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Succession on the Polonina Balds in the Western Bieszczady, the Eastern Carpathians

- Jan Jeník -

SUMMARY

Termination of pasturing by cattle resulted in profound alteration of vegetation on treeless summits (= polonina balds) in the Western Bieszczady, Poland. Observations from 1980, compared with earlier descriptions and evidence from the neighbouring Ukrainian Carpathians, made it possible to distinguish four stages in the development of vegetation above timberline:
1) Prior to human colonization, the size and pattern of subalpine grasslands and scrub were maintained by joint action of summit climate and herds of wild ungulates.
2) Introduction of cattle resulted in the expansion of flower-rich communities dominated by *Nardus stricta* and *Vaccinium myrtillus*.
3) About ten years after removal of cattle, only the first signs of change in the size and species composition of balds were detected.
4) In 1980 species-poor communities dominated by *Calamagrostis arundinacea* and *Deschampsia caespitosa*, were observed completely replacing - contrary to earlier prediction - the *Nardetum carpaticum orientale* and *Vaccinietum myrtilli*; stands of *Calamagrostis villosa*, a species recorded in this area for the first time, contributed to the latest observed pattern of the polonina balds.

ZUSAMMENFASSUNG

Die waldfreien Kammlagen (= Polonina-Matten) der westlichen Bieszczady im SO-Grenzgebiet Polens befinden sich im Zustand einer dynamischen Sukzession, die nach Aufhören der Beweidung am Ende des zweiten Weltkrieges begonnen hat. Zur Abschätzung dieser Veränderungen stehen aus den fünfziger Jahren von polnischen Geobotanikern bearbeitete Monographien zur Verfügung. Auch einige noch ältere Arbeiten aus den Ostkarpaten ermöglichen es dem Verfasser, das 1980 beobachtete Vegetationsbild mit früheren Verhältnissen zu vergleichen und die Frage der Ursprünglichkeit der waldfreien Kämme zu besprechen.
Im allgemeinen kann man vier Perioden in der rezenten Entwicklung der Poloninakämme unterscheiden:
1) Schon vor der menschlichen Kolonisation im 15. und 16. Jahrhundert lag die obere Waldgrenze im Bereich der höchsten Kämme verhältnismäßig niedrig, etwa um 1100 m. ü.M., was durch den Einfluß des waldfeindlichen Gipfelklimas und der bisher unterschätzten Herden wilder Huftiere, (Wisente, Pferde, wilde Rinder u.a.) erklärt werden kann.
2) Nach der Kolonisation verursachte die Almwirtschaft die großflächige Ausbreitung von Borstgras-Gesellschaften, die als "blütenreiche Poloninamatten" beschrieben wurden. Auch Zwergstrauch-Gesellschaften mit *Vaccinium*-Arten und ruderalisierte Flächen wurden vergrößert, die Bestände von *Alnus viridis* vernichtet.
3) Etwa zehn Jahre nach Aufhören der Beweidung wurden bereits Anzeichen einer neu beginnenden Sukzession bemerkbar (nach den damals aufgenommenen Vegetationsaufnahmen), ohne daß sich die künftige Richtung klar erkennen ließ. Vereinzelte Vorkommen von *Calamagrostis arundinacea* und *Deschampsia caespitosa* signalisierte schon die Ausbreitung neuer Dominanten.
4) Etwa 30 Jahre nach Beendigung der Almwirtschaft sind die früher dominierenden Borstgras-Gesellschaften fast verschwunden, und auch die Zwergstrauch-Gesellschaften befinden sich auf dem Rückzug. Die meisten Abhänge sind mit zusammenhängenden Beständen von *Calamagrostis arundinacea* bewachsen; in seichten Vertiefungen und im flachen Gelände wurde *Deschampsia caespitosa* zu einer mächtigen Dominante. Im Gegensatz zu älteren Prognosen werden auch die Zwergstrauch-Gesellschaften von *Calamagrostis arundinacea* und sogar *C. villosa* verdrängt.
Die oben beschriebene Sukzession ist von Interesse für die Verwalter des Bieszczady Nationalparks, weil das Verschwinden der blütenreichen Poloninamatten den natürlichen Wert der Reservate stark vermindert.

INTRODUCTION

Changes in land use and establishment of nature reserves and national parks inhanced, in many European mountains, the succession of plant communities in man-made clearings within the forest belt, and on natural or seminatural summit areas above timberline. Bukovské Mountains in NE Czechoslovakia and the adjoining Western Bieszczady in SE Poland provide striking evidence of these successional changes. My interest in these phenomena started about 20 years ago (see KUČEROVÁ & JENÍK, 1961) and, recently, continued on the Polish territory in the Bieszczady National Park.

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Thanks are due to Polish authorities for their permission to work in the remote parts of the Bieszczady National Park in August 1980.
Nomenclature of vascular plants quoted in this paper follows the flora of JASIEWICZ (1965). - All topographical names and altitudes are given according to AWŁASEWICZ & CICHOWSKA (1979).

BIOGEOGRAPHICAL SETTING

The Western Bieszczady (hereafter abbreviated W. Bieszczady) represent the westernmost section of the Bieszczady Mountains, which themselves are a part of the East Beskids, whose greater portion belongs to the Soviet Union and bears the name of Ukrainian Carpathians. In view of the Polish and Czechoslovac biogeographers, the W. Bieszczady and adjoining Bukovské Mountains belong to the Eastern Carpathians due to the presence of numerous plant and animal species which do not occur in the western mountain chains lying on the Polish/Czechoslovak boundary. The center of Bieszczady lies at approximately 22° 40′ E longitude and 49° 10′N latitude. The chain consists of a number of smaller ranges stretching from NW to SE, namely, Polonina Wetlińska (1253 m), Polonina Caryńska (1297), Bukowe Berdo (1313), Szeroki Wierch (1268), Tarnica (1335), Krzemień (1335) and Polonina Bukowska (1333).

The W. Bieszczady are formed of Flysh sandstones faulted during the Tertiary by orogenetic forces pushing from SW, and creating elevated crests stretching in the above mentioned NW to SE direction (KLIMASZEWSKI, 1948). Irregular and incomplete records of meteorological factors provide only a rough estimate of climatic conditions in the foothills at 500 to 600 m altitude: mean annual temperature is about 6°C, annual amplitude of the monthly means exceeds 21°C, annual rainfall amounts to a total of 1000 mm, and prevailing winds blow from SW and S (PAŁCZYŃSKI, 1962; ZARZYCKI, 1963). Local environment is strongly differentiated by relief and elevation; the annual averages of air temperature and rainfall totals for the summit areas are about 4°C and 1200 mm, respectively.

The W. Bieszczady retain a high percentage of forest cover belonging mostly to various associations of beach forest, identified by ZARZYCKI (1963) as *Fagetum carpaticum* and *Luzulo-Fagetum*. The area above 1100 m is occupied by large subalpine grasslands, scrub, dwarf scrub and rocky communities containing numerous plant species biogeographically linked with the highest elevations of the Carpathians (JASIEWICZ, 1965). ZARZYCKI (op.c.) and JASIEWICZ (op.c.) have assumed that natural treeless areas on the summits exceed 1260 and 1200 m, respectively. PAŁCZYŃSKI (1962) has considered a greater part of his newly described *Nardetum carpaticum orientale* as a primary plant community. However, in view of the generally higher position of the timberline in neighbouring ranges of the Carpathians, the origin of treeless summit areas (= poloninan balds) in the W. Bieszczady has permanently been questioned.

The remote W. Bieszczady were colonized in the 15th and 16th century by the Bojkowie and Łemkovie, two relict tribes that cleared forests on the valley bottoms, and utilized summit grasslands for sheep and cattle pasture. Considerable biotic stress on the polonina grasslands can be estimated according to the numbers of cattle raised in this area in the past (KUBIJOWICZ, 1927 sec. PAŁCZYŃSKI, 1962): In 1913 and 1926, Polonina Wetlińska was the summer range of 960 and 320 head, Polonina Caryńska of 350 and 120 head, the summit grasslands around Halicz of 1900 and 900 head, respectively. These numbers suggest extensive grazing, and, necessarily, a decisive influence on the size and floristic composition of the polonina balds.

World War II was a period of major change in the development of the W. Bieszczady. The events of the war and, particularly, combats between national defence forces and armed bands in the post-war period, expelled the greater part of inhabitants, destroyed the villages and left the whole area abandoned. Since the fifties, the Polish government promoted recolonization and economic restoration of this area. In 1973, Bieszczadski Park Narodowy (Bieszczady National Park) has been established, and exploitation of the polonina grasslands continued only in Polonina Wetlińska, the westernmost ridge of the W. Bieszczady.

RECENT PATTERN

Though relatively short, the period of human colonization markedly altered the landscape pattern of the W. Bieszczady by felling and burning of forests, by grazing of domestic animals and cultivation of fields. In 1980, the year of my observations, i.e. about 35 years after termination of regular management

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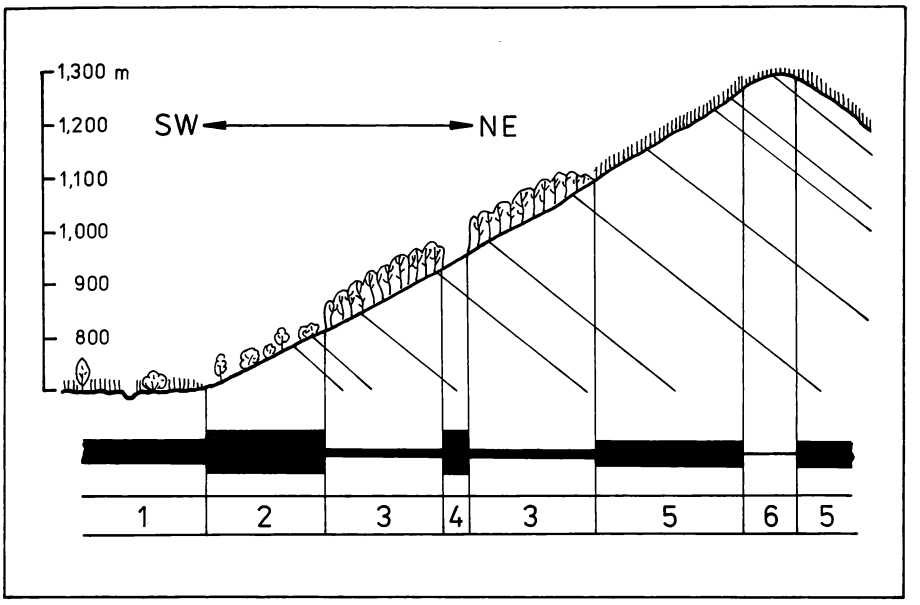

Fig. 1: General pattern of vegetation in the W. Bieszczady in 1980:
1 - flood-plain with wet meadows, marshes and willow carr, 2 - scrub on abandoned fields, 3 - beech forest, 4 - man-made clearings with little progress of succession, 5 - tall-grass communities, 6 - short-grass communities.

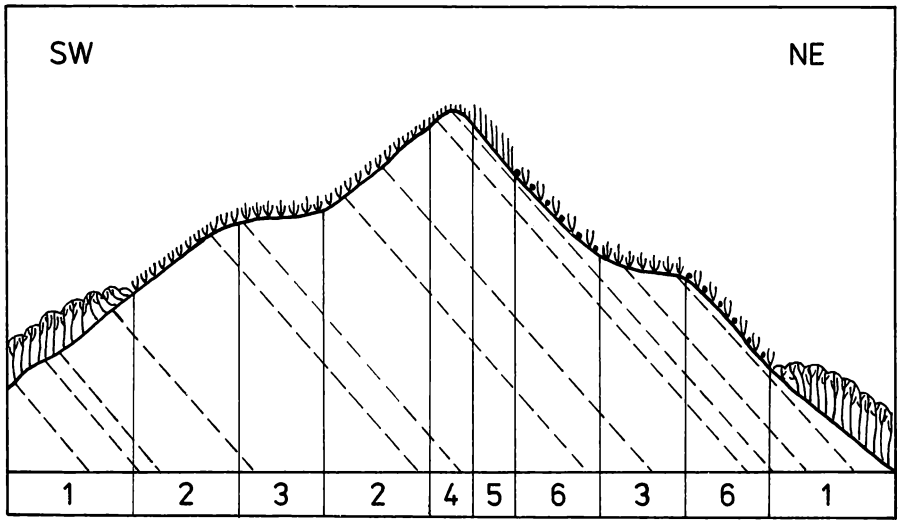

Fig. 2: Distribution of vegetation types in the summit area of the W. Bieszczady in 1980:
1 - elfin beech forest,
2 - tall-grass community with *Calamagrostis arundinacea*,
3 - tall-grass community with *Deschampsia caespitosa*,
4 - short-grass community with *Festuca supina*,
5 - tall-grass community with *Calamagrostis villosa*,
6 - dwarf scrub of *Vaccinium myrtillus* invaded by *Calamagrostis arundinacea*.

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of this area, the general pattern of forests, natural balds and man-made clearings was still visible in all the ranges of these mountains (Fig. 1). Although cut only occassionally, wet meadows and sedge marshes in the valleys remained sparcely invaded by willows and alders. Abandoned old-fields and pastures on the lower slopes of the valleys were in a more advanced stage of recolonization by pioneer shrubs and trees (e.g. *Crataegus* spp., *Rosa* spp., *Betula verrucosa*, *Alnus incana*). Unless artificially afforested, clearings within the beech forest belt showed very little progress toward woodland. The timberline, too, appeared as a stabilized boundary between the elfin beech forest and polonina grassland.

In greater detail, the summit areas showed similar patterns of vegetation over the entire territory of the present-day national park where grazing of domestic animals has been excluded (Fig. 2). Species-poor grasslands with *Calamagrostis arundinacea* covered the south facing slopes, while an unbalanced community of the same species and *Vaccinium myrtillus* prevailed over the northern slopes. Slightly inclined landings or depressions on slopes of all aspects, and larger flat summit areas were inhabited by a community predominated by *Deschampsia caespitosa*. In the late summer, yellow mature culms of *Deschampsia caespitosa* contrasted with the still green tussocks of *Calamagrostis arundinacea*; this resulted in a conspicious strip stretching along the contour line and covering a flat landing caused by soft sandstone strata of the Flysh series (Fig. 3).

The crests in the W. Bieszczady vary a great deal according to the depth of available soil, occasional occurrence of sandstone outcrops, orientation of slopes toward the cardinal point, exposure to prevailing winds and distribution of snow during winter and spring. However, similarity of rocks, and similarity of both direction and inclination of geological strata made it possible, in 1980, to sketch a typical pattern (Fig. 4). A plant community with the prevailing *Festuca supina* occupied the steep upper slopes with shallow soil, shallow snowpack in winter, and full exposure to insolation, wind action and frost. Precipitous rock faces were inhabited by a species-rich community of biogeographically interesting vascular plants, such as *Anemone narcissiflora*, *Carex rupestris*, *Scabiosa lucida*, *Cotoneaster integerrima*, *Saxifraga aizoon*, *Campanula rotundifolia* ssp. *polymorpha* etc. (for floristics see JASIEWICZ, 1965). North facing slopes close to the summits were occupied by stands of *Vaccinium myrtillus*, *V. vitis-idaea*, *Empetrum hermaphroditum*, *Lycopodium selago*, *Sphagnum quinquefarium*, *S. nemoreum*, *Polytrichum formosum* and *P. commune*.

In a number of localities, namely in the area of Szeroki Wierch, Tarnica, Krzemień, Polonina Caryńska and Polonina Wetlińska, we have observed larger stands of *Calamagrostis villosa*, a grass species reported for the first time from these mountains (compare the absence in JASIEWICZ, 1965; MEUSEL et al., 1965). These stands occured largely on northern and north-eastern slopes. A rather different stand of same species was on terrestrialized south facing scree of the westernmost part of Polonina Wetlińska (Hnatowe Berdo 1253 m): *Calamagrostis villosa* 4.4, *C. arundinacea* +.2, *Vaccinium myrtillus* 2.2, *V. vitis-idaea* +, *Stellaria holostea* +, *Sedum fabaria* +, *Luzula nemorosa* +.2, *Solidago virgaurea* ssp. *alpestris* +, *Angelica silvestris* +, *Laserpitium latifolium* +, *Astrantia major* +, *Silene cububalus* +, *Gentiana asclepiadea* +, *Rumex arifolius* +, *Salix silesiaca* +.2, *Rosa pendulina* +, *Picea excelsa* r.

While the last mentioned community appeared as an ancient relict, the ridge of Polonina Wetlińska remained under the influence of moderate grazing, due to its position outside the boundaries of the Bieszczady National Park. Remarkably, it was only here where species-rich and flower-rich polonina grasslands still occured.

In 1980 I did not observe natural regeneration of beech and substantial advancement of the timberline into the area of the polonina grasslands. The elfin beech woodland at this boundary showed a wedge-like crossection with very few saplings and trees established within the thick sod. Individual small trees, mainly *Sorbus aucuparia*, *Salix caprea* and *S. silesiaca*, rarely occurred in the grassland of dwarf scrub, but there was no trend toward formation of closed thickets. To sum up, after the 35 years which elapsed since the termination of pasturing of cattle, the summit balds obviously did not decrease in size.

PATTERN AFTER REMOVAL OF CATTLE

Three monographs produced by Polish botanists (PAŁCZYŃSKI, 1962; ZARZYCKI, 1963; JASIEWICZ, 1965) represent a reliable source of data referring to the composition of polonina grasslands during the period after termination of cattle grazing in the W. Bieszczady. Field investigations, relevés and floristic

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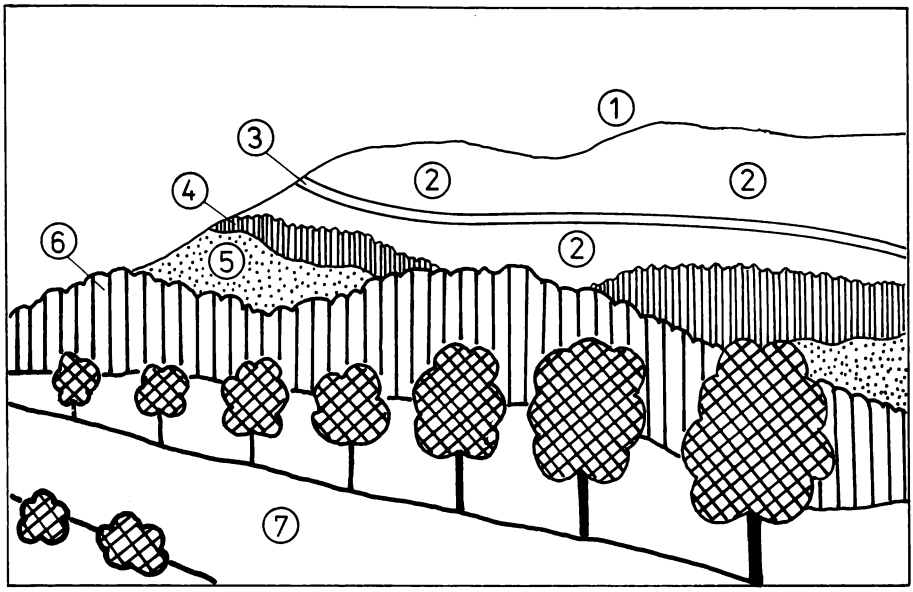

Fig. 3: Panoramic view of SW facing slopes of Polonina Caryńska in August, 1980: 1 - crest-line of the range, 2 - grassland dominated by *Calamagrostis arundinacea*, 3 - strip of grassland dominated by *Deschampsia caespitosa*, stretched along a contour-line landing, 4 - subalpine beech forest, 5 - abandoned fields and pastures, 6 - montane beech forest, 7 - highway Ustrzyki Górne/Brzegi Górne.

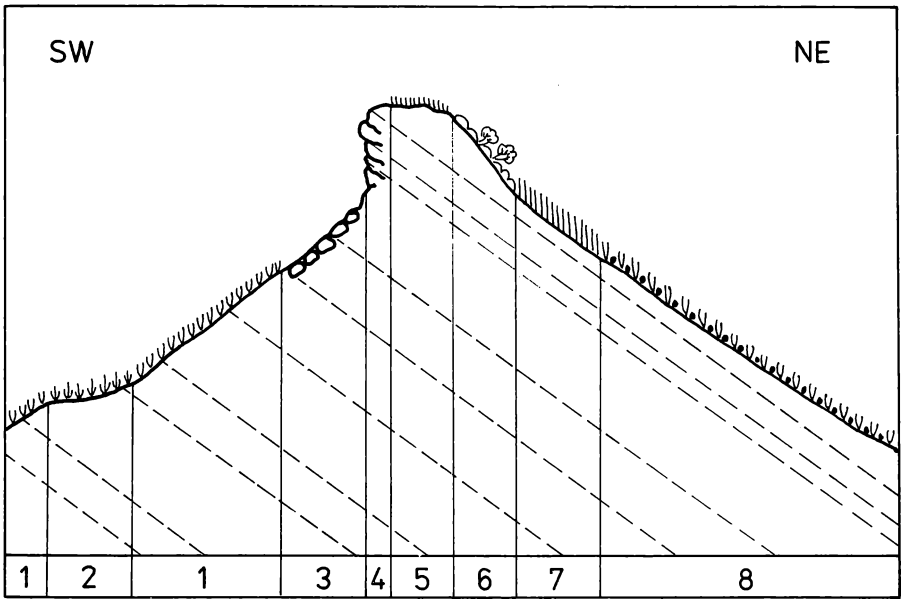

Fig. 4: Schematic illustration of vegetation types in the environs of a large outcrop of the Krosno sandstones on Krzemień (1335 m) in the W. Bieszczady: 1 - grassland with *Calamagrostis arundinacea*, 2 - grassland with dominant *Deschampsia caespitosa*, 3 - short-grass community with *Festuca supina* on terrestrialized scree, 4 - rock face with petrophytes, 5 - wind-swept short-grass and dwarf scrub formation, 6 - *Empetrum* dwarf scrub with mossy hummocks, 7 - grassland with abundant *Calamagrostis villosa*, 8 - dwarf scrub with *Vaccinium myrtillus* invaded by *Calamagrostis arundinacea*.

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observations of the above named authors were recorded between 1954 to 1962, and thus reflect the stage at about one decade following removal of the cattle (compare ZARZYCKI op.c.: 103).

PAŁCZYŃSKI (op.c.:16) described the general distribution of polonina grasslands in the W. Bieszczady as follows: "Microclimatic differentiation of the upper parts of flanks is distinctly shown on polonina grasslands where, commonly, northern slopes are covered by communities of *Vaccinium myrtillus*, and southern slopes by the *Nardeta*" (translated by J.J.) Defining a new association called the *Nardetum carpaticum orientale*, the above mentioned author indicated (op.c: 53) that stands dominated by *Nardus stricta* cover more than a half of the total area of the polonina balds; he considered the same community (op.c.: 56) as a natural rather than a derived secondary grasslands type. The same author predicted successive expansion and ultimate predominance of *Vaccinium myrtillus* (op.c.: 56, Table 18) in the summit balds above the timberline.

PAŁCZYŃSKI (op.c.: 124-125) also recognized the presence of a community with dominant *Deschampsia caespitosa*. His three relevés of this community have been recorded near earlier abandoned kraals. None of the PAŁCZYŃSKIs plant communities with *Calamagrostis arundinacea* received a rank of an association, however, in nine of his 15 relevés of the *Nardetum carpaticum orientale* (op.c.: Table 11) this species does occur as "companion" or even subdominant component.

General distribution of the polonina vegetation types was described by JASIEwicz (op.c.: 15) in phytosociological terms: the *Vaccinietum pocuticum* Pawłowski et Walas 1949 on N flanks, the *Nardetum carpaticum orientale* Pałczyński 1962 on drier S slopes. JASIEWICZ (op.c.: 15-16) also remarked that "only a small surface of the polonina grasslands is occupied by the *Poo-Deschampsietum* described by PAWŁOWSKI from Chivchin Mountains, the present Ukrainian Carpathians".

In the concluding chapter on successional trends in the W. Bieszczady further data from Polish monographers will be mentioned.

PATTERN UNDER MAXIMUM GRAZING

Before the evacuation of local inhabitants in the middle forties, the polonina grasslands of the W. Bieszczady were under heavy stress from cattle grazing (see above). Adequate botanical observations from this period are lacking, however, we can use several monographs describing the vegetation of the neighbouring ranges of the Ukrainian Carpathians, whose utilization and management before the World War II was similar to that of the W. Bieszczady: MALOCH (1931) described the Borzhava range, DEYL (1941) concentrated on the Pop Ivan range, and PAWŁOWSKI & WALAS (1949, field work executed in 1933 and 1936) investigated into the Chivchin Mountains. Also, recently published MALINOVSKI's monographical treatise (1980) of the whole Ukrainian Carpathians can serve as a background for the estimates of the pattern in polonina grasslands exposed to pasture of domestic animals.

All above quoted monographs indicated that species-rich communities dominated by *Nardus stricta* covered large areas, progressively expanding with the increasing numbers of cattle. These stands were distributed both on inclined slopes and flat or even depressed surfaces, often in the vicinity of stands predominated by *Deschampsia caespitosa*. This relationship is well reflected in the syntaxonomical evaluation proposed by PAWŁOWSKI & WALAS (1949, Table 11), whose "*Nardetum*" is synonymous with the *Poeto-Deschampsietum nardetosum*. The work of MALOCH (op.c.), particularly, shows the extensive spreading of secondary communities with *Nardus stricta*, under the influence of grazing, in the period between the two world wars.

Dwarf ericaceous scrub with *Vaccinium myrtillus* and *V. vitis-idaea* must have also been widespread in the exploited areas of the W. Bieszczady. DEYL, PAWŁOWSKI & WALAS, and MALINOVSKI (op.div.) described a variety of syntaxa with dominant *Vaccinium myrtillus*, frequently replacing the primary grassland scrub and forest communities. The work of PAŁCZYŃSKI (1962: 62-65, Table 15) has left good evidence of their past distribution in the W. Bieszczady in the period of intensive pasture. On the other hand, the representation of communities with predominating *Calamagrostis* species in the mountains under study is uncertain, although both *C. villosa* and *C. arundinacea* occupied a significant portion of the polonina region in many ranges of the Ukrainian Carpathian in the same period. Remarkably, in the middle fifties, PAŁCZYŃSKI (op.c.) did not distinguish any syntaxon marked by the dominance of these grasses.

Both the occurrence of short-grass comunities with *Festuca supina* and representations of biogeographically characteristic petrophytes on the summit cliffs

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of the other Ukrainian mountains (compare DEYL, 1941; MALINOVSKI, 1980) suggest that small islands of similar vegetation survived in the Bieszczady even during the period of maximum grazing. Additional grazing and trampling by the cattle, obviously, was a negligible factor in the complex of severe factors creating the "summit environment", viz. wind, frost, erosion and action of wild ungulates.

Present-day occurrence of the subalpine scrub with *Alnus* (= *Duschekia*) *viridis* in the W.Bieszczady (see the list in JASIEWICZ, 1965: 140) is, no doubt, only a remainder of a broader distribution of this species in the past. Individual shrubs and small clumps of thickets scattered on the polonina balds reflect the destructive impact of the shepherds during the period of maximum exploitation. Burning and browsing could have destroyed even larger stands, as is common in other ranges of the Ukrainian Carpathians (KOMENDAR, 1966).

POTENTIAL NATURAL PATTERN

In order to estimate future development, the potential natural vegetation of the summit balds of the W. Bieszczady is of major interest. In view of the comparatively low elevation of these mountains, the possible size of the treeless summit balds must be examined. Also, estimates of potential floristic composition of the polonina grassland and scrub may serve as useful knowledge for management of the Bieszczady National Park.

In the case that the present-day treeless area of the W. Bieszczady adequately reflect the natural predisposition, we must explain the relatively low position of the timberline. At the present time, this line fluctuates between 1100 and 1200 m elevation, although it should reach, according to the normal gradient from the oceanic to continental regions of Europe, an altitude of about 1500 m (MALINOVSKI, 1980: 22). A missing belt of the spruce forest also raises doubts about the indigenous nature of the polonina grasslands in the W. Bieszczady. ZARZYCKI (1963: 99-104) examined this question in detail, and concluded that the "upper limit" of the beech forest was markedly lowered by human impact, and that a narrow strip of the indigenous spruce forest was, very likely, destroyed by Walachian shepherds. The same author, however, agrees that the highest summits were never covered by a closed forest, even during the climatic optimum of the Holocene Era. Treeless clearing surrounding the summit crags cannot be doubted, in view of the presence of many real alpine species (see a list in JASIEWICZ, 1965: 31). An unresolved question remained: How large, actually, were these clearings?

In our opinion, estimates of the potential natural size of polonina grasslands in the W. Bieszczady should take into account the powerful influence of large ungulates that frequented this area until the modern period. Herds of herbivorous *Bos primigenius*, *Bison bonasus*, *Equus ferus sylvestris* and *Cervus elaphus* lived in this area which functioned as one of the last refuges in Europe. Although all of the above named species were well adapted to a forest environment, in the summer, they preferred grazing and browsing on the summit clearings. These treeless habitats provided plentiful pasture, relief from blood-sucking insects, and relative safety from ambush by large predators. We can speculate that a chain of polonina grasslands stretching in the NW to SE direction, connected the core of the Ukrainian Carpathians with the fertile Vistula and San lowlands. This might have played a role in the stabilization of migration routes of some of these wild ungulates. The same routes presumably attracted the Walachian folks who entered, with herds of domesticated animals, the region of the W. Bieszczady at the end of the 13th century (ZARZYCKI, 1963: 16). Selective grazing, browsing and trampling of wild ungulates could have weakened the expansion of the forest and subalpine scrub throughout the Postglacial Age, thus creating a "biotic climax" of the polonina grasslands.

Another important phenomenon we have to deal with is the potential natural occurrence of the subalpine scrub dominated by *Alnus viridis*. Remarkably, this species achieved the westernmost margin of its eastern area of distribution within the W. Bieszczady. The fact that other competitive shrubs represented in the neighbouring Ukrainian Carpathians, namely *Pinus mughus*, *Juniperus nana* and *Rhododendron kotschyi*, did not reach the area under study is of even greater significance. According to MALINOVSKI (1980: 106) *Alnus viridis* has an optimum on cool and wet northern slopes, and none of the ranges of the Ukrainian Carpathians possessed a continuous subalpine belt of this species. In contrast with the needle-leaved scrub, stands of *Alnus viridis* also suffered by browsing of wild herbivores. All these assumptions point out that subalpine scrub covered only a limited area above the lowered timberline.

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Leaving aside various locally developed communities, such as tall-herb communities (*Betulo-Adenostyletea*), spring-head communities (*Montio-Cardaminetea*) or cliff communities (*Asplenietea trichomanis*), we face the question of primary vegetation cover corresponding to the greater part of the polonina balds. Taking into account the excellent overview of MALINOVSKY (1980) and all phytosociological "relicts", merely five kinds of formations could have dominated the common slopes of the W. Bieszczady: dwarf scrub with *Vaccinium myrtillus*, tall-grass grassland with *Calamagrostis arundinacea* or *C. villosa*, and short-grass communities with *Nardus stricta* and *Festuca supina*. The following pattern could be expected: (1) the majority of dry and sunny slopes dominated by *Calamagrostis arundinacea* communities, (2) the majority of north facing slopes with longstanding snow and avalanches covered by stands of *Vaccinium myrtillus*, (3) wind-swept summit areas with shallow and dry soil occupied by *Festuca supina* formation, (4) small patches on northern slopes escaping the snow drifts, housing stands of *Calamagrostis villosa* and, finally, (5) flat areas and seepage zones covered by primary *Deschampsia caespitosa* and/or *Nardus stricta* communities. Fig. 5 shows the assumed ecological differentation between the four presently dominant grass species of the W. Bieszczady balds.

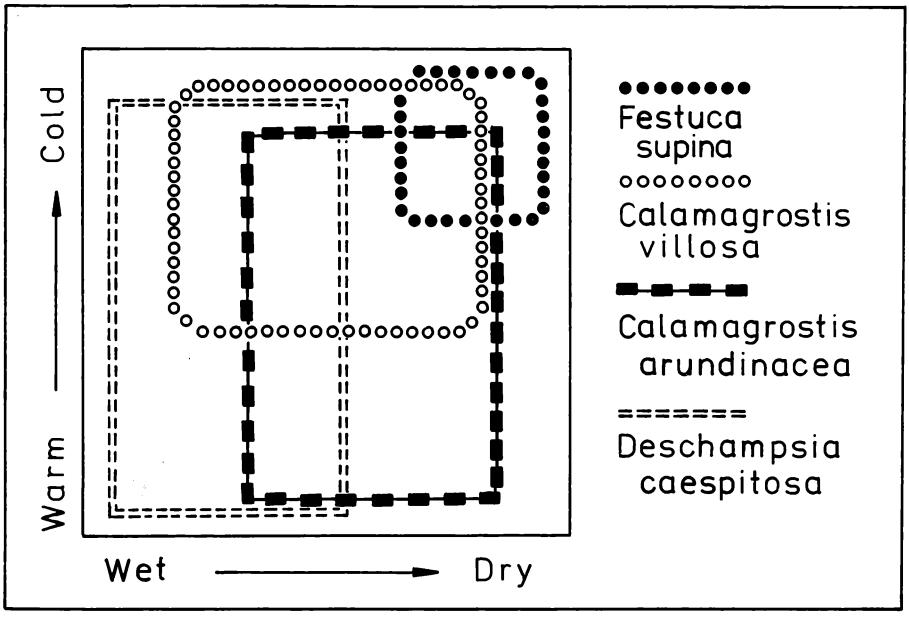

Fig. 5: Ecological differentation or four dominant grass species on the polonina balds, in respect to two environmental gradients; the warm/cold and wet/dry gradients can also be translated as low/high altitude and high/low snow pack, respectively.

SUCCECCIONAL TRENDS

The above short summary of the botanical and ecological aspects of the development in polonina balds of the W. Bieszczady requires further comments on future successional trends. Leaving aside Polonina Wetlińska, we have in mind the territory of the Bieszczady National Park where the influence of grazing cattle has been, so far, excluded. In the past, both wild and domestic large herbivorous ungulates have played an important role in the environmental setting of the species-rich polonina balds. The authorities of the Bieszczady National Park already started reintroducing of European bison (*Bison bonasus*) and, in the future, even introduction of small herds of cattle would be justified in view of the vistas of nature conservancy.

The elevation of timberline will control the size of the polonina balds. Though large ungulates were in the past 35 years excluded (with the exception of red deer) the shifting of the upper forest-line was hardly visible in 1980, which

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agrees with the earlier observations of ZARZYCKI (1963: 102-103) who assumed retardation or even inhibition of the beech regeneration within the sod of the polonina grasses. Introduction of bison or controlled numbers of cattle may stabilize still further this decisive vegetation boundary.

With regard to the polonina grasslands and dwarf scrub, comparison of our observations with those of PAŁCZYŃSKI and JASIEWICZ suggests a rapid rate in alternation of species composition and size of the pertinent cummunities. The *Nardetum carpaticum orientale* Pałczyński 1962 disappeared from the large flanks of the preserved balds in the national park. *Nardus stricta* the dominant grass of this association, could be seen only in withering specimens surviving under the shade of taller grasses. Besides, many subdominants and companion species of the *Nardetum* have obviously declined, e.g. *Hypochoeris uniflora*, *Potentilla aurea*, *Antennaria dioica*, *Thymus pulegioides*, *Hieracium aurantiacum*, *Carex pilulifera*, *Festuca rubra* and *Campanula patula* (placed in upper constancy classes in PAŁCZYŃSKIs Table 11) have become fairly rare. During our studies in 1980, only one stand near a kraal still in use on Polonina Wetlińska could be phytosociologically matched with the species-rich *Nardetum carpaticum orientale*.

Vaccinietum myrtilli Pawł., Sok. et Wal. 1928, another plant community widespread in the period of PAŁCZYŃSKIs investigation, is also declining. The east northern flanks of Polonina Wetlińska, Polonina Caryńska, and Szeroki Wierch showed, in 1980, signs of rapidly advancing *Calamagrostis arundinacea*, within whose tussocks suffocated dwarf scrub of *Vaccinium myrtillus* appeared. Over large areas this species could be seen only in withering specimens covered by dead and live grass leaves. Ultimate disappearance of *Vaccinium myrtillus* from certain slopes appears to be only a matter of a few years. However, there are still numerous habitats in the W. Bieszczady, particularly those covered by late snow patches, where *Vaccinium myrtillus*, in association with *Empetrum hermaphroditum*, remains a vigorous dominant.

The decline of communities dominated by *Vaccinium myrtillus* was not expected by PAŁCZYŃSKI (1962: 128), whose succession diagram assumes a development from *Nardus* stands toward *Vaccinietum myrtilli* in the absence of grazing. According to our observations in 1980, *Calamagrostis arundinacea* and *Deschampsia caespitosa* have progressively occupied the area of the polonina summit balds. About two thirds of the steep slopes have already been covered by stands with dominating *C. arundinacea*. Flat and slightly inclined surfaces on the top of the ranges, and large landings on the flanks, i.e. nearly one third of the total polonina area, became occupied by communities predominated by *Deschampsia caespitosa*, presumably a species-poor variety of the *Poo-Deschampsietum* Pawł. et Wal. 1949. Again, this contrasts with JASIEWICZ (1965: 15 et 18) who remarked that "only small areas of the polonina balds are occupied by the *Poo-Deschampsietum*".

The vitality of "sub-thermophilous" *Calamagrostis arundinacea* in 1980 seemed to be in agreement with the lower elevation of the polonina balds of the W. Bieszczady. This species was already recorded in nine out of 15 relevé of the *Nardetum* and all five relevés of the *Vaccinietum* by PAŁCZYŃSKI (1962: Tables 11 and 15, respectively). Low constancy and cover degree showed *Deschampsia caespitosa* in the same Tables, though its presence in the *Nardetum* could have been expected. We can conclude that about 25 years ago both *Calamagrostis arundinacea* and *Deschampsia caespitosa* were already on their progressive move, however, the latter species started its expansion either later or at a slower pace.

The future role of *Calamagrostis villosa* in the succession in the polonina grasslands of the W. Bieszczady is still difficult to predict. Neither PAŁCZYŃSKI nor JASIEWICZ have recorded stands dominated by this competitive grass, which is quite common in neighbouring ranges of the Western and Eastern Carpathians. The present author assumes that at least part of those stands observed in 1980 was a relict surviving in the W. Bieszczady for many centuries. A few details, however, speak in favour of progressive dispersal of *Calamagrostis villosa*. In the competition with other dominants, this life-form may, ultimately, occupy large northern slopes with less burden of snow, and all summit screes where the tussocks of *Calamagrostis arundinacea* and dwarf scrub of *Vaccinium myrtillus* are less vigorous.

With regard to short-grass communities with *Festuca supina* we assume that their present-day distribution on the exposed summits and cliffs will hardly change even in the future. Comparison with the floristic list in the monograph by JASIEWICZ (1965: 310) suggests that the species richness of the polonina balds will find a permanent refuge in the environs of these highly diversified habitats. Understandingly, the origin of polonina grassland has not been examined in the recent palynological monograph by RAŁSKA-JASIEWICZOWA (1980).

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LITERATURE

AWŁASEWICZ, Z., CICHOWSKA. U. (Ed.) (1979)): Bieszczady, mapa turystyczna, 1 : 75 000. - Warszawa.

BARKMAN, J.J., MORAVEC, J., RAUSCHERT, S. (1976): Code of phytosociological nomenclature. - Vegetatio 32(3): 131-185. The Hague.

DEYL, M. (1940): Plants, soil and climate of Pop Ivan. - Praha.

JASIEWICZ, A. (1965): Rośliny naczyniowe Bieszczadów Zachodnich. - Monographiae Botanicae 20: 3-339. Warszawa.

KLIMASZEWSKI, M. (1946): Podział morfologiczny południowej Polski. - Czasopismo Geogr. 18: 133.

KOMENDAR, V.I. (1966): Forposty gornych lesov. - Užhorod.

KUČEROVÁ, J. , JENÍK, J. (1961): Vegetace hřebene Rabia Skala (1168 m) v Poloninských Karpatech. - Biológia 18: 650-662. Bratislava.

MALINOVSKI, K.A. (1980): Roslinnist´ visokogir´ ja ukrainskich Karpat. - Kiiv.

MALOCH, M. (1931): Boržavské poloniny v Podkarpatské Rusi. - Sb. Výzk. Ústavů Zeměděl. 67: 1-200.

MEUSEL, H., JÄGER, E., WEINERT, E. (1965): Vergleichende Chorologie der Zentraleuropäischen Flora. - Jena.

PAŁCZYŃSKI, A. (1962): Łaki i pastwiska w Bieszczadach Zachodnich. - Roczniki Nauk Rolniczich 99-D: 5-128. Warszawa.

PAWŁOWSKI, B., WALAS, J. (1949): Zespoły roślin naczyniowych Gôr Czywczyńskich. - Bull. Int. Acad. Pol. Sc. Lett., Cl. Sc. Math. Nat., Sêr. B 1948: 117-181. Cracovie.

RAŁSKA-JASIEWICZOWA, M. (1980): Late-glacial and holocene vegetation of the Bieszczady Mts. (Polish Eastern Carpathians). - Warszawa/Kraków.

ZARZYCKI, K. (1963): Lasy Bieszczadów Zachodnich. - Acta Agraria et Silvestria, Ser. Leśna 3: 3-132.

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Zeitschrift/Journal: Tuexenia - Mitteilungen der Floristisch-soziologischen Arbeitsgemeinschaft

Jahr/Year: 1983

Band/Volume: NS_3

Autor(en)/Author(s): Jenik Jan

Artikel/Article: Succession on the Polonina Balds in the Western Bieszczady, the Eastern Carpathians 207-216