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The High Mountain Vegetation of Turkey - a State of the Art Report, Including a First Annotated Conspectus of the Major Syntaxa

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Abstract: This contribution spotlights the present research on the (oreal) subalpine to subnival mountain vegetation of Turkey. It concisely compiles our present knowledge, which is very heterogeneous in geographical terms. The situation is comparatively good in NW and W Anatolia and the western half of the Taurus range, from where a first consolidation stage can be reported. By contrast, the E Taurus remains a largely unexplored area. The North Anatolian chains have hitherto attracted a few local researchers only, and those important pioneering accounts cover less than half of the vegetation types actually present. The results of the last years' field work in the Taurus range represent the core of the presentation and focus on the syntaxonomy and phytogeography of the Tauric System. An annotated conspectus of all known major syntaxa (alliances to class group level) recorded from the Anatolian mountains is presented. It includes 15 first records of mostly Euro-Siberian and Mediterranean orders and classes that proved to be incorrectly interpreted, completely unstudied or as yet unreported. The classification of the N Anatolian mountain vegetation suffered severely by neglecting the rich literature about the neighbouring mountain chains of the Balkans or the Great and Little Caucasus. In taking a broader view, some major vegetation units are re-defined to better reflect Turkey's position in the Eurasian Alpic-Himalayan fold mountain system. A phytogeographical subdivision of the Turkish mountain ranges and all of the Tauric System based on both the asylvatic high mountain vegetation and flora is provided. The subdivision is fully backed by the pattern revealed by the forest communities. Despite the achievements in the past, such a lecture is to a certain extent a tale of ignorance. Pointing out the gaps in our knowledge may help to co-ordinate the studies needed. Another goal is to discuss conflicting or even inappropriate syntaxonomic concepts and working methods to come closer to a common base for future vegetation surveying projects.

Key Words: (Anatolian) mountains, phytogeography, phytosociology, syntaxonomic conspectus, Tauric System, Turkey, vegetation

Introduction

The mountainous landscapes of Turkey, with their remarkable bioclimatic, geomorphological and pedological diversity, support a great many different high mountain vegetation types, which have attracted botanists for more than 150 years. The term high mountain vegetation as applied here refers to the asylvatic vegetation units of the subalpine to subnival belts, which, however, may have secondary anthropogeneous or natural extrazonal range extensions into oreal or even montane elevations. For convenience, it includes all azonal vegetation types, both of the forest zone and the summit regions above. We chiefly deal with land above 2000 m above sea level.

In contrast to that long period of investigation, there are still comparatively few in-depth studies which deal with the vegetation of larger mountain ranges, local monographs that cover all vegetation types or revisionary accounts on selected vegetation units, since the majority of the Turkish botanists have concentrated, for many good reasons, on the forest and steppe vegetation.

A much desired synthetic synopsis regarding the mountain vegetation of Turkey is of course not available, and there is no realistic target for the next decade. As a first step, an annotated conspectus of all known major syntaxa (alliance to class-group level) recorded from the Anatolian mountains, supplements the present paper.

This contribution spotlights the present research on the (oreal) subalpine to subnival vegetation. It concisely compiles our present knowledge, which is very heterogeneous in geographical terms. The situation is comparatively good in NW and W Anatolia and the western half of the Taurus range. After some large-scale studies dealing with all important zonal, extra- and azonal asylvatic vegetation units (Hein et al., 1995, 1998;

Kürschner et al., 1998; Parolly 1995, 1998, 2003, and in prep.), a first consolidation stage can be reported. The results of the last years, field work in the Taurus within the scope of the "PONTAURUS-Project" represent the core of the presentation and focus on the syntaxonomy, ecosociology and phytogeography of the Tauric System, before the mountain vegetation of the Pontids is set into a larger phytogeographical frame as hitherto done.

Despite the many achievements in the past, this lecture must be to a certain extent a tale of my and other peoples' ignorance. Pointing out the widest gaps in our knowledge may stimulate research in those fields and help to coordinate future studies. Another goal in this context is to discuss conflicting or even inappropriate syntaxonomic concepts and working methods to come closer to a common base for future vegetation surveying projects.

The "PONTAURUS-Project"

Scopes and goals

The "PONTAURUS-Project" was carried out for 2 years with 17 weeks of fieldwork in the Turkish mountains. The lion's share concentrated on the Taurus range, with about 3 weeks in the eastern part of the Karadeniz Mountains. The project chiefly focused on the evolution of the mountain flora on a coenological and historical background, broadly considering various aspects of life and growth form analyses, floral and dispersal biology, life strategies, chorotypes, etc. Since all analyses were based on communities, this finally led – unintentionally but necessarily - to the re-evaluation of a certain number of vegetation units.

The following formations and syntaxa have been more closely studied: screes (*Heldreichietea*), rock vegetation (*Silenetalia odontopetalae*), thorn-cushion communities, dwarf-shrublands and gappy subalpine limestone swards (*Astragalo-Brometalia* and, partly, *Onobrychido armeni-Thymetalia leucostomi*), alpine mat-forming communities and the vegetation of windbeaten hilltops and exposed ridges (*Drabo-Androsacetalia*), snow-beds and meltwater communities (*Trifolio-Polygonetalia*) and azonal hydro- and hygrophytic units, such as alpine turfs and low-sedge fens (*Scheuchzerio-Caricetea fuscae, Polygono-Polygonetalia*).

Methods

The project follows the conventions of the Braun-Blanquet approach (Braun-Blanquet, 1964), with all the modifications introduced since that time (Dierschke, 1994; Dierssen, 1990). The combined valuation of the abundance and cover is based on the scale of Barkman et al. (1964) with the recent modification that the "2 m" value was replaced by "1 m".

A broad use has been made in applying the concepts of a deductive syntaxonomy in the sense of Kopecky & Hejny (1978) in classifying communities without particular character species as base, fragmentary or derivative communities of a superordinate unit.

The "Code of Phytosociological Nomenclature" (CPN; Weber et al., 2000) has been applied for all nomenclatural procedures involved. For the treatment of syntaxonomic and nomenclatural problems related to Quézel's pioneering approach (1973) and the lecto-typifications of Quézel et al. (1992) see Hein et al. (1998) and Parolly (1995, 1998).

The "Flora of Turkey and the East Aegean Islands, Vols. 1-11" (Davis, 1965-1985; Davis et al., 1988; Güner et al., 2001) is the major taxonomic and nomenclatural reference for the project. For some taxa, the accounts of the "Med-Checklist" (Greuter et al., 1984-1989) plus a great number of recent monographs have been adopted.

The collected specimens are deposited in B, with duplicates, if available, in ISTE.

Data base

Any large-scale interpretation of vegetation units should be set on the broadest base possible. Figure 1 groups more than 3550 relevés according to syntaxa and into 6 categories - from the original accounts of Quézel (1973) and Quézel & Pamukçuoğlu (1970) and the work of local botanists to the 1999 and 2000 fieldresults; 2320 own relevés make a solid base of samples that follow one standard in conducting and data processing. Including published relevés proved to be problematic, because there is still much disagreement and confusion about such a standard of vegetation sampling: many published relevés do not meet basic prerequisites, such as floristical and site-ecological homogeneity, and some 1000 had to be dropped.

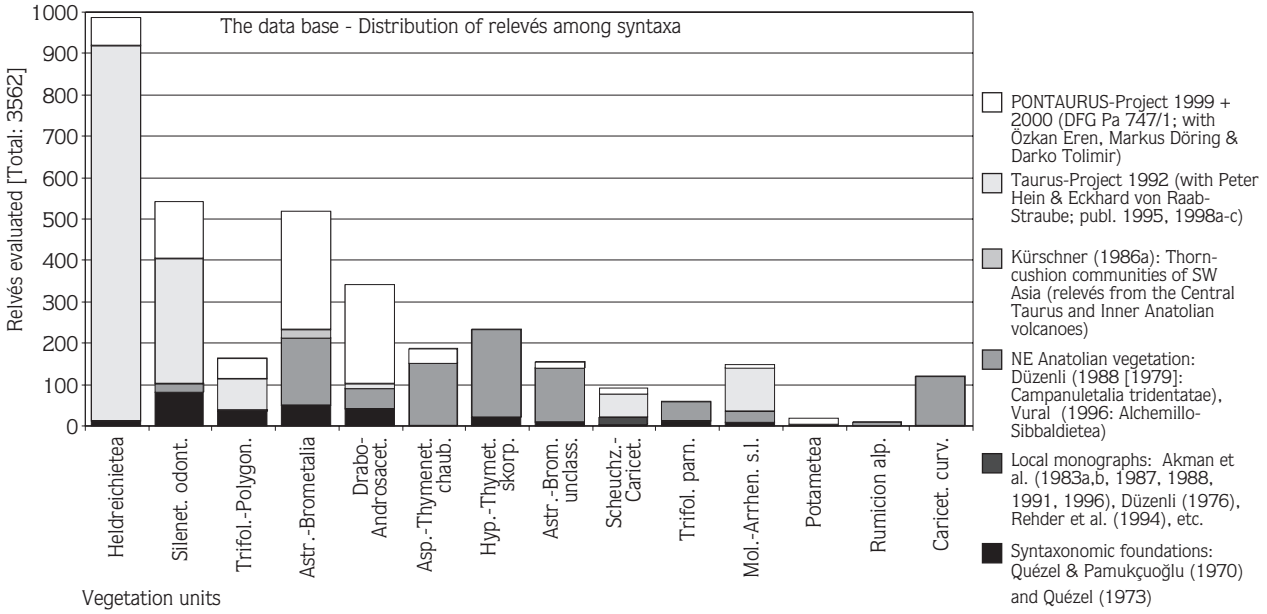

Figure 1. Distribution of relevés among syntaxa. Sources (if not indicated above): PONTAURUS-Project (Parolly, 2004, plus manuscripts); Taurus-Project 1992: Hein et al. (1995, 1998), Kürschner et al. (1998), Parolly (1995, 1998), Raab-Straube (1994, unpubl.); local monographs: Ayaşlıgil (1987), Duman (1990, resp. 1995), Düzenli (1976), Seçmen (1982), Seçmen & Leblebici (1988), Yurakulol (1981).

Maybe hat I should add as a matter of course: that many relevés consider vascular plants exclusively. This is acceptable in a good many habitats, but is a knock-out criterion in many wetland communities and high mountain vegetation types of a Euro-Siberian character, which are abundant in cryptogames, be they bryophytes or lichens.

The high mountain vegetation of the Taurus range - chaos and consolidation

The following chapter deals formation-wise with the high mountain vegetation of the Taurus range, and here exclusively with its western half, from Honaz Dağı to the mountains of Kahramanmaraş, as there is very little information regarding the mountains further east (except, e.g., Behçet, 1990, 1994; Behçet & Özgökçe 1998; Behçet & Ünal, 1999) and no workable classification system. In many cases, especially in all azonal and extrazonal vegetation types, it is appropriate to compare the Taurus and Karadeniz ranges and to briefly comment on the situation in N Anatolian mountains.

For general accounts on the vegetation of the greater Taurus range reference can be made to Ayaşlıgil (1987), Kürschner (1982, 1984), Kürschner et al. (1997), Öztürk et al. (1991), Parolly (1995) and Quézel (1973). Two "classic" studies should be added, which still make good reading today: Kotschy's "Reise in den Cilicischen Taurus über Tarsus" (1858) is the first extensive monograph about the Anatolian mountain vegetation and is noteworthy for its detailed altitudinal profile. Schwarz (1936) conducted the first phytosociological study in Turkey. His "Die Vegetationsverhältnisse Westanatoliens" includes notes on the mountain vegetation of, for example, Bozdağ and Nif Dağ, and already deals with a good many of the communities known today.

Figure 2 summarises the high mountain vegetation mosaic and the Tauric zonation (Kürschner, 1982, 1984) along a N-S profile of the eastern Bolkar Dağları (the main ridge above Maydan). The altitudinal belts can be related to vegetation series.

Talus and scree communities (Heldreichietea)

Taurus range. Not much has changed since my revisionary accounts (Parolly, 1995, 1998) on the subalpine to subnival *Heldreichietea* scree vegetation, including studies on life-strategies and dispersal biology, and, as yet unpublished, data on the floral biology of that formation. The diagnostic species inventory of the units and subunits has been confirmed to a large extent. However, it became clear, after all the mountain syntaxa

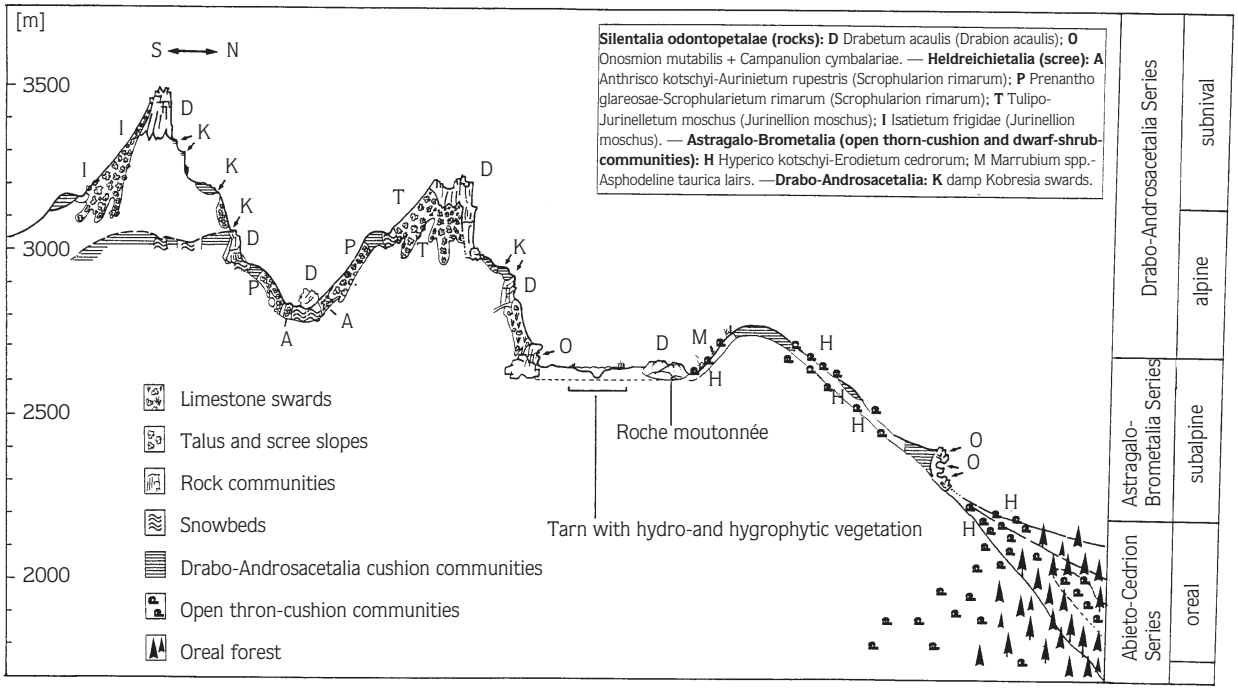

Figure 2. Schematic N-S profile of the eastern Bolkar Dağları (main ridge above Maydan): High mountain vegetation mosaic and Tauric Zonation (cf. Kürschner 1982, 1984) [Section composed of 3 parts, roughly following the broken and bent line Egerkaya - Tahtakaya - Gölkaya - Karagöl - Maydan. Different parts not drawn to scale.].

studied, that a number of characteristic species are in fact (geographical) differential species with their centres of occurrence outside screes.

The genus *Lamium* L. plays an important role in and at the same time demonstrates a major principle of the syntaxonomy and phytogeographical pattern of the Mesogean Tauric System: its communities are often characterised by complexes of vicarious and corresponding species. *Lamium eriocephalum* Benth. subsp. *eriocephalum* is a dominant of the screes of the Cilician Taurus. In the Pisidian and Isaurian Taurus it is replaced by its subsp. *glandulosidens* (Hub.-Mor.) R.R.Mill. In the W Taurus, we encounter the corresponding *Lamium cymbalariifolium* Boiss. agg. The range of the *Scrophularion depauperatae*, expected to reach Honaz Dağı, is confirmed, including the assumption that the *Lamium cymbalariifolium* scree (*Lamietum cymbalariifolii* Parolly 1995) of the Lycian Taurus is to be replaced by a vicarious *L. microphyllum* Boiss. community.

Karadeniz range. Our knowledge of the extension of the class to the north is still very fragmentary. The distribution of the higher-ranked characteristic species suggests that the Karadeniz Mountains form part of the synarea, at least as far as mountains with basiphytic sediments are concerned. The mobile and xeric alpine screes I came across in the north-east of the country were all granitic and support, with *Riccotia aucheri* (Boiss.) Burtt and *Lamium tomentosum* Willd., only a few species which point towards the *Heldreichietea* class. However, there is also no better support for the Euro-Siberian *Thlaspietea rotundifolii* scree vegetation class. The latter is clearly present with siliceous units on damp and stabilised block-screes in montane to subalpine elevations of the Kaçkar Mountains (see appendix).

Chasmophytic vegetation (Silenetalia odonto-petalae)

The major (limestone) syntaxon of higher elevations of the Taurus range, the *Silenetalia odontopetalae*, has been monographed by Hein et al. (1998). As part of the Mesogean East Mediterranean sub-class *Potentillenea speciosae*, they extend in the north-west to Uludağ, and include all of the Levant (Lebanon), and quite probably to parts of the limestone ranges of Iraq and Iran. The recent field work supports the previous subdivision and confirms the range to Honaz Dağı in the west and sets all units on

a more solid base. This is especially important for the newly described *Campanulion isauricae* of the western part of the Central Taurus (Hein et al., 1998), where the number of characteristic species could be increased.

While the situation above 1700 m is more or less consolidated, lower down any delimitation of the *Silenetalia odontopetalae* against a yet unstudied major submontane and Mediterranean unit as well as against the *Parietarietalia judaicae* Rivas-Martinez 1960 ex Br.-Bl. 1963 corr. Oberdorfer 1979 (wall communities) and the *Adiantetea* maiden fern communities, covering fern- and moss-dominated communities of water-sprayed and water-flushed rock surfaces of the Mediterranean in its broadest sense, is unsolved. There is an obvious transition to a major Mediterranean unit, preliminarily referred to as the East Mediterranean *Inulion heterolepidis* (*Cirsietalia chamaepeucis*, see Horvat et al., 1974). On account of the many endemics (cf. Ayaşlıgil, 1987), however, an Anatolian geovicariad is more likely.

It is striking that there is obviously no distinct serpentine rock vegetation in the Taurus range at the association or alliance level. All stands seen are fragments of the known alliances (most basiphytic species lacking) with some serpentinophytes. All of these taxa are no obligate chasmophytes, such as *Prometheum serpentinicum* (Werdermann) 't Hart and *Viola sandrasea* Melchior, hence weakening the base of an eponymous unit recorded from Sandras Dağı (Quézel,1973).

Xeric grasslands, dwarf-shrub and thorn-cushion communities as zonal climax and paraclimax series - Steps towards a re-classification of the Anatolian *Daphno-Festucetales*

Quézel established the *Daphno-Festucetales* super-class to combine the xeric zonal grasslands, dwarf-shrub and thorn-cushion communities of the mountains of the East Mediterranean territories (Barbero et al., 1975; Quézel,1964, 1967, 1973; Quézel & Pamukçuoğlu, 1970).

This super-class also excels in a figurative sense. No other zonal unit in the Near East covers such vast ranges and shows a horizontal distribution from about 1000 to more than 4000 m. It is unrivalled by all other vegetation types in terms of diversity in their constituent species of the different subunits. Neither has any other syntaxon brought forth a comparable number of communities at the alliance and association level. Their classification is sometimes based on outdated concepts and a negligent background of references. More than 40% of all associations and part of the alliances deserve to be sunken in synonymy. The many fragment, base and derivative communities that have been given association rank are not yet considered in this number.

In short, the *Daphno-Festucetales* are the Augean stable of Turkish phytosociology, and it will be a Herculean task to cleanse it. I here make some suggestions for a re-classification of the Anatolian *Daphno-Festucea*, dealt with in detail in a series of forthcoming papers. The following topics are nothing but a first, incomplete outlook and an insight into on-going work.

● **The Astragalo-Brometea - the only Anatolian class**

Figure 3 represents the third generation of maps that show the distribution of xeric communities in SW Asia. In contrast to its precursors (Barbero et al., 1975; Kürschner, 1986a), it combines the ranges of the communities with the boundaries of the phyto-geographical territories of that area. Traditionally, 2 classes have been reported from Turkey: the *Daphno-Festucetea* and the *Astragalo-Brometea* (Kürschner 1986a, b; Quézel, 1973; Quézel & Pamukçuoğlu, 1970). The *Daphno-Festucetea* were said to occur with one order (*Daphno-Festucetalia*) in Greece, the mountains of the East Aegean islands, Thrace and NW and W Anatolia, while most of S, Inner, E and larger parts of N Anatolia should form the range of the xerophytic *Astragalo-Brometea* class.

The important alteration is that I do not consider the *Daphno-Festucetea* to be any longer present in Anatolia. I suggest placing the siliceous vegetation of the western and south-western Anatolian mountains with the gneiss and mica schist predominant in the *Astragalo-Brometea*. To a certain extent these are fragmentary or base communities of the *Astragalo-Brometea* class or the *Astragalo-Brometalia* order only. In many other cases there is considerable evidence to include the communities in the steppe communities of the *Asperulo phrygiae-Thymenetalia chaubardii*.

In the north, former stations of the *Daphno-Festucetea* can be attached to the *Hyperico linarioidis-Thymetalia skorpilii*, another order of the *Astragalo-Brometea*. A closer look at that order and the distribution

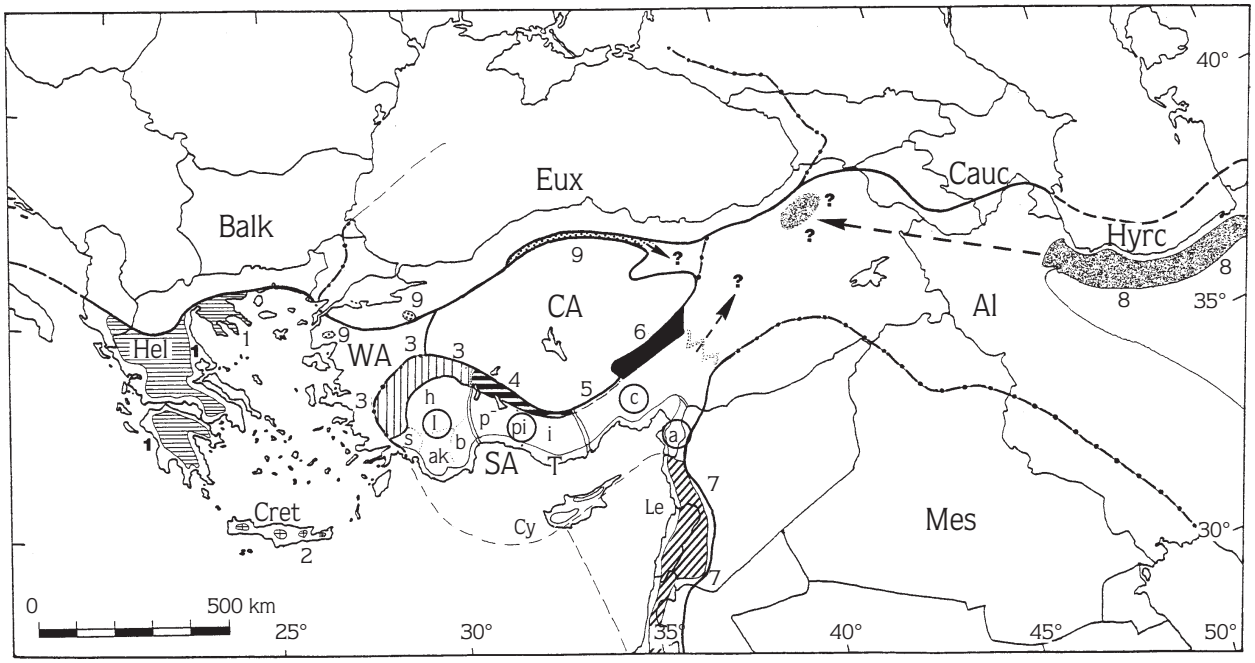

Figure 3. Delimitation and subdivision of the Tauric System under consideration of the chorological subdivision of the East Mediterranean Subregion and adjacent regions and the distribution of the major high mountain syntaxa of the Daphno-Festucetales super-class [**Syntaxa: 1** Daphno-Festucetalia (Daphno-Festucetea; based on Barbero et al., 1975); **2** Saturejetalia spinosae (Daphno-Festucetea; based on Zaffran, 1990); **3-5** Asperulo phrygiae-Thymenetalia chaubardii mountain steppe of the 3 Taurus sectors (this paper); **6** Bromion cappadocici of the Central Anatolian volcanoes (based on Kürschner, 1986a); **7** Nonaeion humilis (based on Kürschner, 1986a; Shmida, 1977), **8** Onobrychidetea cornutae (a very tentative range; cf. Klein, 1987) with assumed range extensions to Turkey (mapped: extrazonal occurrences in the Kaçkar mountains; a much wider range in Turkey is expected; this paper); **9** Hyperico linarioidis-Thymetalia skorpilii (this paper). - **Chorology** (above sectoral level largely in accordance with Meusel et al. 1965; Takhtajan, 1986; cf. here for references; - note: without subdivision of the Aegean and Caucasian territories and no entry of the Araxes lowlands.): Region boundaries: bold solid lines, province boundaries: bold broken lines, sector boundaries: solid lines, district boundaries dotted lines. - **Euro-Siberian Region**: **Balk** Balkan Province; **Eux** Euxine Province; **Cauc** Caucasian Province; - **Mediterranean Region, East Mediterranean Subregion: Hel** Hellenic Province, **Cret** Cretean Subprovince; **SA** South Anatolian Province, **Cy** Cyprian Subprovince, **Le** Lebanon Subprovince, **T** Tauric Subprovince with: **a** Amanos Sector, **c** Cilician Sector, **l** Lycian Sector, **pi** Pisidian Isaurian Sector and **ak** Ak Dağları District, **b** Bey Dağları District, **h** Honaz Dağ District, **i** Isaurian District, **p** Pisidian District, **s** Sandras Dağ District; **WA** West Anatolian Province; - **Irano-Turanian Region, Irano-Anatolian Subregion: Al** Armeno-Iranian Province; **CA** Central Anatolian Province; **Mes** Mesopotamian Province].

of the relevant species suggests they are present on all mountains of NW Turkey (cf. Quézel & Pamukçuoğlu, 1970; Rehder et al., 1994; Figure 3), and are not confined to the North Anatolian Ilgaz Dağ and its surroundings as given in traditional concepts (Akman et al., 1987, 1988; cf. Akman et al., 1983a,b). Therefore, I removed range entries for the *Daphno-Festucetea* from the map of Anatolia and now take the *Astragalo-Brometea* as the only class, as long as it is not demonstrated that – which is also conceivable - the *Hyperico linarioidis-Thymetalia skorpilii* form part of the *Daphno-Festucetea*.

● Drabo-Androsacetalia revisited

There is a recent monograph on the high-mountain mat-forming communities and the vegetation of the windbeaten hilltops and highest summit regions (Parolly, 2004, submitted). The concept of the *Drabo-Androsacetalia* is broadly confirmed: these make up the zonal vegetation of the alpine to subnival belts on limestone. Extrazonal, often small-scale outposts are confined to windswept rocky flats and exposed ridges in oreal to subalpine elevations. The range of the orders tapers to the north-west to include Uludağ as home of the monotypic, ill-defined *Alopecurion lanatae* (Quézel & Pamukçuoğlu, 1970). In the Taurus range, a subdivision of the *Drabo-Androsacetalia* in 3 parts, exactly reflecting the main phytogeographic pattern found there (Lycian, Pisidian-Isaurian, Cilician Taurus Sector) and outlined in earlier papers (Hein et al., 1998; Parolly, 1995, 1998),

is evident. In essence it corresponds to Quézel's 3 alliances, which all needed corrections in their geographic delimitation and in the much enhanced species inventory (also at ordinal level), thus receiving noticeable amendments.

In terms of dispersal biology, the *Drabo-Androsacetalia* are marked by the high proportion of cyclochorous species, such as the many herbaceous Astragali and other *Fabaceae* with inflated calyces or *Asteraceae*, such as *Centaurea drabifolia* Sm., which disperse the whole capitulum. By contrast, the *Astragalo-Brometalia* order has principally an enhanced proportion of ballochory, the thorny Astragali being important components.

● Astragalo-Brometalia - the forgotten order - restored

Since Quézel (1973) established the *Astragalo-Brometalia* order with 3 subordinate alliances, only a few researchers (e.g., Ayaşlıgil, 1987; Düzenli, 1976; Duman, 1995) have attributed "their" xerophytic mountain vegetation to it. In physiognomic terms they represent thorn-cushion communities, dwarf-shrublands and gappy subalpine limestone swards. According to Quézel (1973), the units to be found west of Antalya belong to the *Tanacetion praeteriti* alliance. This can be confirmed, however, with only the name-giving of the former characteristic species retained. There are also convincing arguments for maintaining the other 2 alliances (*Agropyro tauri-Stachydion lavandulifoliae* in the Central Taurus range, *Thuryion capitatae* on serpentine) and the order in total with a strongly altered set of characteristic species. We have to restore this forgotten order, and this is not only due to the CPN's demands.

Thymetalia leucostomi - A comment on a story of success and chaos

The *Onobrychido armeni-Thymetalia leucostomi* order comprises the steppe communities of the Inner Anatolian highland bordering on the foothills of the mountain ranges in the north and south. The establishment of that steppe order by the Akman working group (Akman et al., 1984) and a series of successive papers (e.g., Akman, 1990; Akman et al., 1985, 1991, 1996; Ketenoğlu et al., 1996; Ocakverdi & Oflas, 1999) was so stimulating that it provoked a continuing flood of papers. To all appearances, many researchers later also applied the contents of the order to mid-montane and even subalpine elevations of the Taurus range. This altitudinal and conceptual extension of the *Onobrychido-Thymetalia* was very much to the debit of the idea of the *Astragalo-Brometalia*, which seemed to fade away, all the more since with the description of the *Asperulo phrygiae-Thymenetalia chaubardii* suborder a convenient tool was available to classify the highland communities at moderate elevations. Without referring to Quézel (1973), more and more *Astragalo-Brometalia* species were "covered" and subsequently considered to be characteristic species of the *Asperulo-Thymenetalia* "steppe".

This is no argument against the occurrence of that suborder. The communities continue up the slopes of the northern Taurus incline to above 2000 m to merge into the *Astragalo-Brometalia*, with a clear line between them still to be drawn. Putting together all published units of all types of *Astragalo-Brometea* communities in a synoptic table clearly revealed that a number of *Astragalo-Brometalia* communities were misplaced in the steppe unit. As a by-product, it outlined much of the chaos initially blamed. My evaluations have not yet come to an end, but they show that the *Asperulo-Thymenetalia* are best (and maybe only) supported on schist and are subordinate to the *Astragalo-Brometalia*.

● Strange but necessary: Astragalo-Brometea fused with Trifolio-Polygonetea

Many transgressive stands between the 2 formations suggest that the hygro- to mesophytic vegetation of snow-patch and meltwater communities and of dolines and trampled turfs of the *Trifolio-Polygonetea* should be united with the xeric *Astragalo-Brometea*. The *Trifolio-Polygonetea* represent, from the floristic view-point, the damp wing of the thorn-cushion and dwarf-shrub communities. There are only a few reliable indicators of the damp and fine-soil rich places found throughout the Taurus range, such as *Ranunculus demissus* DC. var. *major* Boiss. and *Taraxacum bithynicum* DC. Many other species work reasonably well on limestone, where the water trickles away quickly (thus creating a sharp difference between fine soil rich and poor sites), but lose their marker quality on mica schist and ultramafics with their much better water capacity.

Most of the geophytes do not help very much in delimiting xeric from hygric groups, at least not with a strict floristical approach. They can be ranked according to their chionophilous degree, from *Colchicum trigynum*

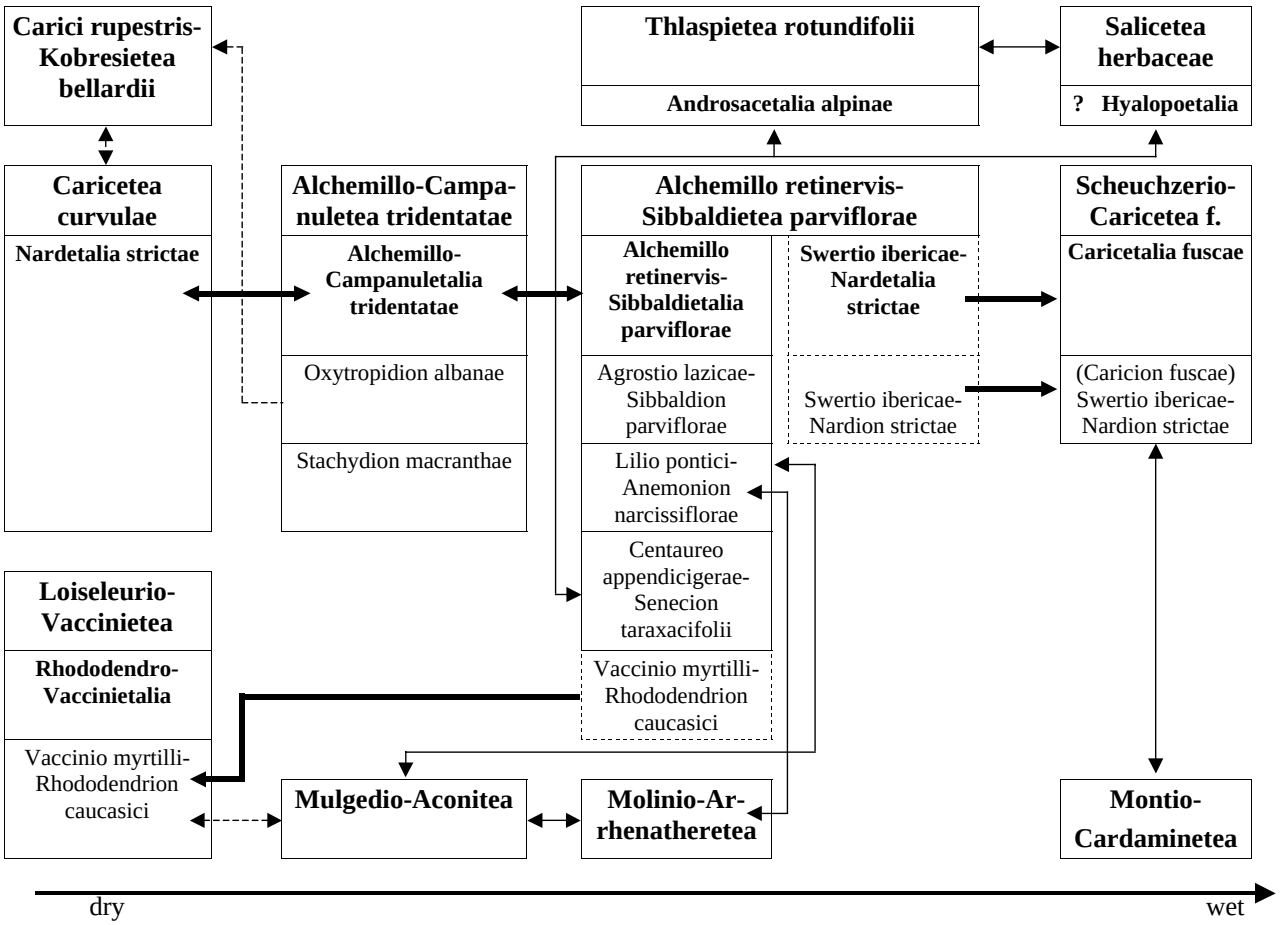

Figure 4. Large-scale versus local classification: Syntaxonomic position of the Alchemillo-Campanuletea tridentatae Düzenli 1988 and the Alchemillo retinervis-Sibbaldietea parviflorae Vural 1996 of NE Anatolia within the Euro-Siberian vegetation. Simple double-sided arrow: cross-connections with regionally unclear delimitation (indicating the possibility of a future transfer from a N Anatolian alliance to a superordinate Euro-Siberian class); bold-faced double-sided arrow: a putative syntaxonomic synonym; bold-faced arrow: a necessary transfer to the Euro-Siberian units indicated.

(Steven ex Adam) Stearn, *Crocus biflorus* Mill. subsp. *isauricus* (Siehe ex Bowles) B.Mathew and *Scilla pleiophylla* Speta (and related taxa of *S. bifolia* L. agg). to *Ornithogalum* L. spp., *Muscari* Mill. spp. and *Gagea* Salisb. spp. The number of geophyte individuals helps, together with the evaluation of the physical condition of the chamaephytes, to delimit the phenological stages of the hygric communities and to judge the period of snow cover. We can use quantitative and qualitative physiognomic features to segregate some of the groups, but this goes beyond the principles of orthodox phytosociology. Species composition alone does not differentiate between major units representing 2 different classes, no matter how different the stands look. By contrast, the alliances of the *Trifolio-Polygonetalia* are well supported owing to local characteristic species of the Taurus sections, and are chiefly differentiated by the regional set of species out of the *Astragalo-Brometalia* and *Drabo-Androsacetalia* (sub)units.

A hygro- to mesophytic, chamaephyte-rich vegetation (*Astragalus hermoneus* Boiss.-*Polygonum cedrorum* Boiss. & Kotschy community), dominated by the eponymous thorny *Astragalus*, has also been described from the Antilebanon mountains (Kürschner, 1986a). This *Polygonetea cedrorum* Shmida 1977 vegetation (nom. inval.; cited in Kürschner, 1986a) parallels the *Trifolio-Polygonetalia* and is, on account of many common species (*Astragalus hermoneus*, for example is a synonym of *A. angustifolius* Lam. var. *violaceus* Boiss.,

one of the characteristic species of the *Trifolio-Polygonetalia*; cf. Kürschner et al., 1998; Quézel, 1973), and a vicariant of it and thus first included here in that order.

● Thorn-cushion and dwarf-shrub communities in the Pontids

For aught I know, nobody has ever studied the siliceous thorn-cushion communities of the NE Pontids. Our first relevés from the southern slopes of the Kaçkar Mountains provide considerable evidence for including them in the *Astragalo-Brometea* class. An attachment to the (basiphytic to neutrophytic) *Astragalo-Brometalia* s. str. is only weakly supported and meets the pedological and phytogeographical expectations: the unit is an outpost of the xeric vegetation of the Armeno-Iranian Province and Armeno-Iranian Subprovince sensu Takhtajan (1986). In displaying *Astragalus caucasicus* Pall. and *A. aureus* Willd. as major components, it bears some resemblance to the communities of the *Onobrychidetea* (*-alia*) *cornutae* from the Iranian Alborz Mountains (Klein, 1987).

According to the concept suggested, the *Astragalo-Brometea* class comprises, in physiognomic terms, a variety of xeric grasslands, dwarf-shrub and thorn-cushion communities, and exceptionally however also limestone snow-beds and doline turfs. In the south-east the range of the Astragalo-Brometea extends to the Lebanon and tapers off in the mountains of Mediterranean Palestine (Figure 3). Since I include the *Onobrychidetea cornutae* Klein 1982 class of the Alborz Mountains on account of some 15 common high-ranked character species as a syntaxonomic synonym, they also cover large parts of Iran.

Hydro- and hygrophytic vegetation

In addition to the *Trifolio-Polygonetalia*, there is a remarkably wide range of hydro- and hygrophytic vegetation communities in the Taurus Mountains, and even more in N Anatolia, all with a predominantly Euro-Siberian outline and main occurrences in the Euxine part of the country. This surprising diversity is found in spite of the often untoward surface conditions in the karstic limestone areas, which are responsible for their patchy and small-scale occurrences. These green lands in xeric surroundings have long attracted men and domestic animals. Often enormous grazing pressure makes many places unattractive for research although they harbour interesting species, and studying and monitoring the community composure and degradation gives us a key tool for qualifying the human impact on mountain ecosystems. The wetland communities can be grouped into at least 6 classes.

The aquatic communities include the ***Charetea fragilis*** communities of submerged macroalgae and the ***Potametea*** pondweed communities, composed of submerged and floating macrophytes. As usual in high mountains, the communities are floristically depauperate.

The vegetation of reeds and sedge-dominated fresh-water and brackish swamps (***Phragmito-Magnocaricetea***) is centred on lower elevations (see, for a first survey, Seçmen & Leblebici, 1988 and Behçet & Özgökçe, 1998 for E Anatolia. See here for additional references), but may ascend up to 2200 m, where they form rather species-rich water-margins with *Eleocharis palustris* (L.) Roem. & Schult. as a dominant species. The *Rorippetum aureae* Quézel 1973 is the only community formally described from the Taurus range up to now. Higher up, the mountain lakes may have very narrow sedge-reed margins, which are better placed in the *Scheuchzerio-Caricetea fuscae* class.

In spite of being much more widespread in the Karadeniz Mountains in submontane to subalpine elevations, there is hardly a limestone or ophiolitic stock in the Taurus without ***Molinio-Arrhenatheretea*** communities. The units belong to the *Polygono-Polygonetalia* order and usually occur between around 1400 and 1800 m. In the Taurus range, flushes with *Dactylorhiza iberica* (M.Bieb. ex Willd.) Soó, *Carex otrubae* Podp., *Juncus compressus* Jacq., and *J. inflexus* L. are prevalent.

Depending on the geological substrate, the vegetation of transitional mires, low-sedge fens and bog hollows of the ***Scheuchzerio-Caricetea fuscae*** is traditionally grouped into 3 orders; 2 are now recorded for Anatolia, and the third is expected (see appendix). Due to the prevailing geology, the (subalpine) alpine stands of the Taurus belong to the basiphytic *Caricetalia davallianae* (Hein et al., 1995). In the Pontids, the acidophytic *Caricetalia fuscae* (as *Swertio hispanicae-Nardetalia strictae* Vural 1996, see below and Byfield & Özhatay, 1997) are widespread. They add here to the list of the major Anatolian upland syntaxa and occupy large portions of the valley bottoms in the siliceous mountains of NE Anatolia.

The bryophyte- and herb-rich vegetation of springs and the edges of fast-running high mountain rapids (***Montio-Cardaminetea***) was hitherto overlooked and only sampled as vegetation complex with the *Scheuchzerio-Caricetea fuscae*. The limits between the 2 classes and contact communities have still to be clarified. The basiphytic *Montio-Cardaminetea* of the Taurus are represented by small mossy patches along runnels and springs. By contrast, acidophytic ones are frequently found in the Kaçkar Dağları and are worth being distinguished as an independent syntaxon.

All of these hygrophytic communities are mainly composed of Euro-Siberian taxa, with Irano-Anatolian species coming a distant second. In most units a fairly large number of species of Balkan, Euxine, Caucasian or Hyrcano-Euxine distribution patterns readily sets them apart from their geosynvicariards of the Alpic system, suggesting the presence of geographical races of associations and vicarious alliances.

High mountain vegetation of the North Anatolian Range: two worlds, one vegetation

Moving from the Taurus to the North Anatolian chains brings us into a totally different area. Euro-Siberian in outline, from both a biological and climatic view-point, apart from the "Mediterranean world", these mountains have hitherto attracted only a few resident researchers. Their important pioneering accounts (e.g., Düzenli, 1988; Vural, 1996) cover less than half of the vegetation types actually present: the conspectus (appendix) adds a surprisingly high number of mostly Euro-Siberian alliances, orders and classes that proved to be incorrectly interpreted, completely unstudied or as yet unreported.

The classification of the N Anatolian mountain vegetation suffered severely - often as a result of the language barrier – from a neglect of the rich literature about the neighbouring mountain chains of the Balkans or the Greater and Lesser Caucasus. This resulted in divergent classification systems, and is exactly the point I wanted to make with the provocative heading "2 worlds, 1 vegetation". Russian and "Caucasian" botanists adopt the proved and sophisticated syntaxonomic system of the European mountains, and apart from a few splilters, they often use even the syntaxonomic units at alliance-level. The Turkish way is splilting. There are no objections to splilting; it is a matter of concept. However, splitting means "to split off from something", and one has to point out the relationships between the 2 parts.

Figure 3 was designed to illustrate the clash of large-scale versus local classification in divergent classification systems. It shows the syntaxonomic position of the *Alchemillo-Campanuletea tridentatae* and the *Alchemillo retinervis-Sibbaldietea parviflorae* within the Euro-Siberian vegetation. The 2 high mountain vegetation classes described from NE Anatolia with its subordinate orders and alliances are encircled by the major Euro-Siberian high mountain vegetation units (classes). Double-sided arrows between the Euro-Siberian classes indicate that the differentiation between the units is as yet unclear in N Anatolia, but is a matter of fact outside it. An example is the unsolved distinction of damp block screes in gully-like depressions (*Murbeckiellion huetii*-like stands of *Thlaspietea rotundifolii*) and snowbed communities on siliceous substrates proper (*Salicetea herbaceae*; cf. Onipchenko, 2002; Onipchenko et al., 1992).

The bold-faced double-sided arrows show a far-reaching congruence: the *Alchemillo-Campanuletea tridentatae* and the core of the very heterogeneous *Alchemillo retinervis-Sibbaldietea parviflorae* classes fall into the *Caricetea curvulaea* (syntaxonomic synonyms; cf. Grabherr, 1993a,b; Korotkov, 1989, 1994; Mucina 1997). A simple arrow points towards a necessary syntaxonomic transfer of a unit (here: alliances) to another class: The inclusion of the *Oxytropidion albanae* into the *Carici rupestris-Kobresietea bellardii* class is likely, but is presently based on a poor data set. These doubts do not exist in 2 other cases.

The species inventory clearly places the *Swertio ibericae-Nardion strictae* in the *Caricetalia fuscae* low-sedge fens (and reduces the superordinate order to a synonym of it; cf. Akatov, 1989, 1991; Dierssen, 1982; Steiner 1993). The *Swertio hispanicae-Nardion strictae* alliance bears a sound set of characteristic species (confirmed by as yet unpublished own relevés) that help to unite stands of all of the Euxine and (W) Caucasian area. However, Vural's relevés (1996) do not all stand the test of homogeneity; they (partly) sample a mosaic including *Scheuchzerio-Caricetea fuscae* fens and the bryophyte-rich *Montio-Cardaminetea* contact vegetation rather than typical stands. In addition, the unrecorded bryophytic components make the relevés to some extent incomparable with Central-European and Caucasian references.

All characteristic species of the *Vaccinio myrtilli-Rhododendrion caucasici* are shared with the order *Rhododendro-Vaccinietalia* (Akatov, 1989; Borlakov & Sablina, 1985; Grabherr, 1993c; Ivanov, 1988; Korotkov, 1989, 1990, 1994; Mucina, 1997; Nachuzrischwili, 1996; Onipchenko, 2002; Onipchenko et al., 1987; Pysek & Srûtek, 1989), which includes dwarf-scrub and heaths of the Arctic and boreo-nemoreous mountains (*Loiseleurio-Vaccinietea*).

It is noteworthy that for all these units - from association to ordinal level - independent syntaxa with the same contents have been described from different parts of the Caucasus (see references cited above). This happened often and by various authors; the names are validly published or without typification, and often use the same eponymous species. In a few cases, the names from the "Anatolian side" seem to have priority. However, this is a nomenclatural skirmish as long as one has not combined the material available from the circum-Pontic mountains. Whatever names a future monographer may accept, he or she has to cope with this fine puzzle: taking a broader view means reducing and re-defining the major NE Anatolian "endemic" vegetation units. After this is done, they will better reflect Turkey's position in the Eurasian Alpic-Himalayan fold mountain system.

Phytogeographic considerations: the concept of the Tauric System

Figure 3 combines, as already mentioned, 2 different aspects. First, it maps the distribution of the major high mountain syntaxa of the *Daphno-Festucetales* super-order. Second, it shows the delimitation and subdivision of the Tauric System considering the chorological subdivision of the East Mediterranean Subregion and adjacent regions.

I have introduced the term Tauric System in previous papers (e.g., Hein et al., 1998; Parolly, 1995, 1998; Parolly & Nordt, 2001) in analogy with the criteria used by Ozenda (1988) for the treatment of the Alpic System. I wish to define and characterise the Tauric System closer here.

It is evident that the Tauric System includes mountain ranges which follow closely the boundaries of the major phytochoria in their core parts. The vegetation integrates elements of the neighbouring regions. It is surely this melting pot effect which contributes to the high speciation potential of those ranges. In tectonical terms the Taurus region encompasses all the Hellenids and Taurids plus a narrow strip of the Pontids. To the east the range tapers away in the Iranids. In floro-genetical terms it is the westernmost mountain system which belongs to the Mesogean Sub-realm in the sense employed by Quézel (1973), Takhtajan (1986) and Zohary (1973).

Principles of subdivision: The subdivision of the System has been established on the basis of the high mountain vegetation, but it is fully supported by floristic data. It gains general validity in being backed by the forest vegetation. Everybody who bothers to check the ranges of the higher-ranked forest communities (e.g., Barbero & Quézel, 1976, 1981; Quézel & Pamukçuoğlu, 1973; Quézel, 1986) will realise that they fall within the borders of the subunits of the Tauric System. A prime characteristic of the Tauric System is its mountain forests composed of *Pinus brutia* Ten., *P. nigra* Arn. var. *caramanica* (Loudon) Rehder, *Juniperus excelsa* M.Bieb., *J. foetidissima* Willd., and especially the Mediterranean firs (*Abies cilicica* (Ant. & Kotschy) Carr. and *A. cephalonica* Loudon being the most important) and *Cedrus libani* A.Rich. The *Cedrus-Abies* forests (*Querco-Cedretalia libani*) outline perfectly the range of the *Astragalo-Brometalia*; they mark the core part of the Tauric System and include the Western and Central Taurus s.l., Cyprus and greater Lebanon. Within the Tauric System, communities of the *Daphno-Festucetales* super-class make up the zonal vegetation of the land above the trees-line.

Chorology: Large parts of the subdivision of the Tauric System presented are more or less congruent with and have been guided by general chorological subdivisions traditionally used (Meusel et al., 1965; Takhtajan, 1986). In a sort of dialogue between my field observations and the references it was possible to establish a chorological subdivision of the Tauric System according to hierarchic categories. The largest part belongs to the East Mediterranean Subregion (East Mediterranean Province Group sensu Meusel et al., 1965). Crete is treated as part of the Hellenic Province. The central portion of the Tauric System - supporting the *Cedrus-Abies* forest climax - corresponds to a broader South Anatolian Province that comprises 4 subprovinces, the Tauric, Cyprian, Lebanon and Palestine Subprovinces. The naming of the sectors of the Tauric territories follows Parolly (1995) in distinguishing a Lycian, a Pisidian-Isaurian and a Cilician

Sector from the Amanos Sector (see Meusel et al., 1965 for synonymy; cf. also Davis, 1971, who suggested ranking the Mediterranean parts of Turkey, W Anatolia, the Taurus and the Amanos as districts). In all likelihood, along the Anatolian Diagonal another, the Cataonian Sector, may spread north-east of the Cilician, increasingly displaying Central Anatolian and Armeno-Iranian elements.

Between the sectors, the differentiation of the vegetation is mainly at alliance level, while provinces often possess particular orders. Within these mountain sections there are portions of mountain ranges and isolated stocks with unique associations and a particular endemism to make them reasonably distinct from the neighbouring areas. One is tempted to apply the category of district to keep Sandras Dağı, Ak Dağları and Bey Dağları separate from the more westerly Anatolian mountains encircling Honaz Dağı. The future may show that the Honaz Dağ District may include parts or all the hatched range in Figure 3 (signature 3), may unite a range which can roughly be described as the areas of *Marrubium rotundifolium* Boiss. and *Astragalus flavescens* Boiss., and may then better represent a sector of its own. We should note that these hatched territories do in the majority belong to the adjoining provinces, but the island-like mountains with high mountain vegetation relate it to the South Anatolian Province.

To attach the Alborz and even more the Zagros to the Tauric System is arbitrary; the few studies available do not exclude this idea (Klein, 1982, 1987, 1988), but one has to state that this is much better supported coeno-syntaxonomically (and thus historically) than by the present vegetation, and especially by the forests.

Perspectives: the credit and debit sides

To sum up, and somewhat optimistically, we can characterise the situation in the western half of the Taurus range as consolidating. We have a good idea about the phytosociological links of the majority of the syntaxonomically relevant species. We have a syntaxonomic reference system which will face only minor changes. This does also mean that one cannot expect the “discovery” of too many new alliances. At the association level there are surely some new descriptions to come, but the number of units to be relegated to synonymy will also increase.

In N Anatolia our knowledge is relatively poor. The list of major units provided here is nothing but a first platform. We need a lot of supporting relevés that must be seen in the light of the Euro-Siberian literature, including the many Russian references on the Caucasus.

In the future, phytosociological research should concentrate on poorly understood and recorded units and local monographs, dealing with all community types and not only with the dominant units. People who write local monographs should show some retention in describing new syntaxa. Rank less communities are in most respects workable and do not cause all those nomenclatural troubles in the case of heterogeneity. Finally, we need revisionary accounts on a broad base of references, which will reduce step-wise the flood of superfluous names to a set of manageable units.

After that, we can start to understand how vegetation works. Yet this is still beyond the horizon for many vegetation units.

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Appendix

An annotated conspectus of the major asylvatic syntaxa of the Anatolian mountains

The following list is primarily intended to give a brief syntaxonomic survey of the major syntaxa mentioned in the text. At the same time, it attempts to be a first, preliminary conspectus of the Anatolian high mountain syntaxa. It partly reflects the current state of knowledge, but also includes a certain number of syntaxa with altered syntaxonomic positions and 15 new records. The changes below ordinal level, especially within the *Astragalo-Brometea* class, are part of a series of forthcoming papers (Parolly, 2004 and in prep.) and are not yet included; the syntaxonomy given is in this respect still conservative. I have, however, where appropriate, expressed my doubts about the syntaxonomic position of a number of units, and give some of them as unclassified ("Syntaxonomic position unclear"). The arrangement of the classes roughly follows Mucina (1997).

This conspectus can claim completeness only at the class and mostly at the ordinal level, while the alliances are not fully covered for the following reasons:

(a) an insufficient knowledge of the class in Turkey, especially of the Euro-Siberian vegetation types. Some of these units are reported for the first time (marked with an*) and any subdivision would be very tentative.

(b) if, for brevity, reference can be made to easily accessible (Turkish) journals.

I. Aquatic vegetation

Class: Charetea fragilis Fukarek ex Krausch 1964

[Communities of submerged ramificated macroalgae]

* - Found at the bottom of all clear-water lakes of the Taurus range. Eutrophic conditions quickly reduce their species inventory. In many places, the hardy *Chara hispida* L. is the leading species, which may also be found interspersed in the higher vegetation of small and shallow brooklets, pools and even in watering places.

Class: Potametea Klika in Klika & Novák 1941

[Communities of fresh-water radicant submerged and floating macrophytes]

No published relevés available from water bodies above 2000 m from the study area in a strict sense. For E Anatolia and some subunits see Behçet & Özgökçe (1998), for a subdivision see Pott (1995).

II. Vegetation of fresh-water marshes and fens

Class: Montio-Cardaminetea Br.-Bl. et R. Tx. ex Klika 1948

[Bryophyte- and herb-rich vegetation of springs and edges of fast-running high mountain rapids]

Due to a less obviously expressed influence of the geological substrates, especially on the bryophyte cover, basiphytic and acidophytic units are less clear-cut than in Europe. Many of the major characteristic species of the orders and alliances need a re-evaluation in the Anatolian mountains before a classification can be established.

Class: Phragmito-Magnocaricetea Klika in Klika & Novák 1941

[Vegetation of reeds and sedge-dominated fresh-water and brackish swamps]

For E Anatolia and some subunits see Behçet & Özgökçe (1998), for a subdivision see Pott (1995).

Class: Scheuchzerio-Caricetea fuscae R. Tx. 1937

[Vegetation of transitional mires, low-sedge fens and bog hollows]

Three orders and alliances in Turkey; 2 are listed for the first time.

Order: Scheuchzerietalia palustris Nordhagen 1937

[Vegetation of transitional mires and bog hollows]

* - Not yet recorded by relevés, but the floristic inventories of peatlands (Ağaçbaşı Yaylası, upper İyidere, Şavvaltepe) provided by Byfield & Özhatay (1997) clearly suggest the occurrence in N Anatolia.

Order: Caricetalia fuscae Koch 1926 em. Br.-Bl. 1949

Syn.: *Swertio ibericae-Nardetalia strictae* Vural 1996 [art 37; **syn. nov.** (syntax. syn.)]

[Acidophytic to subneutral low-sedge fens]

* - Frequently found in N Anatolia (pers. obs., cf. Byfield & Özhatay, 1997).

Alliance: Swertio ibericae-Nardion strictae Vural 1996, *ad interim* [art. 37]

[Acidophytic to subneutral low-sedge fens of the (W) Caucasian and Euxine territories]

Considered here to replace the *Caricion fuscae* Koch em. Klika 1934 as a vicarious alliance in the (W) Caucasus and N Anatolia. For a tentative subdivision of the alliance in Turkey, see Vural (1996). While there is no doubt about its general outline, the name is treated as preliminary since the relevés of the original account are both somewhat inhomogeneous and distinctly incomplete (bryophytes lacking; art. 37).

Order: **Caricetalia davallianae Klika 1934**

[Basiphytic low-sedge fens]

Subalpine to alpine elevations in the Central Taurus range (Hein et al., 1995; pers. obs.) and certainly elsewhere.

III. Lithophytic vegetation: Scree and rock vegetation

Class: **Asplenietea trichomanis (Br.-Bl. in Meier & Bl.-Bl. 1934) Oberd. 1977**

Syntax. syn.: *Parietarietea* Rivas-Martínez ex Rivas Goday 1964

[Chasmophytic vegetation of rock faces, fissures and ledges]

Subclass: **Potentillenea speciosae Hein, Kürschner & Parolly 1998**

[Chasmophytic vegetation of rock faces, fissures and ledges of East Mediterranean mountain ranges]

Order: **Silenetalia odontopetalae Quézel 1973**

[Chasmophytic, predominantly basiphytic vegetation of rock faces, fissures and ledges of NW, W and S Anatolian and adjoining Levantine mountains]

Alliance: **Aubrietion olympicae Quézel &** Pamukçuoğlu **1970**

[Xero- to mesophytic chasmophytic vegetation of Uludağ and surroundings]

Placed by Quézel & Pamukçuoğlu (1970) and Quézel et al. (1992) in the *Potentilletalia speciosae* Quézel 1964, but possibly better included in the *Silenetalia odontopetalae* (Hein et al., 1998).

Alliance: **Silenion odontopetalae Quézel 1973**

[Xero- to mesophytic chasmophytic vegetation of the Batı Toroslar (W Taurus range)]

Alliance: **Campanulion isauricae Hein, Kürschner & Parolly 1998**

Syn.: *Campanulion davisii* Gemici & Görk 1995, nom. nud. [art. 2b]

[Xero- to mesophytic chasmophytic vegetation of the western portion of the Orta Toroslar (Pisidian and Isaurian Taurus)]

The alliance combines stands with *Campanula isaurica* Contandriopoulos et al. and *C. davisii* Turrill, thus a synonymy between the 2 Campanulion alliances can be assumed. The name *Campanulion isauricae* is based on the Geranio glaberrimi-Nepetetum concoloris Quézel em. Hein, Kürschner & Parolly 1998. It refers to the original material of Quézel (1973), who also co-authored *Campanula isaurica,* so that the required ideotaxonomic correctness is provided.

Alliance: **Onosmion mutabilis Quézel 1973**

Original form of name: *Onosmion mutabile* Quézel 1973 [art. 41b]

[Xero- to mesophytic chasmophytic vegetation of montane to subalpine elevations of the eastern portion of the Orta Toroslar (Cilician Taurus range)]

Alliance: **Drabion acaulis Hein, Kürschner & Parolly 1998**

[Xero- to mesophytic chasmophytic vegetation of alpine to subnival elevations of the eastern portion of the Orta Toroslar (Cilician Taurus range)]

Alliance: **Campanulion cymbalariae Hein, Kürschner & Parolly 1998**

[Hygrophytic chasmophytic vegetation of rock faces, fissures and ledges of Anatolian and adjoining Levantine mountains]

Order: **Androsacetalia multiflorae Br.-Bl. in Meier & Bl.-Bl. 1934**

[Chasmophytic siliceous vegetation of rock faces, fissures and ledges of Euro-Siberian territories]

* - At present, there is no classification scheme for the siliceous rock communities of the Pontids. All units recorded hitherto are so weakly linked to the *Silenetalia* that I presently apply the *Androsacetalia multiflorae* order of large parts of Europe and the Caucasus to classify my relevés from the Kaçkar Dağları (cf. Quézel & Pamukçuoğlu, 1970; Onipchenko, 2002).

Class: **Adiantetea Br.-Bl. 1948**

[Chasmophytic, fern- and moss-dominated communities of water-sprayed and water-flushed rock surfaces of Mediterranean Europe]

* - No published records from our area hitherto. Widespread, but very local. In its strict sense to be excluded from the high mountain vegetation, because of its upper distributional limit around 1200-1400 m. However, stands with *Pinguicula hirtiflora* Ten. and *Schoenus nigricans* L. are part of the contact vegetation of the *Silenetalia odontopetalae* (with *Potentilla isaurica* (P.H.Davis) B. Paw.) in that altitude in the Göksu area. The delimitation of the 2 classes in such places remains surprisingly unclear.

Class group: **Thlaspea rotundifolii Parolly 1998**

[Eurasian scree and talus plant communities]

Class: **Heldreichietea Quézel ex Parolly 1995**

Syn.: *Heldreichietea* Quézel 1973 [art. 3b, 8]

[Scree and talus plant communities of S Anatolia and adjacent ranges]

None of the combinations of Quézel et al. (1992), intended to validate the 1973 names (Quézel, 1973), are in fact effective, since the major shortcoming of the previous paper - the lack of (typified) subordinate associations - remains untouched: The 2 associations given - the *Lamio eriocephali-Heldreichietum bupleurifolii* Quézel 1973 (recte: 1992) and the *Cicero incisi-Jurinetum depressae* 1992 (erroneously given as all. nov.) - had required the indication of a type relevé to be in accordance with the CPN. For correct names and (lecto) typifications see Parolly (1995).

Order: **Lamietalia cymbalariifolii Parolly 1995**

[Scree and talus plant communities of the Batı Toroslar (W Taurus range)]

Suborder: **Lamienalia cymbalariifolii Parolly 1995**

[Scree and talus plant communities of the Batı Toroslar (W Taurus range)]

Alliance: **Scrophularion depauperatae Parolly 1995**

Syn.: *Heldreichion bourgaeo-bupleurifolii* Quézel 1992 pp. [art. 8]

[Scree and talus plant communities of the Batı Toroslar (W Taurus range)]

Order: **Heldreichietalia Quézel ex Parolly 1995**

Syn.: *Heldreichietalia* Quézel 1973 [art. 8]

[Scree and talus plant communities of the Orta Toroslar and Güney Doğu Toroslar, the Lebanon and adjoining mountain ranges]

Suborder: Lamienalia glandulosidentis Parolly 1995

[Scree and talus plant communities of the western part of the Orta Toroslar (Pisidian and Isaurian Taurus ranges)]

Alliance: Scrophularion myriophyllae Parolly 1995

Syn.: *Heldreichion bourgaei-bupleurifolii* Quézel 1992 pp. [art. 8]

[Scree and talus plant communities of the western part of the Orta Toroslar (Pisidian and Isaurian Taurus ranges)]

Suborder: Lamienalia eriocephali Parolly 1995

[Scree and talus plant communities of the eastern Orta Toroslar (Cilician Taurus range) and the Lebanon]

Alliance: Scrophularion rimarum Parolly 1995

[Oreal to subalpine scree and talus plant communities of the eastern Orta Toroslar (Cilician Taurus range) and the Lebanon]

Alliance: Jurinellion moschus Parolly 1995

Syn.: *Jurinion depressae* Quézel 1973, nom. prov. [art. 3b, 8]; *Jurinetalia depressae* Quézel 1973, nom. prov. [art. 3b, 3c, 8]; *Jurinetea depressae* Quézel 1973, nom. prov. [art. 3b, 8]

[Alpine and subnival scree plant communities of the eastern Orta Toroslar]

Class: Thlaspietea rotundifolii Br.-Bl. 1948

* [Euro-Siberian scree and talus plant communities and alluvial pebble fans]

Order: Androsacetalia alpinae Br.-Bl. in Br.-Bl. & Jenny 1926

* [Siliceous high mountain scree and talus plant communities]

Alliance: Murbeckiellion huetii Onipchenko 2002

[Open hygrophytic subalpine-alpine scree plant communities on moraine and talus slopes with a permanent or sufficient seasonal water supply]

* - Expected for the north-east edge of Anatolia on account of the species list given by Vural (1996; cf. Figure 4) and recorded from the Kaçkar Dağları (unpubl. own relevés from 1999).

Alliance: Allosuro-Athyrion alpestris Nordhagen 1936

[Communities of stabilised block screes and boulder-fields]

* - Obviously present above Olgunlar (Kaçkar Dağları) in subalpine (to alpine) elevations (pers. obs.) on stabilised granitic talus slopes and boulder-fields with abundant *Rubus idaeus* L.

Order: Epilobietalia fleischeri Moor 1958

[Euro-Siberian mountain communities on flood plain pebble beds]

* - First reported here on account of my field notes of stands with *Myricaria germanica* (L.) Desv., *Salix purpurea* L., *Epilobium colchicum* Albow and *E. dodonaei* Vill. from the Barhal Çay below Olgunlar (Kaçkar Dağları). The community observed comes close to the W Caucasian *Sileno compactae-Salicetum purpureae* Onipchenko 2002 (*Salicion incanae* Aichinger 1933).

IV. Euro-Siberian Alpine vegetation

Class: Loiseleurio-Vaccinietea Eggler ex Schubert

* [Dwarf-shrub subalpine and alpine heathland of boreal and arctic Europe]

Order: Rhododendro-Vaccinietalia Br.-Bl. in Br.-Bl. & Jenny 1926

* [Dwarf-shrub subalpine and alpine heathland of boreal and arctic Europe on poor acidic soils]

Alliance: Bruckenthalion Horvat 1949

[Dwarf-shrub subalpine and alpine heathland of the Central Balkans and N Turkey on poor acidic soils]

Given by Quézel & Pamukçuoğlu (1970) and Barbero et al. (1975) attached to the *Vaccinio-Piceetea* (-*alia*) Br.-Bl. 1939.

Alliance: Vaccinio myrtilli-Rhododendrion caucasici Vural 1996, *ad interim* [art. 37]

[Caucasian and Euxine montane to subalpine *Rhododendron caucasicum* Pallas scrub communities]

The unrecorded cryptogames and a certain degree of heterogeneity may make it necessary to reject the above combination and to use, after a thorough revision and much more field-work, the later name *Rhododendrion caucasici* Onipchenko 2002 in the future.

Class: Salicetea herbaceae Br.-Bl. 1948

Syn.: *Alchemillo retinervis-Sibbaldietea parviflorae* Vural 1996 pp. [art. 37; **syn. nov.** (syntax. syn.)]

[Snow-bed communities on siliceous substrates]

* - First recorded from Anatolia. My pers. obs. and relevés from the Kaçkar Dağları are a rather good match of the major Caucasian units (Korotkov, 1994; Onipchenko, 2002; Onipchenko et al., 1992. The application of the names * *Hyalopoetalia ponticae* Onipchenko 2002 and especially * *Saxifragion sibiricae* Onipchenko 2002 is in all likelihood possible; many characteristic species of these units are present in the species inventory of the *Alchemillo retinervis-Sibbaldietea parviflorae*. The *Saxifragion sibiricae* colonises damp open rock and scree; the distinction from *Murbeckiellion huetii* communities seems still to be somewhat arbitrary (Figure 4).

Class: Caricetea curvulae Br.-Bl. 1948

Syn: *Juncetea trifidi* Hadac in Klika et Hadac 1944 [art. 2b], Juncetea trifidi Hadac 1946 [art. 36]; *Alchemillo-Campanuletea tridentatae* Düzenli 1988 p.max.p. [art. 3g; **syn. nov.** (syntax. syn.)]; *Alchemillo retinervis-Sibbaldietea parviflorae* Vural 1996 pp. [art. 37; **syn. nov.** (syntax. syn.)]

[Siliceous alpine and boreal grasslands]

For subordinate units refer to Figure 4 and the discussion above. All names can only be considered "*ad interim*" solutions due to the lack of cryptogams, and in the case of the *Alchemillo retinervis-Sibbaldietea parviflorae*, additionally due to a certain extent of heterogeneity, sampling vegetation complexes rather than stands of communities.

Order: Caricetalia curvulae Br.-Bl. in Br.-Bl. et Jenny 1926

Syn.: *Alchemillo-Campanuletalia tridentatae* Düzenli 1988 p.max.p. [art. 3g; **syn. nov.** (syntax. syn.)]; *Alchemillo retinervis-Sibbaldietalia parviflorae* Vural 1996 pp. [art. 37; **syn. nov.** (syntax. syn.)]

[Siliceous alpine and boreal grasslands]

* - Figure 4 may serve as an explanation of how far the heterogeneous material of Vural (1996) comes close to the *Caricetalia curvulae* order. It also reflects the present unsatisfying approaches for a subdivision. Any attempt must remain very provisional as long as the Turkish material is not compared with the many relevés available from the Caucasus. - For subunits see Düzenli (1988) and Vural (1996).

Order: Trifolietalia parnassi Quézel 1964

[Hygro- to mesophytic siliceous carpet turfs of Greece and NW Anatolia, often with a long-lasting snow-cover]

Alliance: Trifolion parnassi Quézel 1964

The only major subunit (including 3 associations) of the order; hitherto recorded from Uludağ, Boz Dağ and Kaz Dağı (Quézel & Pamukçuoğlu, 1970). The species inventory given has much overlap with the then un-described *Trifolio-Polygonetalia* of the Taurus range (Kürschner et al., 1998; Quézel, 1973). The common species are chiefly the Anatolian component of the eastern communities, lacking in the stands of Greece. Note that *Nardetalia* species are nearly completely absent within the *Trifolio-Polygonetalia*.

Class: Mulgedio-Aconitetea Hadac & Klika in Klika 1948

* [Subarctic-subalpine to alpine tall-grass and tall-herb grasslands and related krummholz of European and N Asiatic mountains]

Order: Calamagrostietalia villosae Pawowki et al. 1928

[Subalpine to alpine meadows and tall-herb communities]

* - Obviously present in all Karadeniz mountain ranges with its characteristic tall-herb fringes of mountain forests and meadows. With a revised set of characteristic species, the *Lilio pontici-Anemonion narcissiflorae* Vural 1996 fits in its general outline in this class.

Order: Rumicetalia alpini Mucina in Karner & Mucina 1993

[Nitrophytic, tall herbaceous communities of the (montane) subalpine to alpine belts of European and N Asiatic mountains, often distinct lair communities]

Alliance: Rumicion alpestris Rübel ex Klika in Klika & Hadac 1944

[see order]

Strongly under-recorded: for the only relevés available from Uludağ, see Rehder et al. (1994). Lush lair communities are wide-spread in the Doğu Karadeniz Mountains and occur within or close to high mountain settlements.

V. Temperate grasslands

Class: Molinio-Arrhenatheretea R. Tx. 1937

Syn.: *Molinio-Juncetea* Br.-Bl. in Br.-Bl. et al. 1947 [art. 8]; *Plantaginetea majoris* R. Tx. & Preising ex von Rochow 1951 (syntax. syn.); *Agrostietea stoloniferae* Görs 1968 (syntax. syn.)

[Nutrient-rich, mesic (pastures, hay meadows, lawns) and wet anthropogeneous grasslands]

For deviating concepts of the class see Mucina (1997) and Pott (1995).

Order: Potentillo-Polygonetalia R. Tx. 1947

Syn.: *Agrostietalia stoloniferae* Oberd. in Oberd. et al. 1967 (syntax. syn.)

[Carpet-turfs of wet or periodically flooded sites under more or less temperate conditions]

VI. Oromediterranean high mountain vegetation

Super-class: Daphno oleoidis-Festucetales variae Quézel 1972

[E Mediterranean high mountain grasslands, dwarf-shrub and thorn-cushion communities]

Class: Astragalo microcephali-Brometea tomentelli Quézel 1973 em. Parolly hoc loco

Syn.: *Astragaletea mediterranea* Zohary 1973 [art. 8]; *Astragaletea armeno-turcica* Zohary 1973 [art. 8]; *Oxytropidetea cornutae* Klein 1982, **syn. nov.** (syntax. syn.). - Incl.: *Trifolio-Polygonetea* Quézel 1973, **syn. nov.**

[High mountain grasslands (including basiphytic snow-patch meadows), xerophytic dwarf-shrub and thorn-cushion communities of Anatolia, the Levant and NW Iran]

The emendation is necessary due to the unification of the xerophytic *Astragalo-Brometea* and the meso- to hygrophytic *Trifolio-Polygonetea* classes.

Order: **Astragalo microcephali-Brometalia tomentelli Quézel 1973**

[Oreal to subalpine xerophytic grasslands, dwarf-shrub and thorn-cushion communities on alkaline, ultramafic or schistose soils of Anatolia, the Levant and NW Iran]

Alliance: **Tanacetion praeteriti Quézel 1973**

Original form of name: *Tanacion preteriti* Quézel 1973 [art. 41a,b]

[Oreal to subalpine xerophytic grasslands, dwarf-shrub and thorn-cushion communities on chiefly alkaline (and rarely schistose) soils of the Batı Toroslar (W Taurus range)]

Alliance: **Agropyro tauri-Stachydion lavandulifoliae Quézel 1973**

Original form of name: *Agropyro tauri-Stachyion lavandulaefoliae* Quézel 1973 [art. 41a,b] - Epitheta added in Quézel et al. (1992).

[Oreal to subalpine xerophytic grasslands, dwarf-shrub and thorn-cushion communities on chiefly alkaline (and rarely schistose) soils of the Orta Toroslar and adjoining parts of the Güney Doğu Toroslar (Central Taurus range and western portion of the E Taurus range)]

Alliance: **Thuryon capitatae Quézel 1973**

[(Montane) oreal to subalpine xerophytic grasslands, dwarf-shrub and thorn-cushion communities on ultramafic soils of the Batı and Orta Toroslar (W and Central Taurus range]

Traditionally regarded as classifying the serpentinophytic stands of the Cilician Taurus and its outliers. There are some floristic arguments for using a broader concept covering all of the serpentine area of the Taurus range. *Alyssum* L. spp. (such as *A. masmeneum* Boiss. and *A. propinquum* Baumg.) in particular support a wider range of the alliance, while at the same time a number of the characteristic species given by Quézel (1973) (e.g., *Sideritis phlomoides* Boiss. & Bal.) were also found on limestone; cf. Parolly (1995) and forthcoming papers). This overcomes the lack of a classification scheme for "classic" serpentine vegetation in the west, such as on Sandras Dağı.

Order: **Drabo-Androsacetalia Quézel 1973, nom. cons. prop. hoc loco [art. 42]**

Syn.: *Alopecuretalia lanatae* Quézel & Pamukçuoğlu 1970, **syn. nov.**; *Androsaco congestae-Drabetalia brunifoliae* Quézel 1992 ("1973"), nom. invers. et superfl. [art. 29a, c; **syn. nov.**]

[Alpine to subnival mat-forming communities and the vegetation of windbeaten hilltops and exposed ridges]

Quézel's (1973) alteration of the name Alopecuretalia lanatae in favour of *Drabo-Androsacetalia* is an offence against the CPN (art. 29a,c), even if one follows his argument that this is a "better" name (with a wider geographical range to be applied). If I suggest here the name *Drabo-Androsacetalia* as a *nomen conservandum* instead of restoring the *Alopecuretalia*, this is for 3 reasons: (1) This is a well-introduced name and the only one used by Anatolian authors and in all important monographs. The superfluous name-inversion and typification (Quézel et al., 1992) has also been ignored by all researchers. (2) The base of the *Alopecuretalia lanatae* is weak. In the original diagnosis the monotypic order and *Alopecurion lanatae* alliance (including 1 association with 2 subassociations) is based on 6 relevés only (Quézel & Pamukçuoğlu, 1970). The unit has never been recorded again, although the *Acantholimon ulicinum* (Schult.) Boiss. community of Rehder et al. (1994) is more or less congruent, although with many more species. These

authors, however, do not give any syntaxonomic reference. (3) The range of the *Alopecuretalia lanatae* is situated at the outer edge of the total range of that vegetation type: the stands are floristically depauperate, especially in respect of higher-ranked characteristic species.

For subdivision see Parolly (2004) and Quézel (1973).

Order: **Onobrychido armeni-Thymetalia leucostomi Akman,** Ketenoğlu, **Quézel & Demirörs 1984**

Syn.: *Onobrycho armeni-Thymetalia leucostomi* Akman, Ketenoğlu & Quézel 1985 [art. 5, 41b]

[Xerophytic grasslands, dwarf-shrub and thorn-cushion communities of Inner Anatolia and the foothills of the adjoining mountains of the Tauric System]

There are different indications of the years of publication (1984, 1985) given by the authors in different papers themselves (e.g., Akman et al., 1991: "1985"). There is in general much nomenclatural confusion in this order and its subunits, also due to deviating citations of authors, typifications, etc. in the papers of this collective of authors. I follow here, without checking author combinations and exact publication dates, the version of Quézel et al. (1992), and the obvious lecto-typification referring to the "1984" paper.

Suborder: **Asperulo phrygiae-Thymenetalia chaubardii Akman, Quézel, Barbero** Ketenoğlu **&** Aydoğdu **1991**

[Xerophytic grasslands, dwarf-shrub and thorn-cushion communities of the montane complex of the mountains of the Tauric System bordering on Inner Anatolia]

As pointed out above, the suborder has in the future to be narrowed down considerably, with a large portion of its communities (e.g., the *Minuartion juniperino-pestalozzae* Ketenoğlu et al. 1996) falling into the *Astragalo-Brometalia* order.

In its traditional sense, the suborder includes c. 6 alliances; for alliances see Akman et al. (1991, 1996) and Ketenoğlu et al. (1996).

Alliance: **Astragalion ptilodis Quézel &** Pamukçuoğlu **1970**

Orginal form of name: *Astragalion ptilodes* Quézel & Pamukçuoğlu 1970 [art. 41b]

[High mountain xerophytic dwarf-shrub and thorn-cushion communities of W Anatolia]

Preliminarily transferred (from the *Daphno-Festucetea*) under this suborder. It needs a thorough revision of the oreal to subalpine vegetation on non-limestone substrates (especially mica schist), before its position can be assessed. See also Gemici & Görk (1995), who obviously up-graded some of the groupments of Quézel & Pamukçuoğlu (1970) to (invalid) alliances placed in the *Daphno-Festucetea* class.

Alliance: **Bromion cappadoci Kürschner 1986, nom. prov. *ad interim*** [art. 3b]

[Xerophytic grasslands, dwarf-shrub and thorn-cushion communities of the high Inner Anatolian volcanoes]

Based on relevés from Hasan Dağı (Düzenli, 1976) and Erciyes Dağı (Kürschner, 1986), the unit is still incompletely known. Recording *Bromus cappadocicus* Boiss. & Bal. and other characteristic species of this alliance in *Astragalo-Brometea* communities from some other places (unpublished relevés) weakens the putative independent status of the unit. For its overall species inventory, it is transferred here from the *Astragalo-Brometalia* under the *Onobrychido armeni-Thymetalia leucostomi*. In all likelihood it is only a mere substrate-conditioned fragment of the order.

Order: **Hyperico linarioidis-Thymetalia skorpilii Akman, Quézel, Yurdakulol, Ketenoğlu & Demirörs 1987**

[Xerophytic grasslands, dwarf-shrub and thorn-cushion communities of the Central and W Karadeniz Mountains]

See the comments on this order above in the main text. A weakly defined order, presently with much overlap to the major syntaxa of the Taurus range (e.g., Drabo-Androsacetalia). This and the suggested

range extension to the west (which will together result in an emended order), makes much more field work necessary.

For alliances see Akman et al. (1987, 1988); cf. Akman et al. (1983a,b).

Alliance: **Hyperico-Verbascion Akman & Ketenoğlu 1976**

[Grassland and dwarf-shrub communities of the Köroğlu and Semen mountains]

Uncertain position. Very probably to be included in the *Hyperico linarioidis-Thymetalia skorpilii* and here of doubtful affinities and a somewhat isolated position.

Order: **Trifolio anatolici-Polygonetalia arenastri Quézel 1973**

Syn.: *Polygonetea cedrorum* Shmida 1977 [art. 5, 8; **syn. nov.** (syntax. syn.)]

[Hygro- to mesophytic vegetation of dolines, snow-patch and meltwater communities of the Taurus range and the greater Lebanon]

Alliance: **Thlaspion papillosi Kürschner, Parolly & Raab-Straube 1998**

[Snow-patch and meltwater communities of the Batı Toroslar (W Taurus range) and the Pisidian-Isaurian Taurus range]

Alliance: **Bolanthion frankenioidis Quézel 1973**

[Hygro- to mesophytic vegetation of dolines and mesophytic turfs of the Batı Toroslar (W Taurus range) and the Pisidian-Isaurian Taurus range]

Alliance: **Trifolio-Polygonion Quézel 1973**

[Hygro- to mesophytic vegetation of dolines, turfs, snow-patch and meltwater communities of the eastern Orta Toroslar (Cilician Taurus)]

VII. Expected syntaxa

The following units are expected for the mountains of Turkey, since they occur in neighbouring areas and at least parts of the characteristic species of the classes are present in Anatolia. Mentioned to stimulate the search for these interesting communities.

Class: **Oxycocco-Sphagnetea Br.-Bl. & R. Tx. ex Westhoff et al. 1946**

[Vegetation of ombrogenic raised bogs (and wooded boreal bogs)]

No definitive phytosociological records hitherto available, but likely to occur on account of the typical floristic inventory of peatlands given by Byfield & Özhatay (1997) from N Anatolia.

Class: **Carici rupestris-Kobresietea bellardii Ohba 1974**

Syn.: Kobresio-Elynetea Oberd. 1957 [art. 8]

[Circumpolar cold-steppe and fjeld vegetation, and alpine wind-swept *Kobresia* Willd. grasslands]

Expected for N Anatolia; not yet documented by relevés, but backed by pers. obs., which need confirmation by relevés (cf. Figure 4).

Class: **Prangetea ulpoterae Klein 1982**

[Irano-Anatolian communities dominated by tall *Apiaceae* and other tall ephemeroids]

Hitherto recorded from Iran (Alborz Mountains) and Iraq (Helgurd dagh; cf. Klein 1988), but irradiations expected to NE and E Anatolia.

VIII. Excluded syntaxa

Order: Potentilletalia speciosae Quézel 1964

[Aegean and S Balkan xero- to mesophytic chasmophytic vegetation]

See Hein et al. (1998), Quézel (1964, 1967), Zaffran (1990) and the comment under *Aubrietion olympicae, Aplenietea trichomanis*.

Class: Daphno oleoidis-Festucetea variae Quézel 1964

[High mountain grasslands (including basiphytic snow-patch meadows), xerophytic dwarf-shrub and thorn-cushion communities of S Albania, Greece, Crete (?: if not *Astragalo-Brometea*) and the East Aegean Islands; Thrace (?)]

Not given from Anatolian territory (mountains of NW and N Anatolia) for the reasons discussed above. In our area it is most probably replaced by the Astragalo-Brometea.

Class: Isoeto-Nanojuncetea Br.-Bl. & R. Tx. ex Westhoff et al. 1946

Syn.: *Isoeto-Nanojuncetea* Br.-Bl. & R. Tx. 1943 [art. 8]

[Dwarf amphibious vegetation of banks and bottoms of mesophytic (and eutrophic) temporary water-bodies]

There is no sound base for occurrences of the *Isoetetea* class and the *Isoetetalia* order in the Taurus range as given by Gemici & Görk (1995). This misleading generalisation refers to a few scrappy relevés coming from montane altitudes, to which Quézel (1973) attached only provisionally and with hesitation the "*Isoetea* label". In the meantime, the order in its narrow sense has been recorded for Turkey. However, it is confined to acidophytic, seasonally dry and winter-flooded places in the Mediterranean belt of the Menderes massif in W Turkey (for details see Kürschner & Parolly, 1999).