 (1869).

English vernacular names: heal-all, self-heal, woundwort, lamb's ears, hedgenettle.

German vernacular names: Wollziest, Ziest.

Persian vernacular names: Shatra, Sourolesrafil, Sonbolehei, Zaban-Barreh.

PLANTS herbaceous, annual, biennial or mostly perennial, sometimes suffruticose or rarely dwarf shrubs, with simple and/or branched glandular or non-glandular hairs, often strongly aromatic. LEAVES simple, rounded, broadly ovate-cordate to lanceolate, petiolate or rarely sessile, usually toothed. INFLORESCENCE thyrsoid or sometimes racemoid, flowers pedicellate, rarely sessile, verticillasters two- to 20-flowered, condensed or remote, with or without bracts and bracteoles. CALYX zygomorphic, five-lobed, lobes equal to unequal (3:2), tubular to campanulate, five- to ten-veined, throat of tube often barbate. COROLLA strongly two-lipped; upper lip erect to subpatent, concave, entire to emarginate, hooded or sometimes almost flat, pubescent outside; lower lip flat, with median lobe usually much longer than lateral lobes; corolla tube slightly or obviously longer than calyx tube or rarely shorter than it. STAMENS four, ascending, longer than corolla tube, posterior pair usually shorter than anterior ones which bend perpendicularly below the anthers. STIGMA lobes subequal or slightly unequal. NUTLETS brown to almost black, broadly elliptic,

oblong, obovoid or subglobose, rounded at the apex, often angular to winged near the base, $2.5\text{--}4.3 \times 1.2\text{--}2.8$ mm.

Distribution: Subcosmopolitan (excluding Australia, New Zealand). Main centre in the Mediterranean region and SW Asia.

CHARACTER EXPLANATION
(FIGS 1A-G, 2A-G, 3A-F, 4A-E, 5A-O)

Habit

Among the taxa studied, three species are annual, whereas the majority of species are herbaceous perennial. In contrast to herbaceous species with elongated stem internodes (Fig. 1C), the four spiny species (e.g. *S. acerosa* and its allies) exhibit a subshrubby or cushion-forming habit with reduced internodes (Fig. 1A). Consequently, they produce few-flowered axillary clusters in contrast to the dense, many-flowered verticillasters found in perennial herbaceous species (Figs 1E, 3C, 4A). Some perennial species are chasmophilous (Fig. 1F, G). These species are distributed in the Zagros Mountain range in western Iran (e.g. *S. benthamiana* Boiss.).

Leaves

In some species, basal leaves are present (e.g. *S. byzantina* K.Koch and *S. sylvatica*), but most species of *Stachys* do not have a basal leaf. Irrespective of the considerable variation in size, shape of the leaves is rather constant. They are always simple and primarily ovate to less frequently lanceolate (e.g. *S. palustris* L.) or cordate (e.g. *S. sylvatica*, *S. alpina*), with entire (e.g. *S. trinervis* Aitch. & Hemsl., Fig. 4D), crenate (*S. obtusifolia* Boiss.) or toothed (e.g. *S. cretica* L.) margins.

Inflorescences

The terminal verticillate inflorescence found in the majority of herbaceous *Stachys* is formed of axillary clusters with reduced peduncles and pedicels (Fig. 1C). It can be congested in a tapering (Fig. 1D) or remote (Figs 2F, 3B) inflorescence. The reduction in number of flowers (Figs 2D, 3D, 4B) has occurred independently in many cases (e.g. in *S. fruticulosa* M.Bieb.).

Bracteoles

Some species of *Stachys* (e.g. *S. pilifera*) are characterized by having distinct bracteoles approximately two-thirds as long as the calyx and spiny at the apex. However, a few species possess inconspicuous bracteoles (e.g. *S. sylvatica*). The bracteoles are oblong,

elliptic (Fig. 3D), lanceolate and linear (Fig. 2D) to setaceous (Fig. 1B) in shape.

Calyx

An actinomorphic calyx is characteristic for most species, but some have a weakly zygomorphic calyx with slightly unequal (three forming the upper lip, two forming the lower lip) teeth (e.g. *S. byzantina* and its allies). In a single exception, the calyx could also be gibbose (*S. annua*; Fig. 3E) or in another rare case inflated ellipsoid (*S. inflata*). The teeth vary from triangular (Fig. 2C) to lanceolate to narrowly triangular (Fig. 4E). Calyx teeth are herbaceous at the apex in most *Stachys* spp. but may be spiny in a few species (e.g. *S. aucheri*). Moreover, several *Stachys* spp. are characterized by recurved calyx teeth (Figs 1E, 2G), in contrast to the erect state observed in other species.

Corolla

The colour ranges from white or creamy to pale or golden yellow and from mauve to purple. The corolla is two-lipped (one lobe forming the upper lip, three lobes forming the lower lip) with the posterior lip straight and emarginated and the anterior lip spreading. The tube of the corolla is longer than the calyx in a few species, e.g. *S. kermanshahensis* (Fig. 2E), but is nearly of the same length as the calyx in most cases.

Stamens

The four stamens are shorter or longer than the corolla tube, with straight or connivent filaments, and subparallel or divaricate thecae.

Style

The style is bifid with subequal branches (with the lower branch often slightly longer).

Pollen

The basic shape of the pollen grains in most taxa studied is prolate-spheroidal (Fig. 5A), but subprolate, spheroidal and oblate-spheroidal pollen grains can also be found in a few species. The grains are usually tricolpate (the amb triangular; Fig. 5A), but also tetracolpate (the amb circular to more or less square, e.g. in *S. iberica* M.Bieb. and *S. atherocalyx*; Fig. 5C). The surface is microreticulate (most frequent type; Fig. 5B), reticulate, perforate, foveolate-psilate or foveolate (Salmaki *et al.*, 2008a).

Nutlets

The basic shape of nutlets in most taxa studied is obovoid, but can be globose, broadly obovoid, oboval, obtriangular and oblong (in outline) in a few species. Regarding the sculpturing pattern of the nutlet

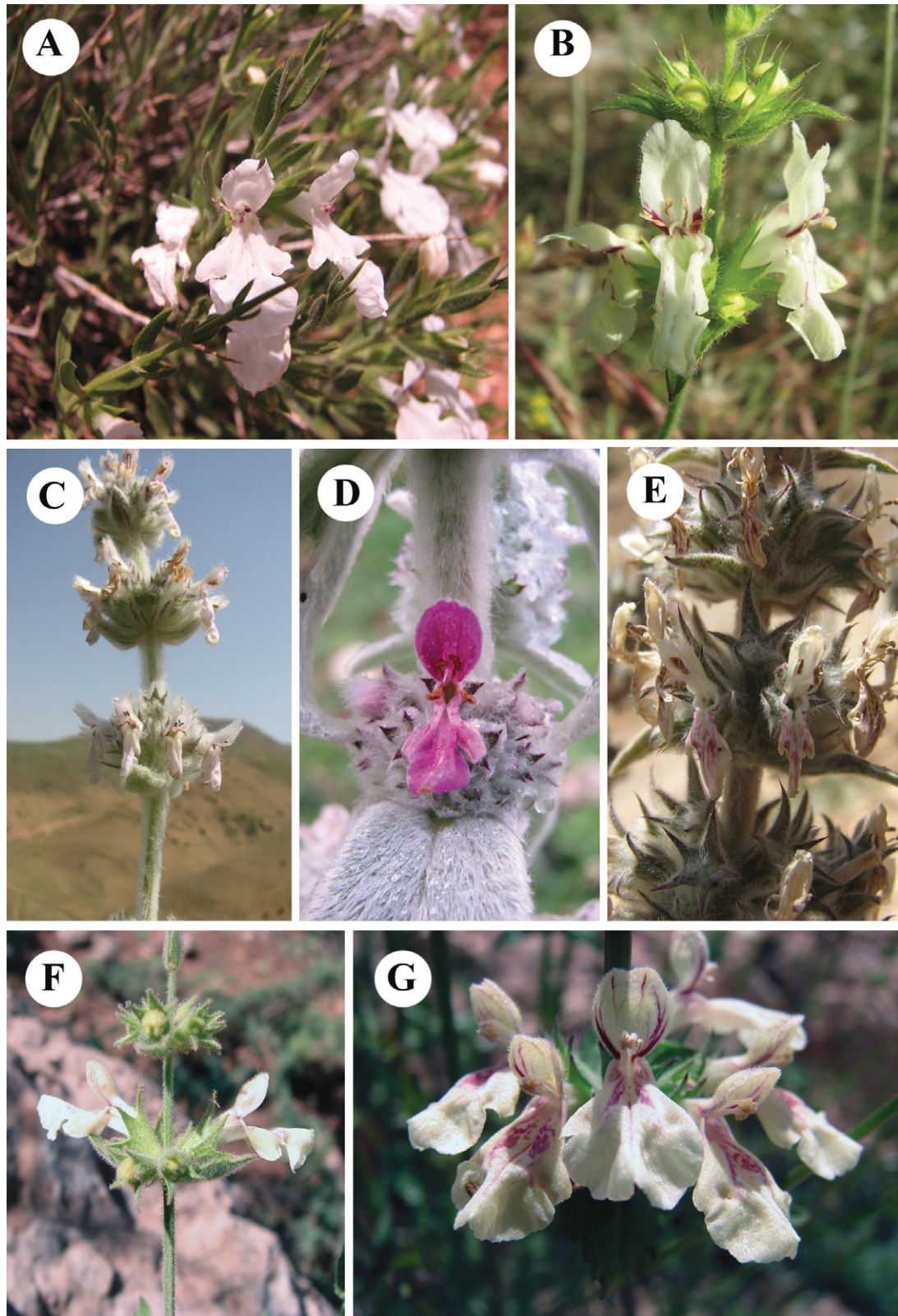


Figure 1. A, *S. acerosa* (Zarre & Salmaki 35881); B, *S. atherocalyx* (Zarre & Salmaki 39801); C, *S. balansae* (Zarre & Salmaki 36532); D, = *S. byzantina* (Zarre & Salmaki 35912); E, *S. cretica* subsp. *garana* (Zarre & Salmaki 36507); F, *S. kurdica* subsp. *asterocalyx* (Zarre & Salmaki 35909); G, *S. benthamiana* (Zarre & Salmaki 35897).

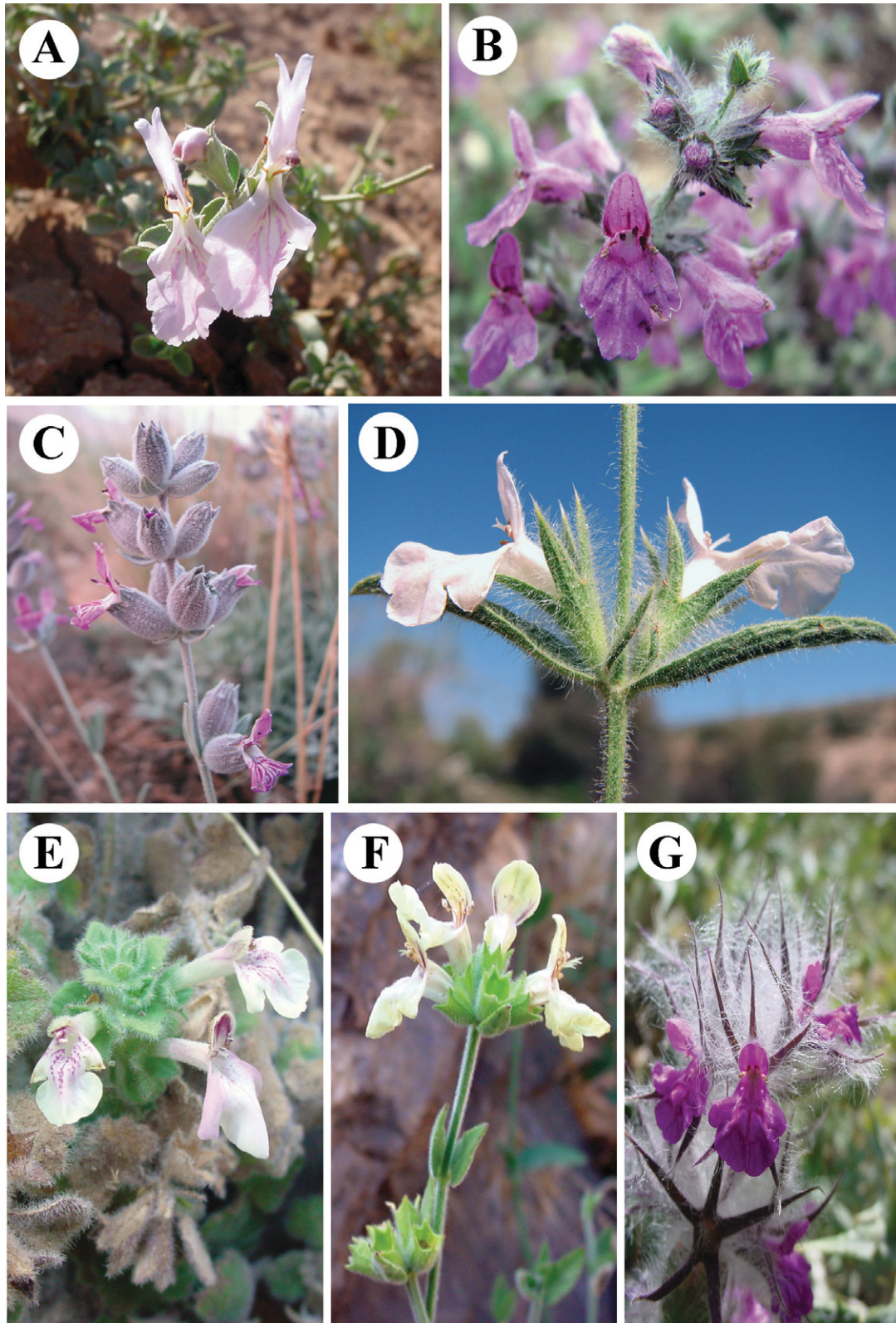


Figure 2. A, *S. fruticulosa* (Zarre & Salmaki 36529); B, *S. iberica* subsp. *georgica* (Salmaki et al., s.n.); C, *S. inflata* subsp. *inflata* (Salmaki & Zarre 36505); D, *S. pilifera* susp. *ixodes* (Zarre & Salmaki 35907); E, *S. kermanshahensis* (Zarre & Salmaki 36504); F, *S. kurdica* subsp. *kurdica* (Zarre & Salmaki 36517); G, *S. lavandulifolia* (Salmaki & Zarre 35898).

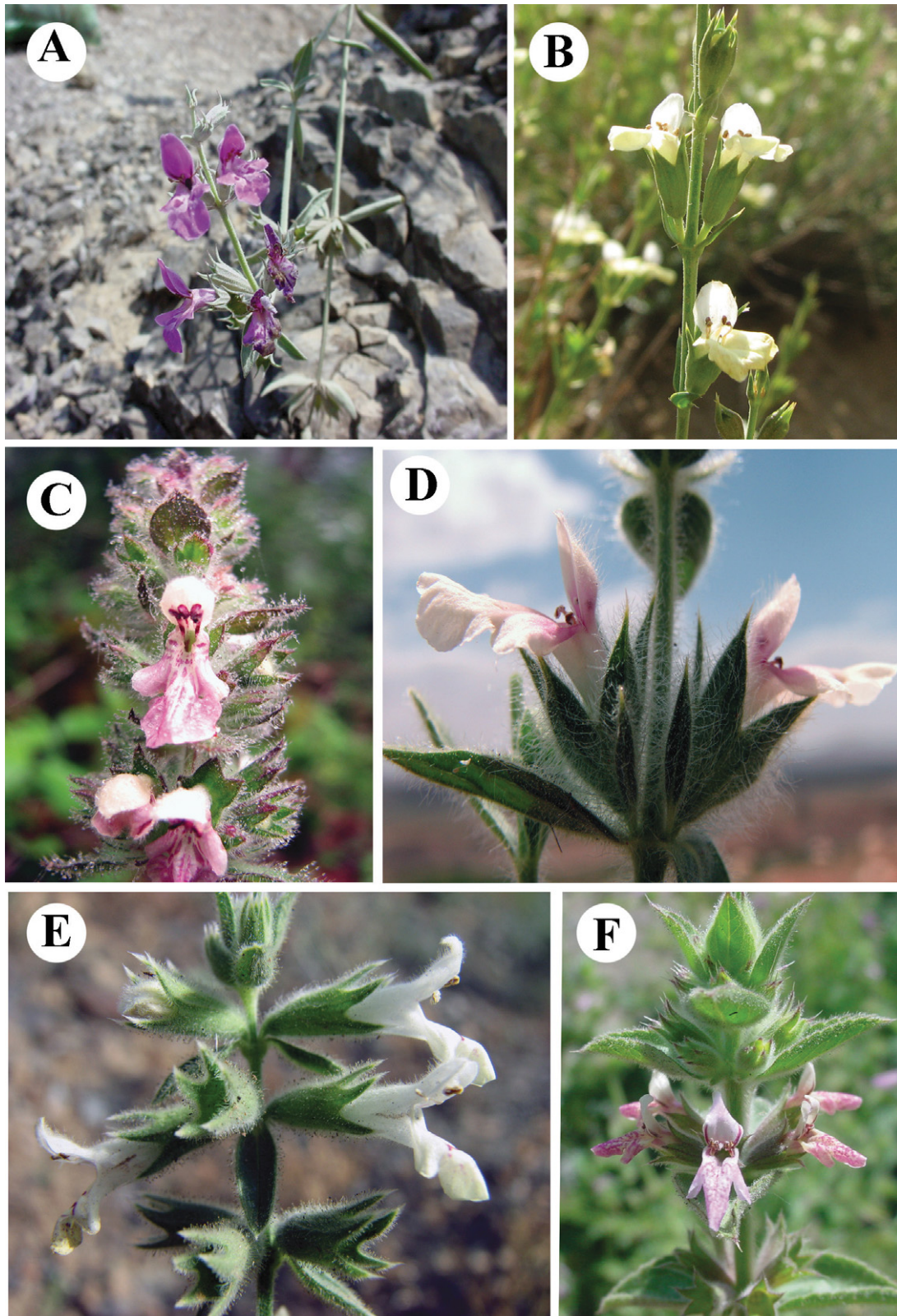


Figure 3. A, *S. laxa* (Salmaki et al. 36872); B, *S. multicaulis* (Zarre & Salmaki 35891); C, *S. alpina* (Zarre & Salmaki 35913); D, *S. pilifera* subsp. *pilifera* (Zarre & Salmaki 35893); E, *S. annua* (Salmaki et al. 36518); F, *S. setifera* (Zarre & Salmaki 36510).

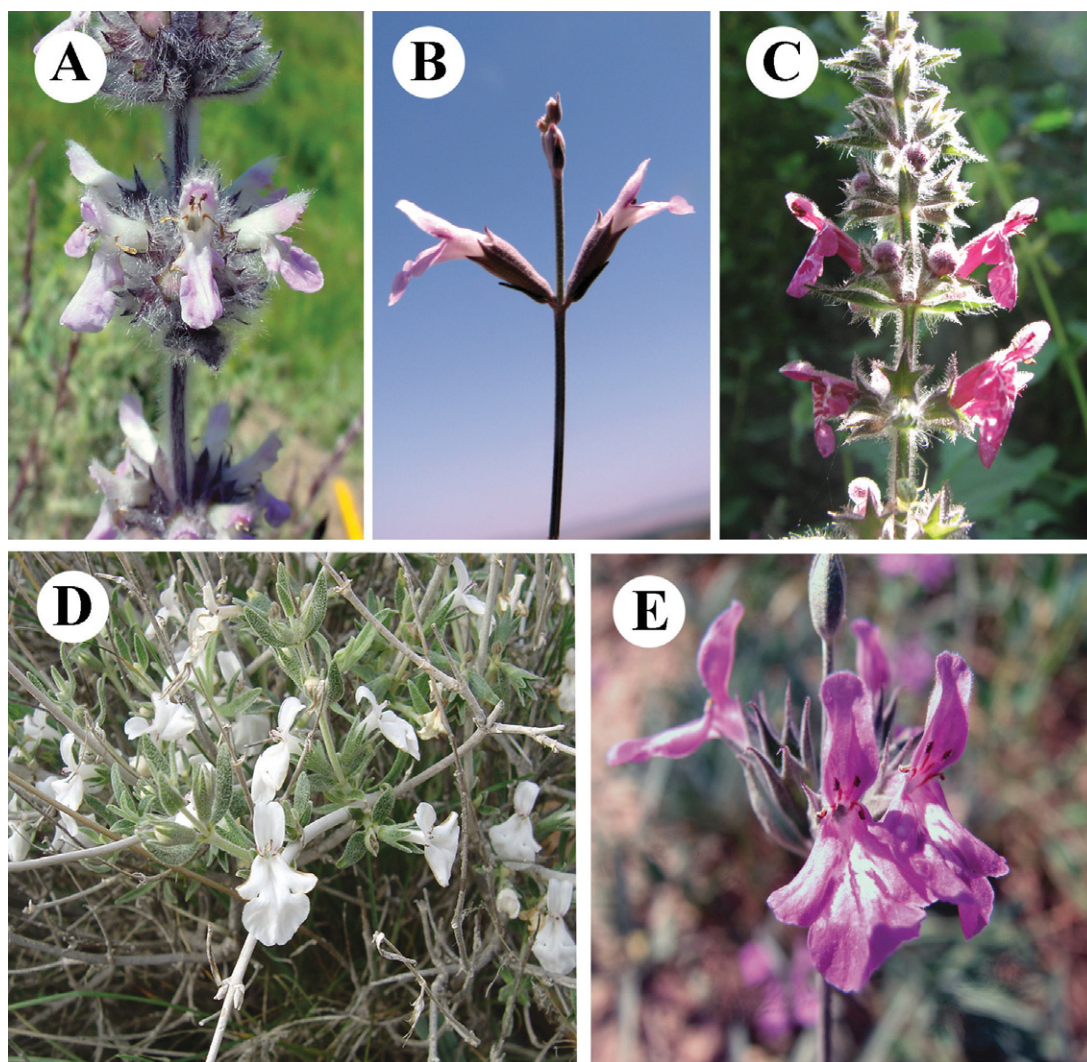


Figure 4. A, *S. spectabilis* (Zarre & Salmaki 36531); B, *S. subaphylla* (Zarre & Salmaki 36868); C, *S. sylvatica* (Salmaki *et al.*, s.n.); D, *S. trinervis* (Zarre *et al.* 38225); E, *S. turcomanica* (Zarre *et al.* 38080).

surface, seven basic types can be distinguished: minutely reticulate (Fig. 5D), verrucate (Fig. 5E), colliculate (Fig. 5F), scalariform, ruminant, foveate and rugose. The minutely reticulate type is the most common among the studied species, but variations in alignment, size and shape of its component cells provide further evidence that are useful as diagnostic characteristics (Salmaki, Zarre & Jamzad, 2008b).

Hairs

The important characters in terms of indumentum are presence of glandular (Fig. 5G) and non-glandular hairs (Fig. 5I), thickness of hair cell walls, number of cells (unicellular or multicellular), presence of dendroid and multinodal hairs (Fig. 5O) or uninodal hairs stellate at base (Fig. 5L), presence of vermiform hairs (Fig. 5K), orientation of hairs and presence of papillae

on hair surface (Fig. 5J). The glandular hairs can be subdivided into subtypes: stalked (Fig. 5H,M), subsessile (Fig. 5G, K) or sessile (Fig. 5N). The stalks of the glandular hairs can be uni- or multicellular. Simple unbranched and branched hairs constitute two subtypes of non-glandular hairs (Salmaki *et al.*, 2009a).

Phenology

Flowering and fruiting between May and July; peak flowering in June.

ENUMERATION OF TAXA

1. *Stachys acerosa* (Fig. 1A)

Stachys acerosa Boiss., *Diagn. Pl. Orient.* 7: 57 (1846). *Type:* IRAN, ad latera in orientem-spectantia m. Sabst-Busch (Sabz Poushan) prope Schiras

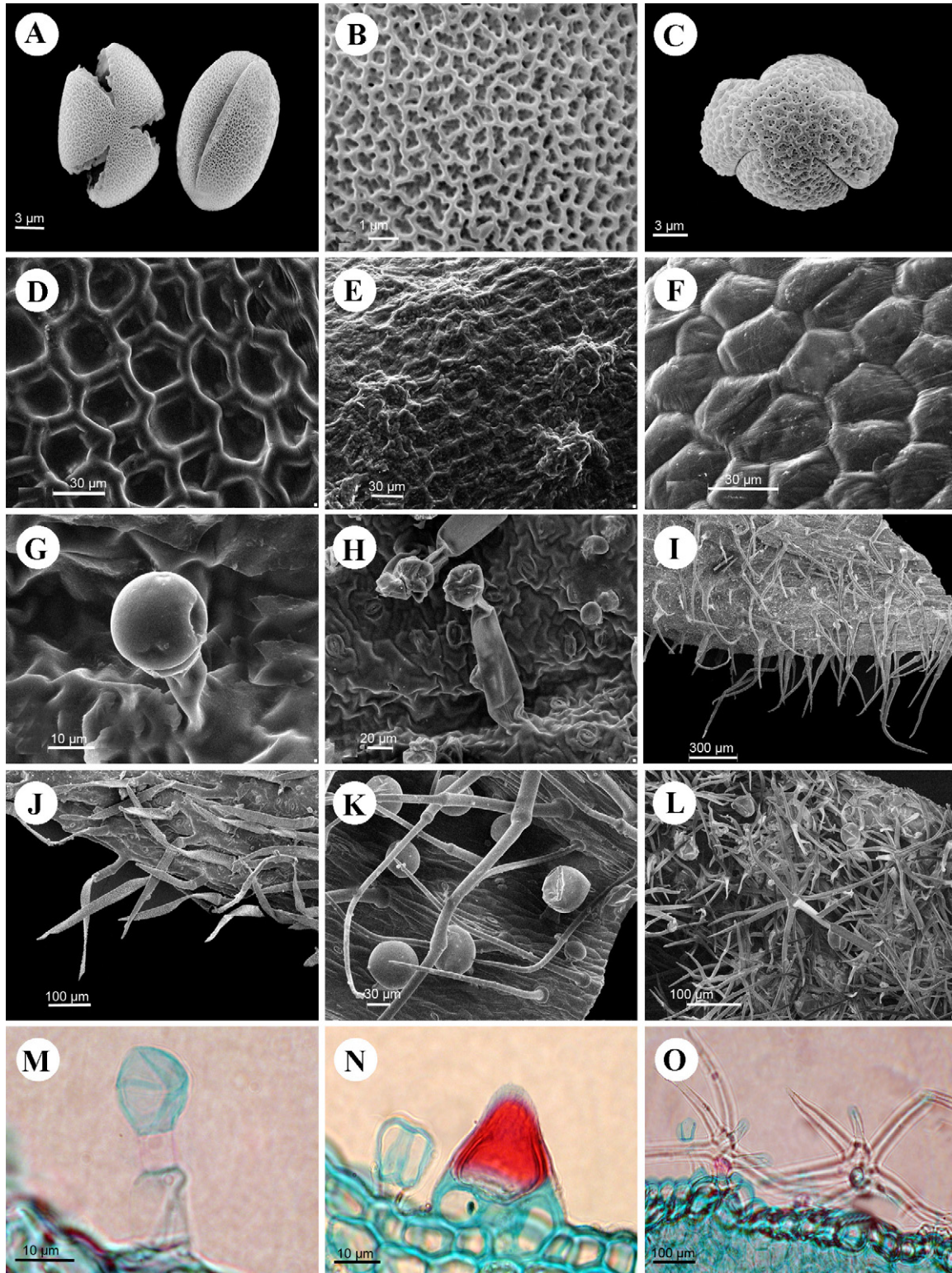


Figure 5. A–C, SEM micrographs of pollen grains in *Stachys* spp.: A, *S. kurdica* subsp. *kurdica*; B, *S. kermanshahensis*; C, *S. atherocalyx*. D–F, SEM micrographs of nutlets in *Stachys* spp.: D, *S. kurdica* subsp. *kurdica*; E, *S. persepolitana*; F, *S. fruticulosa*. G–O, SEM micrographs and LM images of trichomes in *Stachys* spp.: G, *S. pilifera* subsp. *pilifera*; H, *S. alpina*; I, *S. spectabilis*; J, *S. fruticulosa*; K, *S. spectabilis*; L, *S. lavandulifolia*; M, *S. byzantina*; N, *S. cretica* subsp. *cretica*; O, *S. inflata* subsp. *inflata*.

DIAGNOSTIC KEY TO THE SPECIES OF *STACHYS* IN IRAN

1. Plants cushion-forming or prostrate in habit, woody at base; flowering stems spinescent and/or with rigid branches; calyx teeth spinescent; verticillasters remote, composed of two to four flowers.....2
- 1'. Plants erect or creeping (*S. setifera*), mostly herbaceous, never cushion-forming, rarely woody at base; flowering stems usually ending with inflorescence, stem not transformed to a thorn at apex; calyx teeth unarmed; verticillasters often with more than six flowers.....5
2. Plants prostrate at base, ± herbaceous at least in upper part, densely covered by long simple hairs up to 2–3 mm; bracteoles distinct, 5–11 mm long.....3
- 2'. Plants with ascending basal branches, robust and woody, sparsely covered by short simple hairs shorter than 1 mm; bracteoles absent or indistinct.....4
3. Flowering stems transformed to thorns at apex; glandular hairs of the stem sessile to subsessile; calyx 8–12 mm, calyx teeth 3–6 mm long.....5. *S. aucheri*
- 3'. Flowering stem unarmed at apex; glandular hairs of the stem stalked; calyx 10–16 mm, calyx teeth 4–8 mm long.....24. *S. pilifera*
4. Flowering stem transformed to a thorn at apex; calyx teeth 3–6 mm long; corolla white, 18–20 mm long, corolla tube 8–12 mm long.....1. *S. acerosa*
- 4'. Flowering stems unarmed at apex; calyx teeth 2–4 mm long; corolla creamy to yellow, 12–18 mm long, corolla tube 6–9 mm long.....20. *S. multicaulis*
5. Plants saxicolous (usually dwelling in rock crevices, chasmophilous); flowering stems fragile at base; cauline leaves 1.0–2.5(–3.0) × 0.5–2.0 cm.....6
- 5'. Plants non-saxicolous; stems non-fragile at base; cauline leaves > 3.0 × 2.0 cm.....10
6. Flowers white to pink; corolla tube clearly longer than the calyx tube; bracteoles shorter than two-thirds of the calyx tube.....7
- 6'. Flowers golden yellow; corolla tube as long as the calyx tube; bracteoles shorter than half of the calyx tube.....9
7. Plants green; leaves ovate, sparsely covered by short simple hairs; verticillasters usually congested towards apex.....32. *S. veroniciformis*
- 7'. Plants silvery; leaves broadly ovate to rounded, densely covered by simple long hairs up to 2.5 cm; verticillasters remote.....8
8. Bracteoles as long as the calyx, ± 10 mm.....16. *S. lanigera*
- 8'. Bracteoles shorter than the calyx, 4–5 mm long.....13. *S. kermanshahensis*
9. Plants densely covered by glandular hairs with long stalk.....7. *S. benthamiana*
- 9'. Plants covered by short or long simple hairs, glandular hairs absent.....15. *S. kurdica*
10. Floral leaves spinescent; calyx teeth mucronate at apex.....26. *S. setifera*
- 10'. Floral leaves not spiny; calyx teeth non-mucronate.....11
11. Vermiform or extremely long simple hairs up to 4–5 mm present; upper corolla lip densely covered by long simple hairs on outer surface usually exerted from the lip.....12
- 11'. Hairs up to 2 mm, non-vermiform, if 4–5 mm long (*S. lavandulifolia*) then stellate at base; upper corolla lip glabrous to sparsely hairy, hairs non-exserted from the lip.....16
12. Plants silvery; densely covered with long hairs up to 5 mm; basal leaves oblong to elliptic, cuneate-attenuate at base.....8. *S. byzantina*
- 12'. Plants green to greyish; basal leaves ovate, oblong or lanceolate, cordate at base.....13
13. Calyx 6–7 mm.....27. *S. spectabilis*
- 13'. Calyx ≥ 10 mm.....14
14. Plants green, sparsely hairy in inflorescence; basal leaves ovate to ovate-rounded, 10–18 × 7–12 cm, distinctly cordate at base; calyx teeth 2–3 mm.....2. *S. alpina*
- 14'. Plants greyish, densely hairy all over; basal leaves oblong-lanceolate to oblanceolate, 4–10(–15) × 1–3 cm; calyx teeth > 3 mm.....15
15. Verticillasters remote; calyx 12–16 mm; teeth recurved, mucronate.....9. *S. cretica*
- 15'. Verticillasters congested; calyx 10–12 mm; teeth usually erect, non-mucronate.....6. *S. balansae*
16. Indumentum of dendroid multinodal hairs with ± equal arms; anther thecae subparallel.....17
- 16'. Indumentum of simple hairs, when stellate hairs present, then with a central long arm 2–5 mm, multinodal hairs present or absent; anther locules divaricate.....23
17. Stems almost leafless, the few present leaves 1.0–1.5 × 0.2–0.3 cm; calyx up to 7 mm long; teeth c. 1 mm; verticillasters remote, with two flowers.....28. *S. subaphylla*
- 17'. Stems with distinct leaves (> 1.5 cm); calyx > 7 mm; verticillasters usually congested above, with four to six (to eight) flowers.....18

18. Plants dwarf subshrubs but not cushion-forming; flowering stems robust and white; two minute appendages present at leaf axils; sparsely covered by short stellate hairs.....30. *S. trinervis*
- 18'. Plants herbaceous, covered by branched and multinodal hairs with long axis; appendages at leaf axils absent.19
19. Calyx teeth triangular to oblong-lanceolate, 2.0–3.5 × 1.5–2.0 mm, obtuse at apex.....20
- 19'. Calyx teeth lanceolate-subulate, 2.5–5.0 × 1.0–1.5 mm, acute and spinescent at apex.....21
20. Basal leaves sessile, rounded, 2–4 × 2–3 cm, crenate at margin.....21. *S. obtusicrena*
- 20'. Basal leaves petiolate, ovate to elliptic, 2.0–4.5 × 1.0–1.5 cm, entire at margin.....12. *S. inflata*
21. Leaves ovate-orbicular, densely conduplicate; corolla tube shorter than the calyx tube; bracteoles numerous.14. *S. kotschyi*
- 21'. Leaves lanceolate, flattened; corolla tube longer than the calyx tube; bracteoles few.....22
22. Leaves discoloured, upper surface green, lower surface silvery; calyx teeth 3–5(–6) mm.....18. *S. laxa*
- 22'. Leaves concolourous, upper and lower surface silvery; calyx teeth 2–3 mm.....31. *S. turcomanica*
23. Shoots both sterile and fertile, the sterile ones with basal rosette leaves; hairs stellate at base.....24
- 23'. Shoots all fertile, i.e. terminating with inflorescences; long stellate hairs absent.....26
24. Calyx 2.5–3.0 cm long; central arm of stellate hairs 4–5 mm long.....17. *S. lavandulifolia*
- 24'. Calyx up to 2 cm; central arm of stellate hairs up to 3 mm.....25
25. Floral leaves ovate; calyx teeth triangular, half as long as the tube.....34. *S. × tomentosa*
- 25'. Floral leaves oblong to lanceolate; calyx teeth subulate to filiform, two-thirds as long as the tube.33. *S. × sintenisii*
26. Plants dwarf subshrubs, flowering stems woody and robust, sparsely covered by appressed short papillose simple hairs; verticillasters remote, often with two flowers; bracteoles inconspicuous, setaceous, as long as the pedicels.....10. *S. fruticulosa*
- 26'. Plants herbaceous, covered by short and long simple hairs and glandular hairs never appressed or papillose; verticillasters usually congested above, with four-six (–eight) flowers; usually with distinct bracteoles.....27
27. Plants annual with basal leaves not arranged in rosette, oblanceolate; calyx urceolate in fruit, densely hairy at mouth.....19. *S. melampyroides*
- 27'. Plants mostly perennial with basal rosettes of leaves, sometimes annual (*S. annua* and *S. persepolitana*) then the basal rosette leaves absent, ovate-lanceolate to ovate-elliptic; calyx non-urceolate in fruit, sparsely hairy at mouth.....28
28. Leaves ovate to broadly ovate, cordate at base.....29
- 28'. Leaves oblong, elliptic to lanceolate, cuneate or rarely cordate (in few samples of *S. annua*) at base.....30
29. Lower cauline leaves large, 4–12(–15) × 4–10 cm; petiole 4–10 cm; stem densely covered with short hairs *c.* 0.2 mm.....29. *S. sylvatica*
- 29'. Lower cauline leaves small, 1.0–4.5 × 1.0–2.5 cm; petiole 2.5–4.5 cm; stem sparsely covered with short hairs 0.05 mm.....23. *S. persepolitana*
30. Leaves petiolate; stem covered with short hairs *c.* 1 mm.....31
- 30'. Leaves subsessile to sessile; stem covered with hairs > 1 mm.....32
31. Leaves crenate at margin; calyx gibbose; corolla creamy yellow.....3. *S. annua*
- 31'. Leaves dentate at margin; calyx symmetrical; corolla pink.....22. *S. palustris*
32. Stamens slightly longer than corolla tube; corolla pink to purple changing to blue or violet when dried.....11. *S. iberica*
- 32'. Stamens obviously longer than upper corolla lip; corolla yellow.....33
33. Calyx teeth lanceolate-subulate, at least as long as the tube, narrower than 1 mm; verticillasters congested-spicate towards apex, few remote below.....4. *S. atherocalyx*
- 33'. Calyx teeth triangular-lanceolate, ± half of the tube, wider than 1 mm; verticillasters remote throughout, few approximate above.....25. *S. recta*

(Shiraz), 1848, *Kotschy 418* (holotype: G-BOIS!; isotypes: C: photograph!, G!, LE!, M!, W!).

PLANTS perennial, cushion-forming, woody at base. STEMS thorny, from a thick base becoming thin further up, 15–25 cm, profusely branched near base, usually erect, internodes 1.0–2.5 cm long, sparsely covered with appressed short simple hairs up to 1 mm and short subsessile to sessile glandular hairs 0.2–0.5 mm. BASAL LEAVES absent. CAULINE LEAVES oblong to elliptic, 2.5–3.0 × 0.4–0.6 mm, margin entire, apex spinescent, attenuate at base,

subsessile to sessile, hairy as the stem. FLORAL LEAVES lanceolate, 0.8–1.0 × 0.3–0.5 cm, margin entire, sessile. VERTICILLASTERS two-flowered, remote, pedicels 1.5–2.0 mm long. BRACTEOLES absent. CALYX regular, tubular, 8.0–12.5 × 3–5 mm; teeth subequal, spinescent at apex, triangular to lanceolate, sparsely covered with appressed long simple hairs and subsessile to sessile glandular hairs at margin; teeth 3–6 mm long. COROLLA white, 18–20 mm long; tube 8–12 mm long, subequal to calyx tube; upper lip 3–5 × 3.0–3.5 mm; lower

lip distinctly trilobed, 7–10 × 6–10 mm. NUTLETS oblong in outline, 3.5–4.0 × 1.5–2.0 mm, verrucate on surface, wingless.

Phenology: Flowering and fruiting from early June to July.

Distribution and ecology: West, south-west and central Iran (endemic, Fig. 8A), alpine to subalpine areas, mountainous gravelly slopes mostly with limestone as substrate, exposed cliffs and ridges; elevation 2200–3800 m; Irano-Turanian element. They form a community with several other cushion-forming plants of the steppe vegetations in the area such as species of *Astragalus* L., *Acantholimon* Boiss. and *Daphne mucronata* Royle.

Conservation status: LC (IUCN, 2008). Due to their intense smell and spiny form, the plants are resistant to grazing (the most serious threat to plant vegetation in the country). Populations of this species are composed of numerous individuals in close proximity.

Affinities and variation: *Stachys acerosa* is closely related to *S. aucheri*, especially in habit and in having a thorny flowering axis. *Stachys aucheri* is densely covered by long simple hairs, but this is not the case in *S. acerosa*. Moreover, *S. acerosa* differs from *S. aucheri* by lacking a distinct bracteole and having a large calyx and long calyx teeth. Two other species morphologically resembling *S. aucheri* are *S. multicaulis* and *S. pilifera*. All these species were assigned to section *Aucheriana* (Bhattacharjee, 1980) characterized by prostrate or cushion-forming habit woody at base, by few-flowered verticillasters and spiny calyx teeth.

Selected specimens examined: **W**: Prov. Esfahan: On the road between Semiroom and Shahreza, c. 1 km to police station, *Zarre & Salmaki 35895* (TUH); 10 km Ardakan to Kumar, *Assadi & Abouhamzeh 46319* (TARI); Esfahan, Ghameshlou protected area, Cheshmeh-Senjed Mts, *Yousefi 127* (TARI); W Esfahan, 35 km SE Daran, *Renz 1724* (E); Chehel-Dokhtar Kuh prope Damaneh, *Renz 1723* (E), *Wendelbo 1762* (E). Prov. Bakhtiari: East of Kalar Mts, c. 12 km to Vastegan, *Zarre & Salmaki 35881* (TUH); Sar-Astaneh pass, above Vastegan village, *Zarre & Salmaki 35890* (TUH, TARI); Delikan village, *Rehinger 321* (K); Zardeh-Kuh, above Kuhrang valley, *Archibald 2982* (E), *27327* (K); Pashma-Kuh, *Rehinger 47425* (K); Chehel Dokhtaran Kuh, Lordegan, Zardkuhe-Bakhtiari Mts in front of Kuhrang tunnel, *Mozaffarian 57692* (TARI). Prov. Lorestan: Ghali-Kuh, on the road to Aligoudarz, *Runemark & Lazari 26472* (TARI); 58 km from Aligoudarz to

Shoul-Abad, *Runemark & Lazari 26513* (TARI); Osh-torankuh Mts, above Teihoun village, *Assadi & Mozaffarian 37134* (TARI). **S**: Prov. Kerman: Kerman, in reg. sub-alpina et alpina montis Kuh Lalesar, *Bournmüller 4300* (LE); Lalehezar Mts, Zarda village, *Foroughi & Assadi 1633* (TARI). Prov. Fars: Shiraz, Kuh-e Moudeh prope Dasht-e Arzhan, *Stapf 651* (WU); Shiraz, Kuh-e Bungi prope Dasht-e Arzhan, *Stapf 649* (WU). **C**: Prov. Markazi: Arak, Kuh-e Sefid-Khani, *Strauss509* (LE); 50 km SSW Sultanabad, *Kœie 779* (LE: ex C); Rasband Mts, *Mozaffarian 48353* (TARI).

2. *Stachys alpina* (Fig. 3C)

Stachys alpina L., Sp. Pl. 581 (1753). *Type*: Herb. Linn. no. 736.3 (LINN: photograph seen, lectotype (designated by Falciani in *Lagasalia* 19: 194, 1997).

=*S. alpina* subsp. *macrophylla* (Albov) Bhattacharjee, Notes Roy. Bot. Gard. Edinburgh 33(2): 277 (1974).

=*Eriostomum alpinum* Hoffmanns. & Link ex Steud., Nomencl. Bot. 1: 806 (1821), *nom. inval.* (cited as synonym).

=*S. macrophylla* Albov, Prodr. Fl. Colch. 1: 202 (1895).

=*S. masanderana* Bornm. & Gauba, Repert. Spec. Nov. Regni Veg. 49: 269 (1940).

=*Stachys sericea* Ledeb. Fl. Ross. 3: 412 (1849).

=*Stachys persica* S.G.Gmel. ex C.A.Mey., Verz. Pfl. Casp. Meer.: 94 (1831), **syn. nov.** holotype: [Iran], in Persiae prov. Ghilan, Gmelin (LE!).

PLANTS perennial erect herbs, mesophytic, up to 1 m tall with creeping rhizome. STEMS thick, 50–100 cm, non-branched or rarely branched beneath the flowering axis; internodes 8–12 cm long; covered with long vermiform hairs up to 3 mm and stalked or subsessile to sessile glandular hairs. BASAL LEAVES cordate or broadly ovate, 10–18 × 7–12 cm; subcrenulate to dentate at margin; apex ± acute; cordate at base; petiole 4–12 cm; hairy as the stem. CAULINE LEAVES ovate to broadly lanceolate, 6–9 × 3.0–6.5 cm, subcrenate to dentate at margin, acute at apex, cordate at base, hairy as the stem and basal leaves. FLORAL LEAVES similar to cauline leaves but smaller, elliptic to lanceolate, 1–4 × 0.5–3.0 cm, apex acute, margin crenate to dentate, sessile. VERTICILLASTERS remote, sometimes congested at the top of flowering axis, ten- to 20-flowered, pedicels 1.5–3.0 mm long. BRACTEOLES lanceolate to linear, numerous, herbaceous, 4–8 mm long, acute at apex but unarmed, softly pilose. CALYX subbilabiate, subcampanulate, 9–11 × 4–5 mm; teeth subequal, lanceolate, erect to slightly recurved at fruiting time, 2–3 mm long, with glandular and long simple hairs at margin. COROLLA pink, 10–20 mm long; tube ± included in the calyx, 5–8 mm long; upper

corolla lip 4–9 × 4.0–4.5 mm, densely covered with long simple hairs outside usually exerted from the lip; lower corolla lip trilobed, 6–12 × 7–9 mm. NUTLETS globose, 2.5–3.0 × 2.4–2.8 mm; minutely reticulate on surface, broadly winged.

Phenology: Flowering and fruiting between July and early August.

Distribution and ecology: Northern Turkey, Armenia, Georgia, Azerbaijan, northern Iran. Hyrcano-Euxine element (Fig. 8A). Slopes of mountainous forests, preferring soils with high percentage of clay and humus; elevation 900–2000 m.

Conservation status: NT (IUCN, 2008). In Iran, human disturbances in hyrcanian forest mean the species is almost threatened, but it is more widespread in neighbouring countries.

Affinities and variation: *Stachys macrophylla* has been described as closest to *S. alpina* and differs from it in having a dense indumentum at the lower surface of leaves. Bhattacharjee (1974) reduced *S. macrophylla* to subspecific rank under *S. alpina*. *Stachys persica* was considered to be distributed in north to north-west Iran (Rechinger, 1982), but characters separating it (mainly smaller leaf size) from *S. alpina* are of low taxonomic importance and show continuous variation. *Stachys alpina* is distinguishable from all other taxa occurring in Iran by its large cordate leaves and branched flowering stems that are sparsely covered by long vermiform hairs and stalked to sessile glandular hairs.

Selected specimens examined: **N**: Prov. Gilan: Sefidrud river, *Bornmüller 7969* (B); Loshan, *Gaubá 1683* (B); high mountains forest jungle, *Lindsay 1067* (K); in fagetis W Asalem (Navroud), versus Khalkhal, *Rechinger 43403* (B, K, W); road of Asalem to Khalkhal, *Wendelbo & Shirdelpour 14906* (E); Lahijan, Siah-Kal, Shah-e Shahidan, *Jamzad & Asri 71758* (TARI). Prov. Mazandaran: Kelardasht, Rudbarak, *Sanei 7301* (TARI); Kolyak village, *Zarre & Salmaki 35913* (TARI). **W**: Prov. Ardabil: Heyran pass, *Ghahraman, Tarighi & Agustin 4a* (TARI, TUH).

3. *Stachys annua* (Fig. 3E)

Stachys annua (L.) L., Sp. Pl. ed. 2: 813 (1763). *Type*: BM-000646054 [lectotype designated by Nelson in Jarvis & al., Taxon 50: 510 (2001): Herb. Clifford: 310, *Stachys 7*, sheet A 'annua', image seen at <http://www.nhm.ac.uk/jdsml/research-curation/research/projects/linnaean-typification>). = *Betonica annua* L., Sp. Pl. 1: 573 (1753). = *Stachys betonica* Crantz, Stirp. Austr. ed. 2(4): 264 (1769).

= *Stachys pubescens* Ten., Fl. Nap. 1, Prodr. 34 (1811).

= *Stachys balbissii* Link, Enum. Hort. Berol. 2: 110 (1821).

= *Stachys maritima* d'Urv., Enum. P1. Ins. Pont. Eux. 68 (1822) non Gouan (1764).

= *Stachys decumbens* Willd. ex Benth. in Linnaea 11: 336 (1837) non Pers. (1806).

= *Stachys micrantha* C.Koch, Linnaea 21: 690 (1848).

= *S. adenocalyx* C.Koch, Linnaea 21: 691 (1848).

= *Stachys neglecta* Klokov ex Koccko in Fl. USSR 4: 289 (1955).

PLANTS annual, biennial or perennial branched herbs with basal rudimentary leaves. STEMS ± thin, 20–45 cm long, simple or branched, usually erect, rarely procumbent; internodes 4–6(–8) cm long; sparsely covered by short simple papillate hairs up to 2 mm and subsessile to sessile glandular hairs. BASAL LEAVES ovate-oblong to ovate-lanceolate, 1.5–4.5 × 1.0–2.5 cm, crenate at margin; obtuse at apex, usually attenuate or rarely cordate at base, hairy as the stem, petiole 3.0–4.5 cm long. CAULINE LEAVES similar but smaller than basal leaves, ovate-rhomboid, 2.0–3.5 × 1.0–1.5 cm, crenate-dentate at margin; apex obtuse; usually cuneate to attenuate, petiole 1–2.5 cm. FLORAL LEAVES elliptic to lanceolate, 0.7–2.0 × 0.4–0.6 cm, weakly crenate or entire at margin, subsessile to sessile. VERTICILLASTERS four- to six- (-eight)-flowered; remote, ± congested above, pedicels 1.0–1.5 mm long. BRACTEOLES few, linear to setaceous, herbaceous, 1.0–2.5 mm long, acute at apex but unarmed, often glabrous, rarely with short and long simple hairs. CALYX bilabiate, tubular, gibbous at base, 8–12 × 4.0–5.0(–5.5) mm; teeth subequal, 2.5–4.0 mm long, triangular-subulate to lanceolate, ± erect to subrecurved, covered with papillate short simple or long hairs at margin, sometimes also with glandular hairs, glabrescent. COROLLA creamy yellow, sometimes with red spots, 14–20 mm long, tube longer than calyx tube, 11–13 mm long; upper corolla lip 4–5 × 3.5–5.0 mm; lower corolla lip indistinctly trilobed, 6–8 × 7–9 mm. NUTLETS broadly obovoid, 3.0–3.7 × 2–2.8 mm, minutely reticulate on surface, with narrow wing.

Phenology: Flowering and fruiting between early June and July.

Distribution and ecology: Europe to eastern Asia but more frequent in eastern Turkey, northern and eastern Iraq, Georgia and Iran (Fig. 8A). It usually prefers soils with high percentage of clay; mountainous slopes.

Conservation status: NT (IUCN, 2008). In Iran the status of this species is almost threatened, but it is more widespread in neighbouring countries; elevation 500–2600 m.

Affinities and variation: Contrary to Rechinger (1982), we follow Bhattacharjee (1982) in considering *S. pubescens* as conspecific with *S. annua*. It is closely related to *S. maritima* Gouan distributed from southern Europe (Spain, France, Corsica, Italy, Yugoslavia and Bulgaria) to the Caucasus and Black Sea coast, but differs from it in having longer calyx teeth and congested spicate inflorescences.

Selected specimens examined: **N**: Prov. Mazandaran: Chalus pass, *Furse & Synge 338* (K); Firuzkuh, Veresk to Pol-e Sefid, Orim village, *Salmaki et al. 36518* (TUH); Yush to Baladeh road, *Zarre et al. 35871* (TUH); S Ramsar, W Javaherdeh, *Runemark & Maassoumi 20775* (TARI); S Amol in Haraz valley, *Furse 7109* (K); Chalus, Kandavan, *Rechinger 48279* (W); Firuzkuh, Veresk bridge, *Wendelbo & Foroughi 13036* (E, TARI); Kelardasht, *Amini & Bazargan 18560* (TARI, TUH); Kuh-e Nizwa prope Rim, *Wendelbo 1023* (TARI). **W**: Prov. Ardabil: Asalem to Khal Khal, W Almas pass, *Wendelbo & Assadi 18429* (TARI). Prov. Hamadan: 8 km W Hamadan, *Pabot 28256* (TARI). **C**: Prov. Tehran: Tehran, *Termeh 14566* (W: ex IRAN); Tehran, Chitgar, *Foroughi 131* (TARI); Tehran, Oshan-Fasham, Paloun-Gardan Mts, *Zarre & Moazzeni 35869* (TUH); Tehran. **E**: Prov. Golestan: Golestan forest, *Furse 7357* (K); Golestan forest, *Foroughi 5527* (TARI); Jahan-Nama protected area, Saad-Abad mahale, *Jafari 36760* (TUH). Prov. Semnan: Shahroud, Kuh-e Abr, *Rechinger 55425* (W, WU). Prov. Khorasan: Bojnourd, Mahdasht, *Joharchi 4026* (FUMH); W Boujnourd, between Darkesh and Havar, *Joharchi & Zangoi 35478* (FUMH).

4. *Stachys atherocalyx* (Fig. 1B)

Stachys atherocalyx K.Koch, *Linnaea* 21: 691 (1848). *Syntypes*: Caucasus, in Transkaukasien; und im Tschorukgebiete [Turkey A8 Çoruh], sehr häufig und zwar auf allen Bodenarten, 1500–1676 m, *K.Koch*

=*S. sideritoides* K.Koch, *Linnaea* 21: 692(1848) non Gill ex Benth. (1848). ≡ *S. recta* var. *sideritoides* (K.Koch) Boiss., *Fl. Or.* 4: 730 (1879).

=*S. linearifolia* K.Koch, *Linnaea* 21: 692 (1848).

=*S. patula* Griseb., *Spic.* 2: 142 (1844).

=*S. acanthodonta* Klokov in *Fl. URSS* 9: 648, t. 18 (1960).

PLANTS perennial, densely branched herbs. **STEM** ± thin, 40–85 cm, densely branched and woody at base, usually erect, internodes up to 5 cm long, sparsely covered by appressed short or long simple hairs up to 2 mm, glandular hairs absent. **BASAL**

LEAVES linear to narrowly oblong-lanceolate, 4–10 × 1.0–1.5 cm, crenate-serrate at margin, acute at apex, attenuate at base, subsessile to sessile, hairy as stem. **CAULINE LEAVES** oblong-lanceolate to lanceolate, 4–10 × 0.4–1.5 cm, sparsely covered by appressed short simple hairs, crenate-serrate at margin, acute at apex, attenuate at base. **FLORAL LEAVES** linear to lanceolate, 2–4 × 0.3–0.4 cm, entire, aristate at apex, sessile, hairy as stem. **VERTICILLASTERS** (four–) six- to eight-flowered, remote below, ± congested above. **BRACTEOLAS** linear to setaceous, 3–6 mm, herbaceous, with short and long simple hairs. **CALYX** tubular to subcampanulate, 10–12 × 3–5 mm, densely covered by appressed short simple hairs; teeth erect, lanceolate-subulate, 5–7 mm long, with long aristate yellow tips 1.5–2.0 mm. **COROLLA** creamy to yellow, sometimes with red spots, 14–18 mm, tube longer than calyx tube, 6–8 mm long; upper corolla lip 4–5 mm long, 3.5–5.0 mm; lower corolla lip indistinctly trilobed, 6–8 × 4–6 mm. **NUTLETS** broadly obovoid, 2–3 × 1.0–1.4 mm, minutely reticulate on surface, narrowly winged.

Phenology: Flowering and fruiting between early and late July.

Distribution and ecology: North-east and east Anatolia, north and north-west Iran, Azerbaijan, Armenia, Georgia, Crimea, north Balkan Peninsula, Romania. Euro-Siberian element (Fig. 8B). It prefers rocky slopes, gravelly ground with *Rhamnus* L. and *Artemisia* L. vegetation types and meadows, near fields, roadside banks; elevation 1350–2160 m.

Conservation status: LC (IUCN, 2008).

Affinities and variation: This species has been reported from Iran in a plant list for the Arasbaran protected area (Assadi, 1988) where it is more or less abundant. However, it is more widespread in neighbouring Caucasus countries up to Europe. The most similar species to *S. atherocalyx* is *S. recta* (a new record for Iran) characterized by its narrowly lanceolate cauline leaves and smaller calyx teeth.

Selected specimens examined: **W**: Prov. E Azarbaijan: Arasbaran protected area, 2 km after Kaleybar to Babak castle, near the road, *Zarre & Salmaki 39801* (TUH); Arasbaran protected area, c. 5 km after Kaleybar to Babak castle, *Salmaki et al.*, s.n. (TUH).

5. *Stachys aucheri*

Stachys aucheri Benth., in A.P. de Candolle, *Prodr.* 12: 487 (1848). *Type*: Persia, 1836, *Aucher-Eloy 2905* (lectotype, designated here: G-DC!), isotype: G!,

G-BOIS! mixed with syntype); Persia, 1837, *Aucher-Eloy 1807* (syntype: G-DC!)

=*Stachys koelzii* Rech. f., Fl. Iran. 150: 383 (1982).

Type: IRAN, Lorestan: Kebara, 1800 m, 15. VI. 1941, *Koelz 18239* (holotype: W!), **syn. nov.**

PLANTS perennial, cushion-forming and woody at base. STEMS from a thick base becoming thin further up, thorny, 15–30 cm, branched near the base, usually erect, internodes 2.5–4.0 cm long, covered with long simple hairs up to 2 mm and subsessile to sessile glandular hairs. BASAL LEAVES oblong to elliptic, 2.5–3.0 × 0.4–0.6 cm, entire at margin, spinescent at apex, with a yellow mucro 2–3 mm long; attenuate at base; subsessile to sessile; hairy as stem. CAULINE LEAVES narrowly oblong, 1.5–2.5 × 0.3–0.5 cm, entire at margin, spinescent at apex, attenuate at base, sessile, hairy as stem. FLORAL LEAVES linear-lanceolate, 0.8–1.5 × 0.4–0.6 cm, entire at margin, sessile, sparsely covered by appressed long simple hairs along with subsessile to sessile glandular hairs. VERTICILLASTERS two-flowered, remote, pedicels 1.5–2.0 mm long. BRACTEOLES four to six, linear, 10–11 mm long, linear, 6–10 mm, acute at apex. CALYX regular, tubular, 8–12 × 3–5 mm; teeth subequal, spinescent at apex, triangular to lanceolate, sparsely covered by appressed long simple hairs and subsessile to sessile glandular hairs, teeth 3–6 mm long. COROLLA white, 18–20 mm long; tube 8–12 mm long, subequal to calyx tube; upper corolla lip 3–5 × 3.0–3.5 mm; lower corolla lip distinctly trilobed, 7–10 × 6–10 mm. NUTLETS oblong in outline, 3.5–4.0 × 1.5–2.0 mm, verrucate on surface, wingless.

Phenology: Flowering and fruiting between late May and early July.

Conservation status: EN (IUCN, 2008); it is an extremely rare species in Iran known only from the type specimens and a few collections mentioned below.

Distribution and ecology: Narrowly endemic to the southern Zagros Mountains (Fig. 8B) and can be found there in steppe vegetations mainly composed of *Astragalus* spp., elevation 1800–2400 m.

Affinities and variation: Although *S. aucheri* was recognized as closely related to *S. pilifera* (Rechinger, 1982), it actually more closely resembles *S. acerosa*. The lectotype of *S. aucheri* (*Aucher-Eloy 2905*) is mixed with the syntype of *S. acerosa* (*Aucher-Eloy 1807*). *Stachys koelzii* was then described as closely related to *S. acerosa* (Rechinger, 1982) based on its smaller corolla and long simple hairs. Detailed examination of the type material in G-BOIS led to synonymy of *S. koelzii* under *S. aucheri* as treated here.

Selected specimens examined: S: Prov. Fars: Dena Mts, Kamar-Siah, *Safaiyan 29* (TARI); Fars, *Hewa 2087* (E).

6. *Stachys balansae* (Fig. 1C)

Stachys balansae Boiss. & Kotschy in Boissier, Fl. Or. 4: 722 (1879). Types: [Turkey] Hab. in schistosis alpium prope Musch inter *Astragalos 7500'* [2286 m], [6.iv.1859], *Th. Kotschy 441* (lectotype designated by Bhattacharjee, 1982: G!, isoelectotypes: K, LE!, W!); monte Jyldisdagh Galatiae, *Wiedemann* (syntype); in graminosis Berytdagh Cataonne, 6000', Haussknecht (syntype: JE); in collibus prope Baibut, *Bourgeau* (syntype); in monte Aslandach Cappadociae, *Balansa* (syntype).

=*S. terekensis* Knorr., Not. Syst. (Leningrad) 15: 341 (1953).

PLANTS perennial, mesophytic ± branched herbs with distinct basal leaves. STEMS thick, 35–100 cm, simple, sometimes branched, erect, internodes 8–12 cm long, covered with long vermiform hairs up to 4 mm and stalked or subsessile to sessile glandular hairs. BASAL LEAVES oblong to ovate-oblong, 4.0–10.5 × 1.5–3.0 cm, usually sparsely rarely densely covered by appressed smooth vermiform hairs and stalked or subsessile to sessile glandular hairs on upper surface, softly villous to glabrescent beneath, crenate-serrate at margin, obtuse to acute at apex, cordate to subcordate at base, petiole 3–10 cm. CAULINE LEAVES oblong to oblong-lanceolate, 3–10 × 1–3 cm, acute at apex, rarely obtuse, truncate at base, serrate at margin, subsessile or with a petiole 1–5 cm long, hairy as basal leaves. FLORAL LEAVES elliptic to lanceolate, similar to cauline leaves but smaller, 3–5 × 1–2 cm, sessile, acute at apex, crenate-serrate at margin. VERTICILLASTERS remote throughout or a few congested above, 1–5 cm distant, ten- to 25-flowered, peduncles 1.5–5.0 mm long, pedicels 1.5–10.0 mm. BRACTEOLES numerous, lanceolate to linear, herbaceous, 6–12 mm long, acute at apex but not spinescent, softly pilose. CALYX subbilabiate, subcampanulate, 10–12 × 5–6 mm, covered with simple long hairs; teeth subequal, ovate to lanceolate, erect or slightly recurved in fruit, 3.0–3.5 mm long, covered by glandular and eglandular hairs at margin. COROLLA rose-pink, 15–20 mm, tube subincluded, 5–8 mm long; upper corolla lip densely covered with exserted simple long hairs outside usually exceeding the lip, 7–9 × 3.0–4.5 mm; lower corolla lip distinctly trilobed, 8–11 × 6–8 mm. NUTLETS obovoid, 2–3 × 2.0–2.4 mm, colliculate on surface, narrowly winged.

Phenology: Flowering and fruiting between late May and early July.

Distribution and ecology: Mainly north-east and east Turkey, Crimea, Azerbaijan, Armenia, north and west Iran (Fig. 8B). On rocky slopes, limestone ravines or stream sides; elevation 2200–3100 m.

Conservation status: NT (IUCN, 2008) in Iran, but widespread in other countries.

Affinities and variation: It is similar to *S. rizeensis* Bahattacharjee, a species distributed in Turkey, but differs from it in habit, leaf shape and ecology.

Selected specimens examined: **N:** Prov. Tehran: 13 km to Dizin from Gachsar, near the river, *Zarre & Salmaki 36509* (TUH). Prov. Mazandaran: Shirgah, *Moussavi 35740* (W: ex IRAN); Kelar-Dasht, *Termeh 14471* (W: ex IRAN), *Lambinon 89466* (M, MSB). **W:** Prov. Ardabil: 21 km to Asalem on the road of Khal Khal to Asalem, at the beginning of Hyrcanian forest, near grasslands, *Zarre & Salmaki 36532* (TUH).

7. *Stachys benthamiana* (Figs 1G, 8C)

Stachys benthamiana Boiss., Fl. Orient. 4: 734 (1879). *Type:* Hab. ad rupes abscissas Persia australis, *Olivier*; Persia australis, *Aucher-Eloy 974 et 2889*; prope Schiras et in monte Kuh Delu, *Th. Kotschy 345*; ad ruinas Persepolis et in monte Kuh Eschker, *Haussknecht s.n.* (syntypes, G!, G-BOIS!, LE!, W!); prope Schiras in monte Kuh Delu *Kotschy 490* (lectotype, designated here: G-BOIS!).

PLANTS perennial, suffruticose, chasmophilous. STEMS thin and fragile, 30–40 cm, with numerous branches at base, erect to decumbent; internodes 4–8 cm long, densely covered by stalked glandular hairs up to 1 mm and subsessile to sessile hairs mixed with smooth short simple hairs up to 0.5 mm. BASAL LEAVES cordate to broadly lanceolate-ovate, 2.5–3.0 × 2.5 cm, dentate to serrate at margin, obtuse at apex, usually cordate at base, hairy as stem, petiole 2 cm. CAULINE LEAVES similar to basal leaves but smaller, cordate to ovate-lanceolate, 2.0–2.5 × 1.5–2.0 cm, petiole 1 cm. FLORAL LEAVES ovate to lanceolate, (0.5–)1.0–1.5(–2.0) × 0.5–1.0 cm, subsessile to sessile. VERTICILLASTERS (two–) six- to eight (–ten)-flowered, congested in a tapering inflorescence, pedicels up to 1 mm long. BRACTEOLLES numerous, linear to setaceous, herbaceous, 2–5 mm long, acute at apex but unarmed, hairy as the leaves. CALYX subcampanulate, 7–10 × 2–3 mm; teeth subequal, lanceolate, ± recurved and widened in fruit, densely covered by stalked glandular hairs, teeth 3–5 mm long. COROLLA golden yellow, sometimes with pale red dots on lower lip, 15–20 mm long; tube usually as long as the calyx tube, 7–9 mm long; upper corolla lip 4–5 × 3–4 mm; lower corolla lip indistinctly trilobed,

8–10 × 6–8 mm. NUTLETS obovoid, 3.0–3.5 × 2.0–2.5 mm, minutely reticulate on surface, wingless.

Phenology: Flowering and fruiting between early June and early July.

Distribution and ecology: West and north-west Iran, north Iraq (Irano-Turanian element, Fig. 8C). Chasmophilous plants dwelling in rock crevices or joints distributed in the Zagros Mountains in western Iran and adjacent areas in neighboring countries; elevation 800–3000 m.

Conservation status: NT (IUCN, 2008). The populations of these plants are composed of few individuals and become small in response to increasing drought in the area.

Affinities and variation: It is distributed frequently in western Iran and has been attributed to the *S. kurdica* complex, known to be a homogeneous (Bhattacharjee, 1982) and taxonomically difficult group (Salmaki *et al.*, 2009b). The delimitation of species in this group based solely on morphological characters is problematic. Presence or absence of glandular hairs and the size of the calyx are among the diagnostic characters used in separating species in this group. It is most similar to *S. kurdica* (northern Iraq, western Iran) but differs from it in having stalked glandular hairs on the calyx and stem. Furthermore, the verticillasters are congested upwards into a dense head in the latter. *Stachys megalodonta* Hausskn. & Bornm. ex P.H. Davis is another species resembling *S. benthamiana* and *S. kurdica*. This species was recorded for Iran by Rechinger (1982) based on several specimens such as *Rechinger 43016-b* (W), *Mirzayan 5508-E* (W), *Iranshahr & Moussavi 15745-E* (W) and *Iranshahr & Moussavi 15752-E* (W), but all these plants are *S. benthamiana*. *Stachys megalodonta* is distributed frequently in Iraq and Turkey and is easily recognizable by its extremely large calyx teeth and sparse calyx indumentum. We have not confirmed the occurrence of *S. megalodonta* in Iran, and therefore it has been excluded from the *Flora of Iran*.

Selected specimens examined: **W:** Prov. Kordestan: 20 km after Kamyaran, Varmahang to Ravansar, *Zarre & Salmaki 36524* (TUH). Prov. Esfahan: Bordakan a Kohrueh 40 km meridiem versus inter Shahreza, *Rechinger 47375* (K); Kuh-e Surmandeh, N Semiroom, *Rechinger 47577* (K); c. 500 m to Semiroom waterfall, rocky cliff beside the road, *Zarre & Salmaki 35897* (TUH), and *Rechinger 47453* (B, W); Semiroom to Shahreza, c. 1 km to police station, *Zarre & Salmaki 35896* (TUH). Prov. Kohgiluyeh:

Kuh-i-Saidun, *Archibald* 3429 (E); on the road toward Yassuj, Sepidan, Tang-e Sorkh village, at the end of Sar-Tang village, *Zarre & Salmaki* 35906 (TUH); Kuh-e Chah-Siah, prope Sivand, *Stapf* 697 (WU); Yasuj, Fahlian, *Riazi* 9351 (TARI); Bordekan, Kohruye 40 km to Shahreza and Semirrom, *Rechinger* 47375 (B). Prov. Bakhtiari: 20 km before Noughan, Do-Polan, *Zarre & Salmaki* 35878 (TUH); Dopolan to Gandomkar, *Hedge* 15245 (E); Kuh-e Shahneshtin, c. 15 km of Brujen, *Wendelbo & Assadi* 1253 (E). Prov. Lorestan: Oshtorankuh, Azna to Takht valley, *Riazi* 9714 (TARI). Prov. Fars: Shiraz, Sabz Pushan, *Stapf* 699 (WU); Shiraz, Kuh-e Bamoo, *Stapf* 694 (WU); Shiraz, Kuh-e Barfi, *Stapf* 695 (WU); Fars, Shiraz, Dasht-e Arzhan, old road of Kazeroon, *Foroughi* 17448 (TARI); Fars, Shiraz, Bamoo protected area, Cheshmeh-e Fil, *Wendelbo & Foroughi* 17616 (TARI); c. 4 km W Shiraz, *Pabot* 6178 (G); NE Shahbad, *Pabot* 1878 (G). Prov. Yazd: 6 km NW Ardakan, *Pabot* 2450 (G).

8. *Stachys byzantina* (Fig. 1D)

Stachys byzantina K.Koch, *Linnaea* 21: 686 (1848). *Type*: [Turkey, A2] Istanbul in Boa Nyukdereh (Buyukdere) am Bosphor auf Mergelboden, 30–60 m, vii 1843, *K. Koch*

=*S. lanata* Jacq., *Ic. Pl. Rar.* 1: 11 (1781) non Crantz (1769). = *Eriostomum lanatum* Hoffmanns. & Link, *Fl. Portug.* 1: 105 (1809).

=*S. olympica* Briq., *Lab. Alp. Marit.* 215 (1893) non Poiret (1817).

=*S. taurica* Zefirov in *Not. Syst. (Leningrad)* 14: 348 (1951).

PLANTS perennial, silvery, mesophytic erect herbs with distinct basal leaves. STEMS thick, 40–100 cm, usually simple, rarely branched, internodes 5.5–12.0 cm long, densely covered by appressed long vermiform hairs up to 5 mm and stalked or sessile to sessile glandular hairs. BASAL LEAVES elliptic to broadly lanceolate, 3.5–8.0 × 1.5–3.5 cm, subcrenulate to entire at margin, ± obtuse at apex, cuneate to rarely rounded at base, hairy as the stem, petiole 2–7 cm. CAULINE LEAVES elliptic to lanceolate, 4–8 × 1.5–3.0 cm, subcrenulate to entire at margin, obtuse at apex, cuneate at base; petiole short, 0.5–2.0 cm long. FLORAL LEAVES elliptic to lanceolate, 3–5 × 1–2 cm, sessile, acute at apex, crenate to entire at margin, hairy as the stem. VERTICILLASTERS remote throughout or a few congested above, 1–6 cm distant, ten- to 30-flowered, pedicels 1.0–1.5 mm long. BRACTEOLES numerous, lanceolate to linear, herbaceous, 4–10 mm long, acute at apex but not spinous, softly pilose. CALYX subbilabiate, subcampanulate, 8–10 × 0.5–2.0 mm; teeth subequal, ovate to lanceolate, erect to slightly recurved in fruit, 1.5–2.5 mm long; with glandular and smooth simple

hairs at margin. COROLLA purple, 13–20 mm long; tube subincluded, 7–8 mm long; upper corolla lip densely covered with long simple hairs outside, hairs usually exerted, 6–12 × 3.0–4.5 mm; lower corolla lip trilobed, 6–8 × 4–5 mm. NUTLETS globose, 2.0–2.7 × 2.0–2.7 mm, minutely reticulate on surface, narrowly winged.

Phenology: Flowering and fruiting between early April and late June.

Distribution and ecology: North and central Turkey, north and north-west Iran, Azerbaijan, Armenia and Georgia (Fig. 8C). This species is a Euro-Siberian element and can be found in flat meadows in submontane steppes or field margins, and densely growing in overgrazed meadows and disturbed lands; elevation (750–) 1800–2800 m.

Conservation status: LC (IUCN, 2008). It is widely distributed in northern Iran and also widespread in other countries.

Affinities and variation: Closely related to *S. thirkei* K.Koch from Turkey but differs from it in having dense vermiform hairs and also compact verticillasters at apex.

Selected specimens examined: **N**: Prov. Gilan: Qazvin to Rasht, Manjil, *Bornmüller* 7466 (B), and *Bornmüller* 7960 (B); in valle fluvii Sefidrud in declivitate montium, *Bornmüller* 7961 (B); Loshan, *Gaub* 1675 (B); W Asalem (Navrud) near Khalkhal (Herabad), *Rechinger* 43363 (B, W); Asalem to Khalkhal, 37 km to Khalkhal, *Zargani* 4021 (FUMH); Asalem to Khalkhal, before beginning of the Hyrcanian forest, *Zarre & Salmaki* 36528 (TUH). Prov. Mazandaran: Kelardasht, northern foothills of Takhte Soleiman, *Furse* 2848 (K); Ramsar, Javaherdeh, *Bozghandi* 34379 (FUMH); Siah-Bisheh, 20 km to Gachsar, *Zarre & Salmaki* 36515 (TARI); Kojour village, *Zarre & Salmaki* 35912 (TUH). Prov. Tehran: Firuzkuh, Veresk bridge, Orim village, *Zarre & Salmaki* 36516 (TARI). **W**: Prov. E Azarbaijan: 1–12 km W Zonuz, *Rechinger* 41338 (B); ENE Tabriz usque 1 km ultra pontem trans fluvium Talkheh Rud (Atschi Tschal), *Rechinger* 40702 (B, W). Prov. Zanjan: Zanjan, Kuh-e Anguran, in declivibus saxosis aridis 3 km W Tashvir, *Rechinger* 41048 (B, W). **E**: Prov. Golestan: between Bandar-e Gaz to Sari, *Rechinger* 5545 (B, K, W); Golestan, S Tangeh-Rah, Kango, *Rezaei & Zangooei* 15553 (FUMH); S Maraveh-Tappeh, E Golidagh, *Joharchi* 35106 (FUMH); Jahan-Nama protected area, *Jafari* 36761 (TUH). Prov. Khorasan: W Bojnourd, c. 5 km to Tangeh-Rah, *Rafei & Zangooei* 29508 (FUMH); W Bojnourd, between Havar & Vashgan,

Agh-Baba, *Faghih-Nia & Zangoeei* 33081 (FUMH). **C:** Prov. Semnan: Sharhrud, Chehel Dokhtar, *Moussavi & Karevandar* 33712 (E).

9. *Stachys cretica* subsp. *garana* (Fig. 1E)

Stachys cretica L. subsp. ***garana*** (Boiss.) Rech.f., Ann. Nat. Hofmus. Wien 48:176 (1937). *Type:* IRAQ, in lapidosis montis Gara Kurdistaniae, *Th. Kotschy* 413 (holotype: G-BOIS!; isotype: G!, K, W!). = *Stachys garana* Boiss., Diagn. ser. 1(12): 76 (1853). = *Stachys cretica* L. var. *garana* (Boiss.) Boiss., Fl. Or. 4: 719 (1879). = *Stachys germanica* L. subsp. *italica* (Miller) Briq. var. *garana* (Boiss.) Briq., Lab. Alp. Marit. 223 (1893).

PLANTS perennial, erect herbs with distinct basal leaves. STEMS 40–100 cm, simple or sometimes loosely branched, sparsely covered with vermiform hairs up to 3 mm and stalked or subsessile to sessile glandular hairs; internodes 9–13 cm long. BASAL LEAVES oblong to elliptic, 4–10 × 2–3 cm, subentire at margin, ± obtuse (rarely acute) at apex, cuneate at base, hairy as stem, petiole 3–6 cm. CAULINE LEAVES elliptic to lanceolate, 6–12 × 1–2 cm, subcrenate at margin, obtuse at apex, truncate at base, with a distinct petiole 1–5 cm long, softly covered by hairs as stem. FLORAL LEAVES similar but smaller than cauline leaves, elliptic to lanceolate, 3–5 × 1–2 cm, subsessile to sessile, acute at apex, crenate to entire at margin. VERTICILLASTERS remote throughout or a few congested above, 1–6 cm distant, ten- to 30-flowered, pedicels 1.0–1.5 mm long. BRACTEOLAS numerous, herbaceous, lanceolate to linear, 4–10 mm long, acute at apex but unarmed, softly pilose. CALYX subbilabiate, subcampanulate, 12–16 mm; teeth subequal, 3.0–3.5 mm long, ovate to lanceolate, erect to slightly recurved in fruit, with glandular and eglandular hairs at margin. COROLLA purple, 13–20 mm; tube subincluded, 7–8 mm long; upper corolla lip densely covered with sericeous-tomentose hairs outside usually exerting the lip, 6–12 × 3.0–4.5 mm; lower corolla lip 6–8 × 4–5 mm, distinctly trilobed, 6–8 × 4–5 mm. NUTLETS obovoid, 2.0–2.5 × 1.5 mm, verrucate on surface, with narrow wing.

Phenology: Flowering and fruiting between early June and early July.

Distribution and ecology: South and east Turkey, northern Iraq, western Iran. Irano-Turanian element (Fig. 8C). Rocky igneous slopes with ± wet soils, undergrowth in *Quercus* L. forest; elevation 1000–2200 m. Also on steep slopes at ± high altitudes, mostly with plants such as species of *Cousinia* Cass., *Echinops* L. and *Euphorbia* L. Compared with its other allies such as *S. byzantina*, this species prefers drier areas.

Conservation status: VU (IUCN, 2008), in Iran the populations of this species are rather poor.

Affinities and variation: Distinguished by its tall and branched flowering stems, oblong leaves, villous calyx, ± approximate verticillasters, and widely recurved calyx teeth (mucro 1–2 mm) at fruiting time with prominent veins.

Selected specimens examined: **W:** Prov. Kermanshah: Shalan versus Dalahu, *Iranshahr & Termeh* 12324 (E); Rijab versus Sarab-e Eskandar, *Iranshahr* 13197 (W: ex IRAN); Kermanshah, Sarmil, Kuh-e Neveh, *Iranshahr* 13223 (E); Kerend to Sar-e Pol-e Zahhab and Sarmil, Nouheh Mts, toward Radar station at the peak of the Mts, *Zarre & Salmaki* 36507 (TUH).

10. *Stachys fruticulosa* (Fig. 2A)

Stachys fruticulosa M.Bieb., Fl. Taur.-Cauc. 2:51(1808). *Type:* in Caucasi orientalis et Iberiae lapidosis montosis, 1808, *Marschall von Bieberstein* (lectotype designated here: LE!; isotype: LE!).

= *S. macrocheilos* Boiss., Diagn. Pl. Or. Nov. ser. 1, 5: 30 (1844). = *S. fruticulosa* M. Bieb. var. *macrocheilos* (Boiss.) Boiss., Fl. Or. 3: 737 (1879).

PLANTS dwarf subshrubs, densely or more frequently loosely branched, woody at base, puberulent throughout. STEMS 15–40 cm, robust and profusely branched near base and leaf axils, usually erect, internodes 2.0–3.0(–3.5) cm long, sparsely covered by appressed papillate short simple hairs 0.3–1.0 mm. BASAL LEAVES absent. CAULINE LEAVES oblong to narrowly lanceolate, 0.5–1.5 × 0.2–0.4 cm, entire at margin, obtuse at apex, attenuate at base, hairy as stem, usually subsessile to sessile, petiole 0.1–0.2 cm. FLORAL LEAVES narrowly lanceolate, 0.5–0.7 × 0.2 cm, entire at margin, subsessile to sessile, as long as or slightly longer than verticillasters above. VERTICILLASTERS two-flowered, remote, pedicels 1–3 mm long. BRACTEOLAS few, minute, linear to subulate, herbaceous. CALYX ± regular, campanulate, 7–10 × 3–5 mm; teeth subequal, triangular-subulate, ± erect to subrecurved, 2.0–3.5 mm long, covered with papillate short simple hairs at margin. COROLLA pink, sometimes with red spots, 15–20 mm long; tube 7–8 mm long, slightly longer than or ± equal to calyx tube; upper corolla lip 4–8 × 4–5 mm, bilobed; lower corolla lip indistinctly trilobed, 8–12 × 7–8 mm. NUTLETS obovoid, 3.5–4.0 × 2.0 mm, colliculate on surface, broadly winged.

Phenology: Flowering and fruiting between late June and late July.

Distribution and ecology: North-east Turkey, Azerbaijan, Georgia, northern and north-west Iran

(Irano-Turanian element, Fig. 8D). It grows on serpentine soils in foothill areas; elevation 400–1700 m.

Conservation status: NT (IUCN, 2008).

Affinities and variation: Related to *S. fruticulosa* M.Bieb. subsp. *grossheimii* (Kapeller) Menitsky (distributed in Armenia) and *S. araxina* Kopell., but differing in its herbaceous calyx with soft spinescent and widely recurved teeth, bilobed upper lip of corolla and stamens longer than corolla tube. *Stachys fruticulosa* grows mostly on serpentine soils in the foothills of a few mountains in north-west Iran, Caucasus and Tauria. It is morphologically and ecologically unique among the studied species due to its shrubby habit and large lower corolla lip.

There is a form of this plant growing in Gilan Province with crowded, narrow and thin stems. This form may represent a new taxon (probably at subspecies rank), but more studies are needed to confirm this.

Selected specimens examined: **N**: Prov. Gilan: Between Qazvin and Rasht, prope Mendschil, *Bornmüller 7960* (G); Loshan towards Jirandeh, 5 km after Cement factory, *Zarre et al. s.n.* (TUH). **W**: Prov. W Azarbaijan: 30 km S Khoy near Shahpur, *Rechinger 41793* (G). Prov. E Azarbaijan: 2–12 km W Zonuz, *Rechinger 41338* (G); 50–70 km from Tabriz towards Ahar, *Lamond 3694* (E); in valle fluvi Talkheh rud, *Rechinger 40526* (G, W); from Tabriz to Marand after Sufian, *Assadi & Mozaffarian 29825* (E); Tabriz to Ahar, on clay soils at foothills, *Zarre & Salmaki 36529* (TUH). Prov. Zanjan: Khamseh, Manjil to Zanjan, c. 3 km W Tashvir, *Lamond & Iranshahr 3467* (E); Kuh Anguran, 3 km W Tashvir, *Lamond & Iranshahr 41048* (G); 5 km Halab to Zanjan, *Zarre & Salmaki 36506* (TUH). **C**: Prov. Tehran: Shahdasht, S Karaj, *Rechinger 54468* (K); Qazvin, in addition oppidi Karaj, *Rechinger 6806* (K); Qazvin, after Moallem-Kalayeh to Ghaleh Hasan-Khan, *Ajani 10096* (TUH); Gazvin, on the road of Gazvin to Alamout, 10 km to Ovan lake, *Zarre & Salmaki 35914* (TUH).

11. *Stachys iberica* subsp. *georgica* (Fig. 2B)

Stachys iberica M.Bieb. subsp. *georgica* Rech.f., in Repert. Spec. Nov. Regni Veg. 53: 84 (1944). *Type*: In pratis montosis, Georgia caucasica, vii 1835, *Hohenacker* (holotype: W!; isotypes: K, W!, LE!).

PLANTS perennial, densely branched herbs. **STEMS** 20–45 cm, erect; internodes 4–6 cm long, sparsely covered by smooth short and long simple hairs up to 2 mm, glandular hairs absent. **BASAL LEAVES** oblong to oblong-lanceolate, 3.5–5.0 × 0.5–1.2 cm, crenate to faintly crenate-dentate at margin,

obtuse at apex, usually attenuate at base, subsessile to sessile, hairy as stem. **CAULINE LEAVES** similar but somewhat smaller than the basal leaves, oblong-lanceolate, 2–3 × 0.4–0.6 cm. **FLORAL LEAVES** lanceolate to ovate-lanceolate, uppermost ones as long as or shorter than the verticillasters, (0.5–)1.0–1.5 (–2.0) × 0.4–0.5 cm, subsessile to sessile, obtuse at apex, usually crenate rarely entire at margin. **VERTICILLASTERS** (two-) four- to six- (eight)-flowered, remote below, few ± congested above, pedicels 1–2 mm long. **BRACTEOLES** few, herbaceous, linear to lanceolate or rarely setaceous, 1.5–3.5 mm long, acute at apex but unarmed, with short and long simple hairs. **CALYX** subbilabiate, subcampanulate to tubular, 6–10 × 3–5 mm; teeth subequal, lanceolate, ± erect to subrecurved, 3–5 mm long, covered by smooth short and long simple hairs at margin. **COROLLA** purplish-pink to creamy white with pink spots, 14–20 mm long; tube usually longer than the calyx tube, 7–9 mm long; upper corolla lip 4–5 × 3–5 mm; lower corolla lip indistinctly trilobed, 8–11 × 5–10 mm. **NUTLETS** broadly obovoid, 3.0 × 1.0–1.5 mm, minutely reticulate on surface, narrowly winged.

Phenology: Flowering and fruiting between early June and early July.

Distribution and ecology: Mainly eastern Turkey, Azerbaijan, Armenia, Georgia, northern and western Iran, western Iraq (Fig. 8D). Irano-Turanian element. Limestone slopes or serpentine rocks and scree, streams and river-sides, steppes and igneous banks; elevation 800–2400 m. It grows mainly in disturbed areas beside roads or edges of cultivated fields among plants such as species of *Euphorbia* or *Teucrium* L.

Conservation status: VU in Iran (IUCN, 2008), but more widespread in neighbouring countries.

Affinities and variation: Similar to *S. sparsipilosa* R.Bhattacharjee & Hub.-Mor. and also *S. iberica* subsp. *iberica* from Turkey but characterized by fruiting calyx with teeth as long as the calyx tube.

Selected specimens examined: **N**: Prov. Mazandaran: S Ramsar, W Javaherdeh, *Runemark & Maassoumi 20775* (TARI); Alamdeh, Galandroud, *Sabeti 1707* (TARI); Kellar-Dasht, *Foroughi 102-20* (E, TARI); Kellar-dasht, *Salmaki et al., s.n.* (TUH).

12. *Stachys inflata* (Fig. 2C)

Stachys inflata Benth., Lab. Gen. Sp. 562 (1834). *Type*: ‘Africa Septentrionali’ (K: based on a specimen sent to Bentham from the Horticultural Society of London).

KEY TO SUBSPECIES IN IRAN

1. Calyx broadly inflated, 18–24 × 12–18 mm; its teeth triangular, obtuse at apex..... subsp. *inflata*
 1'. Calyx slightly inflated, 12–20 × 8–12 mm; its teeth lanceolate, acute at apex..... subsp. *caucasica*

=*Stachys inflata* Benth. subsp. *albopannosa* Rech.f., Österr. Bot. Z. 99: 47 (1952).

PLANTS perennial, caespitose herbs. STEMS 15–50 cm, numerous, densely branched at base, usually simple further up, erect, internodes 3–6 cm long, densely covered by dendroid multinodal hairs 0.5–1.5 mm long with two to five arms and subsessile to sessile glandular ones. BASAL LEAVES oblong to elliptic, 2.0–4.5 × 1.0–1.5 cm, entire at margin, usually obtuse or rarely acute at apex, attenuate at base, hairy as stem, petiole 0.3–0.5 cm. CAULINE LEAVES similar to basal leaves, gradually passing into sessile floral leaves, oblong to elliptic, 1.5–3.5 × 0.6–1.2 cm, hairy as the stem and basal leaves, petiole 0.2–0.3 cm. FLORAL LEAVES oblong to lanceolate, 1.2–2.5 × 0.4–0.8 cm, shorter than the verticillasters, obtuse at apex, entire at margin, hairy as cauline leaves, shortly petiolate to sessile. VERTICILLASTERS (three-) four- to six (eight)-flowered, remote (congested in a tapering inflorescence); pedicels minute. BRACTEOLES numerous, herbaceous, linear to lanceolate, 6–8 mm long, hairy as leaves. CALYX inflated, ellipsoid, subregular, 12–20(–24) × 8–18 mm; teeth subequal, triangular, obtuse, 2.5–3.5 mm long, hairy as leaves. COROLLA pink to purple with white or yellow spots on upper and lower lips, rarely creamy to pale yellow, 20–30 mm long; tube subequal to calyx tube, 10–15 mm long; upper corolla lip 5–10 × 4–5.0 mm; lower corolla lip indistinctly trilobed, 5–15 × 6–10 mm. NUTLETS obovoid, 3.0–3.5 × 2.4–3.0 mm, foveate on surface, wingless.

Stachys inflata Benth. subsp. *inflata* (Fig. 2C)

PLANTS greenish grey to silvery, densely or ± sparsely hairy. CALYX broadly inflated, 18–24 × 12–18 mm; calyx teeth triangular, obtuse at apex, 1–2 mm.

Phenology: Flowering and fruiting between early June and July.

Distribution and ecology: North-east Turkey, eastern Iraq, Armenia, Iran, Azerbaijan, Armenia, Georgia (Fig. 8D); Irano-Turanian element. *Stachys inflata* is the most widespread species of the genus in the above-mentioned countries. In Iran, this species usually grows in submontane steppes; elevation (750–) 1800–2800 m.

Conservation status: LC (IUCN, 2008), forming dense populations in most subalpine steppes in Iran.

Affinities and variation: *Stachys inflata* and other species formerly attributed to section *Ambleia* (*sensu* Bhattacharjee, 1982) are characterized by having branched trichomes. This species is similar to *S. kotschyi* but can be easily distinguished from it by its inflated calyces with small triangular teeth.

Selected specimens examined: **N**: Prov. Mazandaran: Kojour village, *Zarre & Salmaki 35910* (TUH); Yush-Baladeh road, Baladeh village, *Salmaki 36520* (TUH). **W**: Hamadan: c. 10 km to Avaj from Razan, Avaj pass, *Salmaki & Zarre 36505* (MSB; TUH). Prov. Kordestan: NW Malayer, *Archibald 2634* (E); prope Salavatbad, 25 km E Sanandaj, *Rechinger 42777* (K); S Sanandaj, *Jacobs 6680* (E). Prov. Kermanshah: Harsin, *Maassoumi 53* (K, TARI). Prov. Esfahan: c. 3 km after Badroud to Natanz, on the road of Kashan to Esfahan, *Zarre & Salmaki 35892* (TARI, TUH). Prov. Kohgiluyeh: c. 22 km after Hana toward Padena, *Zarre & Salmaki 35899* (TARI, TUH). **S**: Prov. Yazd: Shir-Kuh, 20 km SSW of Taft, *Aryavand et al. 1386* (E). Prov. Fars: between Jahrom and Asmangerd at the Shiraz road, *Motov 4069* (K); Shiraz, inter segetes in collibus Shiraz, *Kotschy 359* (G). **E**: Prov. Golestan: Jahan-Nama protected area, Chahar-Bagh to Shah-Kuh, *Jafari 36757* (TUH). **C**: Prov. Tehran: Alborz Mts, Firuzkuh area, *Furse & Synge 472* (K); c. 34 km after Tehran to Saveh, Parandak, *Amin & Bazargan 1829* (TUH); Firuzkuh, Zarrin-Dasht, *Babakhanlou & Amin 18141* (TARI); Damavand, Absard, *Dini & Azaram 13816* (TARI); Qom, c. 63 km S Qom, Vashnoveh, *Amin & Bazargan 18692* (TUH); c. 15 km N Firuzkuh, *Salmaki et al., 36519* (TUH).

Stachys inflata Benth. subsp. *caucasica* (Fig. 8D)

Stachys inflata Benth. subsp. *caucasica* (Stschegl.) Takht., in Takhtadzhani & Fedorov, Fl. Erevana: 260 (1972). = *Stachys inflata* var. *caucasica* Stschegl., Bull. Soc. Imp. Naturalistes Moscou 4: 474 (1851). ≡ *S. schtschegleevii* Sosn. ex Grossh., Fl. Kavkaza 3: 314 (1932) *Type*: Caucasus [Armenia], entre Erivan et Nakhitschevan, entre ce devnier et Ordubad, *Sosnowsky*.

PLANTS silvery, always densely hairy. CALYX slightly inflated, 12–20 × 8–12 mm; teeth lanceolate, acute at apex, 2.0–3.5 mm.

Phenology: Flowering and fruiting in July.

Distribution and ecology: North-east Turkey, Azerbaijan, Armenia, Georgia, north-west Iran (Fig. 8D). In Iran it is distributed only in the north-west of the country. It is a Euro-Siberian floristic element; elevation 800–2200 m.

Conservation status: VU (IUCN, 2008), in Iran known only from few localities, but more widespread in the Caucasus.

Affinities and variation: It is similar to *S. inflata* subsp. *inflata* but differs in calyx shape and teeth.

Selected specimens examined: W. Prov. W Azarbaijan: 95 km SE Maku versus Marand, *Rechinger 39278* (K, W). Prov. Ardabil: Ahar to Kaleybar, c. 10 km before Kaleybar, *Rezazadeh & Mozaffarian 83570* (TARI); Kaleybar, Ghaleh Babak, *Ghahraman et al. 17508* (TUH).

13. *Stachys kermanshahensis* (Fig. 2E)

Stachys kermanshahensis Rech.f., Pl. Syst. Evol. 134: 290 (1980). **Type:** IRAN, Kermanshah, Dalahu (Shalan-Dalahu), Mt. Kuh-e Golhaye zard, Barvand-e Sofla, 2220 m, *Moussavi & Satei 15696* (holotype: W!; isotypes: IRAN, G!)

PLANTS perennial, suffruticose, saxicolous, densely branched herbs, woody at base. STEM thin, 10–15 cm, densely branched at base, prostrate to decumbent, fragile, internodes 1.0–1.5 cm long, densely covered by spreading long simple hairs 2–3 mm long and stalked (c. 1 mm long) or subsessile to sessile glandular hairs. BASAL LEAVES cordate to broadly ovate, 2.0–2.5 × 2.0–2.5 cm, dentate at margin, obtuse at apex, usually truncate at base, densely hairy as the stem, petiole 0.3–0.5 cm. CAULINE LEAVES similar to basal leaves and gradually passing into sessile floral leaves. FLORAL LEAVES ovate to broadly lanceolate, 1.0 × 0.5–0.7 cm, shortly petiolate to sessile, otherwise similar to cauline leaves. VERTICILLASTERS (two-) three- to four (to five)-flowered, congested in a tapering inflorescence; pedicels minute. BRACTEOLES few or absent, herbaceous, linear to setaceous, 4–5 mm long, sparsely hairy. CALYX subregular, infundibular, 7–8(–9) × 3–4(–5) mm; teeth subequal, lanceolate, 3–4 mm long, covered with short (< 0.5 mm) to long simple hairs and stalked glandular hairs at margin. COROLLA white to creamy with purple spots on upper and lower lips, 14–20 mm long; tube obviously longer than calyx tube, 10–12 mm long; upper corolla lip 3–4 × 2.5–3.0 mm; lower corolla lip indistinctly trilobed, 6–8 × 5–6 mm. NUTLETS obovoid, 3.0–3.3 × 2.0–2.5 mm, minutely reticulate on surface, wingless.

Phenology: Flowering and fruiting between early June and early July.

Distribution and ecology: Western Iran (endemic, Fig. 9A); elevation 1000–2200 m.

Conservation status: EN (IUCN, 2008). Due to its unique habit type on limestone-bearing soils near rocks and cliffs, it is known only from few sparse patches in Kermanshah Province in Iran and it is at high risk.

Affinities and variation: *Stachys kermanshahensis* is easily distinguishable from *S. veroniciformis*, perhaps its closest relative, by broad to rounded leaves and a villous indumentum. This species differs from *S. lanigera* with similar habit and habitat mainly in its bracteoles and calyx length. The latter has a long calyx (10–12 mm) and longer (10–12 mm) and wider bracteoles.

Selected specimens examined: W. Prov. Kermanshah: c. 5 km after Tout-shami village toward Mar-e Khamoush cave, *Zarre & Salmaki 36504* (TUH); Rijab, Shalan village, Sarab-e Eskandar, *Zarre & Salmaki 36522* (TUH).

14. *Stachys kotschyi* (Fig. 6)

Stachys kotschyi Boiss. & Hohen. in P.E.Boissier *Diagn. Pl. Orient. ser.*, 1, 5: 32 (1844). **Type:** Iraq, in rupestribus Mts Gara Kurdistan, versus Cacumen, *Kotschy 367* (holotype: G-BOIS!; isotypes: G!, M!, W!). =*S. haussknechtii* Vatke, *Bot. Zeit.* 33: 46 (1875).

PLANTS perennial, caespitose herbs, silvery, ± woody at base. STEM thin, densely branched at base, usually simple further up, 15–50 cm, erect, internodes 3–6 cm long, stipules present at leaf base, densely covered by stellate hairs 0.5–1.5 mm long with two to five arms and subsessile to sessile glandular hairs. BASAL LEAVES oblong to elliptic, 2.0–4.5 × 1.0–1.5 cm, entire at margin, obtuse or rarely acute at apex, attenuate at base, hairy as stem, petiole 0.3–0.5 cm. CAULINE LEAVES similar to basal leaves, gradually passing into sessile floral leaves, oblong to elliptic, 2.0–3.5 × 0.6–1.2 cm, entire at margin, otherwise similar to basal leaves, petiole 0.2–0.3 cm. FLORAL LEAVES oblong to lanceolate, 1.2–2.5 × 0.4–0.8 cm, shorter than the verticillasters, shortly petiolate to sessile, obtuse at apex, entire at margin. VERTICILLASTERS (three-) four- to six- (to eight)-flowered, remote, congested in a tapering inflorescence toward the apex; pedicels minute. BRACTEOLES numerous, herbaceous, linear to lanceolate, 6–8 mm long, hairy as the leaves. CALYX regular, campanulate, 10–20 × 3–6 mm, recurved in fruit; teeth subequal, lanceolate, acute at apex, 2.5–4.5 mm



Figure 6. *S. kotschyi*: A, habit; B, flower; C, dissected calyx; D, corolla. Ghahraman et al. 21664 (TUH).

KEY TO SUBSPECIES IN IRAN

1. Calyx 6–8 mm long, tubular to campanulate, its teeth lanceolate to subulate, without glandular trichomes, covered by double indumentum consisting of long spreading simple trichomes mixed with short appressed ones....subsp. *kurdica*
- 1'. Calyx up to 6 mm long, star-like with erect teeth at fruiting time, calyx teeth triangular, covered by appressed short papillose trichomes.....subsp. *asterocalyx*

long, hairy as the bracteoles. COROLLA pink to purple, 10–18 mm long; tube shorter than the calyx tube, 6–8 mm long; upper corolla lip 5–7 × 4–5 mm; lower corolla lip distinctly trilobed, 5–10 × 6–10 mm. NUTLETS obovoid, 3.0–3.5 × 2.4–3.0 mm, foveate on surface, wingless.

Phenology: Flowering and fruiting between early June and early July.

Distribution and ecology: North and north-east Iraq and western Iran (Fig. 9A). Growing in mountainous slopes and steppes among other cushion-forming plants such as *Acantholimon* and *Astragalus*; elevation 1000–2000 m.

Conservation status: VU (IUCN, 2008). It is rare in Iran, but is distributed more frequently in adjacent eastern Iraq.

Affinities and variation: This species is recorded here for the first time from Iran. It can be distinguished from *S. inflata* by its non-inflated calyx, shorter corolla tube (included in calyx) and lanceolate, longer calyx teeth acute at apex.

Selected specimens examined: W. Prov. Lorestan: Khorramabad, Aleshtar, *Ghahraman et al.* 21664 (TUH).

15. *Stachys kurdica*

Stachys kurdica Boiss. & Hohen. in P.E. Boissier, *Diagn. Pl. Or. ser. 1*, 5: 31 (1844). *Type*: [Iraq] KURDISTAN, in rupestribus totius m. Gara Kurdistaniae, versus cacumen, 1841, *Th. Kotschy 390* (holotype: G-BOIS!; isotypes: G!, LE!, M!, W!).

=*S. ballotiformis* Vatke, *Bot. Zeitung (Berlin)* 33: 448 (1875); **syn. nov.** *Type*: [Iraq/Iran] Iter Syriaco-Armeniacum, Kurdistan, Pir Omar Gudrun, 4000 ped., 6.6.1867, *Haussknecht 806* (holotype: W!).

=*S. plebeia* Vatke, *Bot. Zeitung (Berlin)* 33: 449 (1875).

=*S. benthamiana* Boiss. var. *clinopodioides* Boiss., *Fl. Or.* 4: 735 (1879).

PLANTS perennial, saxicolous, suffruticose herbs with woody base. STEM thin and fragile, numerous, erect to decumbent, 15–40 cm, internodes 1–3 cm

long, sparsely covered with short simple hairs up to 0.5 mm long or sometimes glabrous. BASAL LEAVES ovate to lanceolate, 1.2–1.5 × 1.0–1.2 cm, hairy as stem, petiole 0.5 cm. CAULINE LEAVES similar to basal leaves but somewhat smaller, gradually passing into sessile floral leaves, ovate to lanceolate, 0.8–2.5 × 0.5–1.8 cm, dentate at margin, acute at apex, usually truncate at base, hairy as stem and basal leaves, petiole 0.2–0.3 cm. FLORAL LEAVES ovate-lanceolate, 0.5 × 0.3 cm, shortly petiolate to sessile, acute at apex, weakly dentate at margin, sparsely covered with smooth short simple hairs. VERTICILLASTERS (two-) three- to five- (to six)-flowered, remote, pedicels up to 0.2 mm long to sessile. BRACTEOLES few absent or few, herbaceous, linear to setaceous, 1–3 mm long, usually hairy as the leaves, sometimes glabrous. CALYX subregular, infundibular, 4–8 × 2–3 mm; teeth herbaceous (not rigid), blunt, subequal, lanceolate, ± recurved and widened in fruit, 1–3 mm long, sparsely covered by smooth short simple hairs. COROLLA lemon yellow, 12–15 mm long; tube usually equal to calyx tube, 5–6 mm long; upper corolla lip 4–5 × 2–3 mm; lower corolla lip indistinctly trilobed, 6–8 × 5–6 mm. NUTLETS broadly obovoid, 3.0–3.3 × 2.5–2.7 mm, scalariform minutely reticulate on surface, narrowly winged.

Stachys kurdica Boiss. & Hohen. subsp. *kurdica* (Fig. 2F)

STEMS numerous, densely branched at base. CAULINE LEAVES 0.8–1.5 × 1.0 cm; pedicels sessile. CALYX 6–8 mm long; tubular to campanulate; covered by double indumentum consisting of long spreading simple trichomes mixed with short appressed trichomes.

Phenology: Flowering and fruiting between early June and early July.

Distribution and ecology: South-east Turkey, northern Iraq, western Iran (Fig. 9A); Irano-Turanian element. Steep sandstone or limestone slopes, or on cliffs and rocks; elevation 760–1350 m.

Conservation status: LC (IUCN, 2008); widespread in western Iran and adjacent countries, especially in rock crevices.

Affinities and variation: The delimitation of species in the *S. kurdica* complex (*S. kurdica* and its allies) based solely on morphological characters is problematic. The close relationship and synonymy of *S. ballotiformis* under *S. kurdica* was suggested based on isoenzyme markers (Salmaki *et al.*, 2009b). Among populations studied there, *S. ballotiformis* and *S. kurdica* showed the lowest genetic distance (Salmaki *et al.*, 2009b), which does not support their recognition as independent taxa. The main difference between these two putative taxa should be the absence of long hairs in *S. kurdica* according to *Flora Iranica* (Rechinger, 1982), but, based on a hair micromorphological study (Salmaki *et al.*, 2009a), the occurrence of long hairs is most probably age-dependent, so that the younger specimens can be identified as *S. ballotiformis* and older ones as *S. kurdica*. So, we consider *S. ballotiformis* to be a synonym of *S. kurdica*. On the other hand, *S. kurdica* is closely related to *S. subnuda* Montbret & Aucher ex Benth. (distributed in eastern Turkey), from which it differs in having oblong-lanceolate median cauline leaves and broadly triangular to oblong-lanceolate and herbaceous (not rigid) blunt calyx teeth.

Selected specimens examined: **W:** Prov. W Azarbaijan: Qotur, W Khoy, *Rechinger 41643* (B, G); Chalil-Kuh, N Razhan, *Rechinger 48747* (B, W); Qotur valley, Khoy, *Iranshahr 3429* (E), and *Lamond 4016* (E); Prov. Kordestan: Chehel-Cheshme, 44 km NE Marivan (Dezh-Shahpur), *Rechinger 43016* (B); in montibus Pir Omar Gudrun, *Hauskschecht 806* (W); 20 km after Kamyaran to Ravansar, *Zarre & Salmaki 36517* (TUH); *c.* 20 km after Kamyaran and Varmanhang to Ravansar, *Zarre et al. 36517* (TUH). Prov. Kermanshah: Bisotoun Mts, *Zarre & Salmaki 35890* (TUH); 101 km after Pol-e Dokhtar toward Eslamabad-e Gharb, Shahbodagh pass, *Zarre & Salmaki 35877* (TUH); about 5 km after Tout-Shami village toward Mar-e Khamoush cave, *Zarre & Salmaki 36508* (TUH); *c.* 10 km after Gahvareh toward Kouzaran, *Salmaki & Zarre 36512* (TARI, TUH); on the road of Kermanshah to Kamyaran, *c.* 15 km after Kermanshah, above Miyan-Bandar village, *Zarre & Salmaki 35889* (TUH); 18 km to Kermanshah from Hamadan, *Zarre & Salmaki 36513* (TUH). Prov. Hamadan: 20 km N Nahavand, Gerin Mts, above Gerusab, *Assadi & Mozaffarian 36916* (TARI). Prov. Lorestan: Saravan Mts, 20 km SE Dowroud, *Rechinger 48059* (B, G); 90 km SE Khorramabad near Sefid-Dasht, *Rechinger 44780* (B); Osh-toran Kuh, Saravand, 20 km SE Dowroud, *Rechinger 48059* (G); Ghali Kuh, 50–60 km to Aligudarz, *Rechinger 48007* (G); Khorram-Abad to Pol-e Dokhtar historical bridge, 40 km after Khorram-Abad, mountains above Tang-e-Tir, *Zarre & Salmaki 35886*,

35888 (TUH); Khorram-Abad, Pol-Dokhtar, *Riazi 9572* (E). Prov. Bakhtiari: 2 km after Gandom-Kar, from Do-Polan toward Izeh, Helen forest protected area, *Zarre & Salmaki 35880* (TUH).

Stachys kurdica subsp. *asterocalyx* (Fig. 1F)

Stachys kurdica Boiss. subsp. *asterocalyx* (Rech.f.) Salmaki; **comb. & stat. nov.** = *Stachys asterocalyx* Rech. f., Bot. Jahrb. Syst. 71: 533 (1941). *Type:* IRAN, Fars, Kuh-e Kable, in faucibus umbrosis, *Stapp 696* (holotype: WU!; isotype: WU!).

STEMS loosely branched. CAULINE LEAVES 1.5–2.5 × 1.2–1.8 mm; pedicels up to 0.2 mm. CALYX 6 mm long; infundibular; covered by appressed short papillose trichomes.

Phenology: Flowering and fruiting between early April and early June.

Distribution and ecology: Endemic to southern Iran (Fig. 9A). This subspecies is confined to the southwest of the country, where it is distributed on large shady rocks at an altitude of 1500–2100 m; Irano-Turanian element. It has a more southern distribution pattern than the type subspecies.

Conservation status: NT (IUCN, 2008). Although it shows the same ecology as the type subspecies, it is known from few localities with sparse patches of limited individuals.

Affinities, variation and typification: As the morphological differences between *S. kurdica* and *S. asterocalyx* are rather minor, we reduced the latter here to subspecific rank. According to *Flora Iranica* (Rechinger, 1982) *S. asterocalyx* is similar to *S. ballotiformis* (considered here as a synonym of *S. kurdica*) but differs from it in having densely papillose, appressed short hairs, whereas *S. benthamiana* is characterized by stalked glandular hairs. For separating *S. kurdica* subsp. *asterocalyx* and subsp. *kurdica* we referred to other morphological characters such as leaf shape, calyx features and corolla size instead of hairs. See also the note under *S. kurdica* subsp. *kurdica*.

Of three type specimens deposited in WU the most complete one bearing Rechinger's handwriting and type label is the holotype and two other are referred here as isotypes.

Selected specimens examined: **S.** Prov. Fars: Between Behbahan and Deh-Dasht, Khiz Mts near the Koushk village, *Assadi & Abou-hamzeh 38701* (TARI); Shiraz,

Dasht-e Arjan to Kazeroun, 1 km after Dasht-e Arjan, rocky cliffs facing the road, Zarre & Salmaki 35909 (TUH).

16. *Stachys lanigera*

Stachys lanigera (Bornm.) Rech.f., Bot. Jahrb. Syst. 71: 528 (1941). *Typus*: IRAN, Kermanshah: Kerind, in monte Noa Kuh, *Strauss* (lectotype, designated here: B!; isotype: W!, WU!) = *Stachys fragillima* var. *lanigera* Bornm., Beih. Bot. Centralbl. 33(2): 189 (1915).

PLANTS perennial, saxicolous, suffruticose herbs with woody base. STEM thin, 10–15 cm, decumbent, much branched at base, fragile, internodes 1.0–1.5 cm long, densely covered by appressed smooth short hairs up to 1 mm and long simple hairs to 3 mm with stalked or subsessile to sessile glandular hairs. BASAL LEAVES broadly ovate, 1.0–1.5 × 1.0–1.2 cm, densely covered with appressed long simple hairs and stalked to subsessile or sessile glandular hairs, dentate at margin, obtuse at apex, usually truncate at base, petiole 0.3–0.5 cm. CAULINE LEAVES similar to basal leaves, gradually passing into sessile floral leaves. FLORAL LEAVES ovate to broadly lanceolate, 1.0 × 0.5–0.7 cm, shortly petiolate to sessile, obtuse at apex, dentate at margin, hairy as cauline leaves. VERTICILLASTERS (one-)two(to three)-flowered, congested in a tapering inflorescence; pedicels subsessile to sessile. BRACTEOLES few, herbaceous, linear to setaceous, ± 10 mm long, densely smooth, short, simple hairy. CALYX subregular, ± 10 × 3–4 mm; teeth subequal, lanceolate, 2.0–2.5 mm long, covered with simple hairs and glandular hairs at margin. COROLLA white to creamy with purple spots on upper and lower lips, 14–20 mm long; tube longer than calyx tube, 10–12 mm long; upper corolla lip 3–4 × 2.5–3.0 mm; lower corolla lip indistinctly trilobed, 6–8 × 5–6 mm. NUTLETS obovoid, 3.0–3.3 × 2.0–2.5 mm, minutely reticulate on surface, wingless.

Phenology: Flowering and fruiting July.

Distribution and ecology: Iran (endemic to western Iran, Fig. 9B); elevation 1200–1500 m.

Conservation status: EN (IUCN, 2008), no collections have been made from this species after the type collection.

Affinities and variation: It is an extremely rare plant in Iran known from a single collection. In contrast to its close relative, *S. fragillima* Bornm. (known from E Iraq), it has short calyx teeth, large corolla tube and dense appressed hairs.

Selected specimens examined: Known only from the type gathering (WU).

17. *Stachys lavandulifolia* (Fig. 2G)

Stachys lavandulifolia Vahl, Symb. Bot. 1: 42 (1790). *Type*: ‘In Oriente’ [*Stachys lavandulifolia* Galeopsis orientalis lavandulæfolio calyce vilosissimo Tournefort Corol. ded. Broussonet] (C: photograph!) = *Zietenia lavandulifolia* (Vahl) Link, Enum. Hort. Berol. Alt. 2: 110 (1822). = *Zietenia orientalis* Gled., Mém. Acad. Roy. Sci. Hist. (Berlin) 1766: 3 (1766), nom. superfl.

= *Stachys lavandulifolia* var. *glabrescens* Bhattacharjee & Hub.-Mor., Notes Roy. Bot. Gard. Edinburg 33: 283 (1974).

PLANTS perennial, decumbent herbs, with creeping rhizome and basal rosette leaves beside some sterile axes. STEM thin, 10–30 cm, numerous, erect, internodes 2.0–3.0(–3.5) cm long, covered by stellate hairs with a long central arm up to 5 mm and five to eight shorter arms up to 0.5 mm, and stalked glandular and clavate hairs. BASAL LEAVES elliptic to oblong-lanceolate, 2–8 × 0.5–1.5 cm, entire to finely dentate at margin, obtuse at apex, attenuate at base, hairy as the stem, petiole 1–4 cm. CAULINE LEAVES similar to basal leaves but smaller, oblong to lanceolate, 2.0–2.5 × 0.5–0.7 cm, subsessile to sessile, hairy as basal leaves. FLORAL LEAVES elliptic-oblong, 1.5–2 × 0.5–1.0 cm, similar to cauline leaves. VERTICILLASTERS (two-)four to six-flowered, usually remote, pedicels 1–2 mm long. BRACTEOLES few, herbaceous, linear, 2–3 mm long, sparsely appressed, short, simple, hairy. CALYX ± regular, campanulate, 25–30 × 3.0–5 mm; teeth subequal, triangular-subulate, recurved, 10–20 mm long, sparsely covered by exerted long vermiform hairs unequally stellate at base but mixed with dense subsessile to sessile glandular hairs. COROLLA pink to purple, sometimes with white spots, 16–20 mm long; tube 7–10 mm long, tube slightly longer than calyx tube; upper corolla lip 4–6 × 3.0–4.5 mm; lower corolla lip indistinctly trilobed, 8–10 × 7–10 mm. NUTLETS broadly obovoid, 2.5–3.0 × 2.0–2.3 mm, reticulate on surface, wingless.

Phenology: Flowering and fruiting between early June and mid July.

Distribution and ecology: Mainly eastern and southern Turkey, Armenia, Azerbaijan, Georgia and Iran (Fig. 9B); Irano-Turanian element; limestone to igneous rocky slopes and screes, elevation 1000–3660 m.

Conservation status: LC (IUCN, 2008). Although this species is used extensively by indigeneous people as a

medicinal herb or herbal tea, due to its widely spreading rhizomes the populations of the plant are not threatened in the area.

Affinities and variation: The species is characterized by its large calyx and long calyx teeth, basal leaves at sterile branches arranged in rosette, stellate hairs radiating from a basal node including a main central long arm along with several smaller ones. Branched hairs, however, with more nodes are characteristic for instance in *S. inflata*, which is the nearest frequent species of *Stachys* in Iran. Hybrids between these two species are relatively frequent in Iran (see below under the hybrids).

Selected specimens examined: **N:** Prov. Mazandaran: Alborz Mts, *Strauss 7950* (WU); Lar valley, 3 km after Delichay, *Zarre & Salmaki 36527* (TUH); Firuzkuh, Gaduk pass, 10 km to Orim village, *Zarre & Salmaki 36764* (TUH); Gaduk pass, c. 10 km to Orim, *Salmaki et al., 36867* (TUH). **W:** Prov. Kordestan: 15 miles to SE Mahabad, *Furse 2147* (K); Kauleh, between Sanandaj and Saqqez, *Archibald 2139* (K); Steppe mountains N and NW Iran, *Cowan & Darlington 2139* (K). Prov. Lorestan: N Doroud, facing slopes in vary stony clay, *Archibald* (E); Doroud, *Archibald 1557* (E); Karaghan, *Pichler 176* (WU); W Iran, *Strauss 1241* (WU). Prov. Kohgiluyeh: c. 22 km after Hana to Padena, *Salmaki & Zarre 35898* (TUH). **E:** Prov. Golestan: Azad Shahr, *Polumin 11895* (K). Prov. Khorasan: NE Chenaran, Baghich Mts, *Hojjat & Zangoeei 32845* (FUMH); East Qouchan, Yadak, *Joharchi & Zangoeei 12882* (FUMH); NW Neyshaboer, Marosak, Heydari Mts, *Joharchi 34927* (FUMH); N Mashhad, Kalat area, *Joharchi & Zanghoeei 16823* (FUMH). **C:** Prov. Tehran: Elburs, Touchal prope Shahrestanak, *Bornmüller 7951* (WU); Tehran, 13 km to Dizin from Gachsar, near the river, *Zarre & Salmaki 36521* (TUH); Qazvin to Alamout, c. 10 km to Ovan lake, *Salmaki et al. 35916* (TUH).

18. *Stachys laxa* (Fig. 3A)

Stachys laxa Boiss. & Buhse, Nouv. Mém. Soc. Imp. Naturalistes Moscou 12: 179 (1860). *Type:* Radkan, VIII. 1848, *Buhse* (holotype: G-BOIS!).

PLANTS perennial, caespitose to suffruticose herbs, with woody base. STEM thin, branched at base but simple or somewhat branched further up, 30–60 cm, erect, internodes 4–8 cm long, densely covered by dendroid two- to five-armed multinodal hairs with two to five arms 0.3–0.6 mm along with subsessile to sessile glandular hairs. BASAL LEAVES oblong to elliptic, dicolourous with upper side greenish and almost glabrous and lower side silvery and densely hairy as the stem, 2.5–5.0 × 0.6–1.2 cm, entire at margin, usually acute at apex or rarely

acuminate, usually attenuate at base, petiole 0.3–0.5 cm. CAULINE LEAVES similar to basal leaves, gradually passing into sessile floral leaves, oblong to elliptic, 2.0–3.5 × 0.5–1.0 cm, covered with branched hairs and subsessile to sessile glandular hairs, otherwise similar to basal leaves, petiole 0.1–0.2 cm. FLORAL LEAVES elliptic to lanceolate, 0.8–2.0 × 0.2–0.4 cm, shortly petiolate to sessile, acute at apex, entire at margin, hairy as basal leaves. VERTICILLASTERS (four-) five- to eight (–ten)-flowered, remote, pedicels minute. BRACTEOLES few, herbaceous, linear to lanceolate, 2–4 mm long, with branched hairs along with subsessile to sessile glandular hairs. CALYX subregular, infundibular, 8–10 (–12) × 3.5–5.0 mm; teeth subequal, triangular to lanceolate, recurved in fruit, 3–5 (–6) mm long, with dense branched hairs along with subsessile to sessile glandular hairs. COROLLA pink to purple with white or yellow spots on lower lip, 12–18 mm long; tube subequal to calyx tube, 9–12 mm long; upper corolla lip 4–6 × 2.5–4.0 mm; lower corolla lip indistinctly trilobed, 6–8 × 7–10 mm. NUTLETS obovoid, 3.0 × 2.0–2.2 mm, rugose on surface, wingless.

Phenology: Flowering and fruiting between early June and early July.

Distribution and ecology: Iran (endemic to north-east Iran, Fig. 9B). It prefers rocky slopes, stony ground in vegetation of *Rhamnus*, *Artemisia* and *Berberis* L.; elevation (1200–)1500–2400 m.

Conservation status: LC (IUCN, 2008).

Affinities and variation: *Stachys laxa* is closely related to *S. turcomanica* but differs from it mainly in its leathery and discolourous leaves (upper surface green and lower surface silvery). See also the note about *S. leucomalla* under hybrid taxa.

Selected specimens examined: **N:** Prov. Mazandaran: S Amol, *Archibald s.n.* (K); 25 miles of Amol, Haraz river valley, *Furse 7073* (K); 34 km S Amol, *Petersen 243* (E); 34 km S Amol toward Siah-Bisheh, *Ajani 10086* (TUH). **C:** Prov. Tehran: Persia borealis, Alborz, *Pichler s.n.* (WU); Nezva-Kuh area, Near Orim, *Wendelbo 1016* (E); Firuzkuh, 13 km on the road of Firuzkuh to Semnan, *Assadi & Mozaffarian 35254* (TARI); Firuzkuh, Veresk bridge, *Foroughi 7384* (TARI); Gadouk pass, near the Veresk bridge, *Zarre & Salmaki 36525* (TUH); Firuzkuh, Gadouk pass, Nizva Mts, near the Orim village, *Salmaki et al. 36872* (TUH); near Rudkhaneye Gur Sefid, 14 km E Firuzkuh on road to Semnan, *Podlech & Mozaffarian 55387* (MSB). Prov. Semnan: Shahrud, N slopes of Shahvar Mts, from Meighan to Termeh, towards Panavaran,

Mozaffarian 78120 (TARI), 49 km from Shahpasand on the road to Shahrud, Til-Abad, *Wendelbo & Assadi 29954* (TARI).

19. *Stachys melampyroides* (Fig. 7)

Stachys melampyroides Hand.-Mazz., Ann. K. K. Naturhist. Hofmus. 27: 415 (1913). *Type*: Iraq, Kurdistan, Riwandous, in mt. Sakri-Sarkhan, 1700 m, *Bornmüller 1663* (lectotype designated here: B!; isotypes: B!, K, W!, WU!); [Turkey C8] Mardin: Binibil, in vineis, 28 vi 1888, *Sintenis 1177* (syntypes K, LD); in glareosis ad fluvium Zab Ala, *Haussknecht* (syntype JE).

=*S. ramosissima* Boiss., Fl. Orient. 4:7474 (1879), nom. illeg. non Montbret et Aucher ex Benth (1836).

PLANTS annual herbs. STEM thin, 10–25 cm, simple or sometimes branched, erect, internodes 0.5–2.0 cm long, covered by short simple hairs c. 0.1 mm along with stalked or sessile glandular hairs. BASAL LEAVES oblanceolate to lanceolate, 1.5–3.0 × 0.2–1.0 cm, faintly crenate to dentate at margin to subentire, usually obtuse at apex, attenuate at base, shortly petiolate to subsessile, covered by short simple hairs along with stalked or sessile glandular hairs. CAULINE LEAVES similar to basal leaves, lanceolate to elliptic, 0.8–2.5 × 0.4–0.6 cm, subentire or entire at margin, obtuse or rounded at apex, attenuate at base, subsessile, hairy as basal leaves. FLORAL LEAVES lanceolate, 0.6–2.0 × 0.3–0.5 cm, sessile, obtuse at apex, entire at margin. VERTICILLASTERS in dense spikes, with few remote, four- to six (–eight)-flowered, pedicels often 0.5–1.0 mm, rarely subsessile to sessile. BRACTEOLES indistinct. CALYX regular, urceolate to campanulate, 7–9 × 1.5–2.5 mm; teeth subequal, lanceolate to subulate, recurved in fruit, 3–4 mm long, acute and spinescent at apex, sparsely appressed, short, simple, hairy. COROLLA purple to pink, 10–12 mm long; tube longer than calyx tube, 8–10 mm long; upper corolla lip 1–2 × 1 mm; lower corolla lip indistinctly trilobed, 2–3 × 1.5–3.0 mm. NUTLETS obovoid, 1.0–1.4 × 1.0 mm.

Phenology: Flowering and fruiting between early May and early June.

Distribution and ecology: South-east Turkey, northern Iraq, western Iran (Fig. 9C); Irano-Turanian element. Shaley screes and gullies of calcareous rocks; elevation 780–1250 m.

Conservation status: NT (IUCN, 2008). In Iran it is known only from a few localities with few individuals.

Affinities and variation: This species is recorded for the first time from Iran here. *Stachys melampyroides*

is unique in Iran and easily to identify based on its annual habit with branched flowering stems and narrow leaves (Fig. 5) and glabrous calyx with recurved teeth.

Selected specimens examined: Prov. Lorestan: Khorramabad, Veisian, Chal-e Ahmad, *Veiskarami 23907* (TUH).

20. *Stachys multicaulis* (Fig. 3B)

Stachys multicaulis Benth., in A.P.de Candolle, Prodr. 12: 486 (1848). *Type*: Persia, *Aucher Eloy 1809* (Lectotype designated here: G-DC! mentioned in protologue along with a sample in K; isotypes: G-BOIS!, G!).

PLANTS perennial, cushion-forming, woody at base. STEM from a thick based becoming thin further up, 20–40 cm, profusely branched near the base and leaf axils, usually erect, internodes 1.0–2.5 cm long, sparsely covered with appressed short simple hairs up to 1 mm and short subsessile to sessile glandular hairs. BASAL LEAVES elliptic to narrowly elliptic, 2–3.5 × 0.4–0.6 mm, sparsely covered by appressed long simple hairs and subsessile to sessile glandular hairs, entire at margin, spinescent at apex, attenuate at base, subsessile to sessile. CAULINE LEAVES oblong, 0.8–1.5 × 0.3–0.5 cm, sessile, otherwise similar to basal leaves. FLORAL LEAVES linear-lanceolate, 0.5–1.0 × 0.2–0.5 cm, sessile, similar to cauline leaves. VERTICILLASTERS two-flowered, remote, pedicels 1.5–2.0 mm long. BRACTEOLES absent. CALYX regular, tubular, 9–14 × 3–5 mm; teeth subequal, spinescent at apex, 2–4 mm long, triangular to lanceolate, sparsely covered with appressed short simple hairs up to 1 mm and short subsessile to sessile glandular hairs at margin. COROLLA creamy to yellow, 12–18 mm long; tube 6–9 mm long, subequal to the calyx tube; upper corolla lip 3.0–5.5 × 2.5–4.0 mm; lower corolla lip indistinctly trilobed, 6–10 × 6–9 mm. NUTLETS obtriangular in outline, 3.3–3.7 × 1.6–2.0 mm, colliculate on surface, narrowly winged.

Phenology: Flowering and fruiting between early June and mid July.

Distribution and ecology: Endemic to Zagros Mountain ranges (Fig. 9C) and usually distributed in sub-alpine steppe vegetations with limestone as substrate.

Conservation status: NT (IUCN, 2008).

Affinities and variation: Triangular calyx teeth which are one-quarter the length of the calyx as a whole and the corolla tube shorter than the calyx are the main

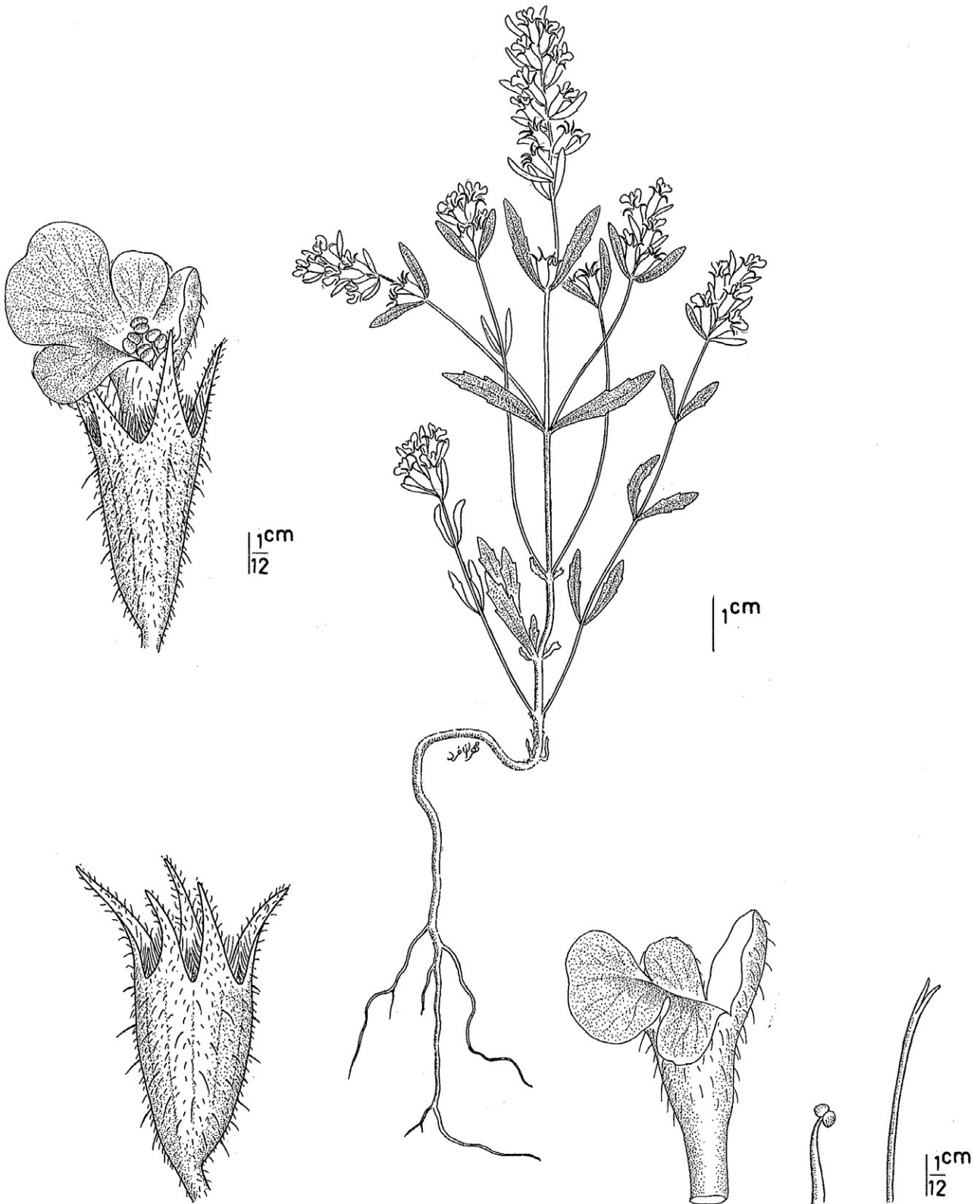


Figure 7. *S. melampyroides*: A, habit; B, flower; C, dissected calyx; D, corolla. Veiskarami 23907 (TUH).

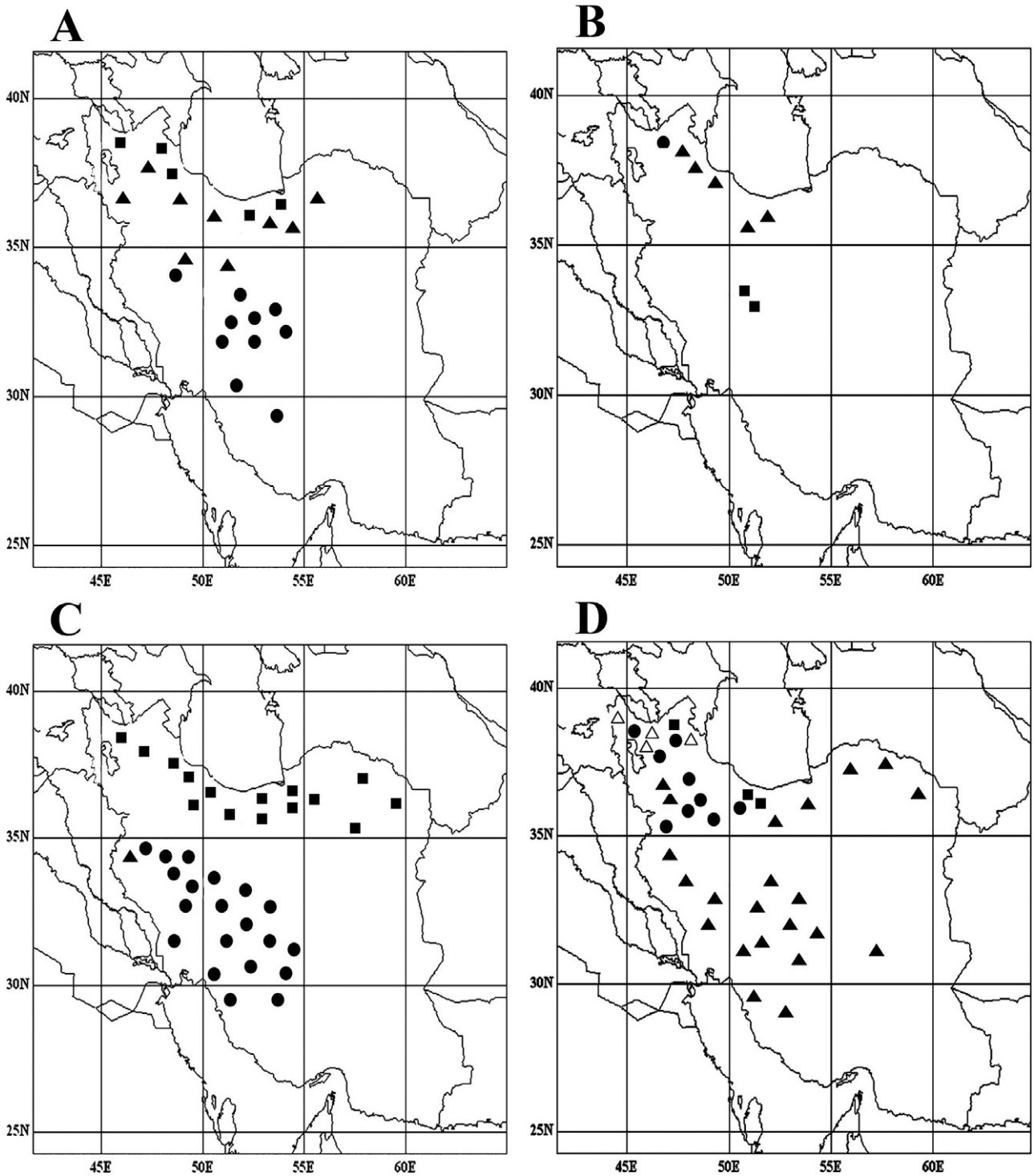


Figure 8. Distribution of *Stachys* taxa in Iran: A, *S. acerosa* (●), *S. alpina* (■), *S. annua* (▲); B, *S. atherocalyx* (●), *S. aucheri* (■), *S. balansae* (▲); C, *S. benthamiana* (●), *S. byzantina* (■), *S. cretica* subsp. *garana* (▲); D, *S. fruticulosa* (●), *S. iberica* susp. *georgica* (■), *S. inflata* subsp. *inflata* (▲), *S. inflata* subsp. *caucasica* (Δ).

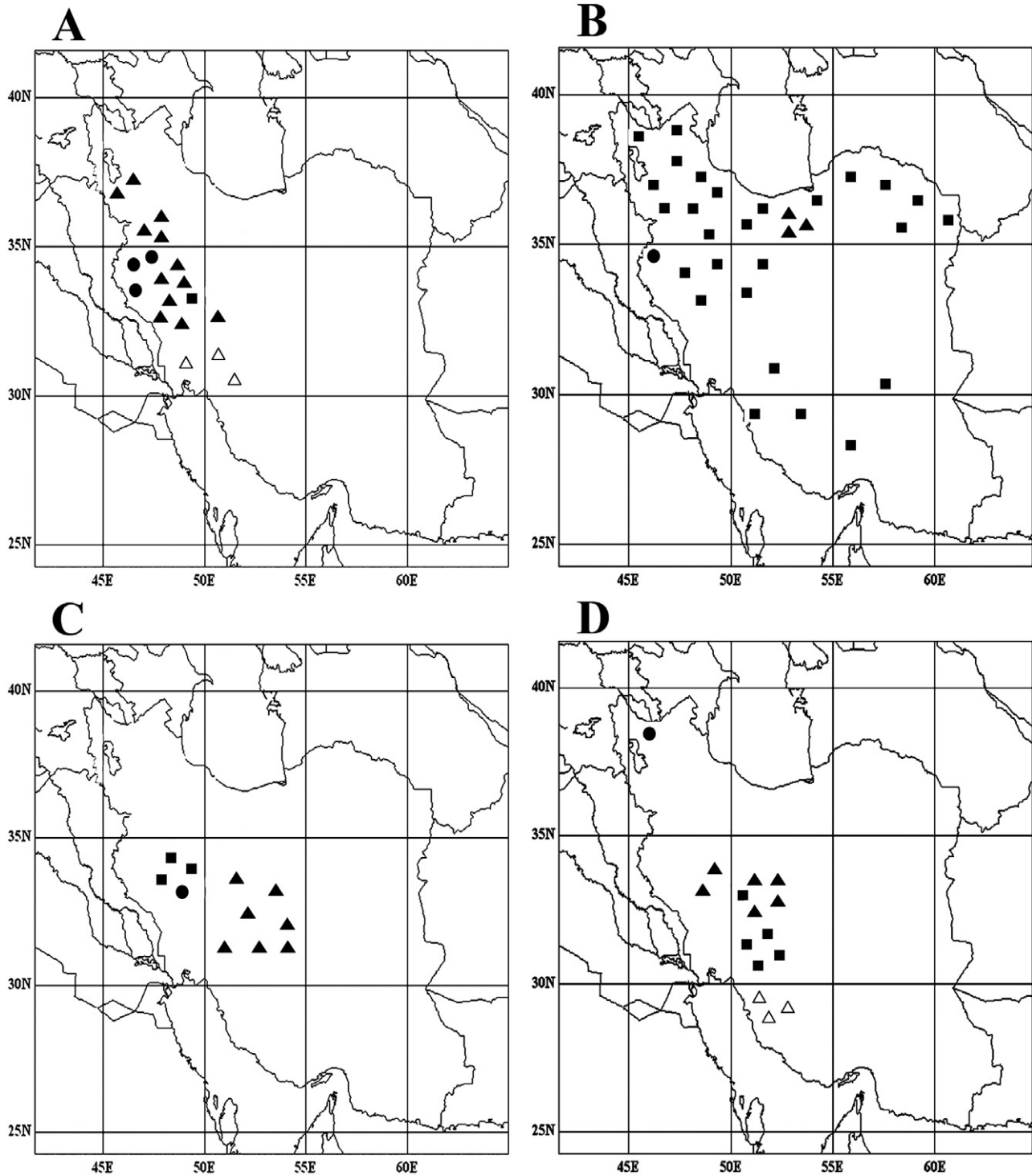


Figure 9. Distribution of *Stachys* taxa in Iran: A, *S. kermanshahensis* (●), *S. kotschy* (■), *S. kurdica* subsp. *kurdica* (▲), *S. kurdica* subsp. *asterocalyx* (Δ); B, *S. lanigera* (●), *S. lavandulifolia* (■), *S. laxa* (▲); C, *S. melampyroides* (●), *S. multicaulis* (■), *S. obtusirena* (▲); D, *S. palustris* (●), *S. persepolitana* (■), *S. pilifera* subsp. *pilifera* (▲), *S. pilifera* subsp. *ixodes* (Δ).

diagnostic characters of this species. It is related to *S. acerosa* but differs from it mainly in its non-thorny flowering stems. In the former just the leaves and the calyx teeth are spinescent and sparsely covered by short simple trichomes (< 0.1 mm).

Selected specimens examined: **C:** Prov. Markazi: Rasvand, *Strauss s.n.* (K); Arak, Rasband Mts, *Mozaffarian 48352, 48353* (TARI). **W:** Prov. Hamadan: Elwend Mts, *Pichler* (B); Hamadan, in Peshawar Mts, *Strauss s.n.* (B); c. 3 km after Ganjnameh, on the road Hamadan to Ganjnameh, N slopes of Alvand Mts, *Zarre & Salmaki 35891, 36526* (TUH). Prov. Kermanshah: Kermanshah, *Strauss s.n.* (B); Kermanshah, *Hausknecht 809* (G-BOIS).

21. *Stachys obtusirena*

Stachys obtusirena Boiss., *Diagn. Pl. Orient. ser. 1, 7: 57* (1846). *Type:* Persia, Kuh-e Dinar, 2900–3500 m, *Kotschy 599* (holotype: G-BOIS!; isotypes: K!, M!, W!).

PLANTS perennial, caespitose herbs. STEM thin, 15–40 cm, usually densely branched at base, erect, internodes 2–4 cm long (remote), densely covered by dendroid two- to five-armed multinodal hairs 0.3–0.6 mm long and subsessile to sessile glandular hairs. BASAL LEAVES circular, 2–4 × 2–3 cm, crenate to dentate at margin, usually obtuse or rounded at apex, cordate at base, subsessile to sessile, hairy as stem. CAULINE LEAVES circular, similar to basal leaves, 1.5–3.0 × 1.5–2.5 cm, entire at margin, sessile, hairy as basal leaves. FLORAL LEAVES circular, 1.0–1.5 × 1.0 cm, otherwise similar to cauline leaves. VERTICILLASTERS four- to eight-flowered, remote; pedicels absent or reduced. BRACTEOLES absent. CALYX subregular, tubular, 7–10 × 3.5–5.0 mm, hairy as the leaves; teeth subequal, triangular, erect, obtuse at apex, 2–3 mm long. COROLLA purple, 12–18 mm long; tube included in the calyx tube, 9–12 mm long; upper corolla lip 4–6 × 2.5–4.0 mm; lower corolla lip indistinctly trilobed, 6–8 × 7–10 mm. NUTLETS obovoid, 3.0 × 2.0–2.2 mm, rugose on surface, wingless.

Phenology: Flowering and fruiting between early June and early July.

Distribution and ecology: Endemic to the Zagros Mountains in western Iran (Fig. 9C). Found in high montane areas among some cushion-forming plants such as *Astragalus* and *Onobrychis* Mill.; elevation 2000–3500 m.

Conservation status: VU (IUCN, 2008); a very rare plant forming sparse patches.

Affinities and variation: The results of micromorphological and morphological studies and biogeographical evidence suggest that *S. obtusirena* is isolated from its allies in section *Ambleia* (*sensu* Bhattacharjee, 1982), which are also characterized by dendroid hairs. *Stachys obtusirena* is unique in section *Ambleia* due to its sessile leaves which are broadly ovate to rounded in shape and regularly crenate at margin.

Selected specimens examined: **W:** Prov. Kohgiluyeh: Kuh-e Daena, *Kotschy 861* (K); Kuh-e Bull, *Stapf 647* (WU); Kuh-e Dena, *Riazi 7365* (TARI). Prov. Bakhtiari: N slope of Kuh-e Kallar, S Sibak, *Mozaffarian 57267, 57415* (TARI), *77350* (TARI, TUH); Lordegan, Kuh-e Rig, from Deh-e Kohneh, *Mozaffarian 57541* (TARI). Prov. Fars: N side of Dena Mts, near Ab-Mahaleh, *Assadi & Mozaffarian 31449* (TARI). Prov. Esfahan: N side of Dena Mts, above the village Noghol, *Assadi & Abouhamzeh 46109* (TARI). Prov. Yazd: Yazd, Dehbala, Shirkuh, *Foroughi 1956* (E); Yazd, Shirkuh, 20 km SSW Taft, *Aryavand et al. 1397* (E, TARI); Yazd, Shirkuh, above Deh-Bala, *Davis 787* (E); Yazd, Tezerjan, Kuh-e Barfkhane, *Mozaffarian 77533* (TARI); Yazd, Mehriz, Kuh-e Lakhese from Damghan valley, *Mozaffarian 77489* (TARI); Yazd, Deh-Bala, Shirkuh, *Foroughi & Assadi 17966* (TARI); Barfkhaneh, Tezerjan, *Foroughi 5563* (TARI).

22. *Stachys palustris*

Stachys palustris L., *Sp. Pl.* 580 (1753). *Type:* Herb. Linn. no. 736.2 (LINN) (lectotype: designated by Hedge in Ali & Nasir (ed.), *Fl. Pakistan* 192: 187, 1990).

PLANTS perennial, mesophytic herbs with creeping rhizomes. STEM thin, 15–80 (rarely up to 100 cm), usually simple, erect, internodes 6–13 cm long, sparsely covered by short simple hairs c. 1 mm long along with subsessile to sessile glandular hairs. BASAL LEAVES oblong to lanceolate, (3.0–)5.0–10.0 × (1.5–)2.0–4.0(–5.0) cm, dentate or serrate at margin, acute and sometimes mucronate at apex, usually truncate at base, hairy as stem, petiole 0.2–1.5 cm. CAULINE LEAVES lanceolate, 6–10 × 2.5–6.0 cm, dentate to serrate at margin, acute at apex, usually attenuate at base, gradually passing into sessile floral leaves, hairy as basal leaves, petiole 0.2–1.5 cm. FLORAL LEAVES similar to cauline leaves but smaller, lanceolate, 2–4 × 0.8–2.0 cm, subsessile to sessile. VERTICILLASTERS remote throughout or a few confluent above, 1–5 cm distant, (four–)six(–ten)-flowered, ± congested in a tapering inflorescence, pedicels 1.0–1.5 mm long. BRACTEOLES eight to ten, herbaceous, lanceolate to linear, 4–7 mm long, acute at apex but not spinescent, with smooth simple long hairs. CALYX subbilabiate, campanulate, 6–9 × 3–5 mm; teeth subequal, ovate to

lanceolate, erect to slightly recurved in fruit, 2–3 mm long, with glandular and smooth simple hairs at margin. COROLLA pink with white spots on lower lip, 12–16 mm long; tube rarely equalling or usually slightly longer than calyx tube, 6–8 mm long; upper corolla lip 3–5 × 2.0–3.5 mm; lower corolla lip trilobed, 5–6 × 4–7 mm. NUTLETS broadly obovoid, 2.5–3.5 × 2–3 mm, minutely reticulate on surface, narrowly winged.

Phenology: Flowering and fruiting between early June and mid July.

Distribution and ecology: North America, temperate Eurasia to northern Turkey (Fig. 9D); Euro-Siberian element. It is a weed growing in Europe and is also known from northern Turkey. In Iran there is no reliable record of this species except for that reported in *Flora Iranica* (Rechinger, 1982); elevation 1200–1500 m.

Conservation status: LC (IUCN, 2008).

Affinities and variation: *Stachys palustris* and its closest relative *S. sylvatica* are mesophytic herbs with creeping rhizomes, lax inflorescences and narrow, setaceous and minute bracteoles. Both species are widespread throughout temperate Eurasia. *Stachys palustris* differs from *S. sylvatica* mainly in having lanceolate leaves and pink corolla (not dark red).

Selected specimens examined: None traced or seen in Iran.

23. *Stachys persepolitana*

Stachys persepolitana Boiss., Diagn. Pl. Orient. ser. 1, 7: 56 (1846). *Type*: Persia australis, [Prov. Fars] Kuh-e Ayub (Ajub) prope Persepolis, *Th. Kotschy* 407 (lectotype designated here: G-BOIS!; isotype: B!, G!, LE!); and *Th. Kotschy* 817 (syntype: G-BOIS!).

PLANTS annual simple herbs. STEM thin, 15–25(–30) cm, internodes 0.5–2.0 cm long, sparsely covered by short simple hairs *c.* 50 µm, densely papillose. BASAL LEAVES ovate, 1.0–1.5 × 1.0–1.2 cm, faintly crenate to dentate at margin to subentire, usually obtuse at apex, attenuate at base, petiole 2.5–4.0 cm long, hairy as stem. CAULINE LEAVES similar to basal leaves, ovate, 0.8–3.2 × 1.0–2.2 cm, subentire or entire at margin, obtuse or rounded at apex, attenuate at base, hairy as basal leaves, petiole 0.5–2.0 cm. FLORAL LEAVES lanceolate, 1.0–2.0 × 0.5–1.0 cm, sessile, obtuse at apex, entire at margin, hairy as cauline leaves. VERTICILLASTERS few, remote, four- to six(–ten)-flowered; pedicels minute. BRACTEOLES absent. CALYX ± two-lipped, ± campanulate, 9–12 × 5–7 mm; teeth subequal, 3–4 mm long, lanceo-

late to subulate, recurved in fruit, acute at tip, covered with short simple hairs and subsessile to sessile glandular hairs. COROLLA purple to pink, 24–28 mm long; tube longer than calyx tube, 15–18 mm long; upper corolla lip 7–9 × 1.5 mm; lower corolla lip indistinctly trilobed, 6–10 × 6–8 mm. NUTLETS obtriangular in outline, 2.3–2.8 × 2.0–2.2 mm, verrucate on surface, wingless.

Phenology: Flowering and fruiting between May and early June.

Distribution and ecology: Endemic to western and southern Iran (Fig. 9D). This species prefers wet habitats and soils with a high percentage of clay. Open ground with *Lamium amplexicaule* L. and *Veronica* L.; elevation 1400–1900 m.

Conservation status: VU (IUCN, 2008). It is very rare in the area.

Affinities and variation: Boissier (1879) was doubtful about attributing this species to the genus *Stachys*. The presence of densely papillose short scabrid hairs (Salmaki *et al.*, 2009a), a midrib consisting of two equally large vascular bundles and cleistogamous flowers (Bornmüller, 1915) are characters indicating an isolated position of *S. persepolitana* in *Stachys*.

Selected specimens examined: **W**: Prov. Kermanshah: Bisotoun, *Strauss* (B). Prov. Kohgiluyeh: *c.* 38 km from Yasuj to Sisakht, *Habibian & Mortazavi* 139 (TARI); Yasuj, *c.* 51 km to Fahlian, *Riazi* 5433 (TARI). Prov. Khuzestan: Deh-Dez, Sefid Mts, *Mozaffarian* 74538 (TARI). Prov. Fars: *c.* 15 km from Giroutabad to Ghir, *Assadi & Sardabi* 41409 (TARI). Prov. Fars: Bamo protected area, Cheshmeh-Fil, *Wendelbo & Foroughi* 17663 (TARI); *c.* 20 km from Baba-Meidan toward Kohgiluyeh, *Assadi & Abouhamzeh* 38414 (TARI); Shiraz, Deh-Bid, *Riazi* 5424 (TARI). Prov. Kerman: Deh-Bakeri, Anaran, *Mirtajjedini* 83818 (TARI).

24. *Stachys pilifera*

Stachys pilifera Benth., in A.P.de Candolle, Prodr. 12: 487 (1848). *Type*: IRAN: Persia australis, *Aucher-Eloy* 1808 (lectotype designated here: G-DC!); *Aucher-Eloy* 5189 (syntypes G!, G-BOIS!); *Kotschy* 631 (syntypes: G!, G-BOIS!, LE!, W!).

PLANTS perennial, prostrate and decumbent herbs. STEM from a thick base becoming thin further up, 15–30 cm, unarmed, branched near base and leaf axils, usually erect toward apex, internodes 1.0–2.5 cm long, densely covered by long simple hairs up to 2.5 mm and stalked glandular capitate hairs up to 30 µm. BASAL LEAVES oblong to elliptic,

KEY TO SUBSPECIES IN IRAN

1. Calyx teeth acute and rigidly spinescent at apex, reaching half of the tube.....subsp. *ixodes*
 1'. Calyx teeth usually obtuse, rarely spinescent, about one-third as long as the tube.....subsp. *pilifera*

2.5–3.0 × 0.3–0.8 mm, obtuse to rounded at apex, entire at margin, attenuate at base, subsessile to sessile, hairy as stem. CAULINE LEAVES elliptic to narrowly elliptic, 1.5–2.5 × 0.4–0.6 cm, obtuse at apex, entire at margin, attenuate at base, sessile, hairy as stem and basal leaves. FLORAL LEAVES lanceolate, 0.8–1.0 × 0.2–0.4 cm, often obtuse (sometimes acute) at apex, entire at margin, sessile, hairy as cauline leaves. VERTICILLASTERS two-flowered, remote, pedicels 1.5–2.0 mm long. BRACTEOLES few (four to six), elliptic to linear, 6–10 mm long, acute at apex. CALYX regular, tubular, 10–16 × 3–6 mm; teeth subequal, 4–8 mm long, mostly spinescent at apex, triangular to lanceolate, densely covered by long simple hairs and subsessile to sessile glandular hairs. COROLLA white, 18–20 mm long; tube 8–12 mm long (subequal to calyx tube); upper corolla lip 3–5 × 3.0–3.5 mm; lower corolla lip distinctly trilobed, 7–10 × 6–10 mm. NUTLETS oblong in outline, 3.5–4.0 × 1.5–2.0 mm, verrucate on surface, wingless.

Phenology: Flowering and fruiting between early June and mid July.

Distribution and ecology: Iran (endemic, Fig. 9D); elevation 1700–2750 m.

Stachys pilifera Benth. subsp. *pilifera* (Fig. 3D)

PLANTS silvery. LEAVES oblong to elliptic. CALYX teeth usually obtuse and frequently not spiny, 4–6 mm long, one-third as long as the tube.

Phenology: Flowering and fruiting between early June and July.

Distribution and ecology: Western Iran (endemic to Iran, Fig. 9D); elevation 1850–2600 m.

Conservation status: LC (IUCN, 2008); compared with related species (*S. acerosa* and *S. aucheri*), *S. pilifera* subsp. *pilifera* is more frequent but not completely resistant to grazing due to lack of thorns.

Affinities and variation: It is similar to *S. multicaulis* in lacking a thorny flowering stem but differs from it by prostrate-decumbent habit and an indumentum of dense exerted long simple trichomes. The calyx teeth are lanceolate and short. See also the note under *S. multicaulis*.

Selected specimens examined: **W:** Prov. Markazi: between Arak and Khomein, Varcheh Mts, *Maassoumi & Mozaffarian 48028* (TARI). Prov. Bakhtiari: W Qashqaei, Kuh-e Surmandeh, N Semirrom, *Rechinger 47574* (W, E); Tang-e Sayad Protected Area, in monte Pir-Kuh, 32 km East of Shahrekurd, *Rechinger 47213* (W, K); Kuhrang, *Wendelbo 1723* (E); Lordegan, Badamestan Mts, North of Boneh-Gerd, *Mozaffarian 54686* (TARI); Boroujen, Gandoman, Barf-e Aftab Mts, *Mozaffarian 7262* (TARI); Bazoft valley, Chebod, N slope of Taraz Mts, *Mozaffarian 57837* (TARI); 22 km to Shahrekurd from Zarrin-Shahr, Rokh pass, near the police station, *Zarre & Salmaki 35874* (TARI). Prov. Esfahan: Balehsun-Kuh, between Damaneh and Khunsar, *Archibald 2698* (E); Semirrom, *Zarre & Salmaki 35893* (TUH); c. 10 km to Semirrom from Shahreza, *Zarre & Salmaki 35894* (TUH).

Stachys pilifera Benth. subsp. *ixodes* (Fig. 2D)

Stachys pilifera subsp. *ixodes* (Boiss. & Hausskn.) Salmaki, **comb. & stat. nov.** ≡ *Stachys ixodes* Boiss. & Hausskn. in P.E. Boissier, Fl. Orient. 4: 738 (1879). *Type:* Persia australis, hab. ad rupes calcareas montis Teng Nalli montis Sawers ad Kuh Nur, 8000', *Haussknecht 345* (lectotype, designated here: G-BOIS!, isotypes: G!, LE!, W!); Inter Dilegun et Maregun, 10000 ped, *Haussknecht 490* (syntypes: G!, G-BOIS!, LE!, W!)

PLANTS greenish grey to silvery. LEAVES elliptic to narrowly elliptic. CALYX teeth usually acute, spinescent, 6–8 mm, reaching half of the tube.

Phenology: Flowering and fruiting between early June and July.

Distribution and ecology: South-west Iran (endemic to Iran, Fig. 9D); elevation 1850–2600 m.

Conservation status: NT (IUCN, 2008); more rarely present in the area than the typical subspecies.

Affinities and variation: It is distinguishable from the type subspecies mainly by its spiny calyx, long calyx teeth and denser indumentum.

Selected specimens examined: Prov. Kohgiluyeh: Teng Nalli montis Sawers ad Kuh-Nur, *Haussknecht 345, 490* (W). Prov. Khuzestan: Deh-Dez, Sefid Kuh, *Mozaffarian 74526* (TARI). Prov. Fars: Shiraz, *Kotschy 631* (WU); Kuh-e Chah-Siah, prope Sivand,

Stapf 655 (WU); prope Dasht-e Arjan, *Stapf 656* (WU); Kuhaye Dashtak prope Emamzadeh Ismael, *Stapf 657* (WU); Shiraz, *Hewa 2087* (K), *2125* (E); Shiraz, Dasht-e Arjan, old road of Kazeroun, Kotal-e Pirezan protected area, *Foroughi 17486* (TARI); Dasht-e Arjan, Arjan-Parishan protected area, *Zarre & Salmaki 35907, 35908* (TUH). Prov. Lorestan. 40 km Roudbar-e Lorestan dam, Khak-Batie village, *Zarre & Salmaki 35885* (TUH).

25. *Stachys recta* subsp. *subcrenata*

Stachys recta L. subsp. ***subcrenata*** (Vis.) Briq., Lab. Alp. Marit. 257 (1893). *Type*: In collibus Dalmatiae montanae, vii–viii [1828?], *Visiani s.n.* = *S. subcrenata* Vis., in Flora 12, Ergänzungsbl. 15 (1829).

=*S. recta* L. var. *major* Ten., Fl. Nap. Syll. 2:292 (1831) non Briq. (1893).

=*S. czernjaevii* Shost., Not. Syst. (Leningrad) 8: 152 (1940).

PLANTS perennial, procumbent herbs. STEM thin, 10–60 cm, usually densely branched at base, simple further up; internodes up to 4.5 cm long, sparsely covered by appressed short simple hairs up to 2 mm, glandular hairs absent. BASAL LEAVES oblong to linear-lanceolate, 3–5 × 0.3–0.8 mm, acute at apex, crenate to irregularly dentate at margin, attenuate at base, subsessile to sessile, hairy as stem. CAULINE LEAVES oblong-lanceolate to lanceolate, 1–3 × 0.3–0.5 cm, crenate-serrate at margin, acute at apex, attenuate at base, hairy as basal leaves. FLORAL LEAVES lanceolate, 0.5–1.5 × 0.2–0.4 cm, entire at margin, aristate at apex, rounded at base, sessile. VERTICILLASTERS (four–)six (–eight)-flowered, remote below, ± approximate above. BRACTEOLAS few, herbaceous or setaceous, lanceolate to linear, 1.0–2.5 mm, hairy as leaves. CALYX subcampanulate, 7–10 × 3–4 mm, hairy as leaves; teeth erect, triangular-lanceolate, 2–3 mm long, with short yellow aristate tips, 0.5–1.0 mm. COROLLA creamy to yellow, 14–18 mm; tube longer than calyx tube, 6–8 mm long; upper corolla lip 4–5 × 3.5–5.0 mm; lower corolla lip indistinctly trilobed, 6–8 × 4–6 mm. NUTLETS broadly obovoid, 2.0–2.5 × 1.0–1.2 mm, minutely reticulate on surface, narrowly winged.

Phenology: Flowering and fruiting in early July.

Distribution and ecology: South-east Europe, Azerbaijan, Armenia, south-west Turkey, north-west Iran (Fig. 10A). Lower slope of mountains among cushions of *Astagalus*, *Centaurea* L. and *Tanacetum* L.; elevation 1700–2300 m.

Conservation status: NT (IUCN, 2008) in Iran, but probably more widespread in the adjacent Caucasus and Turkey.

Affinities and variation: This taxon is recorded here for the first time from Iran. It is known from the Iranian–Turkish border near Uroumieh. *Stachys recta* subsp. *subcrenata* is the only representative subspecies of *S. recta* in Iran and is separated from the other subspecies, subsp. *labiosa* (Bertol.) Briq. (distributed in southern Europe and western Balkan peninsula) and subsp. *recta* (widespread in Europe and the Caucasus), by its longer calyces and narrowly lanceolate, faintly serrate to entirely margined median cauline leaves. The closest relative of *S. recta* is *S. atherocalyx*, from which it is distinguished by lower calyx teeth/tube ratio and broadly lanceolate lower and median cauline leaves.

Selected specimens examined: W. Prov. W Azarbaijan: Uroumieh, Targevar region, Kay to Germi village, *Zarre 12756* (TARI, TUH); and *Zarre & Salmaki 36530* (TUH).

26. *Stachys setifera* (Fig. 3F)

Stachys setifera C.A.Mey., Verz. Pfl. Casp. Meer.: 94 (1831). *Type*: [Azerbaijan] Talish, C.A. Mayer 1862 (isotype: G-BOIS!).

=*Stachys shirini* Parsa, Kew Bull. 3: 226 (1948).

=*Stachys lycopsiformis* K.Koch in Linnaea 21: 692 (1848).

=*Stachys bornmuelleri* Gand., Bull. Soc. Bot. Fr. 65: 68 (1918), nom. illeg. non Hand.-Mazz. (1913).

=*Stachys setifera* subsp. *iranica* (Rech.f.) Rech.f., Fl. Iran. 150: 366 (1982), **syn. nov.** = *S. iranica* Rech.f., Österr. Bot. Z. 99: 44 (1952). *Type*: Iran, Prov. Shahrud-Bustam [Prov. Semnan], in declivibus australibus montium Shahvar ad Nekarman (Nigarman), 2000 m, 20–26.7.1948, K.H. & F. Rechinger 6262 (holotype: W!; isotype: C: photograph!, M!).

=*Stachys setifera* subsp. *daenensis* (Gand.) Rech.f., Fl. Iran. 150: 366 (1982), **syn. nov.** = *S. daenensis* Gand., Bull. Soc. Bot. France 65: 68 (1918). *Type*: Persia australis, ad canales planitiei Kakan pr. Schiras, 16.7.1842, Th. Kotschy 564 (syntype: W!); In graminosis humidis m. Kuh Daëna, 8.7.1843, Th. Kotschy 572 (syntype: W!).

PLANTS perennial, erect prostrate herbs, or rarely ascending, with creeping rhizome. STEM thin, 30–100 cm, usually simple, creeping on the ground, internodes 5–9 cm long, sparsely covered by short simple hairs up to 0.5 mm and longer hairs c. 1.0–1.5 mm and stalked glandular hairs up to 150 µm with capitate head, rarely glabrous in lower parts. BASAL LEAVES ovate-lanceolate to oblong-lanceolate, 4–8 × 1–4 cm, acute at apex, serrate to

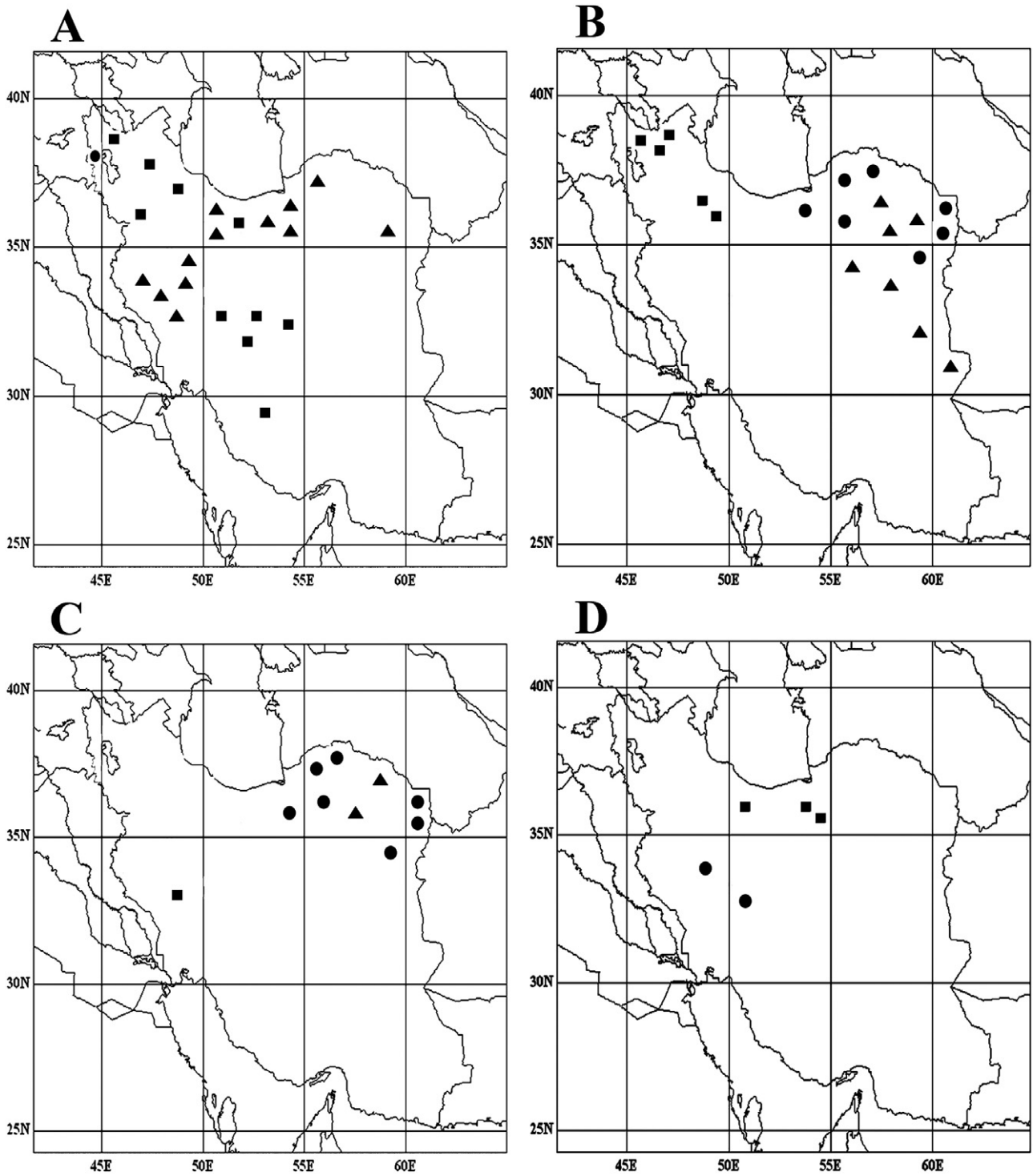


Figure 10. Distribution of *Stachys* taxa in Iran: A, *S. recta* subsp. *subcrenata* (●), *S. setifera* (▲), *S. spectabilis* (■); B, *S. subaphylla* (●), *S. sylvatica* (■), *S. trinervis* (▲); C, *S. turcomanica* (●), *S. veroniciformi* (■), *S. × sintenesii* (▲); D, *S. × tomentosa* (●), *S. × leucomalla* (■).

serrate-dentate at margin or sometimes subentire, truncate to rounded at base, hairy as stem, petiole 0.5–1.0 cm. CAULINE LEAVES similar to lower cauline leaves, ovate-lanceolate, 4–8 × 1–3 cm, mucronate at apex, often entire or rarely dentate at margin, subsessile to sessile, hairy as basal leaves. FLORAL LEAVES similar to cauline leaves but smaller, ovate to ovate-lanceolate, 2–3 × 0.5–1.0 cm, with a mucro c. 1 mm long, subentire to serrate at margin, cuneate at base, subsessile to sessile, hairy as stem. VERTICILLASTERS four- to eight-flowered, remote, 4–6 cm distant, few approximate above, pedicels 0.2–1 mm long. BRACTEOLES few, herbaceous, oblong-lanceolate to linear-lanceolate, 4–7 mm, mucronate at apex, densely covered with simple long hairs. CALYX sub-bilabiate, subcampanulate, 7–10 × 3–4 mm; teeth subequal, 2.5–3.0 mm long, lanceolate-acuminate, recurved in fruit, mucro 1.2–1.5 mm. COROLLA pink, 10.5–14.0 mm; tube subincluded, 4–6 mm long; upper corolla lip 6–8 × 2–3 mm; lower corolla lip indistinctly trilobed, 6–8 × 5–6 mm. NUTLETS obovoid, 2.5–3.5 × 1.5–2.5 mm, minutely reticulate on surface, narrowly winged.

Phenology: Flowering and fruiting between early June and early July.

Distribution and ecology: Iran, Turkey, Turcomania, Afghanistan, Central Asia (Fig. 10A). Lower slopes of mountains with sandy soil, mostly growing at margin of streams; elevation 1200–2700 m.

Conservation status: LC (IUCN, 2008); widely distributed in Iran and adjacent countries.

Affinities and variation: *Stachys setifera* is characterized by its rhizomatous and creeping habit. It grows on sandy riverbeds (wet soils especially at the margin of streams) and is ecologically distinct from other species of the genus. It can be distinguished by its spinescent floral leaves and mucronate bracts. A close relationship between this species and members of section *Stachys* (*sensu* Bhattacharjee, 1982) and *Prasium majus* L. have been discussed on several occasions (Lindqvist & Albert, 2002).

Selected specimens examined: **N:** Prov. Mazandaran: On the road of Yush-Baladeh from Haraz to Chalus, c. 2 km after Baladeh village, *Zarre & Salmaki 36510* (TUH). **W:** Prov. Kordestan: 16 km Husainabad, between Sanandaj and Saqqez, *Archibald 3149* (K); S Sanandaj, *Archibald 3117* (K); montes Chehel-Cheshmeh, 44 km NE Marivan, *Rechinger 43073* (K); near the Saqqez, *Jardine 3432* (E); Marivan to Saghez, c. 11 km to Chenareh, 6 km to Toutsarkhan village, *Zarre & Salmaki 36502* (TUH). Prov. Ker-

manshah: Montes Avroman and Schahu, *Haussknecht* (G-BOIS). Prov. Hamadan: Alvand Mts, *Pichler 176* (WU); c. 10 km after Avaj to Razan, Avaj pass, *Zarre & Salmaki 36523* (TUH). Prov. Lorestran: 39 km to Khorramabad on the road of Kashvar, *Runemark & Lazari 26946* (TARI). Prov. Kohgiluyeh: Kuh Daena, *Kotschy 572* (G-BOIS); Sisakht, *Assadi & Mozaffarian 31326* (TARI); Sepidan, Tangeh Sorkh, *Zarre & Salmaki 35905* (TUH). Prov. Fars: Shiraz, Bamo protected area, *Delbozorgi 32701* (TARI); Shiraz, at the village of Kotal-e Dokhtar, 65 km from Shiraz to Bushehr, *Alava & Bokhari 10668* (E). Prov. Kerman: Rahbour, *Bornmüller 4297* (E, WU); Kerman, Kuh-e Sidseh, *Bournmüller 4299* (WU). **E:** Prov. Khorasan: Kalat-e Naderi, Moghan river to Cheshmeh, *Rafei & Zangoeei 22940* (FUMH); Quchan Mts, Emarat Mts, *Faghihniya & Zangoeei 22452* (FUHM); Darreh-Gaz, Doabi, *Joharchi & Faghihniya 33638* (TARI); East Ghouchan, Goganloo Mts, *Faghihniya & Zangoeei 27505* (FUMH). **C:** Prov. Tehran: Oshan-Fasham area, Paloon-Gardan Mts, *Zarre & Moazzeni 35870* (TUH). Prov. Semnan: c. 15 km N Shahrud, *Assadi & Maassoumi 21030* (TARI); Shahrud, Kuh-e Abr, *Riazi 5343* (TARI); c. 15 km N Shahrud, Nekarman, *Chalabi 21030* (E).

27. *Stachys spectabilis* (Fig. 4A)

Stachys spectabilis Choisy ex DC., Mém. Soc. Phys. Genève 1(2): 457 (1823). *Type:* Planta quaedam culta (described from cultivated material). ≡ *S. germanica* L. var. *spectabilis* (Choisy ex DC.) Briq., in Engler & Prantl, Natürl. Pflanzenfam. 4(3a): 263 (1897). = *Stachys hypoleuca* C. Koch, Linnaea 21: 688 (1848). = *S. elata* K. Koch, Linnaea 21: 687 (1848). = *S. spectabiliformis* Kapeller, Zam. Sist. Geogr. Inst. Rast. 16: 14 (1951).

PLANTS perennial, mesophytic erect herbs with distinct basal leaves. STEM 45–130 cm, simple, sometimes branched, internodes 8–16 cm long, densely covered by appressed long vermiform hairs up to 4–5 mm and stalked or subsessile to sessile glandular hairs. BASAL LEAVES oblong to ovate-oblong, 3–15 × 1–6 cm, usually sparsely or rarely densely softly villous, usually glabrescent beneath, weakly dentate or serrate at margin, acute at apex, subcordate at base, petiole 1–6 cm. CAULINE LEAVES oblong to oblong-lanceolate, 6–10 × 3–7 cm, acute at apex, truncate at base, softly villous and hairy as stem, petiole 1–4 cm. FLORAL LEAVES similar to cauline leaves but smaller, gradually passing into sessile floral leaves, narrowly elliptic to lanceolate, 1–3 × 0.5–1.5 cm, acute at apex, crenate at margin, subsessile, hairy as cauline leaves. VERTICILLASTERS remote throughout or a few confluent above, 1–5 cm distant, ten- to 25-flowered, pedicels 0.1–0.5 mm long. BRACTEOLES numerous, herbaceous,

lanceolate to linear, 5–10 mm long, acute at apex but not spinescent, softly pilose. CALYX sub-bilabiate, subcampanulate, 6–7 × 3–4 mm, covered by simple long hairs; teeth subequal, 3–4 mm long, ovate to lanceolate, with glandular and eglandular hairs at margin. COROLLA rose-pink, 13–15 mm; tube subincluded, 5–8 mm long; upper corolla lip densely covered with exerted simple long hairs at outside, hairs usually exceeding the lip, 4–6 × 2–3 mm; lower corolla lip indistinctly trilobed, 5–8 × 6–8 mm. NUTLETS obovoid, 2.5–3.0 × 1.5–2.0 mm, minutely reticulate on surface, wingless.

Phenology: Flowering and fruiting between early June and mid July.

Distribution and ecology: Turkey, northern Iraq, north, west and central Iran, Azerbaijan, Armenia, Georgia (Fig. 10A); Irano-Turanian element. Stream sides and river banks, wet rocky slopes; elevation 1000–2200 m.

Conservation status: LC (IUCN, 2008).

Affinities and variation: Related to *S. longispicata* Boiss. & Kotschy distributed in the eastern Mediterranean region but differs from it in having many-flowered verticillasters and a sub-bilabiate and less hairy calyx tube. It also resembles *S. pinetorum* (southern Turkey to northern Syria) but can be distinguished by its eglandular, ± erect calyx teeth and usually indistinctly nerved calyx tube.

Selected specimens examined: **W:** Prov. W Azarbaijan: 10 km after Dizaj toward peak of Boz-e Sina Mts, Zarre & Salmaki 36531 (TUH). Prov. E Azarbaijan: Arasbaran protected area, Siagharan-Dagh Mts, Mozaffarian 24263 (TARI); Arasbaran protected area, Seigharan-Dagh Mts, Assadi & Sardabi 24263 (TARI); Prov. Esfahan: Semirom, Vanak, Mozaffarian 62144 (TARI). Prov. Kohgiluyeh: Kuh-e Daena, Kotschy 640 (G-BOIS); Dena Mts, Ab-Mol, Assadi & Mozaffarian 31386 (TARI); Yasuj, near waterfall, Assadi & Abouhamzeh 46257 (TARI). Prov. Bakhtiari: N slopes of Kalar Mts, South of Sibak, Mozaffarian 57393 (TARI). Prov. Fars: S Estahbanat, Bash Mts, Mozaffarian 46982 (TARI); c. 5 km from Ardakan to Yasuj, Assadi & Mozaffarian 31095 (TARI); Fasa, Roniz, Morghak village, Mozaffarian 46952 (TARI). Prov. Yazd: Mehriz, Lakheseh Mts, Mozaffarian 77698 (TARI). Prov. Kerman: prope Kariet-Ul-Arab, Bornmüller 4296 (WU); Kerman, Stapf 2 (WU). **C:** Pov. Tehran: Alborz Mts, Derband, Kotschy 403, 412

(G-BOIS!); Tehran, Shemiran, Buhse 803 (G-BOIS!); Aucher-Eloy 5177 (G-BOIS!).

28. *Stachys subaphylla* (Fig. 4B)

Stachys subaphylla Rech.f., Pl. Syst. Evol. 134: 288 (1980). **Type:** IRAN, Gorgan: In faucibus 14 km E Chaman-e Bid, in fissuris rupium calc. 1100 m, Wendelbo & Cobham 14355 (holotype: W!; isotype: E!).

PLANTS perennial, suffruticose, densely branched with woody base. **STEM** thin but rigid, 30–50 cm, densely branched at base, erect; internodes 2.5–8.0 cm long, small appendages present at base of leaves, densely covered by dendroid two- to five-armed multinodal hairs 0.3–0.6 mm long mixed with subsessile to sessile glandular hairs. **BASAL LEAVES** sublinear, few, 1.5 × 0.2–0.3 cm, acute at apex, entire at margin, attenuate at base, hairy as stem, petiole 0.1–0.2 cm. **CAULINE LEAVES** similar to basal leaves, few, linear, 1.0–1.5 × 0.1–0.2 cm, acute at apex, entire at margin, attenuate at base, subsessile to sessile, hairy as stem. **FLORAL LEAVES** narrowly oblong, 0.2–0.6 × 0.1 cm, acute at apex, entire at margin, hairy as stem, sessile. **VERTICILLASTERS** two-flowered, remote; pedicel c. 1 mm. **BRACTEOLES** absent. **CALYX** regular, tubular, 6–7 × 2–3 mm; teeth subequal, triangular, 1.5 mm long, incurved in fruit, with branched hairs and subsessile to sessile glandular hairs. **COROLLA** pink to purple, 15–20 mm long; tube longer than calyx tube, 8–12 mm long; upper corolla lip 6–8 × 3–4 mm; lower corolla lip indistinctly trilobed, 8–10 × 6–8 mm. **NUTLETS** obovoid, 2.0–2.5 × 1.5–2.0 mm, minutely reticulate on surface, wingless.

Phenology: Flowering and fruiting between early August and mid October.

Distribution and ecology: Iran (endemic to north-east Iran, Fig. 10B); elevation 1100–1300 m.

Conservation status: VU (IUCN, 2008). It is known from just a few patches in north-east Iran.

Affinities and variation: Although this species is related to other species having densely dendroid hairs, it differs from them by its suffruticose dense habit with only few leaves (especially at the upper parts) and by its short calyx (at most 6 mm long) and short calyx teeth (c. 1 mm). Also the verticillasters are only two-flowered and remote in this species.

Selected specimens examined: **E.** Prov. Khorasan: 40 km W Bojnourd, N side of pass between Bojnourd and Golestan, Furse 8943 (K); Western Bojnourd, between Darkesh and Havar river, Zangoeei 32969, Joharchi 33793, and Joharchi & Hojjat 33153

(FUMH); Bojnourd, Eshgh-Abad to Raz, *Hojjat & Zangooei 31132* (FUMH); Bojnourd, c. 15 km Bekkadeh to Robat-e Gharabil, *Hojjat & Zangooei 31160* (FUMH). Prov. Golestan: In faucibus 14 km E Chaman-e Bid, in fissuris rupium, *Wendelbo & Cobham 14355* (W); c. 70 km to Chaman-Bid, *Assadi and Maassoumi 21491* (TARI); 99 km to Azad-Shahr from Ashkhaneh, mountains near the Sharlegh area, *Zarre & Salmaki 36868* (TUH); between Yakhti-Kalan and Soulehgerd, *Ajani 10085* (TUH).

29. *Stachys sylvatica* (Fig. 4C)

Stachys sylvatica L., Sp. Pl. 580 (1753). *Type*: Described from Europe (lectotype designated by J. R. Press in Jarvis 1992: 570, Herb. Clifford: 309, *Stachys* 1, BM-000646043: image at <http://www.nhm.ac.uk/jdsml/research-curation/research/projects/linnaean-typification/>).

=*Stachys trapezuntea* Boiss., Diagn. Pl. ser. 2(4): 38 (1859).

PLANTS perennial, erect mesophytic herbs with creeping rhizomes. STEM ± thick, 50–85 cm, simple or branched, internodes 6–15 cm long, sparsely covered by simple long hairs up to 2 mm and stalked glandular hairs. BASAL LEAVES cordate-ovate, 4–12(–15) × 4–10 cm, acute at apex, sometimes mucronate, crenate to dentate at margin, cordate at base, hairy as stem, petiole 4–10 cm. CAULINE LEAVES cordate-ovate, 6–10 × 2.5–6.0 cm, apex acute, crenate to dentate at margin, cordate at base, hairy as stem, petiole 1–5 cm. FLORAL LEAVES similar to cauline leaves but smaller, subsessile and gradually passing into sessile floral leaves, ovate to lanceolate, 2–6 × 0.8–2.0 cm, acute at apex, crenate to entire at margin, hairy as cauline leaves. VERTICILLASTERS remote throughout or a few confluent above, 1–5 cm distant, (four–)six(–ten)-flowered, ± congested in a tapering inflorescence, pedicels 1.0–1.5 mm long. BRACTEOLES 8–10 in number, herbaceous, lanceolate to linear, 4–7 mm long, acute at apex but not spinescent, hairy as leaves. CALYX subbilabiate, campanulate, 6–9 × 3–5 mm; teeth subequal, 2–3 mm long; ovate to lanceolate, erect to slightly recurved in fruit, hairy as leaves. COROLLA dark red with distinct white spots in lower lip, 15–20 mm long; tube equal to or more usually slightly longer than calyx tube, 8–12 mm long; upper corolla lip 3–5 × 3.0–4.5 mm; lower corolla lip trilobed, 6–8 × 5–8 mm. NUTLETS broadly obovoid, 2.5–3.5 × 2–3 mm, minutely reticulate on surface, narrowly winged.

Phenology: Flowering and fruiting between early June and late July.

Distribution and ecology: North America, temperate Eurasia to northern Iran (Fig. 10B). Euro-Siberian element; slopes of mountainous forests, preferring soils with high percentage of clay; wet locations; elevation 500–1600 m.

Conservation status: LC (IUCN, 2008).

Affinities and variation: The species shows low variation in morphological characters and is very uniform. It is most closely related to *S. palustris*, from which it differs by leaf shape (broadly ovate to ovate, cordate at base) and long petiole and indumentum. See also the note under *S. palustris*.

Selected specimens examined: N. Prov. Gilan: Loshan, on the road toward Jirandeh, *Zarre et al. 36756* (TUH); Asalem to Khalkhal, at margin of forest, *Wendelbo & Assadi 18394* (TARI). W. Prov. E Azarbaijan: Arasbaran protected area, S Veynagh Mts, *Assadi & Maassoumi 20375* (TARI); W Kaleibar, Ziveh village, *Mozaffarian 43667* (TARI); Arasbaran, SE of Makidi, *Salmaki et al., s.n.* (TUH).

30. *Stachys trinervis* (Fig 4D)

Stachys trinervis Aitch. & Hemsl., Trans. Linn. Soc. London, Bot. 3: 97 (1886). *Type*: Afghanistan, in valle fl. Hari Rud, *Aitchison 157* (isotype: G!).

PLANTS perennial, subshrubs, puberulent, woody at base. STEM thin, 20–45 cm, white, profoundly branched near the base and leaf axils, usually erect; internodes 2.5–3.5 cm long, small appendages present at base of leaves, sparsely covered by short branched hairs 0.2–0.4 mm with two branching nodes and subsessile to sessile glandular hairs. BASAL LEAVES oblong to broad elliptic, 3.0–3.5 × 0.5–1.0 cm, obtuse at apex, entire at margin, attenuate at base, hairy as stem, petiole 0.5–1 cm. CAULINE LEAVES oblong, 1.5–2.5 × 0.4–0.6 cm, obtuse at apex, entire at margin, attenuate at base, hairy as basal leaves, petiole 0.3–0.5 cm. FLORAL LEAVES linear-lanceolate, 0.6–1.2 × 0.4–0.5 cm, obtuse at apex, entire at margin, subsessile to sessile. VERTICILLASTERS two-flowered, remote, pedicels 1.5–2.5 mm long. BRACTEOLES absent. CALYX ± regular, campanulate, 7–10 × 3–5 mm; teeth subequal, 3–5 mm long, triangular, ± erect to sub-recurved, obtuse at apex, hairy as leaves. COROLLA white to pink, 15–20 mm long; tube 8–10 mm long, subequal to calyx tube; upper corolla lip 4–8 × 4–5 mm; lower corolla lip indistinctly trilobed, 7–10 × 8–10 mm. NUTLETS oblong in outline, 4.0–4.5 × 2.0–2.2 mm, colliculate on surface, broadly winged.

Phenology: Flowering and fruiting between early June and mid July.

Distribution and ecology: Iran, Turkmenistan and Afghanistan (Fig. 10B); elevation 1100–1600 m.

Conservation status: LC (IUCN, 2008).

Affinities and variation: *Stachys trinervis* grows on serpentine soils in north-east Iran to Afghanistan and is characterized by small appendages in the leaf axils. *Stachys trinervis* differs from its allies (section *Amblesia sensu* Bhattacharjee, 1982) by its short hairs with only one branching node, whereas other species are furnished with multinodal hairs with a long axis. It is also well characterized by having the largest nutlets of the colliculate microsculptured type (Salmaki, Zarre & Jamzad, 2008b).

Selected specimens examined: **E.** Prov. Golestan: *c.* 16 km E Maraveh-Tappeh, *Hevar 3601* (TARI); Golestan Wildlife Park, near Bojnourd by side road to Bekadeh, *Wendelbo et al. 11067* (E); Almehr, *Sabeti 5468* (TARI). Prov. Khorasan: Quchan to Sultanabad in outer Elburz foothills, 60 miles to S Mashhad, *Furse 5221* (K); Sabzevar to Esfarayen, *c.* 11 km after Sabzevar, *Moazzeni 36756* (TUH); N Mashhad, Karou, *Joharchi & Zargani 19944* (FUMH); SW Torbat-e Heydarieh, Pirmahou, *Faghihniya & Zangoeei 23803* (FUMH); Kashmar, SE Bareskan, Sir village, *Faghihnia & Zangoeei 24779* (FUMH); Mashhad to Sarakhs, *c.* 64 km to Sarakhs, *Jamzad et al. 75803* (TARI); Mashhad, Zoshk, *Foroughi 1423* (TARI); *c.* 70 km to Neyshabour from Kashmar, *Assadi & Mozaffarian 35638* (TARI); Mashhad, Torbat-e Heydarieh, 15 km to Torbat-e Heydarieh, *Zarre et al. 38225* (TUH).

31. *Stachys turcomanica* (Fig 4E)

Stachys turcomanica Trautvet., Trudy Imp. S.-Peterburgsk. Bot. Sada 9: 463 (1886). *Type:* Kizyl Arvat, A. Becker (isotype: LE!).

=*Stachys* × *paraplesia* Rech.f., Fl. Iran. 150: 395 (1982) [*S. inflata* Benth. × *S. turcomanica* Trautvet.] syn. nov., *Type:* Prov. Shahrud-Bustam (Prov. Semnan), in jugo Khush-Yailaq, 2000–2200 m, 17.6.1948, K.H. & F. Rechinger 5456-b (holotype: W!).

PLANTS perennial, caespitose herbs, branched at base. STEM thin, 15–50 cm, usually simple, rarely branched at base, erect; internodes 7–11 cm long, covered densely or sometimes sparsely by long branched multinodal hairs provided by long axis and subsessile to sessile glandular hairs. BASAL LEAVES oblong to elliptic, 5–10 × 1–2 cm, entire at margin, usually obtuse or rarely acute at the apex, usually attenuate at base, hairy as stem, petiole 1–3 cm. CAULINE LEAVES similar to basal leaves, gradually passing into sessile floral leaves, oblong to elliptic, 3–7 × 1.0–1.5 cm, apex usually obtuse or rarely acute,

entire at margin, usually attenuate at base, hairy as basal leaves, petiole 0.5–1.0 cm. FLORAL LEAVES oblong to lanceolate, 1–3 × 0.5–1.0 cm, obtuse at apex, entire at margin, hairy as cauline leaves, shortly petiolate to sessile. VERTICILLASTERS (four–)six to eight(–ten)-flowered, remote, subsessile to sessile. BRACTEOLES numerous, herbaceous, linear to lanceolate, 1–5 mm long, hairy as stem. CALYX subregular, campanulate, 8–12(–15) × 3–5 mm; teeth subequal, narrowly triangular to lanceolate, incurved in fruit, 2–3 mm long, covered with branched hairs and subsessile to sessile glandular hairs. COROLLA pink to purple with white spots in lower lips, 15–20 mm long; tube subequal to calyx tube, 6–8 mm long; upper corolla lip 7–10 × 4–6 mm; lower corolla lip indistinctly trilobed, 8–10 × 6–10 mm. NUTLETS obovoid, 3.0–3.4 × 2.4–2.8 mm, foveate on surface, wingless.

Phenology: Flowering and fruiting between early June and late July.

Distribution and ecology: North-east Iran, Turkmenistan (Fig. 10C); elevation 1000–2600 m.

Conservation status: LC (IUCN, 2008).

Affinities and variation: *Stachys turcomanica* is distinguished from its closest relative, *S. laxa*, in having concolourous leaves. According to Rechinger (1982) there is a hybrid between *S. turcomanica* and *S. lavandulifolia* in north-east Iran which had been described as a distinct species, namely *S. × sintenisii* Rech.f. See also the note about the latter under hybrids. The occurrence of another hybrid mentioned by Rechinger (1982) between *S. turcomanica* and *S. inflata*, namely *S. × paraplesia*, could not be confirmed by this study. During field studies in the type locality of the latter (near Khosh Yailagh village in north-east Iran), we found a large population of *S. turcomanica* forming a submontane community in the area with *Astragalus khoshjailensis* Širj. & Rech.f. In this area *S. inflata* was absent. So, the possibility of occurrence of a hybrid between these taxa is low. Furthermore, none of the observed individuals could be regarded as a hybrid. The type of *S. × paraplesia* resembles the individuals studied in the field in all morphological characters and shows no peculiarity, making it intermediate between *S. inflata* and *S. turcomanica*. The slightly inflated calyces probably caused Rechinger (1982) to consider *S. paraplesia* as a hybrid taxon. This may also be observed in other populations of *S. turcomanica*.

Selected specimens examined: **N:** Prov. Mazandaran: Chalus, Hassan-Abad valley, *Pabot 3566* (TARI); *c.* 67 km from Alam-Deh to Kojour, *Runemark &*

Mozaffarian 28149 (TARI); Kelardasht, *Gheisari 3221* (TARI); Veisar, Dasht-e Nazir, *Foroughi 1379* (FUMH). **E:** Prov. Golestan: Gorgan, between 2 to 8 km E Maraveh-Tappeh, *Hewer 3807* (TARI); Gorgan, *Hewer 3729* (E; TARI); Golestan forest, 40–70 miles E Gonbad-e- Cabus, *Furse 7272* (K); SE Bojnourd, *Merton 3912* (K); Western Bojnourd, highlands between Jozak and Chaman-Bid, *Jaharchi & Zangoeei 32654* (FUMH); Golestan National Park, between Sharlegh and Cheshmeh-Khan, *Naqinezhad 35811* (TUH); Between Yakhteh-Kalan and Soulehgerd, *Ajani 10084* (TUH). Prov. Khorasan: N Bojnourd, between Taze-Galeh and Darpand, *Joharchi & Zangoeei 330* (FUMH); Bojnourd, c. 58 km Shahpasand, *Foroughi 5536* (TARI); c. 12 km to Bojnourd on the road of Shirvan to Bojnourd, *Assadi & Maassoumi 50870* (TARI); Gorgan, Golestan National Park, Almeh, *Mozaffarian & Abouhamzeh 59059* (TARI); Ca. 12 km to Jifan from Bojnourd, *Assadi & Maassoumi 50221* (TARI). **C.** Prov. Semnan: Shahr-Bust.: In jugo Khush Yailaq, 2000–2200 m, 17. VI. 1948, *K.H. Rechinger 5456b* (holotype of *Stachys × paraplesia*: W); Shahroud, Kuh-e Abr, *Rooshan 7372* (TARI); 15 km to Bojnourd before tunnel, *Zarre et al. 38080* (TUH).

32. *Stachys veroniciformis*

Stachys veroniciformis Rech.f., Pl. Syst. Evol. 134: 289 (1980). *Type:* Iran, Kermanshah, Dalahu (Kuh-e Golhaye Zard, Barvand-e Sofla, 2200 m, *Moussavi & Satei 15695* (holotype: W!; isotype: IRAN)).

PLANTS perennial, suffruticose, woody at base. STEM thin and fragile, 10–15 cm, densely branched especially at base, decumbent: internodes 1.0–1.5 cm long, densely covered by smooth short, exserted long simple hairs 0.2–0.5 mm and stalked or subsessile to sessile glandular hairs. BASAL LEAVES cordate to broadly ovate, 2.0–2.5 × 2.0–2.5 cm, dentate at margin, apex obtuse, usually truncate at base, with 0.5–1.0(–1.2) cm petiole, covered by short simple hairs and stalked to subsessile–sessile glandular hairs. CAULINE LEAVES similar to basal leaves, gradually passing into sessile floral leaves. FLORAL LEAVES ovate to broadly ovate, 1.0 × 0.5–0.7 cm, shortly petiolate to sessile, apex obtuse, dentate at margin, hairy as stem. VERTICILLASTERS (two–)three–four(–five)-flowered, congested in a tapering inflorescence, flowers ± sessile. BRACTEOLES linear to setaceous, few or rarely absent, herbaceous, 1–3 mm long, sparsely covered by smooth short simple hairs. CALYX subregular, infundibular, 7–8(–9) × 3–4(–5) mm; teeth subequal, lanceolate, 3–4 mm long, covered with short to exserted long simple hairs and stalked glandular hairs at margin. COROLLA white to creamy with purple spots at upper and lower lips, 14–20 mm long; tube longer than the calyx tube,

10–12 mm long; upper corolla lip 3–4 × 2.5–3.0 mm; lower corolla lip indistinctly trilobed, 6–8 × 5–6 mm. NUTLETS obovoid, 3.0–3.3 × 2.0–2.5 mm, minutely reticulate on surface, wingless.

Phenology: Flowering and fruiting between early June and mid July.

Distribution and ecology: Iran (endemic, Fig. 10C); elevation about 2200 m.

Conservation status: CR (IUCN, 2008). Known only from type locality in western Iran.

Affinities and variation: *Stachys veroniciformis* is well characterized by having golden yellow flowers and a short petiole (up to 1.5 cm) and an indumentum of sparse short simple hairs.

Selected specimens examined: Not traced.

HYBRID TAXA

Stachys × sintenesii [*Stachys lavandulifolia* × *Stachys turcomanica*]

Stachys × sintenesii Rech.f., Fl. Iran. 150: 395 (1982). *Type:* Turcomania: Ashkabad, Suluklü, ad fines Persiae, in declivibus montium, 5.VIII.1990, *Sintenes 816* (holotype: LD, isotype: W!).

PLANTS perennial, suffruticose herbs with creeping rhizomes. STEM thin, 20–30(–35) cm, usually simple, rarely branched at base, erect, internodes 4–7 cm long, covered by stellate hairs with a long central arm up to 3 mm and five to eight shorter arms up to 0.5 mm long mixed with some branched multinodal arms with long axis; subsessile to sessile glandular hairs also present. BASAL LEAVES oblong to elliptic, 5–8 × 0.5–1.0 cm, entire at margin, usually obtuse or rarely acute at the apex, usually attenuate at base, hairy as stem, petiole 1.5–2.0 cm. CAULINE LEAVES similar to basal leaves, gradually passing into sessile floral leaves, narrowly oblong to elliptic, 4–5 × 0.4–0.6 cm, apex usually obtuse or rarely acute, entire at margin, usually attenuate at base, hairy as basal leaves, shortly petiolate to sessile. FLORAL LEAVES oblong to lanceolate, 2.2–2.5 × 0.2–0.5 cm, obtuse at apex, entire at margin, hairy as cauline leaves, sessile. VERTICILLASTERS three- to five-flowered, remote, subsessile to sessile. BRACTEOLES numerous, herbaceous, linear to lanceolate, 1.0–1.5 mm long, hairy as stem. CALYX ± regular, campanulate, 15–20 × 4–6 mm; teeth subequal, subulate-filiform, ± erect, 8–14 mm long, covered with branched hairs and subsessile to sessile glandular ones. COROLLA pink to purple with white spots on lower lip, 15–21 mm long; tube subequal to calyx

tube, 6–8 mm long; upper corolla lip 7–11 × 4–6 mm; lower corolla lip indistinctly trilobed, 8–10 × 6–10 mm.

Phenology: Flowering and fruiting between June and early July.

Distribution and ecology: North-east Iran (endemic, Fig. 10C); elevation 1000–2400 m.

Conservation status: VU (IUCN, 2008). It is a very rare plant in the area.

Affinities and variation: Although the type specimen resembles *S. lavandulifolia*, we also observed few specimens in Khorasan province (north-east Iran) with calyx similar to *S. lavandulifolia* but leaves and growing habit similar to *S. turcomanica*.

Selected specimens examined: **E**: Prov. Khorasan: from Shirvan to Western Bojnourd, *Joharchi & Zangooei 16688* (FUMH); NE Bojnourd, between Ali-Mohammad and Rabat, *Faghihnia & Zangooei 23567* (FUMH).

Stachys × *tomentosa* [*Stachys inflata* × *Stachys lavandulifolia*]

Stachys* × *tomentosa (Benth.) Rech.f., Fl. Iran. 150: 395 (1982). *Type*: Persia, *Aucher-Eloy 5166* (holotype: G-BOIS!) ≡ *Stachys tomentosa* Benth, in A.P.De Candolle Prodr. 12: 489 (1848).

=*Stachys* × *bodeana* Bunge, Mém. Acad. Sci. Imp. Petersbg. Sér. 7, 21, 1: 71 (1873).

=*Stachys lavandulifolia* Vahl var. *brachyodon* Boiss., Fl. Or. 4: 743 (1879).

PLANTS perennial, suffruticose herbs with creeping rhizome. STEMS thin, 20–30 cm, densely branched at base, usually simple further up, erect, internodes 2.0–3.0(–3.5) cm long, covered by stellate hairs with a long central arm up to 3 mm and five to eight shorter arms up to 0.5 mm long mixed with some branched multinodal arms with long axis and with stalked glandular and clavate arms. BASAL LEAVES elliptic to oblong-lanceolate, 2–5 × 0.5–1.5 cm, entire to faintly dentate at margin, obtuse at apex, attenuate at base, hairy as the stem, petiole 1–4 cm. CAULINE LEAVES similar to basal leaves but smaller, oblong to lanceolate, 2.0–2.5 × 0.5–0.7 cm, subsessile to sessile, hairy as basal leaves. FLORAL LEAVES ovate, 1.0–1.5 × 0.8–1.0 cm, shorter than the verticillasters, acute at apex, entire at margin, hairy as cauline leaves, shortly petiolate to sessile. VERTICILLASTERS (three–)four- to six-(eight)-flowered, remote below but congested in a tapering inflorescence above; pedicels minute. BRACTEOLES numerous, herbaceous, linear to lanceolate, 6–8 mm long, hairy as leaves.

CALYX ± regular, campanulate, 12–18 × 4–6 mm; teeth subequal, triangular-lanceolate, ± erect, 6–9 mm long, sparsely covered by exerted long vermiform hairs unequally armed and stellate at base mixed with dense subsessile to sessile glandular hairs. COROLLA purple, sometimes with white or pink spots, 16–20 mm long; tube 7–10 mm long, tube slightly longer than or sometimes equal to calyx tube; upper corolla lip 4–6 × 3.0–4.5 mm; lower corolla lip indistinctly trilobed, 8–10 × 7–10 mm.

Phenology: Flowering and fruiting between June and early July.

Distribution and ecology: Iran (endemic, Fig. 10D); elevation 1500–2200 m.

Conservation status: VU (IUCN, 2008). It is a very rare plant in the area.

Affinities and variation: *Stachys* × *tomentosa* is morphologically intermediate between *S. inflata* and *S. lavandulifolia*. The leaves in the hybrid samples resemble those of *S. lavandulifolia*, the calyx is intermediate between both parent species having long teeth of *S. lavandulifolia* and inflated tube of *S. inflata*, and the corolla is similar to *S. inflata*. *Stachys* × *tomentosa* can be found very rarely in localities where both parent species grow in dense populations beside each other.

Selected specimens examined: **C**. Prov. Kashan: Mooteh protected region, in montibus N Muteh (Mooteh) ad minas derelictas, *Rechinger 46970* (W); **W**. Prov. Bakhtiari: E Shahrekurd, Rokh pass, *Zarre & Salmaki s.n.* (TUH); Prov. Lorestan: Boin-e Miyandasht, on the road to Aligudarz, *Zarre & Salmaki s.n.* (TUH).

DOUBTFUL TAXA

Stachys × *leucomalla* [*Stachys inflata* × *Stachys laxa*]

Stachys* × *leucomalla (Bornm. & Gauba) Rech.f., Fl. Iran. 150: 396 (1982). *Type*: Persia, in valle fl. Chalus, 1500 m, *Gauba 1682* (holotype: B) ≡ *Stachys leucomalla* Bornm. & Gauba, Feddes repert. 49: 271 (1940).

PLANTS perennial, herbaceous, with woody base. STEM branched at base but simple or slightly branched further up, 20–40 cm, erect, internodes 4–6 cm long, densely covered by branched stellate hairs with two to five arms mixed with subsessile to sessile glandular ones. BASAL LEAVES oblong to elliptic, bicolourous with upper side greenish and almost glabrous and lower side silvery and densely hairy as the stem, 2.5–3.5 × 0.6–0.8 cm, entire at

margin, usually acute at apex or rarely acuminate, usually attenuate at base, petiole 0.3–0.5 cm. CAULINE LEAVES similar to basal leaves, gradually passing into sessile floral leaves, oblong to elliptic, 1.5–2.5 × 0.5–1.0 cm, covered by branched hairs and subsessile to sessile glandular hairs, otherwise similar to basal leaves, petiole 0.1–0.2 cm. FLORAL LEAVES elliptic, 0.8–1.0 × 0.2–0.5 cm, subsessile to sessile, acute at apex, entire at margin, hairy as basal leaves. VERTICILLASTERS (four-)five to eight(ten)-flowered, remote, pedicels minute. BRACTEOLES few, herbaceous, linear to lanceolate, 2–4 mm long, with branched hairs along with subsessile to sessile glandular hairs. CALYX ± regular, campanulate, 10–12 × 4–7 mm; teeth subequal, triangular, ± erect, 3.5–4.0 mm long, sparsely covered by exerted long vermiform hairs, unequally armed and stellate at base, mixed with dense subsessile to sessile glandular hairs. COROLLA pink to purple with white or yellow spots on lower lips, 12–18 mm long; tube subequal to calyx tube, 9–12 mm long; upper corolla lip 4–6 × 2.5–4.0 mm; lower corolla lip indistinctly trilobed, 6–8 × 7–10 mm.

Phenology: Flowering and fruiting between June and mid July.

Distribution and ecology: North-east Iran (endemic, Fig. 10D), elevation 700–1500 m.

Conservation status: VU (IUCN, 2008). It is a very rare plant in the area.

Affinities and variation: We were not able to find the type specimen of *S. × leucomalla* in B, although we studied all other materials indicated by Rechinger (1982) as *S. × leucomalla*. Among these samples, *Ferguson 180* and *Sharif 1a* and *1b* are *S. inflata*, *Rechinger 5582* is an immature specimen probably also representing *S. inflata*, but *Koelz 16318* represents *S. turcomanica*. The final status of this taxon can only be clarified after studying the type material and visiting the type locality, which is not easy to trace.

Specimens examined: C. Prov. Mazandaran: between Keyasar and Nika river, *Ferguson 180* (W); In valle fluvii Talar, Sorkhabad, *Rechinger 5582* (W); Mazandaran, Shahkuh, *Koelz 16318* (W); Hezar Jarib, *Sharif 1-a*; and *1-b* (W).

CONCLUSION

Twenty-two species and nine subspecies of *Stachys* are recognized in Iran. Furthermore, two hybrids are known in the country and one hybrid is left as doubtful. Based on our detailed field and herbarium studies

the hybrid species occur only in locations where two parent species are frequent and sympatric. The hybrid taxa are generally rare and include mostly a few individuals. Although the number of morphological synapomorphies in some sections of *Stachys* are relatively high (e.g. sections *Fragilicaulis* and *Eriostomum*) indicating their possible monophyly, some other sections seem to be heterogeneous and probably non-monophyletic (for instance sections *Olisia* and *Ambleia*). Due to the worldwide distribution of the genus, its medicinal applications and the larger number of species, a subgeneric classification of the genus based on a molecular phylogeny seems to be the next important step among various potential research disciplines in *Stachys*.

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REFERENCES

- Assadi M.** 1988. Plants of Arasbaran protected area, NW Iran (Part II). *Iranian Journal of Botany* **49**: 1–59.

- Ball PW. 1972.** *Stachys*. In: Tutin TG, Heywood VH, Burgess NA, Moore DM, Valentine DH, Walter SM, Webb DA, eds. *Flora europaea*, Vol. 3. Cambridge: Cambridge University Press, 151–157.
- Basset IJ, Munro DB. 1986.** Pollen morphology of the genus *Stachys* (Labiatae) in North America, with comparisons to some taxa from Mexico, Central and South America and Asia. *Pollen et Spores* **28**: 279–295.
- Bendiksby M, Lisbeth T, Scheen AC, Lindqvist C, Ryding O. 2011.** An update phylogeny and classification of Lamiaceae subfamily Lamioideae. *Taxon* **60**: 471–484.
- Bentham G. 1834.** *Labiatarum genera et species*. London: James Ridgway & Sons.
- Bentham G. 1848.** *Labiatae*. In: De Candolle AP, ed. *Prodromus systematis naturalis regni vegetabilis*. pars 12. Paris: Victor Masson, 27–603.
- Bhattacharjee R. 1974.** Taxonomic studies in the genus *Stachys* with particular reference to the Near East. PhD thesis, University of Edinburgh.
- Bhattacharjee R. 1980.** Taxonomic studies in *Stachys*, Part II, a new infrageneric classification of *Stachys* L. *Notes of 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. 4. Edinburgh: Edinburgh University Press, 199–281.
- Boissier E. 1879.** *Flora orientalis*, Vol. 4. Lyon, Geneva, Basle: H. Georg, 714–749.
- Bornmüller J. 1915.** Reliquiae Straussianae weitere Beiträge zur Kenntnis der Flora des westlichen Persiens. *Beihefte zum Botanischen Centralblatt* **2**: 165–269.
- Briquet J. 1896.** *Labiatae*. In: Engler A, Prantl K, eds. *Die natürlichen Pflanzenfamilien*, Vol. 4. Leipzig: Wilhelm Engelmann, 183–375.
- Codd LE. 1985.** Lamiaceae. In: Leistner OA, ed. *Flora of Southern Africa*, Vol. 28. Pretoria: Botanical Research Institute, Department of Agriculture and Water Supply, 137–172.
- Czerepanov SK. 2007.** *Vascular plants of Russia and adjacent states (the former USSR)*, Vol. 532. Cambridge: Cambridge University Press.
- Demissew S, Harley MM. 1992.** Hair, seed-surface and pollen characters in *Stachys*, Lamioideae (Labiatae) in Tropical Africa. In: Harley RM, Reynolds T, eds. *Advances in Labiatae science*. Kew: Royal Botanic Gardens, 149–166.
- Dumortier BC. 1827.** *Florula Belgica*. *Staminacia: Tornaci Nerviorum*, J. Custerman, 44–45.
- Feinbrun-Dothan N. 1978.** *Flora Palestina*, Vol. 3. Jerusalem: The Israel Academy of Sciences and Humanities, 128–133.
- Harley RM, Atkins S, Budantsev AL, Cantino PD, Conn BJ, Grayer R, Harley MM, de Kok R, Krestovskaya T, Morales R, Paton AJ, Ryding O, Upson T. 2004.** *Labiatae*. In: Kubitzki K, ed. *The families and genera of vascular plants*, Vol. VII. Berlin: Springer Verlag, 167–275.
- Harvey Y, Demissew S. 1994.** *Stachys nemorigava*: a neglected *Stachys* (Labiatae) from Africa. *Kew Bulletin* **49**: 353–358.
- Hedge IC. 1986.** Labiatae of south-west Asia: diversity, distribution and endemism. *Proceedings of the Royal Society of Edinburgh* **89**: 23–35.
- IUCN. 2008.** *Guidelines for using IUCN Red List Categories and Criteria: Version 6.2*. Gland, Switzerland: Prepared by the Standard and Petitions Working Group of the IUCN SSC Biodiversity Assessments Sub-Committee, IUCN. Available at: intranet.iucn.org/webfiles/doc/SSC/RedList/RedListGuidelines.pdf
- Knorring OE. 1954.** *Stachys* L. In: Shishkin BK, ed. *Flora of the U.S.S.R.*, Vol. 21. Leningrad: Akademi Nauk SSSR, 141–173. [In Russian]
- Koeva-Todorovska I. 1978.** *Pontostachys* – a new section of the genus *Stachys* L. *Fitologiya* **10**: 33–40.
- Krestovskaya T, Vassiljeva IM. 1997.** Palynological study in the genera *Stachys* and *Betonica* (Lamiaceae). *Botanicheskii Zhurnal* **82**: 30–41. [In Russian].
- Krestovskaya T, Vassiljeva IM. 1998.** Fruit morphology in the genus *Stachys* (sections *Olisia*, *Chilostachys*, *Chamaesideritis*, *Zietenia*, *Ambleia*) (Lamiaceae) and its significance for systematics. *Botanicheskii Zhurnal* **83**: 12–20. [In Russian]
- Krestovskaya TV. 2003.** On the species of the section *Ambleia* Benth. genus *Stachys* L. (Lamiaceae) from the Asia. *Novosti Sistematiki Vysshikh Rastenii* **35**: 17–148. [In Russian]
- Krestovskaya TV. 2006.** A new section of the genus *Stachys* (Lamiaceae) from south-west Africa. *Botanicheskii Zhurnal* **91**: 1584–1586. [In Russian]
- Krestovskaya TV. 2007.** A new section of the genus *Stachys* (Lamiaceae) from Africa. *Botanicheskii Zhurnal* **92**: 285–293. [In Russian]
- Li HW, Hedge IC. 1994.** *Stachys*. In: Wu ZY, Raven PH (co-chairs of editorial committee). *Flora of China*, Vol. 17. Beijing: Science Press, 178–184.
- Lindqvist C, Albert AV. 2002.** Origin of the Hawaiian endemic mints within North American *Stachys* (Lamiaceae). *American Journal of Botany* **89**: 1709–1724.
- Linnaeus C. 1753.** *Species plantarum*, Vol. 2. Stockholm: L. Salvius.
- Mulligan GA, Munro DB. 1989.** Taxonomy of species of North American *Stachys* (Labiatae) found north of Mexico. *Le Naturaliste Canadien* **116**: 35–51.
- Mulligan GA, Munro DB, McNeill J. 1983.** The status of *Stachys palustris* (Labiatae) in North America. *Canadian Journal of Botany* **61**: 679–682.
- Nelson JB. 1981.** *Stachys* (Labiatae) in southeastern United States. *Sida* **9**: 104–123.
- Pool A. 2007.** New species of *Stachys* (Lamiaceae) from Mesoamerica. *Novon* **17**: 60–66.
- Rechinger KH. 1982.** *Stachys*. In: Rechinger KH, ed. *Flora Iranica*, Vol. 150. Graz: Akademische Druck- und Verlagsanstalt, 354–396.
- Reichenbach L. 1830.** *Flora Germanica*. Leipzig: Cnobloch C, 318–320.
- Salmaki Y, Jamzad Z, Zarre S, Bräuchler C. 2008a.** Pollen morphology of *Stachys* (Lamiaceae) in Iran and its systematic implication. *Flora* **203**: 627–639.

- Salmaki Y, Zarre S, Jamzad Z. 2008b.** Nutlet micromorphology of *Stachys* (Lamiaceae) and its systematic implication in Iran. *Feddes Repertorium* **119**: 631–645.
- Salmaki Y, Zarre S, Jamzad Z, Bräuchler C. 2009a.** Trichome micromorphology of Iranian *Stachys* (Lamiaceae) with emphasis on its systematic implication. *Flora* **204**: 371–381.
- Salmaki Y, Zarre S, Jamzad Z, Matinizadeh M. 2009b.** Circumscription of taxa in the chasmophilous Iranian *Stachys* species (Lamiaceae: sect. *Fragilicaulis*, subsect. *Fragiles*) inferred from isoenzyme variation patterns. *Biochemical Systematics and Ecology* **36**: 907–914.
- Salmaki Y, Zarre S, Lindqvist C, Heubl G, Bräuchler C. 2011.** Comparative leaf anatomy of *Stachys* (Lamiaceae: Lamioidae) in Iran with a discussion on its subgeneric classification. *Plant Systematics and Evolution* **294**: 109–125.
- Scheen AC, Bendiksby M, Ryding O, Mathiesen C, Albert VA, Lindqvist C. 2010.** Molecular phylogenetics, character evolution and suprageneric classification of Lamioidae (Lamiaceae). *Annals of the Missouri Botanical Garden* **97**: 191–219.
- Turner BL. 1994.** Synopsis of Mexican and Central American species of *Stachys* (Lamiaceae). *Phytologia* **77**: 338–337.