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GERALD PAROLLY & PETER HEIN

Arabis lycia (Cruciferae), a new chasmophyte from the Taurus Mts, Turkey, and notes on related species

Abstract

Parolly, G. & Hein, P.: *Arabis lycia (Cruciferae),* a new chasmophyte from the Taurus Mts, Turkey, and notes on related species. – Willdenowia 30: 293-304. 2000. – ISSN 0511-9618.

Arabis (sect. *Drabopsis*) *lycia* is described as a species new to science and illustrated, and its taxonomic position close to *A. bryoides* of the S Balkans is discussed. SEM micrographs of the indumentum of *A. lycia* and its relatives *(A. bryoides, A. carduchorum, A. drabiformis)* are presented and their ecological requirements outlined. The new species is a subalpine cushion-forming plant of shaded vertical limestone rocks along the ridge of the Bakırlı Dağı in the eastern part of the Western Taurus in Turkey. The chasmophytic habit and its stenochory suggests that *A. lycia* should be included in the list of relic endemics known from the mountains W of the Bay of Antalya.

Introduction

While working on the high mountain rock flora and vegetation of the Anatolian Taurus Mts in summer 1992 and visiting the Bakırlı Dağı some 30 km WSW Antalya (Fig. 3), the second author came across a striking chasmophytic cushion-forming *Arabis* (Fig. 1). Because of its pinkish-purplish petals and its ecology, it was taken as a site-ecological variant of *Arabis aubrietioides* Boiss., which in phytosociological respect is among the most important rock plants of the Anatolian high mountain rock vegetation (Ayaşlığil 1987, Hein & al. 1998, Quézel 1973).

Seven years passed since that first record, until the first author had the opportunity to continue his floristic and phytosociological studies in the Taurus range (Hein & al. 1998, Kürschner & al. 1998, Parolly 1995a, b, 2000) and to re-collect this *Arabis* at the same locality. Owing to the early onset of the hot and dry summer in 1999, the plants had nearly all shed their seeds early in July and it was impossible to gather adequate fruiting specimens.

The new material was, however, the basis to study this cushion-forming rock cress, as Parolly's approach failed to identify it with the help of the "Flora of Turkey" (Cullen 1965). A closer look revealed a noticeable number of clear-cut differences between *A. aubrietioides* and the specimens of 1992 and 1999, and that our plant did not match any *Arabis* known from Turkey, the E Mediterranean Subregion and the Near East (cf., e.g., Cullen 1965, Greuter & al. 1986, Hedge 1968, Hedge & Lamond 1980, Jahn & Schönfelder 1995, Jalas & Suominen 1994, Meikle

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Fig. 1. *Arabis lycia* in its natural habitat on the Bakırlı Dağı, 2400 m. – Photograph by P. Hein, 22.6.1992.

1977, Mouterde 1970, Strid & Titz 1986, Zohary 1966, Zohary & al. 1980). It is described here as a new species.

Arabis lycia Parolly & P. Hein, **sp. nova**
Holotype: Türkei, C3 Antalya, Beydağları, Ostflanke des Bakır Tepe [= Bakırlı Dağı] c. 1,5 km südlich Saklıkent, c. 36°45'N, 30°20'E, schattige, überhängende Felswand mit engen Spalten, Kalk, 90-110°, 2400 m, N-exponiert, 22.6.1992, *P. Hein A17-1* (B; isotypes: E, G, ISTE, JE, herb. Hein, herb. Parolly). – Fig. 1-2, 5a-b.

Ab *A. bryoide* habitu dense pulvinato, caulibus 1-2(-3)-foliosis glabrescentibus, foliis majoribus latioribusque, virescentibus pilis furcatis multis et simplicibus paucis vestitis, obovatis-spathulatis et petalis roseis vel malvinis differt.

Description
A low-growing cushion-forming perennial with numerous pink- to mauve-flowered racemes on rather tiny scape-like stems; cushions flat, ± compact, up to 5-15 cm diam., 6-10 cm high; with a stout, woody rootstock. *Leaves* mostly basal in mid-green rosettes, 6-12 × 3-6 mm, densely and softly tomentose of whitish to slightly yellowish, 0.3-0.5(-0.7) mm long, (2-)3-4(-5)-fid long-stalked "stellate" or, more rarely, dendroid and only few simple hairs (chiefly along the leaf margins) (Fig. 5a-b), obovate-spathulate, apex obtuse to (chiefly) bluntly acute, base gradually narrowed to a flattened petiole 2-3 mm long, margin entire or very rarely with a very blunt tooth; the previous leaves or their remains densely clothing the stem below the present year's rosette, giving the rosette shoot a columnar appearance; cauline leaves 1-2(-3), soon falling off (at flowering often absent), broadly lanceolate, acute, sessile with a subcuneate base, 3-5 mm long and up to 2 mm wide, with entire margins and the same indumentum as the basal leaves and the stem. *Stems* unbranched, 2.5-5 cm long (excl. inflorescence), slender (0.5 mm diam.), at base with a rather

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dense indumentum, above and at the end of flowering glabrescent. *Inflorescence* 4-8(-10)-flowered, at first corymbose, later forming a short raceme c. 2-2.5 cm long and c. 1.5 cm wide, not or hardly elongating in fruit; rhachis and pedicels with a very thin (glabrescent?) indumentum or glabrous. *Pedicels* slender, ascending, 5-8 (10) mm long. *Sepals* greenish with paler, partly translucent margins, partly or totally flushed pinkish to purplish, with a few branched and some more simple hairs at back; outer sepals oblong-ovate, flat to slightly concave, obtuse, margins sometimes somewhat undulate-sinuate, c. 2.5(-3) × 1.2(-1.5) mm, moderately saccate at base; inner sepals boat-shaped, concave, obtuse to bluntly acute, margins entire, 3-3.5(-4) × 2-2.5 mm, conspicuously saccate at base. *Petals* pink or mauve, with nerves a little darker, 6-8 × 3-3.5 mm, obovate, rounded at apex, margins ± undulate-sinuate and auriculate, gradually tapering to base. *Stamens* 2.5-3.5 mm long, filaments yellowish-whitish, apically often flushed pink, filiform, only somewhat flattened; anthers oblong, (pale) yellow, 0.8-1.1 × 0.4 mm. *Ovary* cylindrical, glabrous, c. 4 × 0.3-0.4 mm; style short but distinct, c. 0.5 mm long; stigma stoutly capitate. *Siliquae* erect or spreading-erect, straight or slightly curved, 10-14 mm long, at the broadest part c. 1.5 mm wide, apex acute, crowned by persistent style and stigma, base rather abruptly tapering to pedicels; valves pale brown tinged purplish, somewhat shining and keeled; seeds unknown.

Eponymy

The epithet refers to ancient Lycia, chiefly congruent with the Lycian Taurus (Western Taurus Mts, Turkish: Batı Toroslar) and, in phytogeographical terms, with the Lycian Sector sensu Parolly (1995a, 1998), where the Bakırlı Dağı is situated at its eastern edge.

Additional specimen seen

TURKEY, C3 ANTALYA: Beydağları, Bakırlı Dağı above Saklıkent, summit region S of the observatory, 36°49'60"N, 30°20'22"E, c. 2490-2520 m, limestone rock crevices and clefts, 11.7.1999, *Döring, Parolly 6540 & Tolimir* (herb. Parolly).

Site conditions, synecology

Arabis lycia is a rock plant of the subalpine belt and recorded from altitudes between c. 2300 and 2500 m. It is restricted to vertical or slightly overhanging (80-110°) hard limestone and dolomite rock faces. *A. lycia* appears on large rocks only, which due to their inclination and northern exposure are fairly well protected against high irradiation, but not against the impact of wind. The species grows together with, e.g., *Aethionema lycium* I. A. Andersson & al., *Arabis alpina* subsp. *brevifolia* (DC.) Greuter & Burdet, *Asyneuma linifolium* (Boiss. & Heldr.) Bornm. subsp. *linifolium*, *Campanula cymbalaria* Sm., *Laserpitium petrophilum* Boiss. & Heldr., *Scrophularia candelabrum* Heywood, *Silene odontopetala* Fenzl, *S. oreades* Boiss. & Heldr. and *Verbascum pestalozzae* Boiss. It is as a true chasmophyte in narrow clefts of the compact limestone exclusively (Hein & al. 1998, and new observations).

Phytosociologically, *Arabis lycia* (as *A. aubrietioides*) has been reported as a local differential species of a subunit of the Aethionemo lycii-Laserpitietum petrophili Hein & al. 1998. This association is classified among the Silenion odontopetalae Quézel 1973 alliance (rock crevice communities of the Western Taurus) and the Silenetalia odontopetalae Quézel 1973 order, the latter encompassing all presently studied Anatolian basiphytic high mountain rock vegetation (Hein & al. 1998, Quézel 1973). The arabetosum aubrietioidis Hein & al. 1998 subassociation characterises semishaded subalpine rock sites of the Bakırlı Dağı. Consequently, the re-naming and taxonomic change of the differential species must be followed by a synnomenclatoral alteration of the subassociation's name. The formality is, however, left for a phytosociological account to be published elsewhere, updating the results of our previous studies in the light of the many new relevés established in 1999 and 2000 within the scope of the PONTAURUS project (Parolly in prep.).

Affinities and taxonomic position

The subgeneric division of *Arabis* has many problems with conflicting taxonomy (for the classifications of the species of the Flora Orientalis area, see Boissier 1867 and Schulz 1936). The crit-

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Fig. 2. *Arabis lycia* – parts of the holotype at B. – Scale: 1 cm.

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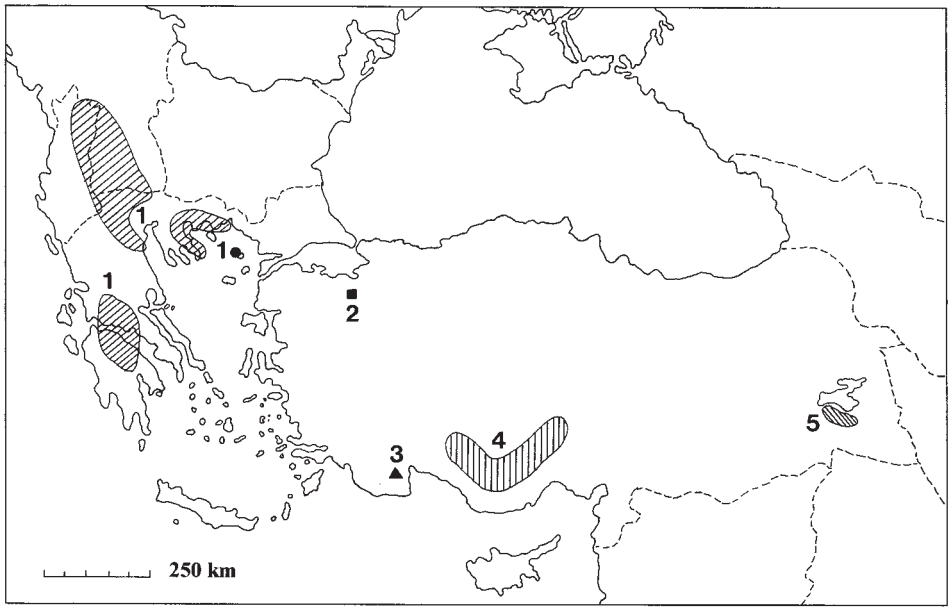


Fig. 3. Distribution of *Arabis lycia* and related species – 1: *A. bryoides* (based on Jalas & Suominen 1994); 2: *A. drabiformis* (based on Cullen 1965, Güleryüz 1998); 3: *A. lycia;* 4: *A. androsacea* (based on Cullen 1965 and own field records); 5: *A. carduchorum* s. str. (based on Cullen 1965).

ical remarks of Rollins (1941), who concluded that in western American *Arabis* truly natural subdivisions of the genus other than the species themselves are non-existent, still holds true and may also explain that information on the subgeneric division of the genus is so scarce in all modern floristic treatments in our area (see above). It was no surprise to find in Boissier (1867) the obvious allies of *A. lycia* in two (weakly differentiated) sections *Pseudarabis* and *Drabopsis*. Here we follow Schulz (1936) who partly united them into a reasonably natural group.

Arabis aubrietioides, the first species to discuss, is a member of *A.* sect. *Arabis* (= *A.* sect. *Euarabis* C. A. Mey.) and close to *A. alpina* s.l. It approaches *A. lycia* only superficially. Both are chasmophytes of limestone rock faces. Resemblance is chiefly due to the short and greenish, not *(A. lycia)* or very rarely and weakly canescent indumentum *(A. aubrietioides)* and the pink to purplish petals. Distinguishing characters clearly prevail: *A. aubrietioides* is a laxly caespitose, tufted and generally taller herb (stems 7-15(-20) cm long) with runners, less developed basal rosettes and, most importantly, with up to 10 distant to overlapping, larger stem leaves, all deeply toothed, cordate, auriculate and amplexicaul. It displays greenish to pale yellowish-brown, linear and much longer (40-50 × 1 mm), flattened and incurved fruits, which are somewhat constricted between the seeds.

All species which appear to be related to *Arabis lycia,* viz. *A. bryoides* Boiss., *A. drabiformis* Boiss., *A. carduchorum* Boiss., *A. armena* N. Busch and *A. androsacea* Fenzl, fall into or are placed close to the broadened *A.* sect. *Drabopsis* Griseb. (incl. *Pseudarabis* C. A. Mey. ex Prantl p.p.), to include "herbae perennes dense caespitosae, foliis minutis ellipticis integerrimis in rosulas dense congestis, scapis floriferis subaphyllis facie *Leucodrabae*" (Boissier 1867: 166). *A. lycia* in these respects fits perfectly into this section.

The other species differ from *Arabis lycia* in their ecology, being mountain plants of rocky slopes, but with the exception of *A. bryoides* not pronounced chasmophytes. They also differ in their indumentum (Fig. 4-5), growth form (a tendency towards dense, cushion-like tufts is ob-

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served in some species though) and, notably, generally green sepals and always white petals. However, in *Arabis* the difference in the flower colour should not be stressed too much because in a number of chiefly pink, lilac or purplish flowering species, white-flowered forms do occur (I. C. Hedge in litt., 2000, cf. Meikle 1977).

Arabis carduchorum Boiss., an endemic of Turkish Kurdistan (Fig. 3), and *A. armena* N. Busch (isotype B!; for illustration see Avetisjan 1966, Buš 1927), found in the Nahičevan area, are only doubtfully different from each other (Hedge 1968). This view is strongly supported by the material at B. Conspecific or not, they are, besides the features mentioned above, distinct from *A. lycia* on account of their linear, clearly pectinate-ciliate rosette and stem leaves. In addition to the somewhat stiff cilia (about 1 mm long), the scattered, rather coarse indumentum consists of shorter, chiefly 3-4-forked "stellate", 0.4-0.5 mm long hairs with all rays of largely the same size. The surface of the hairs is strikingly papillose (Fig. 4a-b).

By contrast, the indumentum of *Arabis drabiformis* Boiss. is composed of only simple, stiff, up to 1-2 mm long hairs on the setose-pilose rosette leaves (Fig. 4c-d). The micro-morphology of the papillate hairs indicates a closer relationship to *A. carduchorum*. *A. drabiformis* is a local endemic of the NW Anatolian Uludağ (Bithynian Olympus, Fig. 3). It differs from *A. lycia* by its laxly caespitose habit, longer (7-16 cm), glabrous and leafless stems, longer siliquae (18-20 × 2 mm) and thicker and shorter filaments (for a detailed description and illustration, see Güleryüz 1998).

Arabis bryoides Boiss. of the southern Balkans is said to be close to and sometimes confused with *A. drabiformis* (Cullen 1965, Strid & Titz 1986). However, *A. bryoides* resembles *A. lycia* even more closely and is likewise a high mountain rock plant. It is regionally ranked among the character species of the SE European Potentilletalia speciosae Quézel 1964 order (Quézel 1964, 1967). It forms low cushions or mats with dead leaves persisting for some time. The ornamentation of the soft indumentum is similar in both species, displaying, intermixed with simple, smooth hairs, a great portion of long-stalked, 2-5-fid hairs (Fig. 5). In *A. bryoides,* the pilae at the leaf margins are, if not the only hair type (Fig. 5c), considerably longer than the "stellate" hairs. The indumentum of the lamina is 2-layered, consisting of short "stellate" hairs overtopped by many forked and simple hairs (Fig. 5d). By contrast, in *A. lycia* most of the simple hairs are of the same length as the forked ones and only scattered and occasionally found in its leaf indumentum. The longer indumentum of *A. bryoides* often tends to give the plant a grey-tomentose appearance. Other differences between these two allies include the completely leafless stem, the smaller and narrower rosette leaves (4-7(-10) × 1.2-2 mm), the subcorymbose inflorescence with only 2-5(-7) flowers, pedicels diverging at an angle of (30-)60° and bearing longer and narrower siliquae (12-35 × 1.4 mm) with an emarginate stigma in *A. bryoides.* The sepals of this species can be purple towards apex and occasionally hairy (as in *A. lycia*), while the petals are always snow-white (for detailed descriptions and illustrations, see Strid 1980 and Strid & Titz 1986).

Arabis androsacea Fenzl, endemic to the Isaurian and Cilician Taurus (Fig. 3), is the only other *Arabis* in the western half of the Taurus Mts that can meaningly be compared with *A. lycia*. *A. androsacea* often forms rather lax tufts with a small number of rosettes only and resembles *A. carduchorum* in many respects. In facies, *A. androsacea* is also similar to *A. lycia,* but with somewhat stouter and distinctly leafy stems, i.e. with 6-8 acute, lanceolate stems leaves, 6-8(9) mm long and less than 2 mm wide, and with (narrowly) lanceolate basal leaves. The indumentum of *A. androsacea* is silver-sericeous, at least when young, with simple and smooth hairs c. 2 mm long, giving the rosettes a strongly felted appearance. The siliquae are very similar in shape to the one of *A. lycia* (and *A. carduchorum*), but considerably longer (up to 28 mm) [note: this and all other measurements, often considerably extending the ranges given in the standard literature, have been taken from herbarium specimens at B]. Moreover, the style is narrower and longer, with a less clearly capitate stigma than in *A. lycia*. *A. androsacea* never grows in saxatile habitats but in rather open dwarf-shrub and thorn-cushion communities (Astragalo-Brometalia order), in doline

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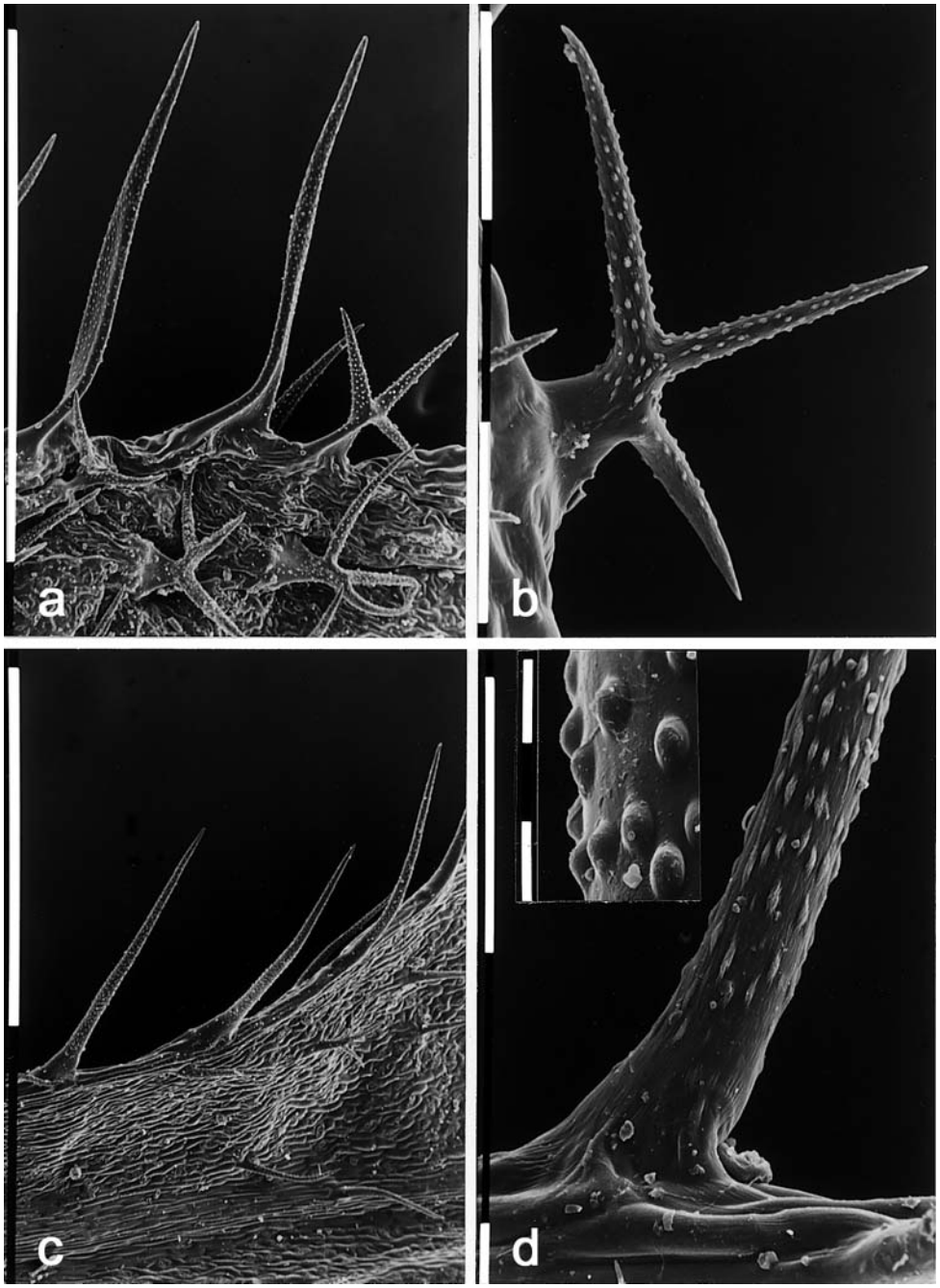


Fig. 4. SEM micrographs of the indumentum of *Arabis carduchorum* (a, b) and *A. drabiformis* (c, d), showing the leaf margin (a, c) and details of a single, papillate hair (b, d). – Scale (1 unit): a, c = 1 mm, b, d = 0.1 mm, detail of d = 0.01 mm; specimens: a-b: cult. Bot. Gard. Berlin, 1887 (B); c-d: [Turkey], Olympus Bithyniae [= Uludağ], *Boissier* (B).

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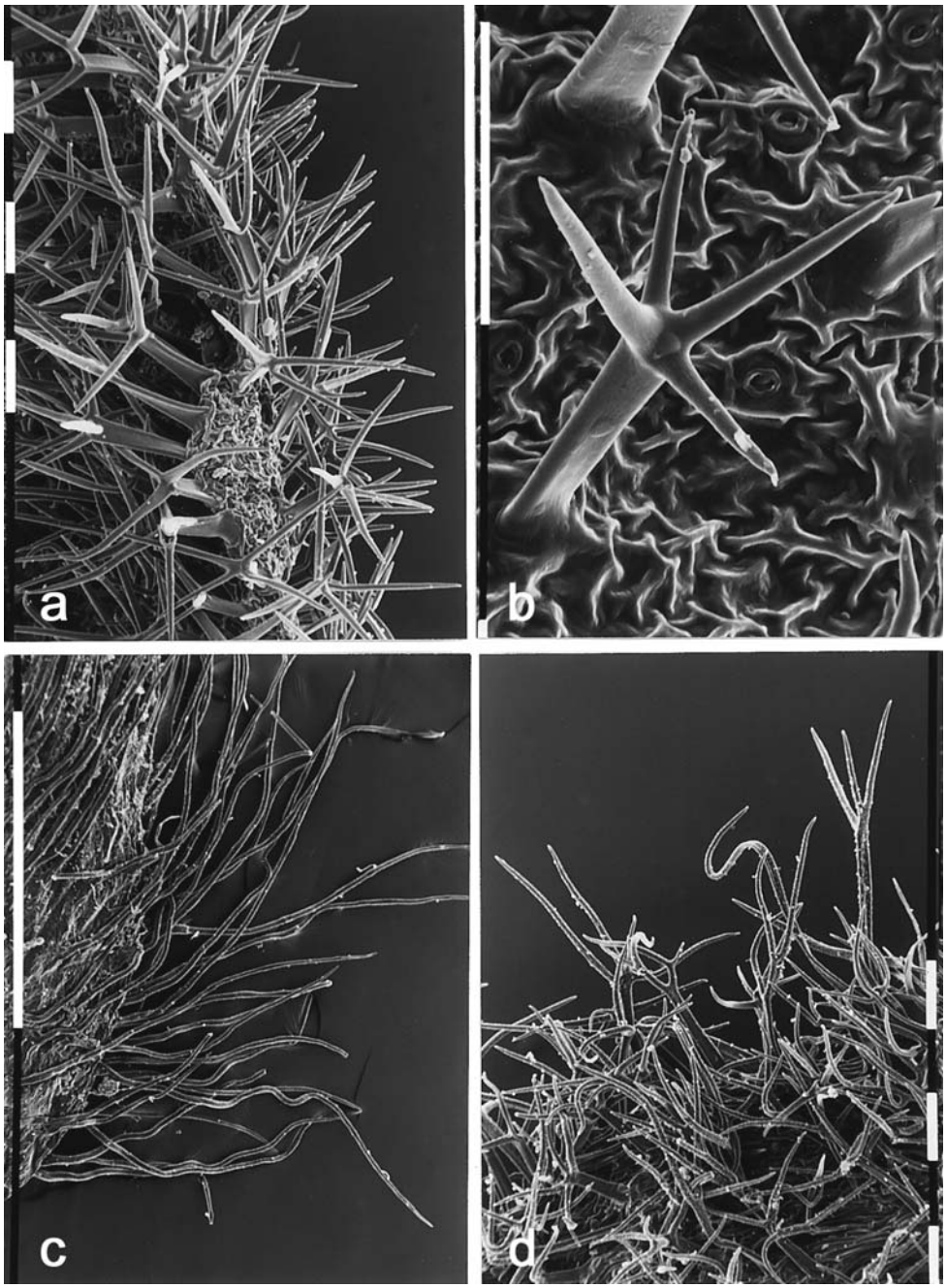


Fig. 5. SEM micrographs of the indumentum of *Arabis lycia* (a, b) and *A. bryoides* (c, d), showing the leaf margin (a, c, d) and a "stellate" hair (b). – Scale (1 unit): a, b, d = 0.1 mm, c = 1 mm; specimens: a-b: holotype at B; c: Griechenland, Sterea Ellas, Fokis, Giona-Massiv, Berg Vraila, 2075-2100 m, 26.6.1982, *Hagemann & al. 340* (B); d: Griechenland, Pieria, Or. Olympos, 2300 m, 7.1960, *Sorger 60-3-36* (B).

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turf (Trifolio-Polygonetalia order) and more rarely in wind-swept places (Drabo-Androsacetalia order); chiefly in oreal to subalpine elevations between 1800 and 2700 m. For a survey of the high mountain vegetation and the major syntaxa of the Taurus Mts, see Ayaşlığil 1987, Hein & al. 1998, Kürschner 1982, 1984, 1986, Kürschner & al. 1998, Parolly 1995a, 1998, Quézel 1973].

Arabis lycia – a paleoendemic of the Lycian Sector

At present, all records of *Arabis lycia* are from a few rocks of a single peak (Bakırlı Dağı) in the Beydağları SW of Antalya, but it is to be expected from neighbouring mountains, especially Çalbalı Dağı. The first author searched in vain for it on Tahtalı Dağı on 8 July 1999. *A. lycia* is regarded as a stenoendemic of the Batı Toroslar (Western Taurus) of E Mediterranean-montane origin.

The eastern part of the Beydağları mountain range, running from Bakırlı Dağı and Çalbalı Dağı to Tahtalı Dağı at the Lycian coast, has probably never been glaciated and is famed for its great number of endemics, with a considerable proportion of paleoendemics (Davis 1971). Besides very local species, e.g. *Asyneuma pulvinatum* P. H. Davis and *Carum rupicola* Hartvig & Strid on Tahtalı Dağı or *Aethionema lycium* I. A. Andersson & al. on Bakırlı Dağı and Çalbalı Dağı, there are some species which characterise all the mountain summits of the eastern Beydağları. This group includes, among others, *Asyneuma lycium* (Boiss.) Bornm., *Dorystoechas hastata* Boiss. & Heldr. ex Benth., *Scrophularia candelabrum* Heywood, *Seseli ramosissimum* Hartvig & Strid (with its type locality on Çalbalı Dağı and first reported here for Tahtalı and Bakırlı Dağı from our 1999 collections [B]), and *Verbascum pestalozzae* Boiss. Mostly, these are plants of cliffs or rock ledges, or taxa with at least partial populations found in rock communities. Such habitats function as refugia for both obligatory chasmophytic relics and partly also for non-chasmophytes (see for the E Mediterranean Subregion, e.g., Davis 1951, Snogerup 1971). Considering this and the somewhat isolated position of *Arabis lycia* (and *A. bryoides*) in the genus together with its stenochory, suggest that *A. lycia* is an addition to the long list of relic endemics known from the mountains W of the Bay of Antalya.

IUCN threat category

In 1992, the authors and Eckhard von Raab-Straube enjoyed one week of field-work on the then undisturbed summit region of Bakırlı Dağı. At his second visit in 1999, the first author was greatly saddened by the fact that in the meanwhile an observatory had been constructed on the mountain ridge. It is supported by a beaten track cut into the rocky slopes above the ski resort of Saklıkent. It was during this construction that not only a beautiful doline – the type locality of the Fritillarietum pinardii Kürschner & al. 1998 – was transformed into an outsize car park. The work on the observatory also destroyed a rock ledge which supported one of the few known colonies of *Arabis lycia*.

Its occurrences are obviously so scattered that this splendid plant could not have been recorded during the two periods of field-work on Bakırlı Dağı in 1998 and 1999 done by Özkan Eren (pers. comm.). Fortunately, no additional construction projects are planned, the ski resort of Saklıkent does not affect the dwindling stands of the rock plants, and the grazing pressure on that mountain, especially in the steep cliffs, is moderate. Nevertheless, we recommend placing *Arabis lycia* under the IUCN threat category "Critically Endangered" (IUCN 1994), because the estimated area of occupancy is less than 10 km² and only a single locality is known.

Conclusion

Because the record of *Arabis aubrietioides* from the Bakırlı Dağı was based on a misidentification, it should be deleted from the flora of the Batı Toroslar (Hein & al. 1998; for the phytogeographically concluded circumscription of the Western Taurus range or Lycian Sector, see Parolly 1995a, 1998). All substantiated records of the Taurus endemic *A. aubrietioides* are from the central and adjoining eastern Taurus range.

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Arabis lycia, tentatively included in the chiefly lithophytic paleoendemics of the mountain range W of Antalya, is unique in being a chasmophyte with compact, mauve flowering cushions and scape-like stems. Its characters place *A. lycia* in *A.* sect. *Drabopsis,* where its closest relative is *A. bryoides*, a basiphytic rock plant of the mountains of the southern Balkans with occurrences in Greece, Albania and the southern parts of the former Yugoslavia (Strid & Titz 1986). Floristic links between the mountain floras of Greece and the Taurus Mts. have been discussed, among others, by Davis (1971), Parolly (1995a) and Strid (1986). There are convincing morphological and ecological arguments for treating *A. lycia* and *A. bryoides* as vicarious species. For an account of the synvicariad chasmophytic syntaxa of the E Mediterranean, see Hein & al. (1998), and for the rock communities of Greece, Quézel (1964, 1967).

In our discussion of the relatives of *Arabis lycia,* considerable stress is laid on the indumentum (Fig. 4-5). *A. lycia* and *A. bryoides* share a mixed indumentum of smooth, "stellate" and simple hairs, while the proportions and the length of hair types are specifically distinct. *A. carduchorum* s.l. (incl. *A. armena*) is reported here to have strongly papillose hairs, but with deviating branching. The last species compared is *A. androsacea,* which differs in its long, silky and simple indumentum of smooth hairs.

The new record underlines the importance of the Lycian Taurus as a speciation centre and refugium area, whose floristic treasures are still far from being fully known. It also emphasises that the Anatolian mountains form one part of the diversity centres of the genus, with 19 species (including eight endemic) of *Arabis* s.str. (excl. *Turritis* L.) in Turkey (Cullen 1965, Davis & al. 1988) and c. 18 in the Flora Iranica area (Hedge 1968). In neighbouring regions, a rapid decline in diversity (especially in perennials of mountain habitats) is observed, with, e.g., only four species in Cyprus, Iraq and Palestine respectively (Hedge & Lamond 1980, Meikle 1977, Zohary 1966).

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