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The serpentine vegetation of Sandras Dađı revisited - Phytosociological studies on high-mountain plant communities of the South Anatolian Taurus Mountains, 4

Abstract

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The serpentine vegetation of Sandras Dađı revisited. Phytosociological studies on high-mountain plant communities of the South Anatolian Taurus Mountains, 4. - The present paper deals with the high-mountain vegetation of Sandras Dađı, a fairly isolated main range in the SW Anatolian Taurus, Turkey, which is largely composed of peridotite rock and stands out for its rich endemic flora. Critically reviewing the phytosociological accounts on this topic, it proposes a classification scheme for the serpentinophytic vegetation in a wider sense. Three associations are described as new to science. While the *Muscari sandrasici-Polygonetum karacae* (meltwater and snow-bed community) fits in spite of its many local serpentinophytes into the *Thlaspion papilloso* alliance (*Trifolio-Polygonetalia*), the zonal mesophytic to xerophytic vegetation could hitherto not be classified satisfactorily. As a solution, the serpentinophytic *Thuryion capitatae* (*Astragalo-Brometalia*) of the Cilician Taurus is expanded in geographical and diagnostic respects, to accommodate also the stands as far West as Sandras Dađı. Here, they can be grouped into a *Genistetum sandrasicae* and an *Odontarrheno masmenaeae-Ebenetum pisidicae*. All communities are characterised by means of life form spectra, chorotype spectra and dispersal biological spectra. The only two available serpentinophytic *Astragalo-Brometalia* syntaxa from Turkey, including the name *Thuryion capitatae*, are validated. In addition, two suballiances are suggested that consider the floristic contrast between the western and eastern parts of the Taurus range.

Key words: *Astragalo-Brometalia*, biospectra, chorotypes, dispersal, ecology, oroxerophytic vegetation, phytosociology, serpentine, snow-beds, SW Anatolia, syntaxa, Taurus System.

Introduction

This is the continuation of long-interrupted series of papers dealing with the high-mountain vegetation and flora of the Taurus Mts. in Anatolia, Turkey (Parolly 1998; Hein & al. 1998; Kürschner & al. 1999; Parolly 2004; Eren & al. 2004). I am pleased to dedicate this part of the study to Prof. Dr George Nakhutsrishvili on the occasion of his 85th birthday. Add multos annos, Gia!

The serpentine massif of Sandras Dağı is in botanical respects one of the classical peaks in Anatolia (Boissier 1867-1884; Davis 1949, 1955; Davis 1965-1985; Davis & al. 1988; Güner & al. 2000). Its many local endemics have attracted the attention of numerous collectors. The mountain range is generally considered to be well known (Hartvig & Strid 1987; Karlén 1987; Özhatay 1981, 1987, 1993; Özhatay & al. 2003), but there are also some more recent additions to its endemic flora (Parolly & Scholz 2004; Varol 2005).

As far as the high-mountain vegetation is concerned, Sandras Dağı has received a fairly comprehensive treatment in Quézel's fundamental "Contribution à l'étude phytosociologique du massif du Taurus" (1973), in which not less than eight communities, classified into five different major syntaxa and formations, are dealt with. These are:

- ▶ three edaphically differentiated *Astragalo-Brometea* Quézel 1973 communities (dwarf-shrub and thorn-cushion communities), included in the otherwise completely basiphytic *Tanacetion praeteriti* Quézel 1973, viz. (1) the "groupement à *Convolvulus cochlearis* et *Chamaecytisus eriocarpus*" on "rocaïlles compactes de faible inclinaison"; (2) the "groupement à *Alyssum propinquum* et *Sesleria phleoides*" on "éboulis fixés, crêtes que sous-couvert forestier clairsemé" and (3) the "groupement à *Ebenus pisidica* et *Plantago carinata*" on "cuvettes terreuses";
- ▶ a "doline" vegetation on humid soil (*Trifolio-Polygonalia* Quézel 1973, *Bolanthion frankenioidis* Quézel 1973, Association à *Plantago carinata* et *Poa persica* var. *alpina* Quézel 1973);
- ▶ a rock community, i.e. the "groupement à *Viola sandrasea* et *Rosularia serpentinicum*" (*Silenetalia odontopetalae* Quézel 1973);
- ▶ a fragmentary flush community (only three 3 species were recorded in the single relevé), which cannot be classified phytosociologically, although Quézel attached it preliminary to his groupement à *Blysmus compressus* et *Rorippa aurea*;
- ▶ and a fragmentarily known scree plant community not supported by particular relevés.

All but one unit, the Association à *Plantago carinata* et *Poa persica* var. *alpina*, which is widespread in the western Taurus, were considered to be restricted to Sandras Dağı and some other neighbouring ophiolitic summits. Quézel's results (1973) were widely confirmed (but without additional relevés) and accepted by Öztürk & al. (1991) and Gemici & al. (1994) in their synthetic study on the high-mountain flora and vegetation of W and S Anatolia. Although unpublished and therefore irrelevant in nomenclatural respects (it includes many invalid new names), the latter study is (or was) circulated with considerable influence among the Turkish scientific community.

In front of such a research history, nobody would realistically expect that something worth to be communicated about the high-mountain vegetation of Sandras Dağı could be left, some minor syntaxonomic or nomenclatural adjustments excepted. However, the contrary was the case. In 1999, while doing extensive fieldwork on the high-mountain vegetation of the Taurus range, I realised that the situation encountered in the field did at best in part match the published results.

The present paper will introduce a new hygrophytic association in showing the independent status of the local unit from the Association à *Plantago carinata* et *Poa persica* var. *alpina* and the *Muscari bourgaei-Ornithogaleum brevipedicellati* Quézel 1973. This new syntaxon is, due to the many serpentinophytes, the most distinct *Trifolio-Polygonetalia* community hitherto known. Moreover, two of three of Quézel's informal *Astragalo-Brometalia* "groupements" are lumped into one here formally described *Genistetum sandrasicae*, while a not yet observed association occurring at windswept places, is added. In this context it must be noted that Quézel's plots have a standard size of 100 m². Experience with the vegetation in the Taurus Mts. has shown this plot size to often end up in site-ecologically and floristically heterogeneous relevés (Parolly 1998; Hein & al. 1998; Kürschner & al. 1998; Parolly 2004).

In an earlier paper, on the occasion of reviewing the high-mountain vegetation of Anatolia (Parolly 2004), I have made some preview suggestions concerning a revised syntaxonomy of the serpentine vegetation of the western Taurus range. Due to the limitation of space, these necessary changes could not be substantiated by relevés. I take here the opportunity to make up for it and to support the proposed concepts by an adequate documentation. As a conclusion, a greatly modified classification of the asylvatic vegetation of Sandras Dağı can be presented, which has more than local value. For Anatolia, it approaches for the first time consistent solutions how to incorporate serpentinophytic stands into a system of basiphytic vegetation units that at the same strongly reflect phytogeographic patterns.

Study area

Sandras Dağı, situated ca. 20 km N of Köyceğiz (Figs. 1-2), culminates in Çicekbaba Tepesi at 2294 m under 37°05'15.76 N and 28°50'21.88 E (Figs. 3-4). Geologically the mountain range is completely composed of ultramafic, softly weathering rocks of the Peridotite nappe (Brunn & al. 1971; Şenel 1991). They crop out of the surrounding Lycian Nappes that comprise mostly limestone units. In higher elevations of Sandras Dağı, peridotites prevail, which contain orthopyroxenes and magnesian olivines. The peridotites are cut by pyroxenites and dolerite dykes. They develop into acidic soils (pH values 4.5-5.5) with very low percentages of CaCO₃ (1-2%).

The forest-line is given by Quézel (1973) at 2100 m, but extensive clearing has widely depressed it to 1600-1800 m (Fig. 3a). Rocky slopes and boulder-rich summit plateaux covered by *Astragalo-Brometalia* communities predominate, but there are also scattered small, flat areas and depressions with abundant finer soil, which support a particular type of herbaceous hygrophytic vegetation (snow-beds).

Materials and Methods

Phytosociological sampling

The present paper follows the conventions of the Braun-Blanquet approach (Braun-Blanquet 1964), with the major modifications introduced since that time (Dierßen 1990;

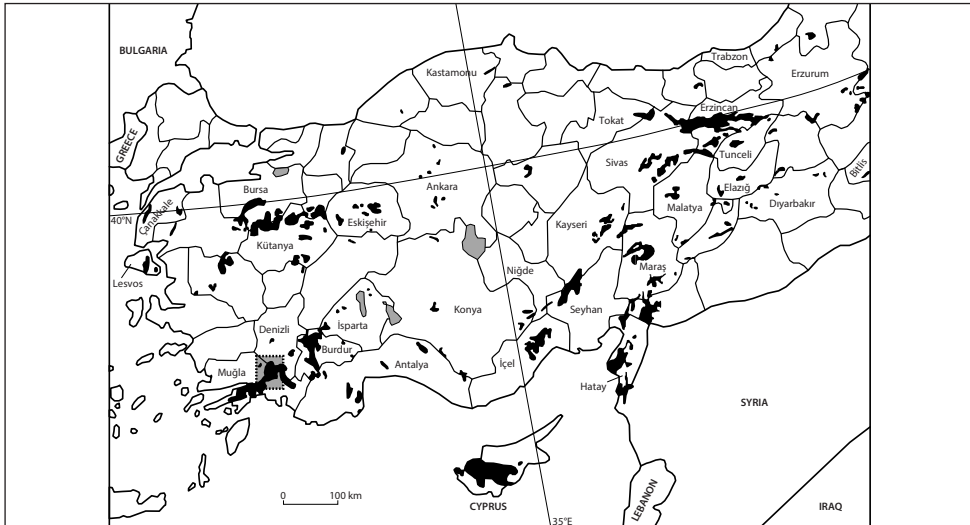


Fig. 1. Situation of the study area in SW Anatolia (approximately indicated by the dotted and high-lighted quadrangle) and distribution of ultramafic rock (in black) in Turkey and adjacent regions (especially Cyprus). Grey: Lakes. – Based on a map by Reeves & Adıgüzel (2004, altered).

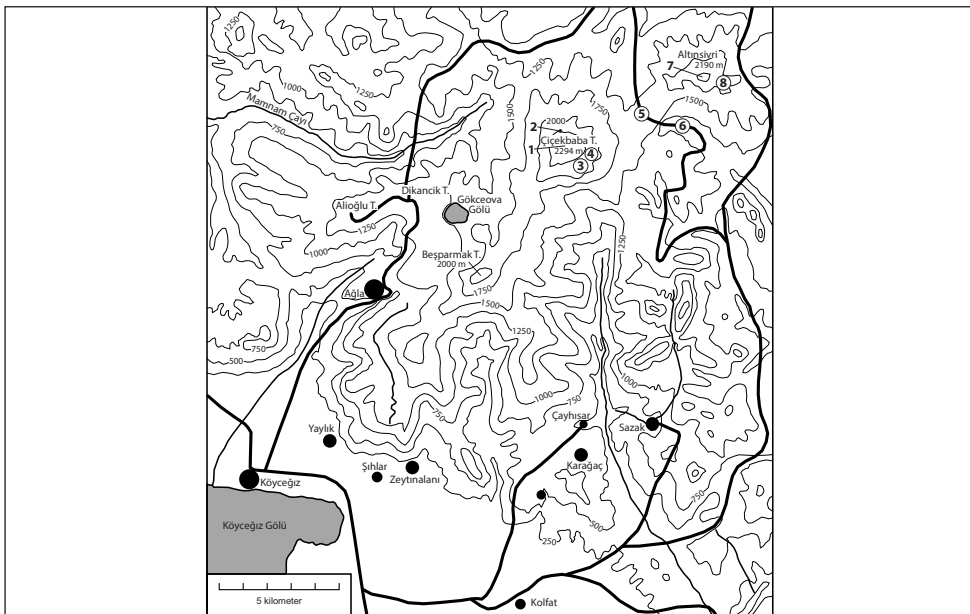


Fig. 2. Topographic map of the wider study area (Sandras Dağı range) and sampling localities (1–8). For more detailed place names, see Appendix 2. Note that the localities shown on the map have been numbered from left to right, while the localities and plots annotated in the appendix are chronologically arranged. Grey: Lakes; black dots: Villages and small settlements. – Based on a map by Özhatay (1993, altered).

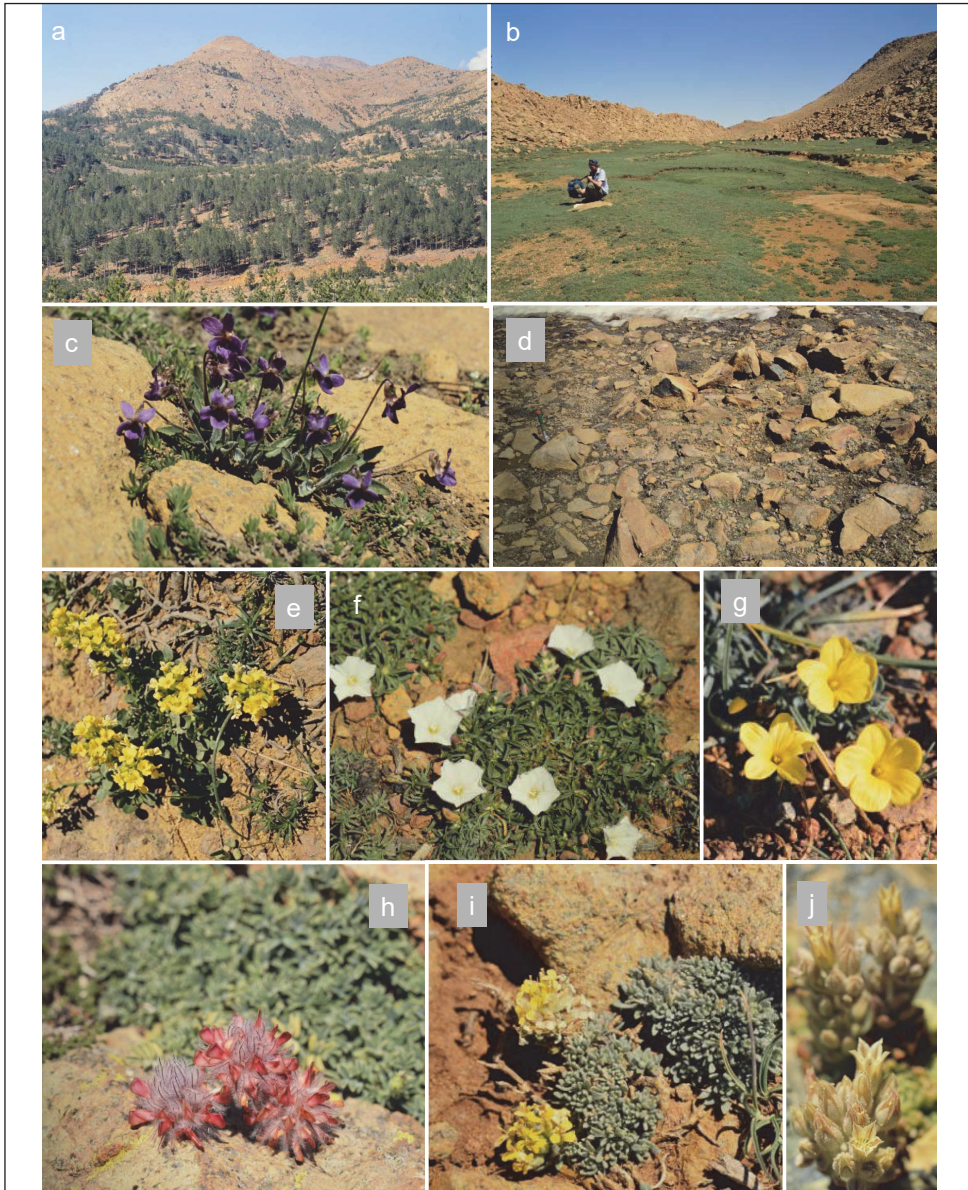


Fig. 3. Landscapes and habitats of Sandras Dağı. **a)** Main summit (Çiçekbaba Tepesi) with *Pinus nigra* var. *caramanica* forest and subalpine belt; **b)** dense snow-bed turf of the *Muscari sandrasici*-*Polygonetum karacae* association with abundant *Plantago holosteum*; **c)** *Viola sandrasea* subsp. *sandrasea*; **d)** stand of a meltwater community (*Muscari sandrasici*-*Polygonetum karacae*) with *Barbarea brachycarpa* subsp. *anfractuosa*, *Colchicum figlalii*, *Scilla pleiophylla*, *Ranunculus heterorhizus* and other geophytes; **e - j)** characteristic serpentine taxa of the Sandras Dağı range: **e)** *Barbarea brachycarpa* subsp. *anfractuosa*; **f)** *Convolvulus libanoticus*; **g)** *Linum boissieri*; **h)** *Ebenus pisidica*; **i)** *Alyssum propinquum*; **j)** *Prometheum serpentinicum*.



Fig. 4. Landscapes and habitats of Sandras Dağı. **a)** Typical site and appearance of a stand of the *Genistetum sandrasicae*; **b)** view from the main summit towards Gökceova Gölü (in the foreground: boulder scree supporting a stand of the *Odontarrheno masmenaeae-Ebenetum pisidicae* association); **c)** *Aethionema speciosum* subsp. *compactum* (white flowers) and *Chamaecytisus pygmaeus* (yellow) within *Genistetum sandrasicae*; **d)** *Anthemis cretica* and *Asperula stricta* subsp. *monticola*; **e)** *Convolvulus compactus*, an individual with an untypically deeply split corolla; **f)** *Cytisopsis pseudocytisus* subsp. *reeseana*; **g)** typical site of the local dwarf-shrub vegetation (*Genistetum sandrasicae*) on the summit flat of Altınsivri facing Çiçekbaba Tepesi; **h)** *Teucrium alyssifolium*.

Dierschke 1994). The combined valuation of the abundance and cover adopts the scale of Barkman & al. (1964) with the modification that the “2m” value is replaced by “1m”.

The field-work was carried out in June 1999. A total of ca. 55 relevés have been established on Sandras Dağı between 1700 and 2300 m. Omitting duplicate relevés, 35 of them entered the community tables (Tables 1-3). In addition, 13 selected relevés of Quézel (1973) are considered (Table 7). All sampling localities are indicated in Fig. 2 and listed with their locality numbers used in the headings of the community tables in Appendix 2.

Composition of community tables; syntaxonomy

The community tables (Tables 1-3) are not straighten out to display the most typical stands only. They sometimes also include, in order either to reflect syndynamical trends or transitions along ecological gradients, floristically heterogeneous, nevertheless very instructive relevés. Such relevés (e.g. relevé 20a, b) are set apart by dotted lines and were not or separately considered in the calculation of the biospectra.

Below the character species (CS) and differential species (DS) of the respected communities (associations and their subunits), the tables are horizontally arranged to exhibit syntaxonomic species groups with ecological and or zonal information, such as *Astragalo-Brometalia* (xeric sites, orcal to subalpine), *Trifolio-Polygonetalia* (damp to chionophytic) and *Drabo-Androsacetalia* (wind-exposed, often lithophytic habitats). The treatment of the diagnostic taxa of the *Astragalo-Brometalia* and the *Astragalo-Brometea* (incl. *Trifolio-Polygonetalia*) and related subunits are in accordance with Parolly (2004) and Eren & al. (2004; see also Kürschner & Parolly 2012).

The “Code of Phytosociological Nomenclature” (ICPN, Weber & al. 2000) has been applied for all nomenclatural procedures involved.

Analyses of life forms, chorotypes and dispersal biology of the communities. Calculation of biospectra

For all communities studied, life form spectra (Table 4), chorotype spectra (Table 5) and dispersal biological spectra (Table 6) are given. Their calculation follows Reichelt & Wilmanns (1973). The life form spectra and dispersal biological spectra are presented weighted, i.e. based on the mean percentage cover value (mpc-value) of the taxa within the communities. By contrast, chorotype spectra consider the species frequency in calculating an un-weighted group percentage (gp-value). Life form, chorotype and dispersal biological features of each species recorded within the communities of Sandras Dağı are compiled in Appendix 1.

The phytogeographic elements were chiefly attributed according to the “Flora of Turkey and the East Aegean Islands” (Davis 1965-1985; Davis & al. 1988; Güner & al. 2000), the “Conspectus Florae Orientalis” (Heller & Heyn 1986-1994; Zohary & al. 1980, 1983), the “Exkursionsflora für Kreta” (Jahn & Schönfelder 1995), the “Geobotanical Foundations of the Middle East” (Zohary 1973), as well as Kürschner (1982, 1984), Parolly (1995), Hein & al. (1998), Kürschner & al. (1998) and Eren & al. (2004).

The analysis of the life forms (Raunkiaer 1934; Ellenberg & Müller-Dombois 1967; for distinguished types see Table 4 and Frey & Lösch 2004) is, as in dispersal biology, largely related to the own field observations backed by voucher specimens and only in the second line reference-based. Most attributions of life forms accord with Jahn & Schönfelder (1995). In cases in which species develop under the influence of their environment two (or three) deviating life forms, the mpc-value were split, if they are found with \pm the same frequency. If one life form of a taxon is less frequent and significant within a syntaxon than the other(s), it is given in brackets and not considered in the calculation at all. The same procedure was followed in the dispersal biology.

Some patterns of dispersal biology were analysed by judging the dispersal mechanism of a taxon from its diaspore morphology (construction type). This theoretical approach was rightly criticised by van der Pijl (1969: 2), but accepted as starting point that cannot be dismissed. Fortunately, the structural aspects can often be supplemented by a wide range of own actual field observations of dispersal (indicated by an exclamation mark in Appendix 1) and references (e.g., Müller-Schneider 1983, 1986, especially for *Poaceae*; indicated by an “L” for literature).

Taxonomy and treatment of critical taxa

Since Quézel (1973) had published his “Contribution“, many plant groups were revised for the then appearing “Flora of Turkey and the East Aegean Islands” (Davis 1965-1985; Davis & al. 1988; Güner & al. 2000) and even later new species were discovered from Sandras Dağı (summarised in Güner & al. 2000, see also Varol 2005). This makes taxonomic and nomenclatural adjustments inevitable.

The accepted names follow “Flora of Turkey”, updated by the “Türkiye Bitkileri Listesi” (Güner 2012), “The Euro+Med PlantBase” (<http://ww2.bgbm.org/EuroPlusMed/query.asp>), “Flora Hellenica” (Strid & Kit Tan 1997, 2002), Böhling & Scholz (2003), Bolliger (1996), Eren & al. (2004) and Parolly & Eren (2006, 2007). Comments in the text and the synoptic table (Table 7) harmonise the taxonomy and nomenclature between Quézel’s (1973) and the present account. These remarks are given in brackets and include: syn. (= synonym); tax. (= taxon added to Flora of Turkey later than 1973) and rev. (= quite likely a misidentification by Quézel).

A proper interpretation of the names was especially needed, when the taxa were taxonomically significant or eponymous, such as those of the “groupement à *Convolvulus cochlearis* et *Chamaecytisus eriocarpus*”, the “groupement à *Alyssum propinquum* et *Sesleria phleoides*“, the “groupement à *Ebenus pisidica* et *Plantago carinata*” and the “groupement à *Viola sandrasea* et *Rosularia serpentinum*“. While *Convolvulus cochlearis*, *Plantago carinata* and *Rosularia serpentinum* are easily detected as synonyms of *C. compactus*, *P. holosteam* and *Prometheum serpentinum*, respectively, “*Chamaecytisus eriocarpus*” turned out to be a mixture of *Ch. pygmaeus* and *Cytisopsis pseudocytisus* subsp. *reeseana*, and *Sesleria phleoides* at all places studied to be *S. alba*. In the case of *Festuca ovina* (s. l.), two species of the group were recorded by the relevés, i.e. *F. elwendiana* and *F. valesiaca* (both were indicated in square brackets in Table 7). Other critical records by Quézel (1973) and necessary changes are discussed, below, in the description of the communities. Appendix 1 lists all taxa recorded.

Results and Discussion

Phytosociology: Community descriptions

Muscari sandrasici-Polygonetum karacae Parolly, **ass. nov.**: Serpentinophytic meltwater community stands and snow-bed turf of the Western Taurus (Table 1; Fig. 3b-e)

Holotypus: Table 1, relevé 7. – CS: *Barbarea brachycarpa* subsp. *anfractuosa*, *Colchicum figlalii*, *Muscari sandrasicum*, *Ranunculus heterorhizus*. DS (loc.): *Polygonum karacae*.

Site conditions. – In sharp contrast to limestone, where the water trickles quickly away, serpentine and associated rocks provide geological substrates which support extensive stands of chionophytic vegetation. On Sandras Dağı, the many, often local serpentinophytes differentiate a floristically very particular vegetation unit, which is described here as a new association. This *Muscari sandrasici-Polygonetum karacae* colonises gently sloping to horizontally stretching valley bottoms, gravelly or stony flats and the flat boulder-fields of the summit region. At such places, it forms a fairly dense, bluish-green to dark green turf (Fig. 3b), in early mountain summer spotted by arrays of flowers. Hartvig & Strid (1987) refer to such stands as “snow-bed meadows”. More rarely, and often only fragmentarily developed, the *Muscari sandrasici-Polygonetum karacae* occurs as a geophyte-dominated meltwater community (Fig. 3d) along the meltwater runnels in various inclinations.

Stands of the associations are preferably found in elevations between 1900 and 2250 m, but there are some remarkable outposts lower down (1650 m) on the depressions of a gravelly plain. On 20-21 June 1999, large snowfields were abundant especially in N- and W-exposures and a few snow-patches in E-facing slopes, all supporting strongly flowing meltwater runnels.

Structure and floristical composition. – In physiognomic respects (see Table 4), the *Muscari sandrasici-Polygonetum karacae* forms either the afore mentioned open, geophyte-dominated meltwater community (along steep and rocky meltwater runnels [Fig. 3d and Table 1a: relevés 20a, 20b] or in shallow depressions below late snow snow-patches (Table 1b: relevés 7-9) or snow-bed turf (Fig. 3b and Table 1b: relevés 10-13, Table 1c: relevés 21-23). The overall impression of stands of the association is that of a carpet-turf dominated by a few, low-growing, rosulate hemicryptophytes and pulvinate chamaephytes (total mpc-value 58.4%), seven geophytic species (19%), a few suffruticose chamaephytes (9.2%, especially due to *Polygonum karacae*) and caespitose hemicryptophytes (6.9%). *Plantago holosteum* (*P. carinata*) is structurally the most significant element.

Because *Plantago holosteum* occurs both as large, flat and compact cushion and as more loosely trailing rosette plant, its mpc-value of 58.2% was split into these two life categories (Ch pulv and H ros). Tragacanthic species are, as it is usual for this vegetation order and for serpentine soils in the Taurus range, seldom and here represented only by *Astragalus angustifolius* var. *violaceus*.

The meltwater vegetation type covers only 5-30% of the surface and the plants are scattered among stones and block debris (proportion of rock and stone 35-80%). In steep and

rocky meltwater runnels close to the snow-fields, the species inventory is, at least in early mountain summer, very fragmentary and consists nearly exclusively of the most chionophytic species. In particular *Colchicum figlalii*, *Scilla pleiophylla*, *Ranunculus heterorhizus* (Fig. 3d), and more rarely *Barbarea brachycarpa* subsp. *anfractuosa* (Fig. 3e), are able to penetrate through the snow-cover and to flower in the midst of the running meltwater, which flows strongest in the afternoon. The two fragmentary relevés 26-27 have not been further considered in the calculation of the biospectra.

By contrast, the turf impression is much more real in the extensive snow-beds (Fig. 3b) with their total vegetation cover ranging normally between 60 and 80% and with lower proportions of stones at the surface. *Plantago holosteum* reaches here its highest combined abundance-coverage values. In addition, the chamaephytic companions and the *Thuryion capitatae* species are physically much better developed than in the meltwater community stands.

The character species of the *Muscari sandrasici*-*Polygonetum karacae* include with *Barbarea brachycarpa* subsp. *anfractuosa*, *Colchicum figlalii*, *Muscari sandrasicum* and *Ranunculus heterorhizus* mostly local (Sandras Dağı and neighbouring summits) or at least SW Anatolian endemics (*Ranunculus heterorhizus*). All but the latter species appear to be exclusive serpentinophytes, while *Ranunculus heterorhizus* also dwells on other non-limestone substrates. As often in the hygrophytic *Trifolio-Polygonetalia* vegetation, the character species are centred in that unit, but they may occasionally even join the early spring flora of open mountain forests.

Barbarea brachycarpa (as *B. minor* and its varieties) has variously been recorded as major character species associated with the *Trifolio-Polygonetalia* vegetation (Kürschner & al. 1998; Quézel 1973; Parolly 2004), before the *B. brachycarpa* aggregate was revised and phytosociologically re-evaluated by Parolly & Eren (2007). Subsp. *anfractuosa* (Fig. 3e) is one of the two serpentinophytes within this geographically and edaphically well differentiated species. It marks places with a long-lasting snow-cover and is hitherto only known from Sandras Dağı proper. *Muscari sandrasicum* is a little bit more widespread than *Barbarea brachycarpa* subsp. *anfractuosa* and is the least chionophytic one among the diagnostic species. *Colchicum figlalii* (as *Merendera figlalii*) is a recent addition to the serpentine flora of Sandras Dağı and Turkey (Varol 2005; Parolly & Eren 2007). Unlike as indicated in its protologue, it is, at the right time and right place, a quite abundant appearance in the summit region of that mountain range.

In addition to the character species of the association, the *Muscari sandrasici*-*Polygonetum karacae* is differentiated against all other *Trifolio-Polygonetalia* vegetation units by a group of species which circumscribe the serpentinophytic *Thuryion capitatae* s. l. Many basiphytic *Trifolio-Polygonetalia* vegetation units are marked by transgressive character species and differential species of the *Tanacetion praeteriti* Quézel 1973 and *Agropyro-Stachydion* alliances Quézel 1973 (all. *Astragalo-Brometalia*). The most remarkable *Astragalo-Brometea* species among them is *Polygonum karacae*. It is a prostrate shrublet first described from Sandras Dağı, but later recorded from several others, much dryer places in the Western and Pisidian and Isaurian Taurus (Eren & al. 2004). It is locally confined to the damp wing of the *Astragalo-Brometea* vegetation.

The set of character species and differential species is equally well represented at ordinal level. *Ornithogalum alpigenum* is ranked here for the first time among this group. The

Table 1. The *Muscari sandrasici*-*Polygonetum karacae* ass. nov. (*Thlaspion papilloso*, *Trifolio-Polygonetalia*) on Sandras Dağı. **1a–b**) typical variant (**1a** relevés from steep and rocky meltwater runnels); **1c**) *Euphorbia erythron* variant.

Relevé no.	20a	20b	11	12	13	10	7	8	9	22	23	21
Locality	2	2	4	4	4	4	4	4	4	6	6	6
Altitude (m)	2150	2200	2000	2000	2050	2000	1900	1950	1950	1650	1650	1650
Exposure	N	NW	-	N	N	W	S	-	S	NE	ENE	NNE
Inclination (°)	25	20	0	8	8	5	2	0	2	4	4	2
Vegetation cover (%)	10	10	60	80	80	75	20	30	15	30	60	60
Proportion of rock and stones (%)	75	65	10	10	10	15	35	50	75	60	35	5
Proportion of fine soil (%)	15	25	30	10	10	10	45	20	10	10	5	35
Square size (m²)	9	12	16	15	15	9	16	16	15	12	12	9
Number of species	8	10	17	15	14	14	16	17	17	21	16	25
	1a		1b						1c			
CS & DS of the association												
<i>Muscari sandrasicum</i>	.	(+)	1m	1m	+	+	+	1m	1m	1m	+	+
<i>Barbarea brachycarpa</i> subsp. <i>anfractuosa</i>	+	1m	.	1	+	+	1	1	1	1	1m	+
<i>Polygonum karacae</i>	+	.	2a	.	.	2a	+	+	1	2a	1	1
<i>Ranunculus heterorhizus</i>	1m	1m	+	1m	1m	1m	1m	1m	+	.	.	+
<i>Colchicum figelii</i>	1m	1m	+	1m	1m	(+)	.	.	.	.	.	.
<i>Euphorbia erythron</i>	.	.	.	.	.	.	.	.	.	+	+	+
DS on serpentine (Thuryion capitatae)												
<i>Odontarrhena masmenaea</i>	.	+	+	1	+	.	+	1	+	1	+	1
<i>Sabulina verna</i> subsp. <i>brevipetala</i>	.	.	1	.	.	.	+	+	+	1m	1	1
<i>Viola sandrasea</i>	.	.	.	+	+	.	+	.	+	.	+	+
<i>Genista sandrasica</i>	.	.	.	.	.	.	.	+	.	.	.	+
<i>Linum boissieri</i>	.	.	.	.	.	.	.	.	.	+	.	.
<i>Aethionema speciosum</i> subsp. <i>compactum</i>	.	.	.	+	.	.	.	.	.	.	.	.
<i>Iberis sempervirens</i>	.	.	.	+	.	.	.	.	.	.	.	.
CS & DS of the Trifolio-Polygonetalia												
<i>Plantago holosteam</i>	.	.	3	4	3	4	2a	1	1	2b	3	1
<i>Lotus alpinus</i>	.	+	1	+	+	1	+	1	+	+	1	1
<i>Alopecurus gerardii</i>	+	.	1	1	+	.	.	+	+	1	.	1
<i>Ornithogalum alpigenum</i>	+	1m	+	.	+	1m	+	+	+	+	1m	.
<i>Trifolium hybridum</i> subsp. <i>anatolicum</i>	.	+	1	+	.	1	1	.	.	1	1	2a
<i>Scilla pleiophylla</i>	1m	1m	1m	1m	1m	+	+	(+)	.	.	.	.
<i>Astragalus angustifolius</i> var. <i>violaceus</i>	.	.	1	.	+	1	.	+	+	.	.	.
<i>Herniaria glabra</i>	.	.	.	.	.	.	.	.	.	+	+	+
<i>Petrorhagia alpina</i> subsp. <i>olympica</i>	.	.	.	.	.	.	.	.	.	1m	.	1m
<i>Bolanthus frankenioides</i> var. <i>fasciculatus</i>	.	.	.	.	.	.	.	.	.	.	.	1
<i>Tragopogon olympicus</i>	.	.	.	.	.	.	.	.	.	.	.	+
<i>Nocca papillosa</i>	(+)	1m										
CS & DS of the Astragalo-Brometalia and Astragalo-Brometea												
<i>Galium incanum</i> subsp. <i>centrale</i>	.	.	+	.	.	1	1	.	+	.	.	.
<i>Anthemis cretica</i> subsp. <i>cretica</i> (incl. subsp. <i>leucanthemoides</i>)	.	.	+	.	.	+	.	+	+	.	.	.
<i>Thymus sipyleus</i> subsp. <i>sipyleus</i>	.	.	.	.	.	.	1	+	+	.	.	.
<i>Arenaria ledebouriana</i> var. <i>ledebouriana</i> (vs. var. <i>pauciflora</i>)	.	.	.	.	.	.	.	.	.	1m	1m	1
<i>Scorzonera szowitzii</i>	.	.	.	.	.	.	.	.	.	+	1m	+
<i>Cyanus reuteranus</i> var. <i>reuteranus</i>	.	.	.	1	.	.	.	.	.	+	.	+
<i>Centaurea cariensis</i> subsp. <i>maculiceps</i>	.	.	.	.	.	.	.	.	.	+	+	.
<i>Koeleria macrantha</i>	.	.	.	.	.	.	.	.	.	.	.	+
<i>Hypericum avicularifolium</i> subsp. <i>depilatum</i> var. <i>bourgaei</i>	.	.	.	.	.	.	.	.	.	.	.	+
Others												
<i>Gagea bithynica</i>	+	1m	1m	1m	1m	1m	1m	1m	1m	1m	1m	+
<i>Poa bulbosa</i> agg.	.	.	+	.	+	1	.	+	+	1m	1m	1m
<i>Rumex acetosella</i>	.	.	.	.	.	.	.	.	.	1m	.	+
<i>Galium imoleum</i>	.	.	.	.	.	.	+	+	.	.	.	.

occurrence of *Scilla pleiophylla* (with its *Lycian-Pisidian-Isaurian* distribution pattern) as well as the observations of *Noccaea papillosa* outside the relevés links the *Muscari sandrasici-Polygonetum karacae* to the *Thlaspion papilloso* Kürschner, Parolly and Raab-Straube 1998 or the *Bolanthion frankenioidis* Quézel 1973, respectively. *Gagea bithynica* is a constant companion, which functions as fine-soil indicator.

Distribution. – The *Muscari sandrasici-Polygonetum karacae* is presently only recorded from its type locality. Its narrow endemics make a wider range extension outside the Sandras Dağı Peridotite Nappe very unlikely; this all the more since the author has studied the vegetation of the very few other mountains in the Taurus range (see Parolly 2004; Eren & al. 2004), where ophiolites or peridotites crop out in high montane or subalpine elevations.

Subdivision, community differentiation. – The montane altitudinal form of the *Muscari sandrasici-Polygonetum karacae* (Table 1c) is distinguished by the substrate-vag Anatolian endemic *Euphorbia erythron*, the *Trifolio-Polygonetalia* species *Herniaria glabra*, *Petrorhagia alpina* subsp. *olympica* and *Bolanthus frankenioides* var. *fasciculatus*, as well as a number of transgressive *Astragalo-Brometalia* species. Due to the shorter period of snow-cover and no additional meltwater supply, the sites of the *Euphorbia erythron* variant are mesic. The most chionophytic species of the association are consequently lacking and replaced by an enhanced number of more robust taxa. Due to the stronger grazing pressure, ruderals (*Rumex acetosella*) and other species adapted to such conditions join the unit (*Herniaria glabra*, *Cyanus reuteranus*, *Scorzonera szowitzii*). This (low) altitudinal form is thus at the same time the trampled turf variant of the *Muscari sandrasici-Polygonetum karacae*. Its distinctness and transitional position towards the mesophytic to xerophytic *Thuryion capitatae* communities is also evidenced by the modified dispersal biological spectrum (see below).

Syntaxonomic comparison and classification. – The many serpentinophytes as well as the occurrence of *Gagea bithynica*, *Ornithogalum alpigenum* and *Anthemis cretica* s. str. (Fig. 4d) make the *Muscari sandrasici-Polygonetum karacae* a distinct and easy-to-identify new association. It is the substrate-vicarious, serpentinophytic unit of the *Muscari bourgaei-Ornithogaleum brevipedicellati* Quézel 1973 (see 5. Concluding remarks), but it has due to the abundance of *Plantago holosteum* and *Alopecurus gerardii* also much affinities with Quézel's "Association à *Plantago carinata* et *Poa persica* var. *alpina*". The *Muscari sandrasici-Polygonetum karacae* is preliminary included in the *Thlaspion papilloso* alliance, because it seems to be premature to establish a particular serpentinophytic (sub)unit, as far as the serpentinophytic vegetation of S Anatolia has not been studied more comprehensively.

Genistetum sandrasicae Parolly, **ass. nov.**: Serpentinophytic dwarf-shrub community of the Western Taurus (Table 2; Fig. 4a, c, g)

Holotypus: Table 2, relevé 6. – CS: *Aethionema speciosum* subsp. *compactum*, *Genista sandrasica*, *Prometheum serpentinum*, *Verbascum cariense*, *Viola sandrasea* subsp. *sandrasica*

drasea. DS (loc.): *Chamaecytisus pygmaeus*, *Cytisopsis pseudocytisus* subsp. *reeseana*.

Incl.: Groupement à *Ebenus pisidica* et *Plantago carinata* (Quézel 1973), groupement à *Convolvulus cochlearis* et *Chamaecytisus eriocarpus* (Quézel 1973) p. p.

Site conditions. – The *Genistetum sandrasicae* is, from ca. 1800 m upwards, the prevailing dwarf-shrub and thorn-cushion community of the high montane and subalpine belt of Sandras Dađı. It holds among the tree-less vegetation units the most extensive stands and occupies in various aspects all suitable ± mesic, moderately xeric or moderately hygic sites of the summit areas. The site amplitude of the community is considerable; it can be found both at flat places and in the steepest rocky slopes (to an angle of slope of 40°). It only recedes in the most xeric, scree-rich and wind-swept S- and W-exposures along the ridges of the summit region, leaving space for the establishment of the xerophytic *Odontarrheno masmenaeae-Ebenetum pisidicae*. With sufficient water supply and soil-cover (usually at least 15-20 cm soil above bedrock), the *Genistetum sandrasicae* also occurs in wind-exposed sites to form the vegetation of the rocky summit flats (Gipfelfluren, Fig. 4g) as it is the situation on Altinsivri. In addition, the *Genistetum sandrasicae* covers large doline-like depressions, sometimes with snow-fields, where it gradually merges into the *Muscari sandrasici-Polygonetum karacae*. During the summer months, the stands of the *Genistetum sandrasicae* suffer increasingly from the summer drought (obs. August 2006); this also explains the principally xerophytic appearance of the community which otherwise clearly prefers mesic sites.

In lower elevations, the *Genistetum sandrasicae* may well replace cleared and strongly browsed *Pinus nigra* var. *caramanica* forests. Very similar stands establish themselves on small to mid-sized clearings in the forest. Fragments of the *Genistetum* form here together with forest initial species the understory under 1-4 m tall pine young growth. Such transitional stands (syndynamical stages) are very often dominated by large clones of the 50-100 cm tall and showy serpentinophytic *Centaurea ensiformis* P. H. Davis. They were not included in the present study.

Structure and floristical composition. – The *Genistetum sandrasicae* is a typical espalier shrub and shrublet community, where creeping chamaephytes hold an amazing 48% mpc-value (see Table 4). Three *Fabaceae* species (*Chamaecytisus pygmaeus*, *Cytisopsis pseudocytisus* subsp. *reeseana*, *Genista sandrasica*) are in particular responsible for this high value, and together with many others, for the predominance of the yellow floral aspect. Another fifth of the life form spectrum is made up by xerophytic half-shrubs, so that the *Genistetum sandrasicae* meets well the physiognomic expectations for an *Astragalo-Brometalia* unit in being dominated by chamaephytes. Tragacanthic species are, characteristically deviating from the situation on limestone, weakly represented (here ± singly by *Acantholimon ulicinum* var. *purpurascens*) and structurally fairly insignificant. Only the most xerophytic variant of the association (variant of *Teucrium alyssifolium*, see below and Table 2b) might be termed as open thorn-cushion community on scree.

Stands of the *Genistetum sandrasicae* usually cover more than 50% of the ground, with various proportions of rock and visible soil at the surface. It is a bi-layered community; the espalier shrubs seldom attain heights of more than 10 cm. The thorn-cushions, too, remain fairly small and low. They are overtopped by 20-40 cm tall graminoids, some taller

Table 2. The *Genistetum sandrasicae* ass. nov. (*Thuryion capitatae*, *Astragalo–Brometalia*) on Sandras Dağı. **2a)** typical variant; **2b)** *Teucrium alyssifolium* variant.

Relevé no.	D5	D4	D1	D2	D3	1	6	5	2	3	4	T1	T2	T3	T4	24	25	
Locality	3	3	4	3	3	7	8	7	7	7	7	7	7	8	8	5	5	
Altitude (m)	2180	2180	1950	2180	2180	2190	2000	2150	2150	2100	2100	2100	2100	2000	2000	1800	1800	
Exposure	S	SW	E	E	W	SE	ESE	SSE	WNW	W	W	ESE	NE	ESE	E	S	S	
Inclination (°)	6	1	27	27	3	0-3	35	8	25	30	25	0-2	6	42	11	20	10	
Vegetation cover (%)	60	75	35	40	60	35	60	65	55	60	70	40	50	50	70	30	25	
Proportion of rocks & stones (%)	5	20	15	40	10	50	15	25	40	40	25	60	25	40	-	65	70	
Proportion of fine soil (%)	35	5	50	20	30	15	5	8	5	0	5	0	25	10	30	5	5	
Square size (m ²)	40	8	15	10	15	30	25	48	40	36	25	60	40	30	25	24	24	
Number of species	23	18	21	22	26	34	36	28	29	27	34	40	30	30	21	36	36	
	2a																2b	
CS & DS of the association																		
<i>Cytisopsis pseudocytisus</i> subsp. <i>reeseana</i>	2b	2a	2a	2a	2a	+	+	2a	2b	3	3	1	2a	2a	3	.	.	
<i>Genista sandrasica</i>	1	1	+	+	2a	.	1	1	.	.	+	1	1	1	+	1	1	
<i>Aethionema speciosum</i> subsp. <i>compactum</i>	1m	+	+	+	+	.	+	+	.	+	+	+	+	+	+	1	+	
<i>Chamaecytisus pygmaeus</i>	+	.	1	.	1	.	2b	3	.	.	.	.	+	2a	1	1	1
<i>Verbascum caritense</i>	.	.	.	.	.	1	.	.	1	+	+	1	+	+	.	.	+
<i>Promethium serpentinicum</i>	.	.	1m	+	+	+	.	.	.	.	.	.	.	.	1m	.	(+)
<i>Scorzonera sandrasica</i>	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
<i>Teucrium alyssifolium</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Astragalus condensatus</i> (incl. <i>A. podperae</i>)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2a
<i>Convolvulus compactus</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
<i>Thesium billardieri</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2a
<i>Silene brevicalyx</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
<i>Cruciata taurica</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
CS & DS of the Thuryion capitatae and subordinate units																		
<i>Odontarrhena masmenaea</i>	2a	1	1	1	1	2a	2a	1	1	2a	1	2a	1	1	.	1	1	
<i>Ebenus pisdica</i>	+	1	+	1	1	2a	1	2a	1	+	2b	2b	2a	1	1	1	1	
<i>Cyanus reuteranus</i> var. <i>reuteranus</i>	1	.	1	1	.	1	+	1m	1	+	+	1m	+	1m	1	+	.	
<i>Alyssum propinquam</i>	.	.	+	.	+	+	1	.	+	1	1	+	1m	1m	1	.	.	
<i>Viola sandrasica</i>	.	1m	1m	+	+	+	+	1m	+	1m	1	1m	1m	1m	.	.	.	
<i>Fumana aciphylla</i>	.	.	.	.	.	1	.	1	+	.	.	.	1	2a	1	.	+
<i>Leontodon asperimus</i>	+	.	.	.	.	1	.	.	.	.	.	+	1	1	1	+	+
<i>Linum boissieri</i>	.	+	.	+	.	.	.	.	1	.	+	+	.	.	.	.	.
<i>Iberis sempervirens</i>	+	1m	1m	1m	.	.	+	.	1	1	1	.	.	.	.	.	.
<i>Sabalina verna</i> subsp. <i>brevipetala</i>	1	+	1	1	1	+	.	1	.	.	.	.	.	.	.	.	.
<i>Gallium tmoicum</i>	+	+	1m	1m	+	+	+	.	.	.	.	.	.	.	.	.	.
<i>Minuartia recurva</i> subsp. <i>carica</i>	+	.	(+)	.	.	.	.	.	.	.	.	1	1	.	.	+	.
<i>Ferulago sandrasica</i>	.	.	.	.	.	+	.	1	.	.	.	1	+	.	.	.	.
<i>Sideritis leptoclada</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
<i>Stipa cucuminis</i>	.	.	.	.	.	.	.	.	(+)	.	.	.	.	1m	.	.	.
<i>Convolvulus libanoticus</i>	.	.	.	.	+	.	.	.	.	(+)	.	.	.	.	.	(+)	.
CS & DS of the Astragalo-Brometalia																		
<i>Scorzonera szowitzii</i>	1	1	.	.	1m	.	+	1	1	+	+	+	1	+	2a	+	+	
<i>Muscari tenuiflorum</i>	.	.	.	.	1m	1m	.	1m	.	.	.	1m	1m	.	.	.	+
<i>Hypericum avicularifolium</i> subsp. <i>deplatum</i> var. <i>bourgaei</i>	+	.	1	+	.	1	+	+	+	+	.	.	.	(+)	.	1	+	
<i>Centaurea cariensis</i> subsp. <i>maculiceps</i>	.	.	.	.	+	.	1	+	.	.	.	.	.	.	+	+	1
<i>Campanula stricta</i> var. <i>libanotica</i>	.	.	.	.	.	+	1	+	.	+	+	.	.	+	1m	1m	1m
<i>Dianthus eretmopetalus</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1m	.	.
<i>Onosma aucheranum</i>	.	.	.	.	.	.	2a	+	.	.	.	.	.	.	2a	.	.
<i>Thymus longicaulis</i> subsp. <i>chaubardii</i> var. <i>alternatus</i>	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Festuca elwendiana</i>	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
CS & DS of the Drabo-Androsacetalia																		
<i>Centaurea drabifolia</i> subsp. <i>cappadocica</i>	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+
<i>Thesium procumbens</i>	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.
CS & DS of the Trifolio-Polygonetalia																		
<i>Bolanthus frankenioides</i> var. <i>fasciculatus</i>	1	+	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.
<i>Plantago holostium</i>	2a	2b	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Corydalis oppositifolia</i> subsp. <i>oppositifolia</i>	1m	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
<i>Ornithogalum alpigenum</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1m	.
<i>Colchicum figlalii</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
CS & DS of the Astragalo-Brometea																		
<i>Thymus sipyleus</i> subsp. <i>sipyleus</i>	.	.	1	1	1	1	1	.	+	.	.	1	2a	2a	1	.	.	
<i>Mattiastrum lithospermifolium</i> subsp. <i>caritense</i>	.	.	+	1m	+	1	1	+	+	+	+	.	.	1m	.	1m	+	
<i>Acantholimon ulicinum</i> var. <i>purpurascens</i>	+	.	1	1	+	+	1	+	+	+	1	2a	.	.	1	+	.	
<i>Asperula stricta</i> subsp. <i>monticola</i>	.	.	.	.	.	+	+	+	1	1	2a	1	1m	+	1	.	.
<i>Bromopsis tomentella</i> subsp. <i>tomentella</i>	.	.	+	.	1m	+	1	1	+	+	+	1m	.	.	.	.	.
<i>Koeleria macrantha</i>	.	.	.	.	.	1	1	1	.	+	.	.	1	1m	1m	.	.
<i>Phlomis armenica</i>	+	.	+	+	.	1	2a	.	+	+	1	+	.	.	.	+	+	
<i>Sedum ursi</i>	.	.	.	.	1m	1m	.	.	+	+	+	+	+	.	.	.	.

Boncuk Dağları), some 40 km to the SE from Sandras Dağı (pers. comm., R. Ulrich, Tübingen). *Genista sandrasica* is an espalier shrublet, which was segregated from *G. lydia* Boiss. as late as 1987 by Hartvig & Strid. Besides the *Fabaceae*, the two higher-ranked character species *Ebenus pisidica* (Fig. 3h) and *Odontarrhena masmenaea* occur with highest constancy and higher abundance-cover values.

Distribution. – The *Genistetum sandrasicae* is hitherto recorded from three places in the Sandras Dağı massif (Akköprü Çögenli, Altınsivri, Çicekbaba Tepesi). At least the driest variant of *Teucrium alyssifolium* ought to have a wider distribution at suitable ultramafic sites in the mountain forest belt of SW Anatolia. This unit is almost certainly present at Tuzla Beli (see Parolly & Kit Tan 2006).

Subdivision, community differentiation. – With the notable exception of the *Teucrium alyssifolium* variant (Table 2b), the association (var. *typicum*; Table 2a) is floristically and physiognomically quite uniform in spite of covering a wide topographical range. Nevertheless, a damp and a dry wing of the type variant can be distinguished, but these units are linked by intermediate stands and, at least at the present state of knowledge, not worth being formally recognised. The rock-strewn sites provide many moist and often wind-sheltered micro-sites, where tiny patches of snow can hang late in the year and support *Trifolio-Polygonetalia* species, especially *Bolanthus frankenioides* var. *fasciculatus* and, at the dampest sites, *Plantago holosteum* (relevés D4 and D5). The mesomorphic *Galium tmoleum* marks locally such conditions. It is a low, caespitose and fairly delicate perennial that is indifferent in its substrate requirements. *Galium tmoleum* is often associated with the *Thuryion capitatae* species *Sabulina verna* subsp. *brevipetala* (*Minuartia verna* subsp. *brevipetala*), for which a second locality exists on Bakırlı Dağı in the Lycian Taurus (Eren & al. 2004). By contrast, *Genistetum sandrasicae* stands sampled at dryer places display enhanced proportions and numbers of xerophytic graminoids (*Festuca valesiaca*, *Koeleria macrantha*, *Sesleria alba*, *Stipa holoserica*, and rarely *Carex kitaibeliana*).

The *Teucrium alyssifolium* variant clearly stands apart in synecological, physiological and floristical respects. More relevés may well show its independent status and further occurrences in montane elevations around the study area. The site studied is a moderately sloping, wind-beaten hilltop in saddle-position (1800 m). The substrate is ± a stabilised, dry ophiolitic scree, including large boulders, which supports an open dwarf-shrub community to *Astragalus condensatus* thorn-cushion community. Suffruticose and creeping chamaephytes dominate, each with about 30%, the physiognomy, and also cushion plants play a somewhat greater role. The differential species include with the tragacanthic *Astragalus condensatus*, *Convolvulus compactus*, *Thesium billardieri* and *Cruciata taurica* four widespread *Astragalo-Brometea* species, which have not developed any particular substrate preferences. However, *Convolvulus compactus* (Fig. 4e) is a good marker for wind-exposed sites, and it has, at least outside the Inner Anatolian steppe communities, a preference for serpentinite. *Silene brevicalyx* is a rarely recorded local endemic. Finally, *Teucrium alyssifolium* (Fig. 4h) seems to be the most significant differential species of the variant. Confined to ultramafic soils, it has a narrow SW Anatolian range in the higher elevations of the

Western Taurus, where it grows often at wind-exposed and rocky places or on serpentine scree (Parolly 2004; Parolly & Kit Tan 2006; Parolly & al. 2007).

Syntaxonomic comparison. – The *Genistetum sandrasicae* matches floristically and ecologically best the groupement à *Ebenus pisidica* et *Plantago carinata* (on “cuvettes terreuses”) and partly the groupement à *Convolvulus cochlearis* et *Chamaecytisus eriocarpus* (on “rocailles compactes de faible inclinaison”, Quézel 1973). The earlier distinction of these communities is largely a sampling artefact due to the limited number of relevés and the inclusion of a fairly large number of taxonomically doubtful species, which cannot be assigned to any other taxon with certainty. Quézel’s relevés are much poorer in species (many diagnostic species lacking) and display an enhanced proportion of ruderals and antipastorals.

Odontarrheno masmenaeae-Ebenetum pisidicae Parolly, **ass. nov.**: Wind-swept, serpentinophytic dwarf-shrub community of the Western Taurus (Table 3; Fig. 4b)

Holotypus: Table 3, relevé 16. – CS: *Aethionema cordatum* subsp. *pichleri*. DS (loc.): *Centaurea drabifolia* subsp. *cappadocica* (weak), *Galium incanum* subsp. *centrale*, *Minuartia erythrosepala* var. *erythrosepala*, *Thesium procumbens* (weak).

Incl.: Groupement à *Alyssum propinquum* et *Sesleria phleoides* (Quézel 1973) p. p.

Site conditions. – Stands of the subalpine *Odontarrheno masmenaeae-Ebenetum pisidicae* inhabit wind-exposed, sunny sites of the summit region (2100-2260 m) of Sandras Dağı. They establish themselves on gentle hilltops and rocky slopes covered by debris (Fig. 4b) and boulders, always in exposures ranging between S and W. Some stands grow on stabilised, dry peridotite scree. Larger amounts of fine soil (5-10%) are always visible at the surface of the plots of the *Odontarrheno masmenaeae-Ebenetum pisidicae*. The shallow, immature soil-cover overlays the parent rock, which often crops out, only for some 5-20 cm and furthers together with the desiccating winds the xeric site conditions. On the other hand, large blocks provide patchily distributed wind-shelter and allow the thriving of a number of hygromorphic to mesomorphic species of the earlier introduced associations within the *Odontarrheno masmenaeae-Ebenetum pisidicae*.

Structure and floristical composition. – Structurally, the *Odontarrheno masmenaeae-Ebenetum pisidicae* is clearly dominated by the various types of chamaephytes (77.4% mpc-value). Thorn-cushions hold only somewhat larger proportions (4.5%) than in the previous association and therefore the *Odontarrheno masmenaeae-Ebenetum pisidicae* is best termed as dwarf-shrub community, in which suffruticose (32.2%) and creeping chamaephytes (13.5%) are the key components with almost balanced proportions (see Table 4).

It is typical of wind-swept places to find enhanced figures for non-tragacanthic cushion plants. Compared with the *Genistetum sandrasicae* this holds true, but a value of 8.3% is far apart from the dimensions attained in wind-swept Drabo-Androsacetalia communities (mpc-values ranging between 30-60%, see Parolly 2004) that normally grow in much higher elevations on alkaline substrate. The other life forms in the spec-

Table 3. The *Ebeno pisidicae-Alysssetum masmenaei* (*Thuryion capitatae*, *Astragalo-Brometalia*) on Sandras Dağı.

Relevé no.	14	15	16	17	18	19
Locality	1	1	1	1	1	1
Altitude (m)	2100	2100	2100	2120	2260	2100
Exposure	SSW	S	W	W	SW	S
Inclination (°)	20	15	5	5	15	20
Vegetation cover (%)	30	20	15	15	30	25
Proportion of rocks & stones (%)	65	70	80	80	60	65
Proportion of fine soil (%)	5	10	5	5	10	10
Square size (m ²)	12	12	12	12	12	12
Number of species	23	17	19	18	20	21
CS & DS of the association						
<i>Galium incanum</i> subsp. <i>centrale</i>	1	2a	1	1	1	+
<i>Minuartia erythrosepala</i> var. <i>erythrosepala</i>	1	+	+	+	+	+
<i>Aethionema cordatum</i> subsp. <i>pichleri</i>	+	+	+	+	(+)	+
CS & DS of the <i>Thuryion capitatae</i>						
<i>Odontarrhena masmenaea</i>	2b	2a	2a	1	2a	1
<i>Alyssum propinquum</i>	1	1	1	1	1	2a
<i>Acantholimon ulicinum</i> var. <i>purpurascens</i>	+	+	+	+	+	1
<i>Minuartia recurva</i> subsp. <i>carica</i>	(+)	.	1	1	1	+
<i>Ebenus pisidica</i>	2a	+	(+)	1	1	(+)
<i>Cyanus reuteranus</i> var. <i>reuteranus</i>	1	.	.	1	+	+
<i>Linum boissieri</i>	.	.	+	1	.	+
<i>Chamaecytisus pygmaeus</i>	+	.	.	.	.	.
<i>Sideritis leptoclada</i>	.	+	.	.	.	.
<i>Noccaea leblebicii</i>	r	.	.	.	.	.
CS & DS of the <i>Astragalo-Brometalia</i>						
<i>Muscari tenuiflorum</i>	+	1m	1m	1	1	.
<i>Scorzonera szowitzii</i>	+	.	1	1	+	+
<i>Centaurea cariensis</i> subsp. <i>maculiceps</i>	+	+	+	+	.	.
<i>Campanula stricta</i> var. <i>libanotica</i>	+	.	+	.	.	.
<i>Hypericum aviculariifolium</i> subsp. <i>depilatum</i> var. <i>bourgaei</i>	.	.	.	.	1	.
CS & DS of the <i>Drabo-Androsacetalia</i>						
<i>Centaurea drabifolia</i> subsp. <i>cappadocica</i>	1	1	1	.	+	+
<i>Thesium procumbens</i>	+	1	+	.	.	.
CS & DS of the <i>Trifolio-Polygonetalia</i>						
<i>Ranunculus heterorhizus</i>	+	1	.	.	.	+
<i>Scilla pleiophylla</i>	.	.	1m	1m	.	.
<i>Plantago holosteum</i>	.	.	.	+	.	+
<i>Ornithogalum alpigenum</i>	.	.	.	+	.	+
<i>Corydalis oppositifolia</i> subsp. <i>oppositifolia</i>	.	.	.	+	.	+
CS & DS of the <i>Astragalo-Brometalia</i>						
<i>Thymus sipyleus</i> subsp. <i>sipyleus</i>	2a	+	1	1	2a	2a
<i>Bromopsis tomentella</i> subsp. <i>tomentella</i>	+	+	+	.	1	1
<i>Arenaria ledebouriana</i> var. <i>ledebouriana</i> (vs. var. <i>pauciflora</i>)	1	+	+	+	+	.
<i>Prunus prostrata</i> var. <i>prostrata</i>	1	1	.	.	1	1
<i>Paronychia chionaea</i>	1	.	1	.	.	+
<i>Festuca valesiaca</i>	1	.	.	.	1	+
<i>Mattiastrum lithospermifolium</i> subsp. <i>cariense</i>	.	.	.	.	+	+
<i>Koeleria macrantha</i>	.	.	.	.	1	.
<i>Sedum ursi</i>	.	.	.	.	1m	.

trum of the *Odontarrheno masmenaeae-Ebenetum pisidicae* are \pm insignificant, leaving aside the combined mpc-values of the hemicryptophytes (12.4%) and of the geophytes (9.3%). The open structure (vegetation cover 15-30%) of the *Odontarrheno masmenaeae-Ebenetum pisidicae* perfectly corresponds with its rocky and wind-swept habitat.

In floristic-phytosociological respects, the *Odontarrheno masmenaeae-Ebenetum pisidicae* seems largely to represent the central association of the *Thuryion capitatae* alliance, and is much poorer in species than the *Genistetum sandrasicae*. It is marked rather by the lack of a greater number of mesophytic species of various phytosociological meaning than by displaying many discriminating diagnostic species. Besides the evident absence of the character species of the *Genistetum sandrasicae*, three taxa differentiate constantly the *Odontarrheno masmenaeae-Ebenetum pisidicae* positively against the *Genistetum*. Two of them, *Minuartia erythrosepala* var. *erythrosepala* and *Galium incanum* subsp. *centrale*, are by no means serpentinophytes, but widespread high-mountain plants indicating wind-exposed sites. The only proper character species, *Aethionema cordatum* subsp. *pichleri*, is widely ignored in the Turkish taxonomic literature (including in Davis & al. 1988), but it in my opinion well deserves formal recognition. In addition to the morphology (see Hartvig & Strid 1987), a particular range (NW and SW Anatolia) and its substrate preferences support this view. Two further differential species (*Centaurea drabifolia* subsp. *cappadocica* and *Thesium procumbens*) are important elements of the wind-swept *Drabo-Androsacetalia* communities of the Taurus, but on Sandras Dağı not exclusive to the *Odontarrheno masmenaeae-Ebenetum pisidicae*: they also occur in the driest sites of the *Genistetum sandrasicae*, especially in the *Teucrium alyssifolium* variant, which bridges the two western associations of the *Thuryion capitatae*. At such places, too, the quite local serpentinophyte *Sideritis leptoclada* was also recorded, those phytosociological links remain unresolved. It is notable that especially the indicators for wind-exposure bring in the pulvinate life forms.

Floristically interesting, though phytosociologically insignificant, is the record of the fairly local serpentinophyte *Nocca leblebicii*, which may in a wider view be among the character species of the suballiance.

Distribution. — Records of the *Odontarrheno masmenaeae-Ebenetum pisidicae* are hitherto confined to Çicekbaba Tepesi, the main summit of Sandras Dağı. Provided that the association is here geoecologically correctly outlined as subalpine, wind-swept, serpentinophytic dwarf-shrub community of the Western Taurus, it is unlikely to expect further stations outside Sandras Dağı, — simply because there are no other serpentinites in the western Taurus culminating 2000 or more metres.

Subdivision, community differentiation. — None.

Table 4. Distribution of life forms in the communities of Sandras Dağı.

Life form (M %)	Muscari sandrasici-Polygonetum karacae, typical variant	Muscari sandrasici-Polygonetum karacae, <i>Euphorbia erythron</i> variant	Genistetum sandrasicae	Odontarrheno masmenaeae-Ebenetum pisidicae
Ch frut acanth (chamaephyta frutescentia acantha)	2.9	.	2.2	4.5
Ch herb (chamaephyta herbacea)	2.2	3.1	0.6	.
Ch pulv (chamaephyta pulvinata)	29.1	20.9	3.4	8.3
Ch rep/rept (chamaephyta repantia/reptantia)	1.5	9.4	48	31.5
Ch succ (chamaephyta succulenta)	.	.	1.2	0.9
Ch suffr (chamaephyta suffruticosa)	9.2	12.2	19.9	32.2
G bulb (geophyta bulbosa)	19	12.8	6.7	8.6
G rhiz (geophyta rhizomatosa)	.	.	.	0.7
H caesp (hemicryptophyta caespitosa)	6.9	15.6	7.1	6.4
H ros (hemicryptophyta rosulata)	29.2	20.3	9.3	3.3
H scap (hemicryptophyta scaposa)	.	0.1	0.3	1
H sem (hemicryptophyta semi-rosulata)	.	0.1	1.3	1.7
T scap hpar (therophyta scaposa hemi-parasitica)	.	.	.	0.9
T sem (therophyta semi-rosulata)	.	5.5	.	.
Total (%)	100	100	100	100

Syntaxonomic comparison. – The *Odontarrheno masmenaeae-Ebenetum pisidicae* matches best the “groupement à *Alyssum propinquum* et *Sesleria phleoides*” (Quézel 1973). The association is firmly nested in the western race of the *Thuryion capitatae* and the *Astragalo-Brometalia*. In spite of the typically wind-swept habitat of *Odontarrheno masmenaeae-Ebenetum pisidicae*, the set of the *Drabo-Androsacetalia* character species is weakly represented; taxa typical of the alliance of the Lycian Taurus (*Paronychion lycicae* Quézel 1973, see Parolly 2004) are notably totally lacking.

Chorotype spectra

The chorotype spectra of the communities of Sandras Dağı studied (Table 5) neatly fit most of the expectations for high-mountain vegetation units of the coastal edge of the Taurus range, where E Mediterranean geoelements and genoelements (endemics of E Mediterranean origin) clearly predominate (gp-values from 64,5-79.1%). Outstanding is, however, the generally high rate of endemism approaching 60% and especially the hitherto unrivalled high gp-values attained for the proportions of narrow endemics (local endemics + endemics of the Western Taurus) within the communities (*Muscari sandrasici-Polygonetum karacae* 30.9%, respectively. 29%; *Genistetum sandrasicae* 27.5%; *Odontarrheno masmenaeae-Ebenetum pisidicae* 20.4%). Total endemism rates oscillating around 60% have been occasionally found in xerophytic high-mountain scree plant and rock communities (Parolly 1995, 1998; Hein & al. 1998), but never to such an extent in hygrophytic *Trifolio-Polygonetalia* vegetation (Kürschner & al. 1998; Parolly, unpublished data) or dwarf-shrub units (*Astragalo-Brometalia* s.l.; Kürschner 1982; Quézel 1973; Parolly, unpublished data). The spectra thus reflect the high degree of local speciation in the SW Anatolian serpentine vegetation. Özhatay & al. (2003) stress the importance of Sandras Dağı for the conservation of (local) endemics and indicate a total of 81 endemic taxa of various range size.

The other peculiarity of the spectra of Sandras Dağı is that the spectra of hygrophytic units and the meso- to xerophytic units are not different as it would be on limestone and further east. Due to its geographical position, the proportion of the Irano-Turanian (mainly: Irano-Anatolian) element is expectedly low in all communities, although slightly increasing along the xeric gradient from the dry variant of the *Muscari sandrasici-Polygonetum karacae* to the *Odontarrheno masmenaeae-Ebenetum pisidicae*. It is noteworthy that there are neither enhanced proportions of Euro-Siberian species nor hygrophytic Irano-Anatolian floristic elements in the snow-patch vegetation of Sandras Dağı, which mark such places in the Central Taurus and in all eastern ranges (Kürschner & al. 1998; Parolly, unpublished data).

Dispersal biology of the communities of Sandras Dağı

An analysis of the dispersal biology of the three associations of Sandras Dağı (Table 6) clearly shows the prevailing conditions within them and reflects the sharp contrast between the hygrophytic *Muscari sandrasici-Polygonetum karacae* (*Trifolio-Polygonetalia*) that is often found at more wind-sheltered places and the more wind-exposed vegetation of the *Thuryion capitatae* dwarf-shrub communities (*Genistetum sandrasicae*, *Odontarrheno masmenaeae-Ebenetum pisidicae*). Zoochory dominates the spectrum of the *Muscari sandrasici-Polygonetum karacae typicum* (mpc-value 67%), while wind dispersal of various types is responsible for similar high percentages in the other two associations.

The montane *Euphorbia erythron* variant of the *Muscari sandrasici-Polygonetum karacae*, which occurs at much dryer places than the typical variant, bridges largely the chionophytic association with the *Thuryion capitatae*, in displaying both high zoochorous and boleochoreous mpc-values. Typical of trampled turf vegetation, the proportion of acanthocorous taxa is enhanced.

Table 5. Distribution of chorotypes in the communities of Sandras Dağı.

Chorotype (G %)	Muscari sandrasici-Polygonetum karacae, typical variant	Muscari sandrasici-Polygonetum karacae, <i>Euphorbia erxthrodon</i> variant	Genistetum sandrasicae	Odontarrheno masmenaeae-Ebenetum pisidicae
End loc (local endemics)	20	16.1	19	15.8
End bt (endemics of the Western Taurus)	10.9	12.9	8.5	4.7
End t (endemics of the Taurus)	13.6	9.7	7.8	6.8
End Anatol (Anatolian endemics)	14.6	17.8	20.2	33
(E)Med ([East] Mediterranean)	20	8	18.3	9.9
IA (Irano-Anatolian)	.	4.8	7.8	9.9
EMed-ES (biregional: EMed-Euro-Siberian)	6.4	8.1	5.7	6.8
EMed-IA (biregional: EMed-IA)	3.6	3.2	5.5	6.3
tri (triregional: EMed-ES-IA)	10.9	11.3	6.7	6.8
subcos (subcosmopolitan)	.	8.1	.	.
Unidentified (sterile)	.	.	0.5	.
Total (%)	100	100	100	100

The unusual high values of zoochory within the *Muscari sandrasici*-*Polygonetum karacae* *typicum* are due to the principally myxochorous *Plantago holosteum*, which alone holds a mpc-value of 58.5%. As in most *Plantago* species, the testa of *P. holosteum* “verschleimt bei Wasserzutritt leicht” (Casper 1974: 565). Myxochory has both a telechorous (long-distance dispersal especially by vertebrates) and an antitelechorous effect (see

Zohary 1973). The latter effect by sticking the seeds to soil and plant surfaces - may help that a good deal of the diaspores remains within the biocoenosis proper - and this can be a narrow meltwater runnel. *Plantago* seeds are also often found in the dung of cattle, sheep and goat (Bonn & Poschod 1998; Müller-Schneider 1983). Endozoochorous dispersal is here confirmed also for Sandras Dağı, where the damp patches dominated by *Plantago holostium* and grasses are a preferred grazing ground. Pellets of goat dung contained dozens of undamaged seeds of *P. holostium* together with a few seeds of *Caryophyllaceae*.

Other zoochorous construction types of diaspores found within stands of the *Muscari sandrasici-Polygonetum karacae* include a limited number of acanthochorous (*Alopecurus gerardii*, *Poa bulbosa*) or elaiosomochorous taxa (e.g., *Colchicum figlalii*, *Gagea bithynica*, *Euphorbia erythron*, *Ornithogalum alpigenum*, *Scilla pleiophylla*, *Viola sandrasea*) with low coverage values. Elaiosomochory mostly occurs in combination with a blastochorous diaspore presentation, confirming the general trend of the spectrum, i.e. the prevalence of engychorous mechanisms. The only other relevant dispersal type within the *Muscari sandrasici-Polygonetum karacae* typical is semachory (mpc-value 17.1%). With the exception of these wind-ballists, anemochory is insignificant within the spectrum.

Exactly these more specialised types of anemochory, especially cyclochory, and to low proportions lophochory, pogonochory, pterochory, characterise together with high percentages of semachory the spectra of the dwarf-shrub communities (*Genistetum sandrasicae* and *Odontarrheno masmenaeae-Ebenetum pisidicae*). In total (specialised anemochory + boleochory/semachory), anemochory holds in both associations mpc-values of ca. 70%. Chaemaechorously dispersed species (cyclochory) predominate in the spectrum of the *Genistetum sandrasicae* with 31.9% due to the high cover and abundance values of the two *Fabaceae* species, *Cytisopsis pseudocytisus* subsp. *reeseana* and *Ebenus pisidica* as well as *Cyanus reuteranus* var. *reuteranus*. In the latter species and in *Centaurea drabifolia* subsp. *cappadocica*, which however is more important in the *Odontarrheno masmenaeae-Ebenetum pisidicae*, whole capitula are dispersed by the wind. Another typical *Astragalo-Brometea* species is *Paronychia chionaea*, where each light-weight constructed diaspore consists of glomerules 10-15 mm in diameter, comprising groups of indehiscent fruits (utricles) enclosed in the persistent calyx and concealed by conspicuous, silvery-scarious bracts. As typical of some *Minuartia* species, the diaspore of *M. erythrosepala* is a cluster of 5-7 flowers in fruiting state aggregated into almost globular cymes. *M. erythrosepala* is in the Taurus range frequently found at wind-exposed places and here diagnostic of the *Odontarrheno masmenaeae-Ebenetum pisidicae*.

Although not as enhanced as in alpine and subnival vegetation units, hydrochory (exclusively represented by ombro-hydrochorous types) is better developed in the *Genistetum sandrasicae* (6.4% mpc) and *Odontarrheno masmenaeae-Ebenetum pisidicae* (11.9% mpc) than in the *Muscari sandrasici-Polygonetum karacae*. Its proportions are positively correlated with increasing elevation. Typical rain-ballists of the Sandras Dağı include mainly *Brassicaceae* such as *Aethionema cordatum* subsp. *pichleri*, *Ae. speciosum* subsp. *compactum*, *Alyssum propinquum* (Fig. 3i), *Iberis semper-virens* and *Noccaea leblebicii*, the *Crassulaceae* species, *Prometheum serpentinum* and *Sedum ursi* as well as *Muscari tenuiflorum*.

Table 6. Distribution of dispersal types in the communities of Sandras Dağı.

Construction type of diaspores	Muscari sandrasici-Polygonetum karacaee, typical variant	Muscari sandrasici-Polygonetum karacaee, Euphorbia erxthronon variant	Genistetum sandrasicaee	Odontarrheno masmenaceae-Ebenetum pisidicaae
	acanth (acanthochorous)	2.2	8.5	3.8	2.2
ball (ballochorous)	5.1	3.1	10.2	6.3
blast (blastochorous)	6.7	12	2	1.8
bole (boleochorous)	17.1	30.8	27.7	49.5
cyclo (cyclochorous)	0.7	0.3	31.9	12.8
ela (elaiosomochorous, myrmecochorous)	6.3	2.9	2.3	3.3
herp (herpochorous)	.	.	0.7	0.8
hydro (ombrohydrochorous)	3.4	1.9	6.4	11.9
loph (lophochorous)	.	.	0.7	0.5
myx (myxochorous)	58.5	36.6	4.4	1.2
pogo (pogonochorous)	.	2	3.7	1.7
pter (pterochorous)	.	1.9	6.2	5.1
sarc (sarcochorous)	.	.	0.1	2.9
Total (%)	100	100	100	100
Specialised anemochory	0,7	4,2	42,5	20,1
Semachory	17,1	30,8	27,7	49,5
Anemochory & semachory	17,8	35,0	70,2	69,6
Autochory	11,8	15,1	12,9	8,9
Hydrochory	3,4	1,9	6,4	11,9
Zoochory	67	48	10,5	9,6

Concluding remarks

The present paper reconsiders and re-evaluates the tree-less high-mountain vegetation of Sandras Dağı. We thus have the first outline of the vegetation types on peridotite of the wider range: for an account of the forest vegetation, see Akman & al. (1979) and Özhatay (1987); for the scrub vegetation of the nearby Köyceğiz-Dalyan Specially Protected Area, see Vural & al. (1995). The present contribution focuses on the edaphically differentiated *Astragalo-Brometea* communities *sensu* Parolly (2004), i.e. including meltwater and snow-bed vegetation. A study of the hygrophytic vegetation (e.g., flushes) lining the brooklets, although recorded in grazed and devastated stands, is omitted here and will be published elsewhere.

The main phytosociological results are compiled in Table 7. Three high-mountain vegetation units are treated in detail (Tables 1-3); all three represent new associations, which only in part fit into Quézel's generally accepted groupements (Gemici & al. 1994; Gemici & Görk 1995; Quézel 1973). Two associations are zonal (*Genistetum sandrasicae*, *Odontarrheno masmenaeae-Ebenetum pisidicae*), both grouped in the *Thuryion capitatae* and *Astragalo-Brometalia*. The third is azonal and confined to snow-beds (*Muscari sandrasici-Polygonetum karacae*, *Thlaspiion papillosoi*, *Trifolio-Polygonetalia*), which however are locally due to the geological substrate abundant and extensive. All units are extraordinary rich in endemic species of various subcategories; especially noteworthy is the high percentage of narrow endemics within the communities (ca. 20-30%).

Establishing three new associations and, below, a new suballiance on the base of just four dozens of relevés that all come from a single mountain massif, seems justified, if one considers that Sandras Dağı is the only place in the Western Taurus, where the unique subalpine vegetation on ultramafic soils can be studied. The subalpine and hygro- to mesophytic units are thus confined to this area, while there are some outposts of xerophytic stands at montane elevations (*Teucrium alyssifolium* variant of the *Genistetum sandrasicae*), of whom we have floristic field notes for comparison (Parolly & Kit Tan 2006). Already in the western edge of the Central Taurus, the serpentinophytic *Astragalo-Brometalia* units are clearly different from the communities described here.

Thuryion capitatae - the montane and subalpine serpentinophytic vegetation of the S Anatolian Taurus range

Thuryion capitatae Quézel ex Parolly

Nomenclatural type (holotypus): *Leontodonto asperrimi-Pseudosempervivietum sempervivi* Quézel ex Parolly, **nom. mut. prop.**, hoc loco. - CS and DS: See Fig. 5.

Note: The name *Thuryion capitatae* is typified by its single subordinate element, the *Leontodonto asperrimi-Cochlearietum sempervivi* Quézel ex Parolly, nom. mut. prop., hoc loco (holotypus: Quézel 1973, Table 22: relevé 1). Quézel in Quézel & al. (1992: 82) failed to validate the name *Thuryion capitatae* by this association, when he transformed the rankles “groupement à *Cochlearia sempervivum* et *Leontodon masmeneanum*” (Quézel 1973) into the “*Leontodo masmeneani-Cochlearietum sempervivi* Quézel 1973” (Quézel & al. 1992) without indicating a type relevé for the association (art. 5, 9 ICPN, Weber & al. 2000). The above lecto-typification of the association validates the *Thuryion capitatae*.

Since *Leontodon masmeneum* Boiss. & Bal. is nowadays considered a synonym of *L. asperrimus* (Willd.) J. Ball (Kupicha 1975) and *Cochlearia sempervivum* was shown to be a member of the genus *Pseudosempervivum* (Boiss.) Grossh., I propose here for the validated association a nomen mutatum in accordance with art. 45 ICPN (Weber & al. 2000).

Leontodon asperrimus is indifferent to the substrate and occurs in a wide range of habitats, although I have observed a certain preference for ultramafic soils. It differentiates the *Thuryion capitatae* against the basiphytic alliances, where it is widely replaced by *L. oxylepis* Boiss. & Heldr. The most characteristic species of the *Thuryion capitatae* alliance and its two suballiances are true indicators of serpentine, which in their vast majority have been proven to be nickel (and cobalt) hyperaccumulators (Brooks 1987; Kruckeberg & al. 1999; Reeves & Adıgüzel 2004). *Centaurea drabifolia* subsp. *cappadocica* differentiates in the western part of the Taurus the *Thuryion* against the basiphytic *Astragalo-Brometalia* alliances; in the Cilician Taurus this taxon has two centres of occurrences: Mid-elevation serpentine areas (*Thuryion* communities) and the basiphytic, wind-swept oxerophytic vegetation of the summit regions (*Drabo-Androsacetalia* communities).

The Thuryion capitatae in the Western Taurus. - The xerophytic to mesophytic *Genistetum sandrasicae* and *Odontarrheno masmeneae-Ebenetum pisidicae* associations of Sandras Dağı are attached to the here modified and validated *Thuryion capitatae* Quézel ex Parolly alliance (for character and differential species see Fig. 5, for its formal validation, see below). By contrast, Quézel (1973), and in suite Gemici & Görk (1995) linked up the communities of Sandras Dağı (groupement à *Convolvulus cochlearis* et *Chamaecytisus eriocarpus*, groupement à *Alyssum propinquum* et *Sesleria phleoides*, groupement à *Ebenus pisidica* et *Plantago carinata*) with the *Tanacetion praeteriti* on account of the occurrence of the following character species of the alliance: *Astragalus sibthorpianus* (as *A. paecilanthus*), *Bornmuellerantha aucheri* (as *Odontites aucheri*) and *Dianthus eretmopetalus*. Today, the *Tanacetion* is accepted with an almost completely revised set of diagnostic species (see Parolly 2004; Eren & al. 2004), to comprise only basiphytic montane to sub-alpine thorn-cushion communities, open grasslands and dwarf-shrub communities.

To accommodate the westernmost communities of the serpentinophytic *Thuryion capitatae*, I suggest here the suballiance ***Ebenenion pisidicae*** Parolly, **suball. nov.** (Holotypus: *Genistetum sandrasicae*). For a full list of its character and differential species, see Fig. 5.

Some of these diagnostic species may deserve brief comments: In their majority, they are not confined to high-mountain ecosystems; *Odontarrhena masmeneae*, *Cytisopsis pseudocytisus* subsp. *reeseana* and *Sideritis leptoclada* for example also differentiate forest communities at lower elevations such as the “Association à *Pinus brutia* et *Cytisopsis dorycnifolia* subsp. *reeseana*” Akman & al. (Akman & al. 1979). With the exception of the substrate-vag *Aethionema cordatum* subsp. *pichleri*, *Cyanus reuteranus* and *Galium incanum* subsp. *centrale*, the bulk of the taxa are closely linked to ultramafites. Most of them are SW Anatolian endemics. *Polygonum karacae* (for the range see Eren & al. 2004), *Ferulago sandrasica* (pers. obs.) and *Stipa cacuminis* (Parolly and Scholz 2004) extend, though with considerable disjunctions, to the western parts of the Central Taurus, where they are components of the local serpentine vegetation (see, Aytaç & al. 2006; Parolly & Scholz 2004).

Table 7. Synoptic table of the *Thuryion capitatae*. Constancy is given in %. – Localities: For own relevés, see Appendix 2; **AY** Acımam Yayları, **SD** Sandras Dağı (both from Quézel 1973). [Taxa occurring in only one column (community with constancy < 20.1% as well as taxa with unclear taxonomic identity in Quézel (1973) have been omitted]... (continue)

Community	Muscari sandrasici-Polygonum karacae, typical variant (hoc loco)	Muscari sandrasici-Polygonum karacae, <i>Euphorbia erythron</i> variant (hoc loco)	Odontarrhena masmenaeae-Ebenetum psidiceae (hoc loco)	Genistetum sandrasicae, typical variant (hoc loco)	Genistetum sandrasicae, <i>Tenarium alyssifolium</i> variant (hoc loco)	Groupement à <i>Convolvulus cochlearis</i> et <i>Chamaecytisus eriocarpus</i> (Quézel 1973)	Groupement à <i>Ebenus psidicea</i> et <i>Plantago carnata</i> (Quézel 1973)	Groupement à <i>Alyssum propinquum</i> et <i>Sesleria phleoides</i> (Quézel 1973)	<i>Leontodon asperriini</i> - <i>Pseudosempervivum sempervivi</i> (Quézel 1973, validated hoc loco)
Locality	2-4	6	1	7-8	5	SD	SD	SD	AY
Altitudinal range (min.)	1900	1650	2100	1950	1800	2000	1800	900	2000
Altitudinal range (max.)	2100	1650	2260	2190	1800	2100	2100	2150	2200
Exposure	N, W (S)	NNE-ENE	S-W	S, E, W	S	S-W	S-SE	S-W	NE-S
Inclination (°)	0-25	2-4	5-20	0-42	10-20	8	0.5	?	10-15
Average vegetation cover (%)	58	50	23	55	28	53	78	63	66
Average proportion of rocks & stones (%)	38	33	70	27	58	?	?	?	?
Average proportion of fine soil (%)	19	17	7.5	16	5	?	?	?	?
Average square size (m ²)	13.7	11	12	29.8	24	100	62.5	100	100
Number of relevés	9	3	6	15	2	3	4	4	5
Average number of species/relevé	14.2	20.7	19.7	27.9	36	13	16.8	16.3	33.6
CS & DS of the associations									
<i>Ranunculus heterorhizus</i>	100	33	50	.	.	.	.	.	.
<i>Barbarea brachycarpa</i> subsp. <i>anfractuosa</i>	89	100	.	.	.	.	.	.	.
<i>Muscari sandrasicum</i>	78	100	.	.	.	.	.	.	.
<i>Polygonum karacae</i> [* as <i>P. setosum</i> (tax.)]	67	100	.	.	.	50*	25*	.	.
<i>Euphorbia erythron</i>	.	100	.	.	.	.	.	.	.
<i>Herniaria glabra</i>	.	100	.	.	.	.	.	.	.
<i>Petrorhagia alpina</i> subsp. <i>olympica</i>	.	67	.	.	.	.	.	.	.
<i>Rumex acetosella</i>	.	67	.	.	.	.	.	.	.
<i>Tragopogon olympicus</i>	.	33	.	.	.	.	.	.	.
<i>Aethionema cordatum</i> subsp. <i>pichleri</i>	.	.	83	.	.	.	.	.	.
<i>Galium incanum</i> subsp. <i>centrale</i>	44	.	100	.	.	33	25	50	.
<i>Minuartia erythrosepala</i> var. <i>erythrosepala</i>	.	.	100	.	.	.	.	.	60
<i>Genista sandrasica</i> [* as <i>G. cf. Lydia</i> (tax.)]	11	33	.	80	100	.	75*	.	.
<i>Chamaecytisus pygmaeus</i> [* as <i>Ch. eriocarpus</i> + <i>Cytisopsis p.</i> subsp. <i>reeseana</i> ? (rev.)]	.	.	17	60	100	100*	[25*]	.	.
<i>Aethionema speciosum</i> subsp. <i>compactum</i>	11	.	.	87	100	.	.	.	.
<i>Verbascum carinense</i>	.	.	.	47	100	.	.	.	.
<i>Prometheum serpentinicum</i>	.	.	.	40	50	.	.	.	.
<i>Cytisopsis pseudocytisus</i> subsp. <i>reeseana</i> [* as <i>Chamaecytisus eriocarpus</i> (rev.)]	.	.	.	100	.	.	[25*?]	.	.
<i>Scorzonera sandrasica</i>	.	.	.	13	.	.	.	.	.
<i>Tenarium alyssifolium</i>	.	.	.	.	100	.	.	.	.
<i>Convolvulus compactus</i> [* as <i>C. cochlearis</i> (syn.)]	.	.	.	.	100	100*	.	.	.
<i>Astragalus condensatus</i> [incl. <i>A. podperae</i>]	.	.	.	.	100	.	.	.	.
<i>Thesium billardieri</i>	.	.	.	.	100	.	.	.	.
<i>Silene brevicalyx</i> [* as <i>S. tunicooides</i> (tax.)]	.	.	.	.	100	.	.	25*	.
<i>Cruciata taurica</i>	.	.	.	.	100	.	.	.	.
CS & DS of the Thuryion capitatae and the Ebenion psidiceae									
<i>Odontarrhena masmenaeae</i> [* as <i>Alyssum masmenaeum</i> (syn.)]	78	100	100	93	100	100*	75*	25*	40*
<i>Leontodon asperriini</i> [* as <i>L. masmenaeus</i> (syn.)]	.	.	.	40	100	33	50	.	80*
<i>Acantholimon ulicinum</i> var. <i>purpurascens</i> [* as <i>A. echinus</i> (tax.)]	.	.	100	87	.	100*	75*	100*	40*
<i>Alyssum propinquum</i>	.	.	100	73	.	33	75	100	.
<i>Iberis sempervirens</i>	11	.	.	53	.	.	25	50	40
<i>Convolvulus libanoticus</i> [* as <i>C. cf. cataonicus</i> (rev.)]	.	.	.	7	.	.	75*	.	100
<i>Cyanus reuteranus</i> var. <i>reuteranus</i> [<i>Centaurea reuterana</i> var. <i>reuterana</i>]	11	67	67	87	50	.	75	.	.
<i>Ebenus psidicea</i>	.	.	67	100	100	.	100	.	.
<i>Fumana aciphylla</i>	.	.	.	40	100	.	50	.	.
<i>Viola sandrasica</i> subsp. <i>sandrasica</i>	44	67	.	87	.	.	.	.	.
<i>Sabulina verna</i> subsp. <i>brevipetala</i> [<i>Minuartia verna</i> subsp. <i>brevipetala</i>]	44	100	.	47	.	.	.	.	.
<i>Linum boissieri</i>	.	33	50	47	.	.	.	.	.
<i>Minuartia recurva</i> subsp. <i>carica</i>	.	.	67	33	.	.	100	.	.
<i>Sideritis leptoclada</i>	.	.	17	.	100	.	.	.	.
<i>Galium tmoleum</i>	.	33	.	47	.	.	.	.	.
<i>Ferulago sandrasica</i>	.	.	.	27	.	.	.	25	.

Table 7. continued.

<i>Clinopodium troodii</i> subsp. <i>vardaranum</i> [* as <i>Calamintha troodii</i> (syn., tax.)]	.	.	.	.	.	.	.	100 ^o	.
<i>Nocca leblebicii</i>	.	.	17	.	.	.	.	.	.
<i>Stipa cacuminis</i>	.	.	7	.	.	.	.	.	.
<i>Pseudosempervivum sempervivum</i> [* as <i>Cochlearia sempervivum</i> (syn.)]	.	.	.	.	.	.	.	.	100 ^o
<i>Thurya capitata</i>	.	.	.	.	.	.	.	.	100
<i>Masmenia rosularis</i> [* as <i>Thlaspi rosularis</i> (syn.)]	.	.	.	.	.	.	.	.	80 ^o
<i>Alyssum mouradicum</i>	.	.	.	.	.	.	.	.	80
<i>Fumana oligosperma</i>	.	.	.	.	.	.	.	.	60
<i>Aethionema speciosum</i> subsp. <i>speciosum</i>	.	.	.	.	.	.	.	.	60
<i>Hypericum scabrum</i>	.	.	.	.	.	.	.	.	60
<i>Phlomis linearis</i>	.	.	.	.	.	.	.	.	40
<i>Fumana grandiflora</i>	.	.	.	.	.	.	.	.	40
<i>Odontarrhena callichroa</i> [* as <i>Alyssum callichroum</i> (syn.)]	.	.	.	.	.	.	.	.	40 ^o
<i>Odontarrhena oxycarpa</i> [* as <i>Alyssum oxycarpum</i> (syn.)]	.	.	.	.	.	.	.	.	40 ^o
<i>Convolvulus cataonicus</i>	.	.	.	.	.	.	.	.	40
<i>Scutellaria diffusa</i>	.	.	.	.	.	.	.	.	40
<i>Sideritis phlomoidea</i>	.	.	.	.	.	.	.	.	40
<i>Lactuca mulgedioides</i>	.	.	.	.	.	.	.	.	40
<i>Ebenus laguroides</i>	.	.	.	.	.	.	.	.	20
CS & DS of the Trifolio-Polygonetalia										
<i>Plantago holosteam</i> [* as <i>P. carinatum</i> (syn.)]	78	100	33	13	.	.	.	100 ^o	.	
<i>Ornithogalum alpigenum</i>	89	67	33	7	.	.	.	.	.
<i>Astragalus angustifolius</i> var. <i>violaceus</i>	56	.	.	.	.	100	.	50	.
<i>Lotus alpinus</i>	89	100	.	.	.	.	.	.	.
<i>Trifolium hybridum</i> subsp. <i>anatolicum</i>	56	100	.	.	.	.	.	.	.
<i>Alopecurus gerardii</i>	67	67	.	.	.	.	.	.	.
<i>Scilla pleiophylla</i>	78	.	33	.	.	.	.	.	.
<i>Colchicum figlalii</i>	56	.	.	7	.	.	.	.	.
<i>Bolanthus frankenioides</i> var. <i>fasciculatus</i>	.	33	.	33	.	.	.	.	.
CS & DS of the Drabo-Androsacetalia										
<i>Centaurea drabifolia</i> subsp. <i>cappadocica</i>	.	.	83	7	100	.	.	.	80	
<i>Thesium procumbens</i>	.	.	50	13	.	.	.	.	.
CS & DS of the Astragalo-Brometalia										
<i>Campanula stricta</i> var. <i>libanotica</i>	.	.	33	47	100	66	25	50	40	
<i>Centaurea cariensis</i> subsp. <i>maculiceps</i>	.	67	67	40	100	.	.	25	.	
<i>Scorzonera szowitzii</i>	.	100	83	80	100	.	.	.	.
<i>Hypericum aviculariifolium</i> subsp. <i>depilatum</i> var. <i>bourgaei</i>	.	33	17	67	100	.	.	.	.
<i>Festuca elwendiana</i> [* as <i>F. ovina</i> (rev.)]	.	.	.	7	.	[33] ^o	[25] ^o	[50] ^o	[60]	
<i>Dianthus eretmopetalus</i>	.	.	.	20	.	33	50	25	.	
<i>Muscari tenuiflorum</i>	.	.	83	33	100	.	.	.	.
<i>Thymus longicaulis</i> subsp. <i>chaubardii</i> var. <i>alternatus</i>	.	.	.	13	.	33	50	.	.	
<i>Onosma aucheranum</i>	.	.	.	27	.	.	.	.	40
<i>Aethionema iberideum</i>	.	.	.	.	.	.	.	.	60
<i>Veronica dichrus</i> [* as <i>V. macrostachya</i> subsp. <i>pisidica</i> (syn.)]	.	.	.	.	.	.	.	.	40 ^o
CS & DS of the Astragalo-Brometea										
<i>Paronychia chionaea</i>	.	.	50	20	100	100	25	25	60	
<i>Phlomis armeniaca</i>	.	.	.	67	100	100	75	100	.	
<i>Arenaria ledebouriana</i> var. <i>ledebouriana</i> [versus var. <i>pauciflora</i>]	.	100	83	13	50	.	.	100	80	
<i>Prunus prostrata</i> [* as <i>Cerasus prostrata</i> var. <i>prostrata</i> (syn.)]	.	.	67	33	.	33 ^o	50 ^o	50 ^o	.	
<i>Koeleria macrantha</i> [* as <i>K. splendens</i> (syn.)]	.	33	17	47	.	.	25 ^o	75 ^o	40	
<i>Festuca valesiaca</i> [* as <i>F. ovina</i> (rev.)]	.	.	50	33	.	[33] ^o	[25] ^o	[50] ^o	[60]	
<i>Bornmuellerantha aucheri</i> [* as <i>Odontites aucheri</i> (syn.)]	.	.	.	7	100	100 ^o	50 ^o	.	.	
<i>Daphne oleoides</i> subsp. <i>oleoides</i>	.	.	.	7	.	33	25	100	80	
<i>Mattiastrum lithospermifolium</i> subsp. <i>carriense</i>	.	.	33	73	100	.	.	.	.
<i>Salvia argentea</i>	.	.	.	7	.	.	25	50	.	
<i>Thymus sipyleus</i> subsp. <i>sipyleus</i>	33	.	100	67	.	.	.	.	.
<i>Bromopsis tomentella</i> subsp. <i>tomentella</i>	.	.	83	67	.	.	.	.	60
<i>Sesleria alba</i> [* as <i>S. phleoides</i>]	.	.	.	13	.	.	.	100 ^o	60 ^o	
<i>Asperula stricta</i> subsp. <i>monticola</i> [* as <i>A. graveolens</i> (rev.)]	.	.	.	67	.	.	50 ^o	.	.	
<i>Stipa holosericea</i>	.	.	.	40	100	.	.	.	.
<i>Silene pruinosa</i>	.	.	.	27	100	.	.	.	.
<i>Asyneuma virgatum</i> subsp. <i>cichoriiforme</i>	.	.	.	13	100	.	.	.	20	
<i>Anthemis cretica</i> subsp. <i>cretica</i> [incl. subsp. <i>leucanthemoides</i>]	44	.	.	47	.	.	.	.	.
<i>Sedum ursi</i> [* as <i>S. laconicum</i> (tax.)]	.	.	17	47	.	.	.	.	80 ^o
<i>Dianthus zonatus</i> var. <i>hypochlorus</i>	.	.	.	7	50	.	.	.	.

Table 7. continued.

<i>Scutellaria orientalis</i> s. l.	-	-	-	-	-	25	25	20
<i>Genista albida</i>	-	-	-	-	-	-	-	80
<i>Helichrysum plicatum</i> s. l.	-	-	-	-	-	-	-	80
<i>Salvia multicaulis</i>	-	-	-	-	-	-	-	60
<i>Ziziphora clinopodioides</i>	-	-	-	-	-	-	-	60
<i>Astragalus angustifolius</i> var. <i>angustifolius</i>	-	-	-	-	-	-	-	40
<i>Onosma armenum</i>	-	-	-	-	-	-	-	40
<i>Silene armena</i>	-	-	-	-	-	-	-	40
<i>Minuartia anatolica</i>	-	-	-	-	-	-	-	40
<i>Teucrium chamaedrys</i> subsp. <i>chamaedrys</i>	-	-	27	-	-	-	-	-
Others								
<i>Poa bulbosa</i> agg. [* as <i>P. alpina</i> (rev.)]	56	100	-	73	100	33*	25*	50*
<i>Teucrium polium</i>	-	-	-	47	100	33	25	25
<i>Gagea bithynica</i>	100	100	-	40	100	-	-	-
<i>Veronica cuneifolia</i> subsp. <i>cuneifolia</i>	-	-	-	27	100	-	-	-
<i>Tragopogon porrifolius</i> subsp. <i>longirostris</i>	-	-	-	-	100	-	-	25
<i>Verbascum adenophorum</i>	-	-	-	13	50	-	-	-
<i>Corydalis oppositifolia</i> subsp. <i>oppositifolia</i>	-	-	33	13	-	-	-	-
<i>Astragalus sibthorpianus</i> [* as <i>A. paecilanthus</i> (syn.)]	-	-	-	-	-	66*	-	75*
<i>Chenopodium foliosum</i> [* as <i>Chenopodium foliosum</i> (syn.)]	-	-	-	-	-	-	50*	25*
<i>Vincetoxicum canescens</i>	-	-	-	-	-	-	25	25
<i>Euphorbia rigida</i>	-	-	-	-	-	-	50	-
<i>Sabulina umbellulifera</i> subsp. <i>fimbriata</i>	-	-	-	-	-	33	-	-
<i>Galium mite</i>	-	-	-	-	-	-	-	60
<i>Bunium microcarpum</i> [* as <i>Carum microcarpum</i> (syn.)]	-	-	-	-	-	-	-	60*
<i>Pelargonium endlicheranum</i>	-	-	-	50	-	-	-	-
<i>Hieracium balansae</i>	-	-	-	-	-	-	-	40
<i>Elystrigia tauri</i>	-	-	-	-	-	-	-	40
<i>Aethionema coridifolium</i>	-	-	-	-	-	-	-	40
<i>Thymus cherlerioides</i> [* as <i>Th. hirsutus</i> (rev.)]	-	-	-	-	-	-	-	40*
<i>Anemone blanda</i>	-	-	-	-	-	-	-	40
<i>Cota tinctoria</i> var. <i>discoidea</i> [* as <i>Anthemis tinctoria</i> var. <i>discoidea</i>]	-	-	-	-	-	-	-	40*
<i>Asplenium obovatum</i>	-	-	-	-	-	-	-	40
<i>Cheilanthes maranthae</i>	-	-	-	-	-	-	-	40
<i>Euphorbia petrophila</i>	-	-	-	-	-	-	-	40
<i>Bromopsis cappadocica</i>	-	-	-	-	-	-	-	40
<i>Sedum album</i>	-	-	-	-	-	-	-	40
<i>Phelipanche oxyloba</i>	-	-	-	33	-	-	-	-
<i>Drymocalis rupestris</i>	-	-	-	27	-	-	-	-

All available relevés of the *Thuryion capitatae* are compared in a synoptic scheme (Table 7). As far as possible, the names of Quézel’s taxa listed in his groupements (1973) have been transferred into the current taxonomy and nomenclature, thus making an interpretation necessary. A certain deal of names, e.g. *Scabiosa brevicaulis*, could not be clarified. For other problems related to Quézel’s units see the comments under 4.1.2. Table 7 shows the independent status of the *Ebenenion pisidicae* and its two subordinate associations.

Interestingly, not all montane vegetation units of the Western Taurus, which grow on ultramafic soil fit neatly into the *Ebenenion pisidicae*. Open stands with abundant *Astragalus creticus* on local and small-scaled ultramafic outcrops on Bakırlı Dağı, which are in close contact with limestone vegetation, represent rather a depauperate *Tanacetion praeteriti* community (*Astragalo-Brometalia*) than an *Ebenenion pisidicae* unit (Eren & al. 2004). Only two character species of the *Thuryion capitatae* have been recorded (*Sabulina verna* subsp. *brevipetala*, *Polygonum karacae*). *Alyssum huber-morathii* is here another faithful serpentinophyte, which however is more often associated to open mountain forests. The same situation (also true in other formations) is frequently encountered in the

Central Taurus, where patchy mosaics of limestone and ultramafic soils apparently never support vegetation dominated by serpentinophytes (Parolly 2004). In addition, the syntaxonomic position of the *Astragalus creticus* community is badly resolved due to the low elevation, where already elements of the *Onobrychido armeni-Thymetalia leucostomi* Akman & al. 1984 steppe communities predominate (for problems of distinguishing this order at its upper distributional limit from the *Astragalo-Brometalia*, reference can be made to Parolly 2004 and Kürschner & Parolly 2012). Nevertheless, broadening the concept of the *Thuryion capitatae* allows now the classification of the high montane and subalpine serpentinophytic *Astragalo-Brometalia* vegetation of the Taurus System.

The eastern stands of the *Thuryion capitatae* are placed in the *Thuryenion capitatae* Parolly, **suball. nov.**, hoc loco (holotypus: as in alliance). For its differential species, see Fig. 5, for site conditions and distribution, Quézel (1973).

Proposed FFH Directive Habitat listing of the Thuryion capitatae and other serpentinophytic vegetation of Turkey. - The serpentinophytic vegetation in Turkey, though comparatively widespread (Fig. 1; Brooks 1987; Kruckeberg & al. 1999; Reeves & Adıgüzel 2004), is underrecorded from a phytosociological point of view. There are no relevés available that would document it from lowland and steppe areas. The single higher-ranked syntaxonomic unit presently defined, the *Thuryion capitatae*, has its strongest affinities with the substrate-analogous vegetation of the Troodos range in Cyprus, which is composed both by E Mediterranean elements (*Odontarrhena cyprica* (Nyár.) Španiel & al. [*Alyssum cypricum* Nyár.], *Hypericum confertum* Choisy subsp. *stenobotrys* (Boiss.) Holmboe, etc.), or local endemics which are closely related to Anatolian species. Such vicarious and pseudovicarious pairs of taxa include *Clinopodium troodii* (Post) Govaerts subsp. *troodii* (Cyprus) vs. *C. troodi* subsp. *vardaranum* (Leblebici) Govaerts (incl. subsp. *grandiflorum* (Hartvig & Strid) Govaerts (SW Anatolia), *Odontarrhena akamasica* (B. L. Burtt) Španiel & al. [*Alyssum akamasicum* B. L. Burtt], *O. chondrogyna* (B. L. Burtt) Španiel & al. [*A. chondrogynum* B. L. Burtt] and *O. troodi* (Boiss.) Španiel & al. [*A. troodii* Boiss.] (Cyprus) vs. *O. masmenaea* (Anatolia) and *Onosma troodii* Kotschy (Cyprus) vs. *O. frutescens* Lam., etc. (Meikle 1977-1985).

The present “Interpretation Manual of the European Union Habitats” of the FFH Directive of the European Union lists the relevant vegetation type of Cyprus as “62B0 Serpentinophilous grasslands” (European Commission 2007). With slight emendations and an altered species inventory, this category could be also adopted for the harmonised Habitat list of Turkey to cover all serpentinophytic *Astragalo-Brometea* communities.

Short comments on the other higher-ranked vegetation syntaxa of Sandras Dağı

In the light of the revision of the *Thuryion capitatae* and the separation of *Ebenenion pisidicae*, the other tree-less high-mountain vegetation units / formations are better understood and allow an outlook considering a wider geographical range:

Meltwater communities and doline vegetation (Trifolio-Polygonetalia). - The *Muscari sandrasici-Polygonetum karacae* is the first community described from ultramafic soils. Due to the many serpentinophytes, it fits only with some reservation

Thuryion capitatae Quézel ex Parolly hoc loco [Range: S + SW Anatolia]	
<p>CS: <i>Alyssum propinquum</i>, <i>Convolvulus libanoticus</i>, <i>Fumana aciphylla</i>, <i>Odontarrhena masmenaea</i> (<i>Alyssum masmenaeum</i>), <i>O. oxycarpa</i> (<i>A. oxycarpum</i>), <i>Pseudosempervivum sempervivum</i> (<i>Cochlearia sempervivum</i>), <i>Viola sandrasea</i> s.l.</p> <p>DS: <i>Acantholimon ulicinum</i> var. <i>purpurascens</i>, <i>Centaurea drabifolia</i> subsp. <i>cappadocica</i> (weak), <i>Iberis sempervirens</i>, <i>Leontodon asperrimus</i> (<i>L. masmenaeus</i>, weak).</p>	
Ebenenion pisidicae suball. nov. [Range: Western Taurus + Western Central Taurus]	Thuryenion capitatae suball. nov. [Range: Cilician Taurus]
<p>CS: <i>Aethionema cordatum</i> subsp. <i>pichleri</i>, <i>Cytisopsis pseudocytisus</i> subsp. <i>reeseana</i>, <i>Ebenus pisidica</i>, <i>Ferulago sandrasica</i>, <i>Linum boissieri</i>, <i>Minuartia recurva</i> subsp. <i>carica</i>, <i>Sabulina verna</i> subsp. <i>brevipetala</i> (<i>Minuartia verna</i> subsp. <i>brevipetala</i>), <i>Stipa cacuminis</i>, <i>Teucrium alyssifolium</i>, <i>Verbascum cariense</i>.</p> <p>DS geogr.: <i>Cyanus reuteranus</i>, <i>Galium incanum</i> subsp. <i>centrale</i>, <i>Polygonum karacae</i>, <i>Sideritis leptoclada</i>.</p>	<p>CS: <i>Alyssum mouradicum</i> (local), <i>Convolvulus catanoticus</i>, <i>Fumana grandiflora</i>, <i>F. oligosperma</i>, <i>Lactuca mulgedioides</i> (<i>L. seticuspis</i>), <i>Masmenia rosularis</i> (<i>Thlaspi rosulare</i>), <i>Odontarrhena callichroa</i> (<i>Alyssum callichroum</i>), <i>O. oxycarpa</i> (<i>A. oxycarpum</i>), <i>Phlomis linearis</i>, <i>Thurya capitata</i>.</p> <p>DS geogr.: <i>Aethionema speciosum</i> subsp. <i>speciosum</i>, <i>Ebenus laguroides</i>, <i>Scutellaria diffusa</i>, <i>Sideritis phlomoides</i>.</p>
Genistetum sandrasicae ass. nov. [Range: Sandras Dağı & adjacent areas]	Leontodonto asperrimi-Cochlearietum sempervivi Quézel ex Parolly, hoc loco [Range: Cilician Taurus]
<p>CS: <i>Aethionema speciosum</i> subsp. <i>compactum</i>, <i>Genista sandrasica</i>, <i>Prometheum serpentinum</i>, <i>Verbascum cariense</i>, <i>Viola sandrasea</i> subsp. <i>sandrasea</i>.</p> <p>DS: <i>Chamaecytisus pygmaeus</i>, <i>Cytisopsis pseudocytisus</i> subsp. <i>reeseana</i>.</p>	<p>CS & DS: see suballiance.</p>
Odontarrheno masmenaeae-Ebenetum pisidicae ass. nov. [Range: Sandras Dağı & adjacent areas]	
<p>CS: <i>Aethionema cordatum</i> subsp. <i>pichleri</i>.</p> <p>DS: <i>Centaurea drabifolia</i> subsp. <i>cappadocica</i> (weak), <i>Galium incanum</i> subsp. <i>centrale</i>, <i>Minuartia erythrosepala</i> var. <i>erythrosepala</i>, <i>Thesium procumbens</i> (weak).</p>	

Fig. 5. Syntaxonomic subdivision of the *Thuryion capitatae* of the Taurus range [CS = character species, DS = differential species, geogr. = geographical].

into the *Thlaspion papilloso* alliance (which hitherto encompassed basiphytic meltwater communities and doline turf only), but well into the *Trifolio-Polygonetalia*. The association ought to be quite special of Sandras Dağı, since there is no other mountain in the Western Taurus, which would provide suitable conditions for it or another chionophytic vegetation unit. Any re-classification would depend on the discovery of similar stands on ultramafics further east. At least in the serpentine areas, which I have studied (Dedegöl Dağları, Oyuklu Dağı, Bolkar Dağları, Aladağları), this is not very likely.

Rock vegetation (*Silenetalia odontopetalae*). – The cliffs and rocks sampled in the upper elevations of Sandras Dağı did not support *Silenetalia odontopetalae* vegetation proper, but fragments of both associations of the *Ebenenion pisidicae* (*Astragalo-Brometalia*) together with a very few chasmophytes such as *Potentilla speciosa* Willd. *Viola sandrasea* and *Prometheum serpentinicum*, etc. are important components of these communities and clearly no chasmophytes. Therefore, it is not possible to accept a local chasmophytic “groupement à *Viola sandrasea* et *Rosularia serpentinicum*” among the *Silenetalia odontopetalae* as proposed by Quézel (1973). The soft weathering forms of the peridotites of the summit region of Sandras Dağı prevent the occurrence of larger cliffs and thus of a particular serpentinophytic rock fissure plant community. In mid-elevations (1400-1700 m) of the massif, shady serpentine rock faces within the forests support mostly monospecific stands of *Lamium sandrasicum* P. H. Davis (Robert Ulrich, pers. obs.), which appears to be a chomophyte.

Scree vegetation (*Lamietalia cymbalariifolii* Parolly 1995, *Heldreichietea* Quézel ex Parolly 1995). – The field work on Sandras Dağı and the records of *Lamium sandrasicum* from rocks revealed my earlier assumption of a serpentinophytic *Lamium sandrasicum* scree plant community, substrate vicarious to the basiphytic *Lamietum cymbalariifolii* Parolly 1995 of the Western Taurus, to be an unsupported speculation (Parolly 1995, 1998, see also the site conditions of *L. sandrasicum* outlined by Mill 1982). In reality, there are no mobile talus slopes on Sandras Dağı at all and the stabilised mounts and block scree are, depending on the exposure and water supply, either covered by stands of the *Ebenenion pisidicae* or by an often fragmentary *Muscari sandrasici-Polygonetum karacae*. In lower elevations, in the mountain forest belt, the localised serpentinophytes *Eryngium thorifolium* Boiss., *Jacobaea sandrasica* (P. H. Davis) B. Nord. & Greuter (*Senecio sandrasicus* P. H. Davis), *Noccaea cariensis* (Carlström) Parolly & al. (see Aytaç & al. 2006), *Teucrium sandrasicum* O. Schwarz, *Verbascum caricense* and *V. trapifolium* (Stapf) Hub.-Mor. are together with many other species frequently associated with patches of scree, deep beds of gravel or even road banks without forming a particular community.

Vegetation of wind-swept sites (*Drabo-Androsacetalia*). – Another important finding is that the communities of the *Drabo-Androsacetalia* vegetation are, at least in the western part of the Taurus, exclusively basiphytic. This order classifies the wind-swept zonal alpine and subnival cushion plant communities as well as subalpine stands of the Taurus System (Parolly 2004). On Sandras Dağı, it is replaced by the *Odontarrheno masmenaeae-Ebenetum pisidicae* (*Astragalo-Brometalia*), which

shows especially in its dispersal spectrum (in particular the high proportion of cyclochorous species) many affinities with the *Drabo-Androsacetalia*.

Özhatay & al. (2003) list Sandras Dağı in floristical respects among the Important Plant Areas (IPAs) of Turkey; this holds certainly also for its serpentinophytic high-mountain vegetation. The phytosociological fundamentals of its understanding were goal of the present paper.

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APPENDICES

Appendix 1. Life forms, chorotypes and dispersal of the taxa recorded from the relevés of Sandras Dağı. An exclamation mark in square brackets [!] indicates confirming own field observations of dispersal, a “L” [L] refers to confirming literature. For general sources of data, see Material and Methods. [Abbreviations: Life forms: **Ch frut acanth** tragacanthic (fruticose) chamaephyte (thorn-cushion), **Ch frut** fruticose chamaephyte, **Ch frut rept** creeping fruticose chamaephyte, **Ch herb** herbaceous chamaephyte, **Ch herb rept** creeping herbaceous chamaephyte, **Ch pulv** pulvinate chamaephyte, **Ch succ** succulent chamaephyte, **Ch suffr rept** creeping suffruticose chamaephyte, **Ch suffr** suffruticose chamaephyte, **G bulb** bulbous geophyte, **G bulb par** parasitic bulbous geophyte, **G rhiz** rhizomatous geophyte, **H caesp** caespitose hemicryptophyte, **H ros** rosulate hemicryptophyte, **H scap** scapose hemicryptophyte, **H sem** semirosulate hemicryptophyte, **NP** nanophanerophyte, **T scap hpar** hemiparasitic scapose therophyte, **T sem** semirosulate therophyte. – Chorotypes: **EMed** East Mediterranean, **End Anatol** Anatolian endemic, **End Anatol (W)** Anatolian endemic (western part of Turkey / W of Anatolian Diagonale), **End bt** Western Taurus (Bati Toroslar) endemic, **End loc** local endemic, **End t** Taurus endemic, **ES** Euro-Siberian, **Eux** Euxine, **IA** Irano-Anatolian, **IT** Irano-Turanian, **Med** Mediterranean, **Pont** Pontic, **subcos** Subcosmopolitan, **tri** triregional (ES-IA-Med). – Dispersal types: **acanth** acanthochory, **ball** ball(aut)ochory, **blast** blast(aut)ochory, **bole** boleochory, **cycl** cyclochory, **dysz** dyszoochory, **ela** elaisomochory, **herp** herpochory, **hydro** (ombro)hydrochory, **loph** lophochory, **myx** myxochory, **pogo** pogonochory, **pter** pterochory, **sarc** sarcochory].

Taxon	Life form	Chorotype	Dispersal type
<i>Acantholimon ulicinum</i> (Willd. ex Schult.) Boiss. var. <i>purpurascens</i> (Bokhari) Bokhari & J. R. Edm.	Ch frut acanth	End Anatol	pter
<i>Aethionema cordatum</i> (Desf.) Boiss. subsp. <i>pichleri</i> (Boiss.) Hartvig & Strid	H scap (G rhiz?)	End Anatol	hydro
<i>Aethionema speciosum</i> Boiss. & Huet subsp. <i>compactum</i> Hartvig & Strid	Ch pulv	End loc	hydro
<i>Allium</i> sp. (sterile)	G bulb	–	bole
<i>Alopecurus gerardii</i> Vill.	H caesp	(E)Med	acanth (dysz)
<i>Alyssum propinquum</i> Baumgartner	Ch suffr rept	End Anatol	hydro
<i>Anthemis cretica</i> L. subsp. <i>cretica</i> [incl. subsp. <i>leucanthe-moides</i> (Boiss.) Griens.]	Ch suffr	EMed	bole (dysz)
<i>Arenaria ledebouriana</i> Fenzl var. <i>ledebouriana</i>	Ch pulv / Ch suffr rept	End Anatol	bole
<i>Asperula stricta</i> Boiss. subsp. <i>monticola</i> Ehrend.	Ch suffr (rept)	End t	bole
<i>Astragalus angustifolius</i> Lam. var. <i>violaceus</i> Boiss.	Ch frut acanth	EMed	ball [!]
<i>Astragalus condensatus</i> Ledeb.	Ch frut acanth	End Anatol	ball
<i>Asyneuma virgatum</i> (Labill.) Bormm. subsp. <i>cichoriiforme</i> (Boiss.) Damboldt	H sem	End Anatol	bole
<i>Barbarea brachycarpa</i> Boiss. subsp. <i>anfractuosa</i> (Hartvig & Strid) Parolly & Eren	H caesp	End loc	bole
<i>Bolanthus frankenioides</i> (Boiss.) Barkoudah var. <i>fasciculatus</i> (Boiss. & Heldr.) Barkoudah	Ch suffr rept	End bt	bole

<i>Bornmuellerantha aucheri</i> (Boiss.) Rothm. [<i>Odontites aucheri</i> Boiss.]	T scap hpar	IA	bole
<i>Bromopsis tomentella</i> (Boiss.) Holub subsp. <i>tomentella</i>	H caesp	EMed-IA	pter (dysz)
<i>Campanula stricta</i> L. var. <i>libanotica</i> (A. DC.) Boiss.	H scap / Ch suffr	EMed	bole
<i>Carex kitaibeliana</i> Bech.	H caesp	(E)Med	acanth [!]
<i>Centaurea cariensis</i> Boiss. subsp. <i>maculiceps</i> (O. Schwarz) Wagenitz	H sem	End. bt s.l.	bole / ela
<i>Centaurea drabifolia</i> Sm. subsp. <i>cappadocica</i> (DC.) Wagenitz	Ch pulv	End Anatol	cycl (ela) [!]
<i>Cephalaria lycica</i> Matthew	Ch suffr	End bt	acanth
<i>Cerastium macranthum</i> Boiss.	H caesp	End t	bole
<i>Chamaecytisus pygmaeus</i> (Willd.) Rothm.	Ch suffr rept	ES-EMed	ball
<i>Colchicum figlalii</i> (Ö. Varol) Parolly & Eren	G bulb	End loc	ela [!]
<i>Convolvulus compactus</i> Boiss.	Ch pulv	EMed-IA	bole
<i>Convolvulus libanoticus</i> Boiss.	Ch suffr	EMed	bole
<i>Corydalis oppositifolia</i> DC. subsp. <i>oppositifolia</i>	G bulb	EMed-IA	ball / ela
<i>Cruciata taurica</i> (Pall. ex Willd.) Ehrend.	Ch suffr	EMed	bole
<i>Cyanus reuteranus</i> (Boiss.) Holub var. <i>reuteranus</i>	H caesp / H ros	End bt	cycl (ela) [!]
<i>Cytisopsis pseudocytisus</i> Jaub. & Spach subsp. <i>reeseana</i> (Guyot) Lassen	Ch suffr rept	EMed	cycl [!]
<i>Daphne oleoides</i> Schreb. subsp. <i>oleoides</i>	Ch frut (NP)	EMed-IA	sarc [!]
<i>Dianthus eretmopetalus</i> Stapf	Ch pulv / Ch suffr	End bt	bole
<i>Dianthus zonatus</i> Fenzl var. <i>hypochlorus</i> (Boiss. & Heldr.) Reeve	Ch pulv / Ch suffr rept	EMed	bole
<i>Drymocallis rupestris</i> (L.) Soják [<i>Potentilla rupestris</i> L.]	Ch suffr	EMed-IA	bole [L]
<i>Ebenus pisidica</i> Hub.-Mor. & Reese	Ch suffr rept	End loc s.l.	cycl [!]
<i>Euphorbia erythron</i> Boiss. & Heldr.	Ch suffr rept	End Anatol (W)	blast / ela
<i>Ferulago sandrasica</i> Peşmen & Quézel	H sem	End t	pter (dysz)
<i>Festuca elwendiana</i> Markgr.-Dannenb.	H caesp	IA	pter (dysz)
<i>Festuca valesiaca</i> Gaudin	H caesp	tri	pter (dysz) [L]
<i>Fumana aciphylla</i> Boiss.	Ch suffr	IA	bole / myx [L]
<i>Gagea bithynica</i> Pascher	G bulb	ES-EMed	blast / ela [!]
<i>Galium incanum</i> Sm. subsp. <i>centrale</i> Ehrend.	Ch suffr	End t	bole
<i>Galium tmoleum</i> Boiss.	Ch herb	End bt	bole
<i>Genista sandrasica</i> Hartvig & Strid	Ch suffr rept	End loc	ball
<i>Helichrysum pallasii</i> Ledeb.	Ch pulv / Ch suffr rept	IA	pogo
<i>Herniaria glabra</i> L.	Ch herb rept	subcos	cyclo [L]
<i>Hesperis kotschyi</i> Boiss.	H sem	End t	bole
<i>Hypericum aviculariifolium</i> Jaub. & Spach subsp. <i>depilatum</i> (Freyn & Bornm.) Robson var. <i>bourgaei</i> (Boiss.) Robson	Ch suffr	End t	bole
<i>Iberis sempervirens</i> L.	Ch suffr	E(Med)	hydro [L]

<i>Koeleria macrantha</i> (Ledeb.) Schult.	H caesp	tri	pter (dysz) [L]
<i>Leontodon asperrinus</i> (Willd.) Endl.	H ros	IA	pogo
<i>Linum boissieri</i> Boiss.	Ch suffr	End Anatol	myx
<i>Lotus alpinus</i> (DC.) Ramond	Ch herb	tri (ES)	ball [!]
<i>Mattiastrum lithospermifolium</i> subsp. <i>cariense</i> (Boiss.) Valdés [<i>Paracaryum lithospermifolium</i> (Lam.) Grande subsp. <i>cariense</i> (Boiss.) R. Mill]	H caesp	EMed	pter / acanth [!]
<i>Minuartia erythrosepala</i> (Boiss.) Hand.-Mazz. var. <i>erythrosepala</i>	Ch herb rept / Ch pulv	End Anatol	cycl [!]
<i>Minuartia recurva</i> (All.) Schinz & Thell. subsp. <i>carica</i> McNeill	Ch pulv	End loc	bole
<i>Muscari sandrasicum</i> Karlén	G bulb	End loc	hydro
<i>Muscari tenuiflorum</i> Tausch	G bulb	tri (EMed-IA?)	hydro
<i>Noccaea leblebicii</i> (Gemici & Görk) Raus [<i>Thlaspi leblebicii</i> Gemici & Görk]	Ch pulv	End loc	hydro
<i>Odontarrhena masmenaea</i> (Boiss.) Španiel & al. [<i>Alyssum</i> <i>masmenaeum</i> Boiss.]	Ch suffr	End Anatol	bole
<i>Onosma aucheranum</i> DC.	Ch suffr	EMed	bole
<i>Ornithogalum alpigenum</i> Stapf	G bulb	End t	blast / ela [!]
<i>Paronychia chionaea</i> Boiss.	Ch pulv / Ch suffr rept	EMed-Pont	cycl [!]
<i>Pelargonium endlicherianum</i> Fenzl	G rhiz	EMed-IA	ball / herp [!]
<i>Petrorhagia alpina</i> (Habl.) Ball & Heywood subsp. <i>olympica</i> (Boiss. & Bal.) Heywood	T sem	EMed-ES	bole
<i>Phelipanche oxyloba</i> (Reut.) Soják [<i>Orobanche oxyloba</i> (Reut.) Beck]	G bulb par	EMed-IA	bole
<i>Phlomis armeniaca</i> Willd.	Ch suffr	End Anatol	bole
<i>Plantago holosteum</i> Scop.	Ch pulv / H ros	Med	myx [!]
<i>Poa bulbosa</i> L. s.l.	G bulb (H caesp)	tri	acanth (dysz) [L]
<i>Polygonum karacae</i> Ziel. & Boratynski	Ch suffr	End t	bole
<i>Prometheum serpentinicum</i> (Werderm.) t'Hart	Ch succ	End loc	hydro
<i>Prunus prostrata</i> Labill. [<i>Cerasus prostrata</i> (Labill.) Ser. var. <i>prostrata</i>]	Ch frut rept	Med	sarc [!]
<i>Ranunculus heterorhizus</i> Boiss. & Bal.	G bulb	End Anatol (W)	bole
<i>Rumex acetosella</i> L.	T sem	subcos	pter [L]
<i>Sabulina verna</i> subsp. <i>brevipetala</i> (Hartvig & Strid) Dillenb. & Kadereit [<i>Minuartia verna</i> (L.) Hiern subsp. <i>brevipetala</i> Hartvig & Strid]	Ch suffr rept	End bt	bole [L]
<i>Salvia argentea</i> L.	H sem	Med	bole / myx
<i>Salvia caespitosa</i> Benth.	Ch pulv / Ch suffr rept	End Anatol	bole / myx [!]
<i>Scilla pleiophylla</i> Speta	G bulb	End (bt)	blast / ela [!]
<i>Scorzonera sandrasica</i> Hartvig & Strid	H ros / Ch pulv	End loc	pogo [!]
<i>Scorzonera szowitzii</i> DC.	H ros	IA	pogo [!]
<i>Sedum ursi</i> t'Hart	Ch succ	End Anatol	hydro

<i>Sesleria alba</i> Sm.	H caesp	End Anatol	pter (dysz)
<i>Sideritis leptoclada</i> O. Schwarz & P. H. Davis	Ch suffr	End loc s.l.	bole
<i>Silene brevicalyx</i> Hartvig & Strid	Ch suffr	End loc	bole
<i>Silene pruinoso</i> Boiss.	Ch suffr	IA (-ES)	bole
<i>Stipa cacuminis</i> H. Scholz & Parolly	H caesp	End t	loph / herp [!]
<i>Stipa holosericea</i> Trin.	H caesp	IA	loph / herp
<i>Teucrium alyssifolium</i> Stapf	Ch suffr	End bt	bole
<i>Teucrium chamaedrys</i> L. subsp. <i>chamaedrys</i>	Ch suffr	ES-Med	bole [L]
<i>Teucrium polium</i> L.	Ch suffr	Med	bole
<i>Thesium billardieri</i> Boiss.	Ch suffr rept	IA	ela
<i>Thesium procumbens</i> C. A. Mey.	Ch suffr rept	EMed-Eux	blast / ela
<i>Thymus longicaulis</i> subsp. <i>chaubardii</i> (Rchb. fil.) Jalas var. <i>alternatus</i> Jalas	Ch suffr rept	End Anatol	bole (myx)
<i>Thymus sipyleus</i> Boiss. subsp. <i>sipyleus</i>	Ch frut rept	End Anatol	bole (myx)
<i>Tragopogon porrifolius</i> subsp. <i>longirostris</i> (Schultz Bip.) Greuter [<i>T. longirostris</i> Schultz Bip.]	H sem	EMed-IA	pogo
<i>Tragopogon olympicus</i> Boiss.	H scap	End Anatol	pogo [!]
<i>Trifolium hybridum</i> L. subsp. <i>anatolicum</i> (Boiss.) Hossain	H caesp	EMed-IA	blast [!]
<i>Verbascum adenophorum</i> Boiss.	H ros	End loc s.l.	bole
<i>Verbascum cariense</i> Hub.-Mor.	H ros	End loc s.l.	bole
<i>Veronica cuneifolia</i> D. Don subsp. <i>cuneifolia</i>	Ch suffr rept	End t	bole
<i>Viola sandrasea</i> Melchior subsp. <i>sandrasea</i>	H ros	End loc s.l.	blast / ela

Appendix 2. Annotated list of sampling localities (plots) on Sandras Dağ above Ağla (see Fig. 2, Table 1–3). Note that the localities shown in Fig. 2 have been numbered from left to right, while the localities and plots are chronologically arranged [relevés established by D Döring & Parolly; T Tolimir & Parolly; 1–25 present author].

Plot / relevé no.	Locality no.	Locality, plot annotation and sampling date
1–5, T1– T2	7	Altınsivri, summit plateau and adjoining rocky inclines, 2100–2190 m, 20.6.1999
1		Summit community (Gipffelur); boulders of compact peridotite to 50 x 50 x 50 cm ³ , densely covered by <i>Rhizocarpum geographicum</i> ; stands up to 30 cm high, mainly in the shelter of stones; reddish ophiolitic fine soil.
2		Rocky, stabilised slope with gentle steps and boulders; stands dominated by ca. 5 cm low shrublets of <i>Cytisopsis pseudocytisus</i> and taller tufts of <i>Poa bulbosa</i> (20 cm high).
3 & 4		As 2, but more turf-like.
5		Summit community (Gipffelur) at the margin of the plateau, few large rocks, structurally similar to plot 1.
T1–T2		Rock-strewn flats and gentle slope close to the summit plateau, with changing proportions of fine soil visible at the surface.
6, T3–T4	8	Altınsivri, eastern flank (above the saddle between Çiçekbaba Tepesi and Altınsivri), 2000 m, 20.6.1999
6		Rocky, stepped slope with swards and m-high boulders.
T3		Steep and rocky slope at the foot of large rock, stepped; xerophytic sward with <i>Stipa cacuminis</i> and <i>Salvia argentea</i> as tallest plants.
T4		Next to plot T3, but only moderately sloping, vegetation more mesophytic and turf-like; with a better water-supply, abundant fine soil.
7–13, D1	4	Çiçekbaba Tepesi, ascent from Çıralı, valley E of the main summit, 37°04'82"N, 028°49'91"E, 1900-2180 m, valley bottom and adjoining grazed slopes, 21.6.1999
7		Valley bottom with snow-beds close to late hanging snow, boulders to 50 x 30 cm ² , abundant fine soil, no scree.
8		As in 7, but with smaller boulders than in previous plot; fine-soil layer thin, relatively compressed, thus surface less denudated than in plot 7 (only a few cm ² of open soil present).
9		As in 8, but stones only 15 x 15 x 10 cm ³ .
10, 12-13		Lower gentle slope with (±) dense carpet turf (snow-beds) ca. 10-50 m above the valley bottom; stands stronger browsed than those of the previous plots.
11		Valley bottom with browsed, dense snow-beds, 2100 m.
D1		Lateral ridge of valley, steep slope ca. 50-60 m above the valley bottom, with open mesophytic dwarf-shrub community and much bare soil.
D2–5	3	Çiçekbaba Tepesi, eastern slope below the main summit, 21.6.1999
D2		Steep, stepped and rocky slope close to meltwater runnels.
D3–5		Flat area (= a step of the rocky, boulder-rich slope) below the last ascent to the summit.
14–19 14 & 15	1	Çiçekbaba Tepesi, summit plateau, 21.6.1999 Fixed coarse scree to block scree.

16 & 17		Stony, almost flat wind-swept hill top.
18		Hill top lateral (E) of main summit, surrounded by block-scrée with various proportions of finer material.
19		Slope with stabilised boulder scree, tentatively poor in fine soil.
20a & b	2	Çiçekbaba Tepesi, N-facing slope, 50-120 m below the summit plateau, 21.6.1999
20a		High-covering meltwater vegetation ca. 8 m from a large snow-field; plot divided by a 50-70 cm wide meltwater runnel with trickling water; few rocks.
20b		As in 12, but closer to the snow and much stronger flow of meltwater.
21–23	6	Çıralı below Altınsivri, 37°03'N, 028°48'E, flat alluvial plain with gravel and fine soil-rich ultramafic soil, supporting sites similar to those of meltwater vegetation, sampled vegetation confined to runnels and small depressions, 22.6.1999
21		Doline-like depression; stands ca. 20 cm high (<i>Odontarrhena masmenaea</i>).
22		Stony runnel; stands ca. 20 cm high (<i>Odontarrhena masmenaea</i>).
23		Surface gravelly; densely packed gravel and debris (mostly < 10 cm), small amounts of fine soil; stands on average very low (ca. 3 cm high, <i>Linum boissieri</i> , over-topped by <i>Poa bulbosa</i> , etc.).
24–25	5	Akköprü Çögenli [= saddle between Altınsivri and Çiçekbaba Tepesi], 22.6.1999.
24		Rocky wind-exposed slope with boulders, coarse- and fine-scrée, compact peridotite.
25		Gentle scree slope with medium-sized stones and a few boulders.