

**Survey on high mountain basiphilous dry meadow of Europe:
convergences and differences**

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ABSTRACT. – Basiphilous plant communities above timberline are dominated, on the European mountains, by *Sesleria* species. *Kobresia myosuroides* dominated communities occur only in large areas of Northern Europe and with some relics in the South of the continent.

Most of species variability of these climax dry meadows is induced by the interaction of climatic, biogeographical and adaptive advantage factors. About 300 phytosociological relevés were collected from all European massives: they are the basis of a biogeographical, ecological and syntaxonomical analysis.

Two completely different climates (Central-European and Mediterranean-mountain) divide two principal syntaxonomical classes (*Seslerietea albicantis* and *Festuco-Seslerietea*); Northern, Southern, Eastern and Western phytogeographical influences characterize different orders and alliances; diversity in adaptive advantages of *Sesleria* species and *Festuca gr. varia*/*Pinus gr. mugo* species produces a sharp differentiation of the communities.

Different massives of the same chain show a very low degree of biotic insularity, whereas a high insularity degree is recognizable between different chains separated by lowlands 300 km about large.

INTRODUCTION

The present work is carried out in the framework of I.A.V.S. project "European vegetation survey". The aim is to synthesize the present knowledge on alpine and high mountain grassland communities which occur on limestone in the European mountains. Basiphilous plant communities above timberline are dominated by *Sesleria* species (fig. 1): *S. albicans* Kit. ex Schultes from Pyrenees to Alps, *S. tenuifolia* Schrader (incl. *S. apennina* Ujhelyi) from Apennines to Dinaric Alps, *S. tenerrima* (Fritsch) Hayek from Makedonia to Southern Greece and *S. bielzii* Schur on Carpathians chain. *Kobresia myosuroides* (Vill.) Fiori assumes an important role only in large areas of Northern Europe (Norway and Iceland) and with relic populations in Northern Spain, Pyrenees, Alps, Dinarids, Carpathians and Apennines.

At present time, only regional and partial reviews have been attempted, always restricted to a chain and often limited to particular associations or

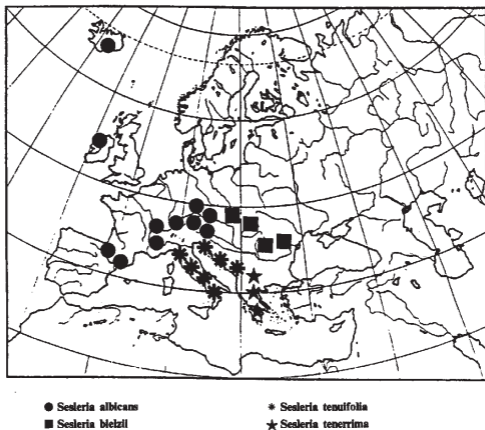


Fig. 1 – Distribution of the four most important *Sesteria* species in the European basiphilous plant communities above timberline.

alliances: Eastern Pyrenees (Braun-Blanquet, 1948), Central-Eastern Pyrenees (Gruber, 1978) and Western Pyrenees (Rivas-Martinez *et al.*, 1991); Alps chain (Pignatti & Pignatti, 1975), South-Western Alps (Barbero, 1968), Central Alps (Braun-Blanquet & Jenny, 1926, Braun-Blanquet, 1949) and Bavarian Alps (Oberdorfer, 1978); Apennines chain (Petriccione, 1991, Petriccione & Persia, 1995); North-Western Carpathians (Klika, 1932, Pawlowski, 1935) and South-Eastern Carpathians (Beldie, 1967); Balkanic Peninsula (Horvat *et al.*, 1974), Northern Dinarids (Horvat, 1930), Southern Dinarids (Lakusic, 1970) and Greek massives (Quezel, 1964, 1967).

DATA AND METHODS

The investigation is based on about 3.000 phytosociological rélevés (Braun-Blanquet approach); 10% are original, collected during eight years (1985/1992) on the major European massives, from

Tatra (North) to Mount Taygetos (South) and from Spanish Pyrenees (West) to Rumanian Carpathians (East); some réleves have been collected also on Rocky Mountains of Colorado (U.S.A.) to comparative purposes.

By a syntaxonomical point of view, the primary high mountain grassland on limestone are allocated, at present time, in 4 classes, 10 orders, 20 alliances and about 100 associations.

Nomenclature of *taxa* follows *Flora Europaea* (Tutin *et al.*, 1964/1980).

RESULTS

The communities show a high degree of uniformity in habitat (mostly exposed sites, always above the timberline), physiognomy (dominance of turf hemicriptophytes and cushion chamaephytes) and ecological adaptations (species with freezing tolerance, low specific leaf area, etc.). Adaptive convergence is a commonly accepted phenomenon for extreme habitats like high mountains.

On the contrary, the same communities are characterized by a considerable variability in species composition, induced by differences in climate, adaptive advantage, biogeographical influences and insularity.

1) *Climate*

According to the present literature, the communities are spreaded over four climatic regions (from 37° to 70° latitude North), approximately correspondent to four different classes:

— *Carici rupestris-Kobresietea bellardii* Ohba 1974 - Characterized by *Kobresia myosuroides*, this Holarctic class has a world-wide distribution following the guide-species: North-America from Rocky Mts. of Colorado to Alaska and Greenland, Northern Asia from Pamir and Altaj to Siberia, Northern Europe in Norway and Iceland; some relics occur in Japan, Caucasus, Northern Spain, Pyrenees, Alps, Dinarids, Carpathians and Apennines. The climate is cold-continental or arctic-alpine (tundra climate), with long frost season (eight months or more), very low mean annual precipitation (from ca. 250 mm in the arctic zone to 1000 mm in the alpine one) and temperature (lesser than 0°C); precipitation is concentrated in the summer. The peculiar character species of the class are *Carex rupestris*, *Dryas octopetala*, *Silene acaulis*, *Gentiana nivalis*, *Aster alpinus* and *Potentilla crantzii*.

— *Seslerietea albicantis* Oberd. 1978 corr. 1990 - Characterized by *Sesleria albicans* and *Sesleria bielzii*, this Central-European class is limited to Alps and Carpathians. The climate is alpine-continental, with long frost season (ca. eight months), high mean annual precipitation (1.500/2.500 mm) and low mean annual temperature (0/1°C); precipitation is concentrated in the summer. The peculiar character species of the class are *Sesleria albicans*, *Anthyllis vulneraria* ssp. *alpestris*, *Helianthemum nummularium* ssp. *grand-*

ifolium, *Phyteuma orbiculare*, *Carduus defloratus*, *Galium anisophyllum*, *Anemone narcissiflora*, *Gentiana verna*, *Thymus alpinus* and *Thesium alpinum*.

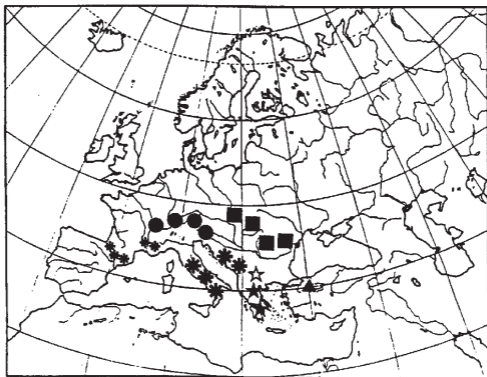
— *Festuco-Seslerietea* Barbero et Bonin 1969 - Characterized by *Sesleria tenuifolia*, this Southern-European class includes the high mountain turf communities of Spanish Pyrenees, Maritime Alps, Apennines and Dinarids. The climate is Mediterranean-mountain, with short frost season (ca. five months), low mean annual precipitation (1.000/1.500 mm) and low mean annual temperature (1/3°C); precipitation is concentrated in the spring and autumn. The peculiar character species of the class are *Festuca circum-mediterranea*, *Koeleria splendens*, *Iberis sempervirens*, *Biscutella laevigata*, *Alyssum montanum*, *Arenaria grandiflora*, *Dianthus sylvestris*, *Astragalus depressus* and *Androsace villosa*.

— *Daphno-Festucetea* Quezel 1964 - Characterized by *Sesleria tenerrima*, this South-Eastern European class occurs on the Southern part of the Balkanic Peninsula, from Makedonia to Peloponnesos, with some relics in North-Western Turkey. The climate is Oro-Mediterranean, very dry, with very short frost season (ca. three months), very low mean annual precipitation (400/1.000 mm) and relatively high mean annual temperature (ca. 5°C); precipitation is concentrated in the winter. The peculiar character species of the class are *Festuca robustifolia*, *Daphne oleoides*, *Aubretia deltoidea*, *Cerastium candidissimum*, *Leontodon crispus* ssp. *graecus*, *Geranium subcaulescens*, *Galium firmum*, *Asyneuma limonifolium*, *Astragalus creticus*, *Berberis cretica* and *Juniperus hemisphaerica*.

2) Adaptive advantage

A considerable diversity in the adaptive advantage of *Sesleria* species versus *Festuca* gr. *varia*/*Pinus* gr. *mugo* (fig. 2) species produces a sharp differentiation in species composition of the communities of *Seslerietea albicantis* and *Festuco-Seslerietea* classes. On the Spanish Pyrenees, the Iberic *Festuca gautieri* occupies the *Sesleria albicans* niche, which is relegated to extreme sites; in the same area the *Pinus uncinata* open communities compete with the primary grasslands in the same altitudinal belt, reducing their extension. On the Carpathians, a very similar phenomenon take place: the Eastern-European *Festuca versicolor* ssp. *versicolor* occupies the *Sesleria bielzii* niche, which becomes co-dominant; the extension of the *Seslerion bielzii* communities is reduced by the adaptive advantage of the *Pinus mugo* communities. A successful competition between this Eastern-European dwarf pine and the *Seslerietalia tenuifoliae* communities occurs also on Balkanic Peninsula, where the primary grasslands are very fragmentary.

At the South-Eastern rim of *Daphno-Festucetea* distribution, the thorny cushion communities of Anatolia (with *Astragalus angustifolius*, *Acantholimon*



SESLERIETEA ALBICANTIS

- *Seslerion coeruleae*
- *Seslerion bielzii*

FESTUCO-SESLERIETEA

- * *Astragaletalia sempervirentis*
- * *Seslerietalia tenuifoliae*

DAPHNO-FESTUCETEA

- ☆ *Edralantho-Seslerion*
- ★ *Astragalo-Seslerion*
- ▲ *Astragalion ptilodes*

Fig. 3 – Distribution of the principal vicarious syntaxa belonging to the three most important classes of European high mountain basiphilous dry meadow.

alliances with some strictly geographical vicarious species changing from North to South. Some examples are:

SESLERIETEA ALBICANTIS, SESLERIETALIA COERULEAE:

Seslerion coeruleae
(Alps)

Sesleria albicans
Festuca quadriflora
Pedicularis rostrato-capitata

Seslerion bielzii
(Carpathians)

Sesleria bielzii
Festuca versicolor
Pedicularis oederi

FESTUCO-SESLERIETEA:**ASTRAGALETALIA SEMPERVIRENTIS****SESLERIETALIA****TENUIFOLIAE**

(Pyrenees, South-Western Alps)

*Festuca gautieri**Globularia repens**Pedicularis pyrenaica*

(Apennines, Dinarids)

*Sesleria tenuifolia**Globularia meridionalis**Pedicularis elegans*

(only on Apennines)

DAPHNO-FESTUCETEA, ONOBRYCHI-SESLERIETALIA and**DAPHNO-FESTUCETALIA:***Edraiantho-Seslerion*

(Makedonia)

Astragalo-Seslerion

(Greece)

Astragalion ptilodes

(NW-Turkey)

Festuca rupicola

—

*Festuca robustifolia**Astragalus angustifolius**Festuca puntoria**Astragalus ptilodes***4) Insularity**

Different massives of the same chain show a very low degree of biotic insularity. On the Apennines, the same association (*Pediculari elegantis-Seslerietum tenuifoliae*) occurs on 17 "islands" over 2.000 m a.s.l., separated by lowlands ca. 50 km large. Only 10 % of the community species (mostly glacial relics) is restricted to one of the massives, 5 % to two (mostly endemic). On the Alps, the same association (*Seslerio-Caricetum sempervirentis*) occurs on about 40 islands over 2.300 m a.s.l., separated by lowlands ca. 30 km large. Species composition shows a very high degree of uniformity: only the relic communities of Prealpi area (uncovered by the last glaciation) are well differentiated because of some important endemic species. On Dinarids, a lot of very insulated associations was described, on the basis of very small floristic differences (mostly one or two non-dominant endemic species !): probably they belong to four or five principal associations, scattered on 20-25 islands, separated by lowland 50 km large about.

On the contrary, a high degree of biotic insularity is recognizable between different chains separated by lowlands 300 km about long. Different well-characterized associations and alliances differentiate Alps from Carpathians and Apennines from Dinarids (but they belong to the same orders and classes).

Carici-Kobresietea class is a special case: one class covers a whole biogeographical Region, including the Northern part of different continents

like North-America, Asia and Europe, splitted only at an order level. Most of the communities species (including dominants) is widespread over the whole area. Biotic insularity seems in this case almost absent, because of the relatively continuous distribution of the class.

CONCLUSIONS

High mountains habitat produce a clear adaptive convergence of species and communities, often very ancient and well-adapted to extreme environments. Macro-climate and phytogeographical history of different regions of Europe are contrasting forces and generate the dominance of different genera (*Kobresia*/ *Sesleria*/ *Festuca*/ *Pinus*) and species (geographical vicarious) in the belt above timberline.

Floristic homogeneity inside of every European mountain chain (also 7-800 km long) confirms the relatively recent origin of the ecological separation among the different massives; their insularity degree is so low that is not corrects speaking about "biogeographical islands". Only the massives of Southern chains (Italian and Balkanic Peninsula), which not have been glaciated during the last glaciation, show a certain floristic variability, in particular because of endemic species. On the contrary, a high degree of biotic insularity is characteristic of different chain separated by lowlands 300 km just long: in this case, a completely different geological history (in particular, orogenesis and glaciation time) originates very important biogeographical differentiations.

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