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**DENDROFLORISTIC REGIONALIZATION OF THE POLISH
PART OF THE EASTERN SUDETY MTS. BASED ON SPECIES
SIMILARITY BETWEEN BASIC SPATIAL UNITS**

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ABSTRACT. Areas of homogenous composition of woody flora were delineated. The dendrofloristic similarity among 208 squares was assessed by cluster analysis (the Euclidean distances, Ward's method) based on the comparison of the presence and absence data. As a result four distinct areas have emerged. As was expected, main differentiating factors were: altitude and fertility of habitats.

Key words: dendroflora, spatial differentiation, Śnieżnik Massif

Introduction

Spatial differentiation of woody flora is a very important characteristic of vegetation. It involves homogeneous areas separated into different regions and is referred to as regionalization. The aim of the present work was division of the Polish part of the Eastern Sudety Mts. into areas of similar dendrofloristic composition (disregarding every properties of species), setting differences and resemblances between them and attempt to define main factors which determine it.

The study area lies on the Polish-Czech borderland and encompasses the Śnieżnik Massif, Bialskie Mts., Złote Mts. and the adjacent parts of the Kłodzko Basin and the Upper Nysa Kłodzka Graben (Fig. 1). It covers about 620 km² and is located between 50°06'-50°29' of the northern latitude and 16°38'-17°02' of the eastern longitude. Its vertical extent amounts to 1140 m – from 285 m on the Nysa Kłodzka river in the vicinity of Kłodzko to 1425 m on the top of the Śnieżnik.

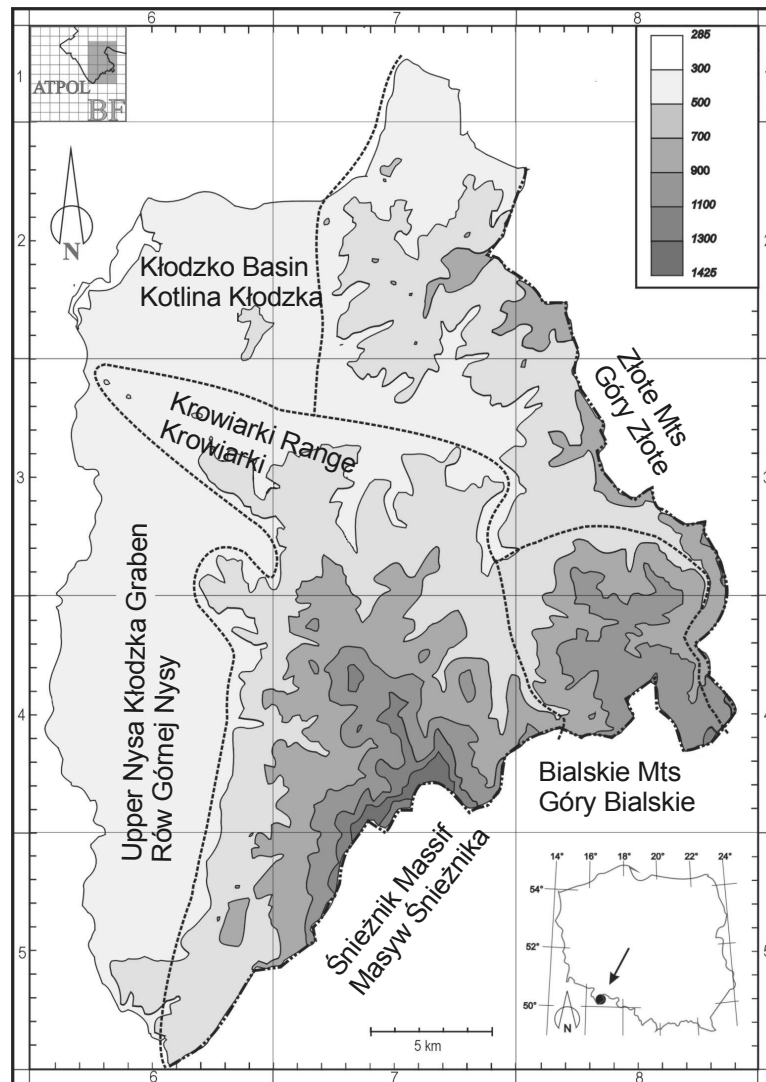


Fig. 1. Hypsometric differentiation and boundaries of main geographical units
 Ryc. 1. Zróżnicowanie hipsometryczne terenu badań i granice głównych jednostek geograficznych

Material and method

Detailed field investigations, conducted in the years 1994-1995 and 1997-1998, were main source of information about contemporary woody flora. Additionally, unpublished records from years 1981-1992 obtained by courtesy of Prof. A. Boratyński were also used (11.3% of total amount). The study area was divided by a grid into 208 basic

spatial units (squares of 2×2 km) according to principles of the Atlas of distribution of vascular plants in Poland (Zajac 1978). All squares were sampled and in total data from 4833 locations were gathered, which resulted in the collection of nearly 65 900 floristic records. The present-day dendroflora of the Polish part of the Eastern Sudety Mts. has been estimated at 217 taxa of trees and shrubs, including 153 native and 64 alien species (Kosiński and Bednorz 2003).

Tree clustering analysis (distance measure: the Euclidean distances; amalgamation rule: Ward's method; performed by the Statistica 5.1 computer program) was used as a statistical tool for determining resemblance of elementary woody flora between particular squares. The similarity coefficient obtained in this way transforms the raw presence/absence data into values that measure how similar two squares are based on the number of taxa shared. Finally, the similarity matrix was used to construct a tree graph that depict the relationships among squares. This dendrogram groups the squares in higher level units and finally is useful to propose regionalization of the study area.

Results and discussion

The cluster diagram (Fig. 2) shows four distinct subsets of squares. The most distinct one is first group (I), which stretches out on the most elevated areas, relatively weakly disturbed by men, situated in three vegetational zones: upper part of lower montane, upper montane and subalpine (Fig. 3, 4). Poverty of woody flora is the main feature,

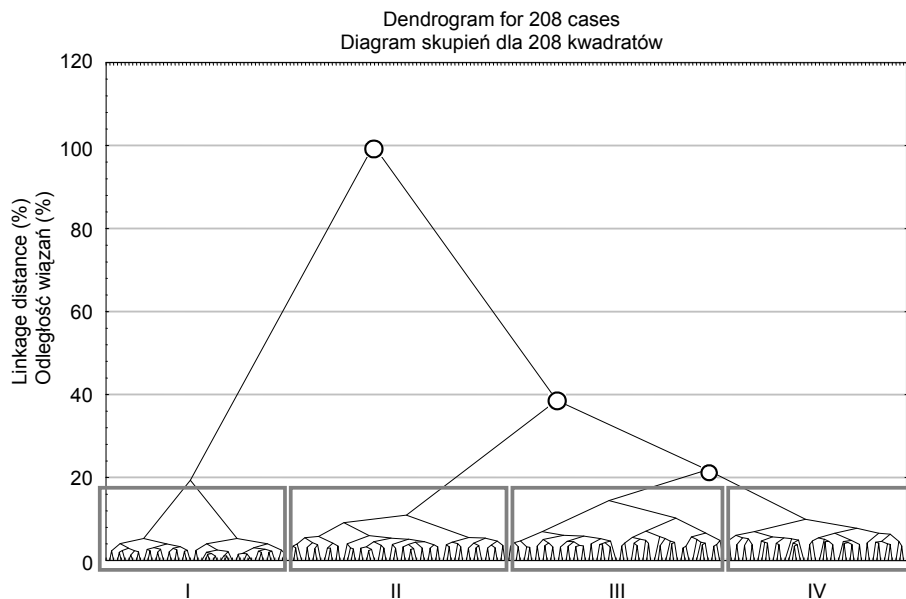


Fig. 2. Similarity in dendrofloristic composition of 208 4-km² squares that cover study area (cluster analysis, the Euclidean distances, Ward's method)

Ryc. 2. Podobieństwo dendroflorystyczne 208 kwadratów o powierzchni 4 km² (analiza skupień, odległości euklidesowe, metoda Warda)

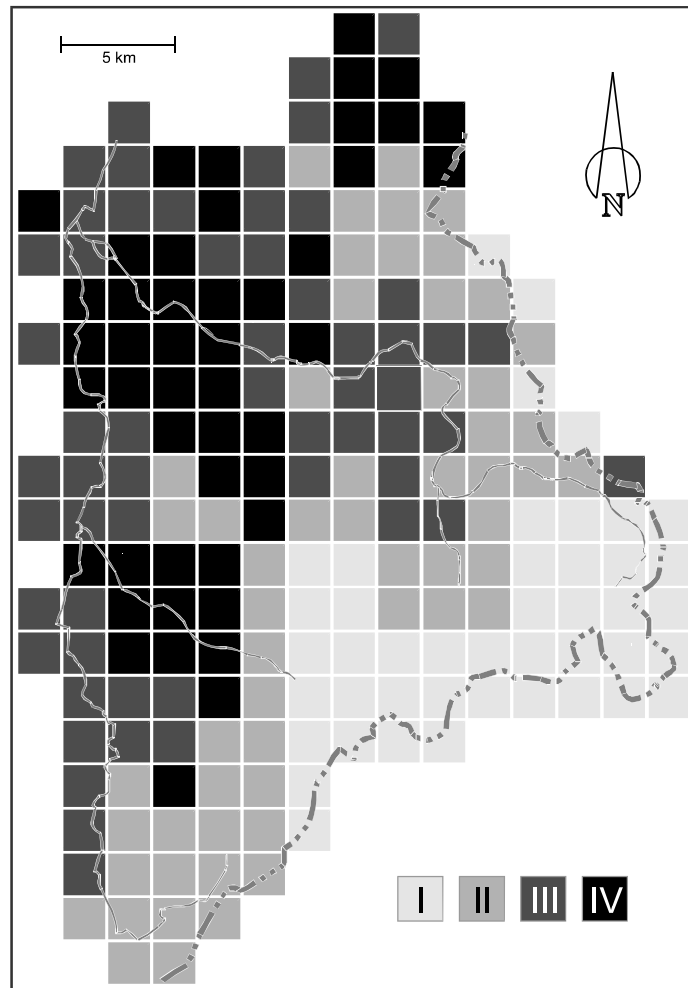


Fig. 3. Spatial distribution of distinguished groups of dendrofloristic homogeneity

Ryc. 3. Rozmieszczenie przestrzenne wyróżnionych obszarów jednorodności dendroflorystycznej

which differs it from the rest of subsets – number of species is twice less numerous than in cluster II (Table 1). A percentage share of acidophilous species, spontaneophytes, woody chamaephytes and megaphanerophytes is also biggest here (Fig. 5, 6, 7). In synecological classification, species connected with forests, montane tall-herbs communities, peat bogs and subalpine heaths communities predominate (Fig. 8). The second area (subset II) has a transitional character between group I and lower lying groups III and IV, which is noticeable on all graphs, however it is more similar to the last ones. In the vertical spectrum it is connected mainly with altitudes 500-800 m (upper part of submontane and lower section of lower montane vegetational zones). The less elevated areas of submontane vegetational zone are occupied mostly by groups

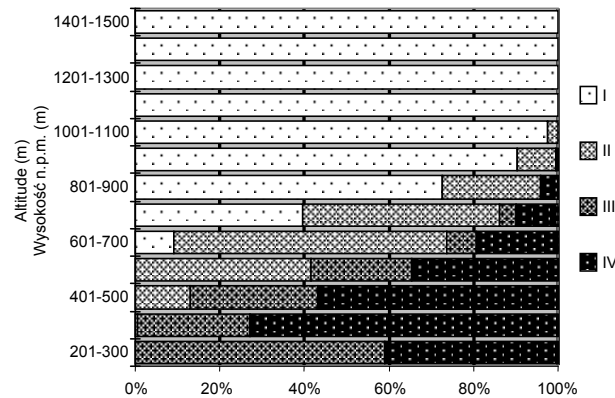


Fig. 4. Distribution of locations from distinguished homogeneity areas in 100-meters altitude layers

Ryc. 4. Udział stanowisk z wyróżnionych obszarów jednorodności w 100-metrowych przedziałach wysokości

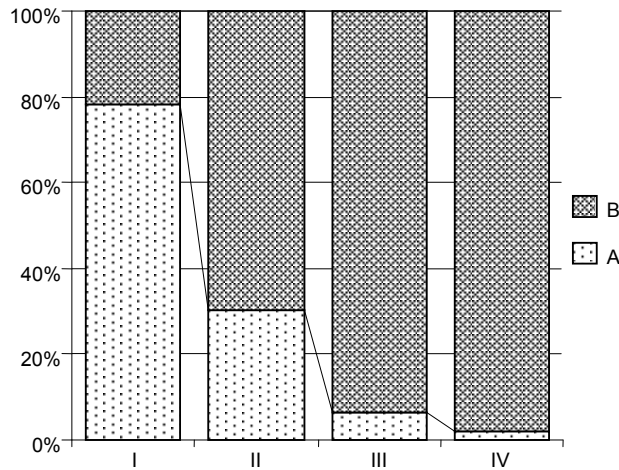


Fig. 5. Percentage share of records of more or less basophilous (*Berberis vulgaris*, *Cotoneaster integerrimus*, *Taxus baccata*, *Cornus sanguinea*, *Daphne mezereum*, *Hedera helix*, *Lonicera xylosteum*, *Rubus caesius*, *R. gothicus*, *Tilia platyphyllos*, *Ulmus minor*) and acidophilous species (*Andromeda polifolia*, *Empetrum hermaphroditum*, *E. nigrum*, *Oxycoccus palustris*, *Vaccinium uliginosum*, *Calluna vulgaris*, *Vaccinium vitis-idaea*) in four groups of homogenous composition of woody flora. Division into base- and acid-loving species has local character and was based on the analysis of the occurrence of species against a background of distribution of basic and acid rocks (Kosiński 2001)

Ryc. 5. Procentowy udział gatunków bazofilnych (*Berberis vulgaris*, *Cotoneaster integerrimus*, *Taxus baccata*, *Cornus sanguinea*, *Daphne mezereum*, *Hedera helix*, *Lonicera xylosteum*, *Rubus caesius*, *R. gothicus*, *Tilia platyphyllos*, *Ulmus minor*) i acidofilnych (*Andromeda polifolia*, *Empetrum hermaphroditum*, *E. nigrum*, *Oxycoccus palustris*, *Vaccinium uliginosum*, *Calluna vulgaris*, *Vaccinium vitis-idaea*) w czterech grupach jednorodności dendroflorystycznej. Wytypowanie gatunków kwaso- lub zasadolubnych ma charakter lokalny i jest oparte na korelacji ich rozmieszczenia z występowaniem podłoża o określonym odczynie (Kosiński 2001)

Table 1

Species richness and mean altitude of the distinguished areas of woody flora homogeneity
Bogatwo gatunkowe i średnia wysokość wyróżnionych obszarów jednorodności
dendroflorystycznej

Area – Obszar	Number of species – Liczba gatunków	Mean altitude – Średnia wysokość (m)
I	72	954.3
II	143	632.9
III	168	470.4
IV	194	469.2

III and IV. There are small differences between them, and a fertility of habitats seems to be the main factor determining their separateness. In comparison to previous areas, both groups (III and IV) stand out by the biggest share of lowland trees and shrubs, and species that occur very rare and sporadic (Fig. 9). In synecological classification, species connected with broadleaved forests and thicket communities predominate here (Fig. 8). The fourth area covers most fertile habitats of the Krowiarki Range (rich in limestone rocks), hills in surroundings of the Wilczka River valley and at north ends of the Złote Mts. (marl and clay soils). This region is distinguished by the richest woody flora and the biggest share of basophilous and the rarest species.

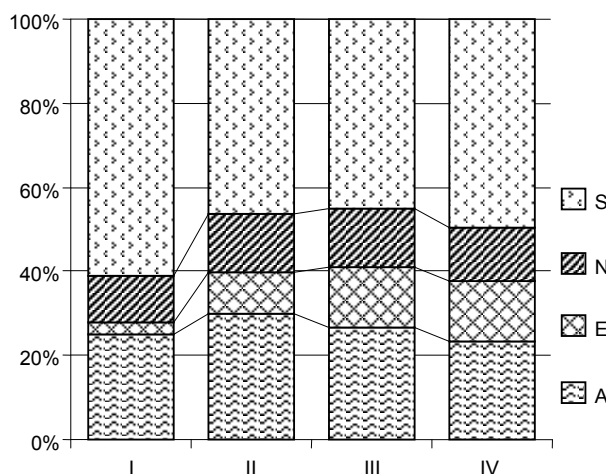


Fig. 6. Percentage distribution of species from geographical-historical categories in four groups of woody flora homogeneity: S – spontaneophytes (native plant species of seminatural and natural habitats), N – neophytes (alien species introduced after the year 1500), E – ephemerophytes (occasionally occurring aliens whose populations are not established), A – apophytes (indigenous plant species expanding in man-made habitats)

Ryc. 6. Udział grup geograficzno-historycznych w czterech klasach jednorodności dendroflorystycznej: S – sponteofity (gatunki rodzime, występujące na siedliskach naturalnych i półnaturalnych), N – neofity (gatunki obcego pochodzenia, które pojawiły się po 1500 roku), E – efemerofity (gatunki obcego pochodzenia pojawiające się efemerycznie), A – apofity (gatunki rodzime, rozpowszechnione na siedliskach antropogenicznych)

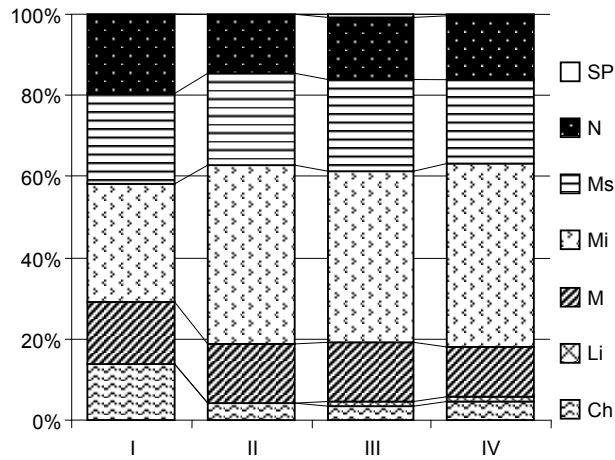


Fig. 7. Percentage distribution of life forms (according to **Kornaś** and **Medwecka-Kornaś** 1986) in four subsets of squares. SP – semiparasites, N – nanophanerophytes, Ms – mesophanerophytes, Mi – microphanerophytes, M – megaphanerophytes, Li – woody vines, Ch – woody chamaephytes
 Ryc. 7. Udział form życiowych (wg **Kornasia** i **Medweckiej-Kornaś** 2002) w czterech klasach jednorodności: SP – półpaszożyty, N – nanofanerofity, Ms – mezofanerofity, Mi – mikrofanerofity, M – megafanerofity, Li – liany, Ch – zdrewniałe chamefity

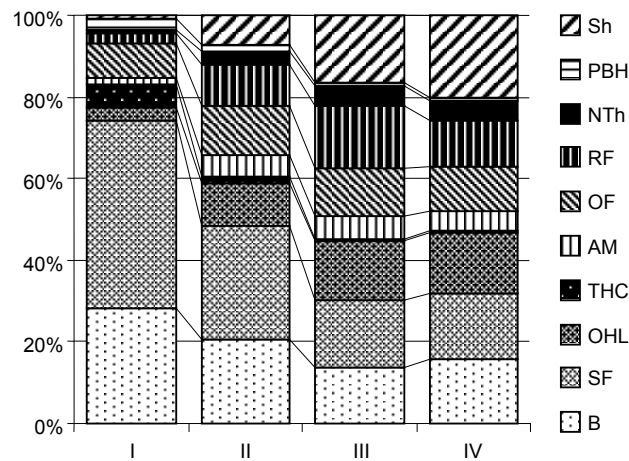


Fig. 8. The percentage distribution of records of species belonging to synecological groups in four subsets of squares. Sh – meso-xerophile communities of shrubs, PBH – peat bogs and heaths, NTh – nitrophilous thickets, RF – riparian forests, OF – oak forests, AM – artificial monocultures of conifers, THC – montane tall-herbs communities, OHL – oak-hornbeam-linden forests, SF – montane spruce forest, B – beech forests

Ryc. 8. Udział grup synekologicznych w czterech klasach jednorodności dendroflorystycznej: Sh – mezo- i kserofilne zbiorowiska zaroślowe, PBH – torfowiska i wrzosowiska, NTh – nitrofilne zarośla, RF – lasy łęgowe, OF – dąbrowy, AM – monokultury drzew iglastych, THC – górskie ziołorośla, OHL – lasy grądowe, SF – bory górnoreglowe, B – buczyny

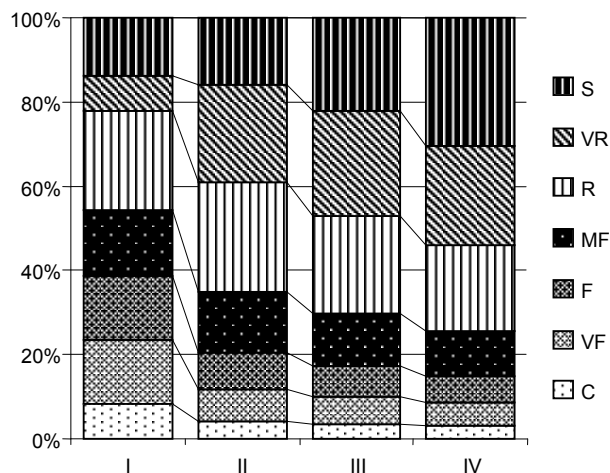


Fig. 9. Distribution of species from distinguished frequency classes in four groups of woody flora homogeneity: S – sporadic (< 1.0% of squares), VR – very rare (1.1-5.0), R – rare (5.1-20), MF – moderately frequent (20.1-40.0), F – frequent (40.1-60), VF – very frequent (60.1-80.0), and C – common (> 80.1)

Ryc. 9. Udział klas częstości w czterech grupach jednorodności dendroflorystycznej: S – gatunki sporadyczne (< 1,0% kwadratów), VR – bardzo rzadkie (1,1-5,0), R – rzadkie (5,1-20), MF – dość częste (20,1-40,0), F – częste (40,1-60), VF – bardzo częste (60,1-80,0), C – pospolite (> 80,1)

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DENDROFLORYSTYCZNA REGIONALIZACJA POLSKIEJ CZĘŚCI SUDETÓW
WSCHODNICH NA PODSTAWIE PODOBIEŃSTWA GATUNKOWEGO
PODSTAWOWYCH JEDNOSTEK PRZESTRZENNYCH

S t r e s z c z e n i e

Za pomocą analizy skupień (odległości euklidesowe, metoda Warda) porównano skład dendroflorystyczny 208 kwadratów i określono stopień podobieństwa między nimi. Na tej podstawie zostały wyznaczone cztery obszary cechujące się jednorodną florą drzew i krzewów. Określono główne czynniki różnicujące te obszary: wysokość nad poziom morza i żyzność siedlisk.

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