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Chorological and synanthropodynamical analysis of trees and shrubs of the Stołowe Mts. (Middle Sudety)

Abstract: The 153 taxa of trees and shrubs were reported from the Stołowe Mts. Two species (*Betula nana* and *Erica tetralix*) were reported probably by mistake, and 7 are now extinct (*Arctostaphylos uva-ursi*, *Chamaecytisus ratisbonensis*, *Genista pilosa*, *Lembotropis nigricans*, *Rosa agrestis*, *Salix lapponum*, *Salix myrtilloides*). The other 144 taxa of trees and shrubs were found in the natural and semi-natural site conditions. The 110 native taxa and 34 anthropophytes are forming the contemporary woody flora. The 44 native taxa belong to various local red data book categories (including extinct), the 63 are not endangered and next 10 are apophytes. A few altitudinal groups of species can be distinguished, which are characterized with specific reaction to the growth of the altitude of localities. The distinct limit in the altitudinal ranges of the woody species occur at elevation of 580–600 m. This altitude was considered as the limit between submontane and montane belts in the Stołowe mountains.

Additional key words: chorology, plant protection, biodiversity, Stołowe mountains, Silesia

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Introduction

The wild woody flora of the Stołowe Mts. include a small number of species. It is connected mainly with relatively restricted area, not to high altitudinal differentiation, little geological variation and intensive anthropoppression. Altitudinally the Stołowe Mts overlap only two layers of vegetation. The lowest portion is covered with the submontane type of vegetation, whereas the upper one is occupied by lower montane forest belt of vegetation. The present plant cover of the both layers is strongly modified when compared with natural one. The submontane belt has been settled for centuries and most of its area is under various types of agricultural utilisation. The forests of

montane belt are modified as a result of the forest economy, mainly by felling of the natural forests and establishing mono-specific plantations of Norway spruce from the XVIII and XIX centuries. The fragments of natural forests survive on small patches only in the Pośna and Dańczówka stream valleys and on the tops of Wielki and Mały Szczeliniec Mt. (Pender 1996; Świerkosz 1998; Jędryszczak 1999). The great areas in the montane vegetation layer have also been deforested, and presently are covered by agricultural or abandoned agricultural lands.

The aim of the present work was the particular determination of contemporary dendro-floristic resources of the Stołowe Mts. with special emphasis on rare and endangered taxa.

Material and methods

The material for the study comes from the field investigations, carried out in the 1980–1997. These observations were compared with literature data (Fiek 1881; Schube 1903; Limpricht 1944) and herbarium materials (predominantly WRSL¹, but also KRAM, KRA, PR and PRC). The more recent literature data have been also utilised (Weretelnik 1990, Pender 1988, 1996; Pender and Macicka-Pawlik 1996a, b, Gołąb 1999; Gołąb and Szefer 1996, Marek 1998, Potocka 1999), as well as unpublished information from the botanists penetrating the Stołowe Mts.

The evaluation of the qualitative and quantitative changes of composition of the woody flora of the Stołowe Mts. has been done by comparing materials collected during field studies with historical data. The rare and endangered (the red data book) species were evaluated especially carefully and needs for their conservation were pointed out. The majority of the studied area was taken into protection in the national park rank, which allows to expect the easier possibilities of protection and conservation of threatened plants.

The long duration of the investigations (1980–1997) allows to collect many of data dispersed in various positions of literature and to make all efforts to find most of the historical data in the field. Some materials, especially concerning of the most interesting taxa, have been published earlier (Boratyński 1986, 1987, 1988, 1991; Boratyński et al. 1997; 1999; Boratyński and Danielewicz 1989; Świerkosz 1996, Solon and Świerkosz 1999).

The taxa introduced in the forests and on the synanthropic sites have been also the object of the present study, except of the cultivars of the *Malus*, *Prunus*, *Cerasus* and ornamental shrubs, which are cultivated in the settlements.

The locality in the present study is considered according the previous studies (Boratyński 1991). The red data book categories follow the Polish plant red data book and previous works (Zarzycki and Szeląg 1992; Kaźmierczakowa and Zarzycki 2001), but the local character of endangerment was pointed out. The local threat categories were based upon IUCN's (1994) criteria and classification. The red book categories have not been determined for plants adventive in the Stołowe Mts (apophytes and athropophytes).

The plant names follows "Vascular Plants of Poland, a checklist" (Mirek et al. 1995), *Salix* hybrids after Rutkowski (1998) and Dostał (1989). Names of plant communities after W. Matuszkiewicz (2001), only the rocky Scots Pine forests after Mikińska (1970).

Characteristics of the terrain

Investigated area of the Stołowe Mts. and Lewin Hills (Wzgórza Lewińskie) are the part of the Middle Sudetes (Walczak 1968; Kondracki 1998). The terrain covered by field studies is adjacent to the Kotlina Kłodzka mesoregion from the North and East, to the Bystrzyckie and Orlickie mountains from the South and is limited by state border from the North and West (Fig. 1).

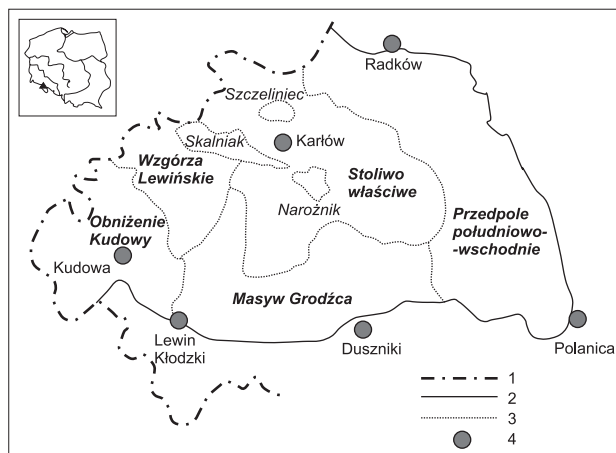


Fig. 1. Geographic position of the Stołowe mountains
1 – state border; 2 – limit of the Stołowe mountains; 3 – limits of geobotanical units; 4 – the more important towns

Altitudinal minimum of the study area is about 350 m (near Radków) and the maximum is 919 m (top of Mt Szczeliniec Wielki). The difference between minimal (355 m) and maximal (919 m) altitudes gives the possibility to obtain the data concerning the altitudinal limits of the ranges of some taxa.

The several geologic units can be distinguished in the region: the granitoides of the Kudowa vicinity formed in variscian orogenesis (granodiorites, granites monzonital and other), the perm sediments (sandstones, conglomerates) and chalk deposits (the layers and interlayers of sandstones, mudstones, loamy marls, limestone gaizes, silstones, shales, etc.). The upper carbon sediments occur in the vicinities of Pstrązna and Bukowina Kłodzka villages (Niemczyk 1999). A dozen of the soil types develop from these rocks, the most frequent among them are the brown soils (typical, acid and leached) and podzolic soils (Szerszeń and Kabała 1996).

The Stołowe Mts. are characterized by the altitudinal differentiation of the climate factors, typical for the mountain regions (Schmuck 1960, 1969). The vegetation period is 173 to 213 days long with the mean annual temperature from 6.1°C at altitude of 400 m to 4.6°C at 720 m and precipitation from 622 mm in Polanica to 996 mm in Duszniki.

¹ Herbarium abbreviations after Holmgren et al. 1990

The potential plant communities in the Stołowe Mts. are *Dentario enneaphylli-Fagetum* Oberd. 1957 ex W. et A. Matuszkiewicz 1960, *Luzulo luzuloidis-Fagetum* (Du Rietz 1923) Markgr. 1932 em. Meusel 1937, *Lunario-Aceretum* Grüneberg et Schlüt. 1957, *Abieti-Piceetum* Szaf., Pawł. et Kulcz. 1923 em. J. Mat. 1978 and *Betulo carpaticae-Pinetum* Mikyska 1970. Generally, the 53 plant associations have been so far recognized in the Stołowe Mts. National Park (Świerkosz 1999). Categories of synanthropisation were utilized after Sudnik-Wojciechowska and Koźniewska (1988).

Results

Abbreviations

- number of localities: **VR** – very rare (1–2 localities); **R** – rare (3–10 localities); **F** – frequent (11–20 localities); **Vf** – very frequent (21–50 localities); **C** – common (more than 50 localities);
- basic synanthropic categories: **Ap** – apophyte (sensu Holub 1971); **Ef** – ephemerophyte; **Ne** – introduced species in phase on naturalising; **Sp** – non-synanthropic spontaneophyte;
- cat. – data of red book category after Zarzycki and Szeląg 1992, Kaźmierczakowa and Zarzycki 2001;
- [...] – category of threat in Stołowe Mts : **Ex** – extinct; **EW** – extinct in wild; **CR** – critically endangered; **EN** – endangered; **VU** – vulnerable; **LR** – low risk, **DD** – data deficient, **Nt** – not threatened;
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PINACEAE

Abies alba Mill. – C, Sp, [LR]. Up to altitude of 855 m, frequently planted. In spite of low level of vitality of old trees, forms natural regeneration (Sznajder 2001).

Picea abies (L.) Karst. – C, Sp, [Nt], (380–910 m).

Picea orientalis Link – VR, Ef. Planted at vicinity of Borek (475 m, KS 1996) and on Pasterska Mt (680 m, KS 1995).

Picea pungens Engelm. – VR, Ef. Planted in the forest on SW slope of Kopa Śmierci Mt (740 m, KS 1996).

Pinus sylvestris L. – C, Sp, [Nt]. Frequently in the fragments of the natural forests on the sandstone rocks, here as a relic form (Bobowicz and Radziejewska 1989, Bobowicz 1993, Bobowicz 1984, Krzakowa and Lisowska 1996), also planted. The last mentioned came from the seeds from the lowlands. The relic forests are very sensitive to air pollution (Vacek and Podrazsky 1996).

Pinus mugo Turra – VR, Sp, [EN]. Only one locality on the plateau of Błędné Skały (Boratyński 1978, 1994). Planted on Mt Szczeliniec (2 individuals, KS 1995, 1997). The population on the Błędné Skały is slightly endangered by intensive tourism activity. It is a small and isolated population probably endangered by gene flow from *Pinus sylvestris*.

Pinus uliginosa Neumann (= *Pinus ×rhaetica* Brügger) – VR, Sp, kat. VU, [EN]. The two natural localities (Błędné Skały, altitude 850 m and Wielkie Torfowisko Batorowskie, altitude of 710 m). Both mentioned populations are composed of small number of individuals and strongly endangered (Boratyński 1978, 1994, Gołąb 1999). Old localities reported by Schube (1903) from peatbogs in Skalniak Mt are extinct.

Pinus cembra L. – VR, Ap. Planted several times on the Mt Szczeliniec Wielki, last time probably in 1970–ties (KS 1996, 1997).

Pinus strobus L. – R, Ne. Known from 6 anthropogenic localities, mainly between Polanica and Szczytna (400–545 m), also as spontaneous seedling (KS 1995, 1996).

Pinus banksiana Lamb. – VR, Ef. Only on the N slope above the railway station in Duszniki (570 m, KS 1996).

Larix decidua Mill. – C, Ap. Frequently planted (in the subsp. *decidua* and subsp. *polonica*) as a forest tree, mainly on the Lewińskie Hills and in the southern parts of the Stoliwo (380–820 m).

Larix leptolepis (Sieb. Et Zucc.) Endl. – R, Ef. Rarely planted in the forests (10 localities), together with the previous species (450–780 m).

Pseudotsuga taxifolia Britton – F, Ef. Quite frequently planted as a forest tree (430–700 m). It forms the seedlings, which do not enter higher forest layers.

CUPRESSACEAE

Juniperus communis L. – VR, Sp, [CR]. On the hill about 0,5 km N of Kulin (690 m, KS 1995) and on NE slopes of Grzywacz in the Grodziec massif (730 m, KS 1992). The latter locality has not been confirmed in the next years (KS 1995, 1996).

Thuja occidentalis L. – VR, Ef. Outside of the towns, where it is frequently planted, the single specimens can be encountered near the houses even far from the settlements (Darnków, Wolany).

Thuja plicata Donn – VR, Ne/Ef. A single seedling has been found near the Szczytnik castle (550 m, KS 1996). It is probably the first stage of the process of neophytisation. Also planted.

TAXACEAE

Taxus baccata L. – VR, Sp, kat. VU, [EW]. It is difficult to say, the old yews, which are growing in Bad Kudowa, Radków and in Darnków are of natural origin (Boratyński et al. 1997). In the past the species was probably a common component of the forests, which can be confirmed in the local toponomastics.

BETULACEAE

Betula pendula Roth – C, Sp, [Nt] (380–910 m).

Betula pubescens Ehrh.

– subsp. *pubescens* – C, Sp, [Nt] (390–905 m);

– subsp. *carpatica* (Willd.) Asch. et Graebn. – R, Sp, [VU] (710–915 m). To the earlier known localities (Boratyński and Danielewicz 1989), Mt Narożnik should be added (850 m, KS 1994–1996).

– *B. ×petraea* Sykora nom. prov. – C, Sp, [Nt]. This is a hybrid of the previous two subspecies (450–915 m). It was included to typical subspecies (Białobrzeska and Truchanowicz 1991) with only a few characters of subsp. *carpatica*.

Betula nana L. – erroneously reported from Wielkie Torfowisko Batorowskie by Rękoś (1977).

Alnus glutinosa (L.) Gaertn. – C, Sp, [Nt]. Commonly up to altitude of 820 m, in the higher elevation also planted.

Alnus incana (L.) Moench – C, Sp, [Nt]. Commonly up to altitude of 840 m.

Carpinus betulus L. – F, Sp, [Nt]. Frequently to altitude of about 600 m, but their potential sites are converted into synanthropic ones. The most elevated locality at 695 m in the Kudowski Potok valley.

Corylus avellana L. – C, Sp, [Nt], (380–850 m).

FAGACEAE

Fagus sylvatica L. – C, Sp, [Nt] (350–820 m).

Quercus robur L. – C, Sp, [Nt]. Commonly in the submontane forest belt, to altitude of 700 m, with the highest locality on Grodziec massif. Planted in Karlów (750 m) and Pasterka (700 m).

Quercus petraea (Matt.) Liebl. – C, Sp, [Nt]. The submontane species with the most elevated locality on the slopes of Brzytwa rock at 700 m.

Quercus rubra L. – F, Ne. Quite frequently planted for years in the forest and in the settlements. Fruits and forms seedlings to about 600 m, on more elevated areas only as efemerophyte. Fruiting of the second generation has been observed near Radków (450 m, KS 1996).

SALICACEAE

Populus tremula L. – C, Sp, [Nt] (365–840 m).

Populus alba L. – VR, Ap. One seedling in Polanica (370 m, KS 1996).

Populus ×canadensis L. – F, Ne (380–765 m). Planted along the roads and in settlements.

Populus ×berolinensis Dippel – R, Ef(Ne). Rarely planted in the settlements (Ostra Góra, Pasterka, Szczytna), possible as kenophyte on the Bystrzyca stream bank near Duszniki (470 m, KS 1996).

Salix alba L. – VR, Ap?. Between Kudowa and Jakubowice (440 m, KS 1994) and near Darnków (480 m, KS 1994), probably planted.

Salix aurita L. – C, Sp, [Nt] (400–870 m).

Salix caprea L. – C, Sp, [Nt] (355–910 m).

Salix cinerea L. – F, Sp, [Nt] (410–770 m).

Salix fragilis L. – C, Sp, [Nt] (355–760 m).

Salix lapponum L – Sp, kat. EN, [Ex]. Species reported from the Małe Torfowisko Batorowskie (Jarosz 1956), possibly erroneously, because without herbarium materials.

Salix myrtilloides L. – Sp, kat. EN, [Ex]. The species reported from Wielkie Torfowisko Batorowskie (Schube 1903, Limpricht 1944), not confirmed after 1945.

Salix purpurea L. – Vf, Sp, [Nt] (380–760 m).

Salix pentandra L. – C, Sp, [Nt] (375–770m).

Salix rosmarinifolia L. – R, Sp, [VU]. Species found on the humid meadows W of Wolany (400 m, KS 1994, 1996, 1997), in the valley E of Homole (690 m, KS 1996), between Borek and Mt Piekielna (470 m, KS 1996) and about 1 km N of Szczytna (430 m, KS 1996). Endangered by meadow melioration and gene flow from *Salix aurita*.

Salix silesiaca Willd. – Vf, Sp, [LR-lc]. 25 localities along streams and in spruce forest (KS 1992–1997). Does not extend down to the submontane belt. The lowest locality at altitude of 600 m in the Zidowka gorge near Ostra Góra, the most elevated at 880 m on Mt Skalniak (KS 1992).

Salix viminalis L. – F, Sp, [Nt]. Commonly at altitudes 450–600 m (KS 1992–1997). The two localities at elevation of 700 m along the “Road of 100 Bends” (Szosa 100 Zakrętów, KS 1992) and one in Karlów (770 m, KS 1992–1998) are probably anthropogenic.

Salix ×capreola J. Kern. (*S. aurita* × *caprea*) – VR, Sp[Nt]. Skałki Łężyckie 720–750 m (Pender 1988; KS 1994, 1995).

Salix ×dasyclados Wimm. (*S. caprea* × *cinerea* × *viminalis*) – VR, Sp, [Nt]. Jakubowice (550 m, KS 1995).

Salix ×multinervis Doll (*S. aurita* × *cinerea*) – R, Sp [Nt] (550–780 m).

Salix ×reichardtii Kerner (*S. caprea* × *cinerea*) – R, Sp, [Nt] (430–750 m).

Salix ×rubens Schrank (*S. alba* × *fragilis*) – VR, Sp, [Nt]. In Wolany (380 m, KS 1996) and Jakubowice (560 m, KS 1995).

Salix ×subaurita Anderss. (*S. aurita* × *silesiaca*) – R, Sp, [Nt] (750–780 m).

Salix ×subcaprea Anderss. (*S. caprea* × *silesiaca*) – R, Sp, [Nt] (730–780 m).

ULMACEAE

Ulmus glabra Huds. – C, Sp, [VU] (370–775 m). Strongly endangered by graphiosis.

Ulmus laevis Pall. – VR, Ef. Individual trees planted in Polanica.

LORANTHACEAE

Viscum album L. – VR, Sp, [DD] – Polanica (Weretelnik 1990).

BERBERIDACEAE

Berberis vulgaris L. – VR, Sp? [LR-nt]. Only one locality on the forest edge N of Kudowa (425 m, KS 1995), possibly of natural origin.

Mahonia aquifolium (Pursh.) Nutt. – VR, Ef. Bad Kudowa (400 m, KS 1996).

HYDRANGEACEAE

Philadelphus coronarius L. (and its ornamental cultivars) – R, Ne. The species naturalizes in the neighbourhood of settlements and enters the thicket communities, the most elevated such locality in Łężno (770 m, KS 1995).

GROSSULARIACEAE

Ribes alpinum L. – VR, Sp, [LR-nt]. Natural stands in the Zidowka gorge above Ostra Góra (660 m, KS 1994) and the Pośna gorge (720 m, KS 1995). Found also on Mt Parkowa in Bad Kudowa (390–420 m, KS 1995), but here probably anthropogenic.

Ribes spicatum E. Robson – R, Sp, [LR-nt]. The lowland species, observed only in the stream valley, with the most elevated locality at altitude of 655 m in the valley of Kudowski Potok.

Ribes rubrum L. – F, Ef. Observed in the villages and along the roads as rest of plantation and in the settlements. More frequent as *R. spicatum*, goes up to altitude of 900 m (near the shelter house on the Mt Szczeliniec Wielki, KS 1995).

Ribes aureum L. – VR, Ef. Only as relic of plantations in Karlów (750 m, KS 1995) and W of Wolany (390 m, KS 1996).

Ribes nigrum L. – R, Sp(Ap), [LR-nt]. Probably natural in the forest on the stream bank N of Borek (460 m, KS 1996) and in Polanica above the pond (375 m, KS 1996), found also in two anthropogenic localities at altitude of 660 m.

Ribes uva-crispa L. – C, Sp, [Nt]. The natural stands observed at elevations of 355–755 m, higher only anthropogenic (as near the shelter house on the Mt Szczeliniec Wielki at 910 m, KS 1994).

ROSACEAE

Spiraea salicifolia L. – R, Ap. Frequently used as hedge plant and sporadically becomes wild, for example in the Bystrzyca valley (500 m, KS 1996) and in Karlów (780 m, KS 1994–1996).

Spiraea ×vanhouttei Zab. – VR, Ef. Planted near Szczytnik castle (540 m, KS 1996).

Spiraea douglasii Hook. – VR, Ef. Roadside near Szczytna (375 m, KS 1996).

Sorbaria sorbifolia (L.) A. Braun – VR, Ef/Ne. Observed sporadically in Polanica as became wild (370–390 m, KS 1996).

Cerasus avium (L.) Moench – C, Sp, [Nt] (380–770 m).

Prunus spinosa L. – C, Sp, [Nt]. Commonly, but only up to 570 m.

Prunus insititia L. – F, Ne. Frequently observed on the balks and along the roads up to altitude of 450 m, mostly as planted, but also naturalized.

Padus avium Mill. – C, Sp, [Nt]. Frequently along the streams in the submontane belt of the whole area up to altitude of 600 m; in Pasterka (720 m, KS 1992) probably only naturalised.

Padus serotina (Ehrh.) Borkh. – VR, Ne. Piekielna Dolina between Szczytna and Polanica (430 m, KS 1996).

Rosa dumalis Bechst. em. Boulenger – F, Sp, [Nt]. Submontane-mountain species, but only one locality higher than 600 m; numerous transitive forms to *Rosa canina* L.

Rosa canina L. – C, Sp, [Nt] (380–785 m). Mostly as form with leaflets somewhat glandular beneath known as *R. squarrosa* (Rau.) Bor. (Rutkiewicz 1998), or more rarely with leaflets hairy (*R. dumetorum* Thuill.).

Rosa multiflora Thunb. – VR, Ef. Between Słowoszów and Bad Duszniki in closed stone-pit (560 m, KS 1995).

Rosa pendulina L. – C, Sp, [Nt] (395–790 m).

Rosa rugosa Thunb. – R, Ef(Ne). Planted and becoming naturalized in the villages and surrounding areas (Batorówek, Karlów, Łężyce, Złotno, etc.) up to altitude of 750 m.

Rosa sherardii Davies – R, Sp, [LR-nt]. Only two localities in Ocieszów (500 and 540 m, KS 1992) and one near the road Szczytna-Batorów (500 m, KS 1993), all of them on convex, S and SE-facing slopes.

Rosa villosa L. – VR, Ap? Probably naturalized in Szczytna (450 m, KS 1996).

Rosa agrestis Savi – Sp, [Ex]. Reported from Bad Kudowa (Limpricht 1944), but not confirmed.

Rosa rubiginosa L. – VR, Sp, [LR-nt]. Reported from Bad Duszniki and Kudowa (Limpricht 1944); several individuals found on Świni Grzbiet at altitudes of 480–500 m (KS 1997).

Malus sylvestris Mill. – F, Sp, [Nt]. Most of localities in the submontane belt with the altitudinal maximum at 710 m in Ludowe (KS 1992).

Malus domestica Borkh. – F, Ef. Frequently planted along the roads.

Pyrus communis L. – Vf, Sp(Ap), [Nt]. In the submontane belt, with altitudinal maximum at 710 m.

Sorbus aucuparia L. – C, Sp, [Nt], (350–910 m).

Sorbus torminalis (L.) Crantz – VR, Ap. Seedlings near the old specimen in Polanica (380 m, KS 1996).

Crataegus monogyna Jacq. – C, Sp, [Nt] (375–750 m).

Crataegus ×macrocarpa Hegetschw. – F, Sp, [Nt]. Frequently at altitudes between 400 and 580 m, on the more elevated only sporadically as between Ludowe and Zielone at 670 m (KS 1996) and near Łężyce at 700 m (KS 1995).

Crataegus laevigata (Poir.) DC. – Vf, Sp, [Nt]. Very frequently in the submontane belt but not higher than 580 m.

Crataegus rhipidophylla Gand. ssp. *rhipidophylla* – VR, Sp, [DD]. Along the forest edges near Wambierzyce (420 m, KS 1995).

Crataegus ×subsphaericea Gand. – VR, Sp, [DD]. Roadside near Ocieszów (530 m, KS 1996).

Crataegus ×media Bechst. – F, Sp, [Nt] (420–650 m).

Cotoneaster integerrimus Medik. – VR, Sp, [CR]. Known from only two probably natural localities: the calcareous rock above Czernica (680 m, Gołąb, Szefer 1996); hill above the road between Lewin Kłodzki and Jeleniów (430 m, KS 1996).

Amelanchier ovalis Medik. – VR, Ef(Ne). Forest edge above Szczytna (460 m, KS 1996).

Rubus angustipaniculatus Holub – VR, Sp, [DD]. Slopes on Mt Hamula near Batorów (550 m, KS 1992).

Rubus caesius L. – C, Sp, [Nt]. Commonly at altitudes 380–700 m, exceptionally higher.

Rubus idaeus L. – C, Sp, [Nt] (375–910 m).

Rubus fabrimontanus (Sprib.) Sprib. – VR, Sp, [DD]. Thickets near Ostra Góra (520 m, KS 1995).

Rubus hirtus Waldst. et Kit. – F, Sp, [Nt] (620–750 m).

Rubus koehleri Weihe – VR, Sp, [DD]. Forest edges near Radków (420 m, KS 1996), forest road near Batorówek (620 m, KS 1992).

Rubus kuleszae Ziel. – VR, Sp, [DD]. Roadside in Czerdna (420 m, KS 1995). Occurs only in Poland and Czech Republic (Zieliński 1996), not reported from the Stolowe Mts.

Rubus nessensis Hall. – VR, Sp, [DD]. Found on three localities but most probably more frequent (400–720 m).

Robus pedemontanus Pinkw. – F, Sp, [Nt] (405–800 m).

Rubus plicatus Weihe & Ness – R, Sp, [Nt] (440–490 m).

FABACEAE

Caragana arborescens Lam. – VR, Ef. Planted on the rocks near Szczytnik castle (540 m, KS 1996).

Genista germanica L. – R, Sp, [LR-nt]. Three stands on wayside between Wolany and Batorów (410, 425, 620 m, KS 1994, 1996), one locality near the forest road between Batorów and Borowina (580 m, KS 1996), in single specimens only.

Genista tinctoria L. – Vf, Sp, [Nt]. Frequent in the Grodziec massif up to altitude of 730 m and in vicinity of Duszniki (Ceglana Góra, Grzywacz); in the Stoliwo portion sporadically, to 705 m on wayside near Wielkie Torfowisko Batorowskie (KS 1993).

Genista pilosa L. – Sp, [Ex]. Reported from the vicinity of Polanica and Szczytna (Schube 1903, Limpricht 1944); not confirmed during last 50 years.

Chamaecystis ratisbonensis (Schaeff.) Rothm. – Sp, [Ex]. Reported from the vicinity of Szczytna (WSRL, Fiek 1881; quoted by Schube 1903, Limpricht 1944 and Zieliński 1975); not confirmed during last 50 years.

Chamaecystis supinus (L.) Link – R, Sp, [Nt]. Frequently near Wolany, Polanica and Szczytna, up to altitude of 500 m (Petrowicz 1980, KS 1991, 1996), reported also from Homole (Limpricht 1944).

Lembotropis nigricans (L.) Griseb. – Sp, [Ex]. Reported from Batorów (near glasswork) (Schube 1903, Limpricht 1944), not found.

Sarothamnus scoparius (L.) Wimm. – F, Ap (?), [Nt]. Probably only planted on the way escarpments and naturalized; altitudinally up to 670 m.

Robinia pseudoacacia L. – F, Ne. Frequently observed near settlements in submontane layer; getting wild and entering natural forest communities. The highest locality near Kociołek (610 m, KS 1995).

THYMELAEACEAE

Daphne mezereum – C, Sp, [Nt]. Common in lower montane layer up to an altitude of 750 m.

TILIACEAE

Tilia cordata Mill. – C, Sp, [Nt]. Commonly up to altitude of 770 m, but above 680 m only planted; numerous large trees among settlements.

Tilia platyphyllos Scop. – F, Sp, [LR-lc]. The natural localities probably only on Świni Grzbiet near Bad Kudowa, near Polanica and Wolany, at altitudes of 350–500 m, the other anthropogenic, the highest (640 m) in Pośna valley including (Pender, Macicka-Pawlik 1996, KS 1996).

ACERACEAE

Acer platanoides L. – C, Sp, [Nt]. Naturally 380–785 m, planted at higher elevations, such as near the shelter house on Mt Szczeliniec Wielki at 910 m (KS 1992).

Acer pseudoplatanus – C, Sp, [Nt] (370–850 m).

Acer campestre L. – VR, Ap/Sp? On Mt Parkowa in Bad Kudowa may be natural (420 m, KS 1996); all other found localities come from plantation, the highest (750 m, KS 1994) in Karlów including.

HIPPOCASTANACE

Aesculus hippocastanum L. – C, Ne. Commonly planted in settlements, enters in the neophyte stage; the most elevated locality in Paterka at 710 m (KS 1992–1996).

SOLANACEAE

Lycium barbarum L. – VR, Ne. Jeżykowice (470 m, KS 1995) and Szczytna (450 m, KS 1996).

Solanum dulcamara L. – R, Sp, [DD]. Near Szczytna (“Pelzeteich”), deteriorated low peat-bog, (460 m, KS 1996), but Weretelnik (1990) reports this species as common in Polanica, Kudowa and Duszniki.

CELASTRACEAE

Euonymus europaea L. – Vf, Sp, [Nt]. Frequently up to the altitude of 600 m; reported from Mt Rogowa Kopa, probably erroneously (Krawiecowa 1966).

RHAMNACEAE

Frangula alnus (L.) Mill. – C, Sp, [Nt] (370–800 m).

Rhamnus catharticus L. – VR, Sp, [LR-lc]. On roadside escarpments near Polanica (400 m, KS 1996) and on the Mt Gajowa near Duszniki (550 m, KS 1996).

CORNACEAE

Cornus sanguinea L. – Vf, Sp, [Nt]. Exclusively in the submontane layer, up to altitude of 550 m.

Cornus sericea L. – R, Ne. In settlements, but also naturalizing; the most elevated locality E of Karlów on the way side, at an altitude of 750 m (KS 1992–1997).

Cornus mas L. – VR, Ef. Single specimen in the Karlówek ruins at an altitude of 750 m (KS 1994).

ARALIACEAE

Hedera helix – R, Sp, [LR-lc]. Only vegetative individuals: Piekielna Dolina between Szczytna and Polanica (420, 425 m, KS 1996), forest near Borek (460 m, KS 1996), forest W of Wambierzyce (525 m, KS 1994), slopes of Darnkowskie Hills above the pond in Darnków (510 m, KS 1995); the stream gorge SE of Kłodowisko (610 m, KS 1996); commonly on Świni Grzbiet in Bad Kudowa (440–480 m, KS 1997). Frequently planted in the settlements, where forms flowers, also on the highest stand in Batorów at an altitude of 540 m (KS 1992).

ERICACEAE

Andromeda polifolia L. – VR, Sp, [CR]. Reported from Wielkie Torfowisko Batorowskie (Limpricht 1944), confirmed recently (AB and ZG 1996, Potocka 1999).

Arctostaphylos uva-ursi (L.) Sprengel. – Sp, kat. [Ex]. Reported from the vicinity of Szczytna (Fiek 1881), not confirmed.

Calluna vulgaris L. – C, Sp, [Nt], (405–915 m).

Vaccinium myrtillus L. – C, Sp, [Nt], (390–910 m).

Vaccinium vitis-idaea L. – C, Sp, [Nt], (410–910 m).

Vaccinium uliginosum L. – R, Sp, [LR-cd]. Only in the most elevated parts, between 710 and 905 m, on the peat bogs and opened sandstone rocks. In the past more common (Schube 1903).

Oxycoccus palustris Pers. – VR, Sp, [VU]. Still exists on Wielkie Torfowisko Batorowskie at altitude of 710 m; on the other localities: Małe Torfowisko Batorowskie and peat bogs of the top of Mt Skalniak (Limpricht 1944) extinct.

Ledum palustre L. – VR, Sp, [CR]. Wielkie Torfowisko Batorowskie, only a few individuals (AB 1996, ZG 1996, Świerkosz 1996, Marek 1998, Potocka 1999); reported from Małe Torfowisko Batorowskie (Limpricht 1944), but extinct at this locality (Boratyński 1990).

Rhododendron luteum L. – VR, Ap. Planted on the Mt Szczeliniec Wielki (Tyszkowski, personal communication, Hryniewicz-Sudnik personal communication).

Erica tetralix L. – Erroneously reported from Wielkie Torfowisko Batorowskie (Rękoś 1977), probably in fact *Empetrum nigrum*.

EMPETRACEAE

Empetrum nigrum L. – R, Sp, [LR-cd]. Mt Szczeliniec Wielki (Boratyński 1986, AB 1990–1997, KS 1993–1997), Mt Mały Szczeliniec, sandstone rocks from NE side (870 m, KS 1997), Wielkie Torfowisko Batorowskie, a few individuals only (710 m, KS 1994), Lisi Grzbiet, on sandstone rocks (Tyszkowski, personal communication, 860 m, KS 1996).

OLEACEAE

Fraxinus excelsior L. – C, Sp, [Nt] (360–790 m).

Syringa vulgaris L. – Vf, Ne (370–770 m). Frequently planted in settlements and naturalizing on the way side thicket communities (*Rhamno-Prunetea* class) or forming its own community.

Ligustrum vulgare L. – F, Sp(Ap). On the sunny slopes of the Bystrzyca valley probably natural, all other localities anthropogenic, but do not goes higher than 580 m.

CAPRIFOLIACEAE

Sambucus nigra L. – C, Sp, [Nt] (370–770 m).

Sambucus racemosa L. – C, Sp, [Nt] (470–910 m).

Lonicera xylostemum L. – Vf, Sp, [LR-lc]. In the submontane layer only, up to an altitude of 600 m.

Lonicera nigra L. – C, Sp, [LR-lc]. At altitudes between 430–790 m, mostly in montane layer (80% of localities).

Lonicera tatarica L. – VR, Ef (Ne). In vicinity of Duszniki (510–515 m, KS 1996) and Jeleniów (520 m, KS 1996), may be naturalized.

Lonicera peryclimenum L. – VR, Sp?, [LR-nt]. Piekielna Dolina near Polanica (380 m, KS 1996), possible natural.

Viburnum opulus L. – C, Sp, [Nt] (370–790 m).

Symphoricarpos albus (L.) S. F. Blake – C, Ne. Planted and naturalised, the most elevated stands in Pasterka (700 m, KS 1994–1996).

Synanthropodynamic analysis

From Stołowe Mts 153 taxa of trees and shrubs were reported. Two species (*Betula nana* L. and *Erica tetralix* L.) were probably reported in error, and 7 are now extinct. The 144 taxa of trees and shrubs were found in the natural and semi-natural site conditions of the Stołowe mountains, 110 native taxa and 34 anthropophytes. The 44 native taxa (including extinct species) belong to various local red data book categories, the 63 are not endangered (the species and/or natural hybrids) and next 10 are apophytes.

The spontaneophytes locally extinct and endangered in various degrees include:

1. The extinct or probably extinct species (cat. Ex):
Arctostaphylos uva ursi (L.) Sprengel
Chamaecytisus ratisbonensis (Schaeff.) Rothm.

- Genista pilosa* L.
Lembotropis nigricans (L.) Griseb.
Rosa agrestis Savi
Salix lapponum L.
Salix myrtilloides L.
2. Species extinct in wild (cat. EW):
Taxus baccata L.
3. The species critically endangered and becoming extinct (cat. CR), found in single specimens, or in populations of no more than 50 individuals:
Juniperus communis L. subsp. *communis*
Ledum palustre L.
Andromeda polifolia L.
Cotoneaster integerrimus Medic.
4. The endangered species (cat. EN), with number of individuals not more than 250, and with high probability of extinction:
Pinus mugo Turra
Pinus uliginosa Neumann
5. The vulnerable species (cat. VU) with number of individuals less than 1000 or frequent, but with factors strongly influencing on the population
Salix rosmarinifolia L.
Oxycoccus palustris Pers.
Ulmus glabra Hudson
Betula carpatica Ehrh. subsp. *carpatica* (Willd.) Asch. et Graebn
5. Rare species, known from small or few populations, but without any known factors threatening or influencing on populations (kat. LR-cd, LR-nt) and near common but slowly decreasing number of individuals (cat. LR-lc):
- 5.1. Conservation dependent (-cd)
Vaccinium uliginosum L.
Empetrum nigrum L.
- 5.2. Near threatened (-nt)
Berberis vulgaris L.
Ribes alpinum L.
Ribes nigrum L.
Ribes spicatum E. Robson
Rosa rubiginosa L.
Rosa sherardii Davies
Lonicera periclymenum L.
Genista germanica L.
- 5.3. Least concern (-lc)
Salix silesiaca Willd.
Tilia platyphyllos Scop
Abies alba Mill.
Rhamnus catharticus L.
Hedera helix L.
Lonicera xylosteum L.
Lonicera nigra L.
6. Taxa with undetermined threat (cat. DD – data deficient), need further research:
Crataegus ×subsphericea Gand.
Crataegus rhipidophylla Gand. subsp. *rhipidophylla*
Viscum album L.

Rubus angustipaniculatus Holub
Rubus fabrimontanus (Sprieb.) Sprieb.
Rubus koehleri Weihe
Rubus kuleszae Ziel.
Rubus nessensis Hall.
Solanum dulcamara L.

The most common **apophytes**, which are naturalizing in the Stołowe mountains include *Larix decidua* Mill., *Spiraea salicifolia* L., *Sarothamnus scoparius* (L.) Wimm., *Acer campestre* L. and *Ligustrum vulgare* L. The most common of them is *Larix decidua*, which is also frequently planted as a forest tree.

The **kenophytes** are represented by 13 species and only a few of them are locally somewhat invasive. To this category belong *Pinus strobus* L., *Thuja plicata* D. Don., *Quercus rubra* L., *Populus ×canadensis* Moench, *Philadelphus coronarius* L., *Prunus insititia* L., *Padus serotina* (Ehrh.) Borkh., *Robinia pseudoacacia* L., *Aesculus hippocastanum* L., *Lycium barbarum* L., *Cornus sericea* L., *Syringa vulgaris* L., *Symphoricarpos albus* (L.) S. F. Blake.

Chorological analysis

A few groups of species can be distinguished, which are characterized with specific reaction to the growth of the altitude of localities. The distinct limit in the altitudinal ranges of the woody species occur at elevation of 580–600 m. This altitude was considered as the limit between submontane and montane belts in the Stołowe mountains (Świerkosz 1998). The other characteristic altitude is located at about 700 m, which attain the lowland-montane species. These differentiations allow distinguishing several groups of non-synanthropic spontaneophytes.

To the **lowland-submontane** category belong taxa with distinct altitudinal limit at about 580–600 m. This elevation can be somewhat higher only locally, on the S-facing slopes of Mt Grodziec, in the Kudowski Potok valley and on the southern slopes near Łężyce. This group includes taxa: (in the brackets altitudinal maximum) *Lonicera periclymenum* (380), *Crataegus rhipidophylla* subsp. *rhipidophylla* (420), *Berberis vulgaris* (425), *Ribes nigrum* (460 – natural), *Solanum dulcamara* (460), *Rubus plicatus* (490), *Chamaecytisus supinus* (500), *Crataegus ×subsphericea* (530), *Rosa sherardii* (540), *Rhamnus catharticus* (550), *Cornus sanguinea* (550), *Prunus spinosa* (570), *Salix viminalis* (600 – natural), *Padus avium* (610 – natural), *Hedera helix* (610), *Genista germanica* (620), *Ribes spicatum* (655).

The locally **submontane species** form the next group, which overlaps those with 70% of localities in the submontane layer, but sometimes entering elevations of above 600 m. To this group can be included such species as *Tilia cordata* (680 – natural), *Carpinus betulus* (695), *Salix rosmarinifolia* (690), *Quercus robur* (700), *Q. petraea* (700), *Crataegus ×macrocarpa* (700),

Malus sylvestris (710), *Pyrus communis* (710), *Genista tinctoria* (730), *Rosa dumalis* (730), *Alnus glutinosa* (735 – natural).

To **montane** group belong taxa, which occur only in the montane belt, and his lower elevation limit is about 600 m. It is possible to distinguish three groups of this species:

- a) **montane**, which lower limit of distribution not exceeding altitude of 600 m: *Pinus mugo* (850), *Salix silesiaca* (600–880), *Betula pubescens* ssp. *carpatica* (710–915).
- b) **relatively montane**, which have more than 70% localities in this belt, sometimes occurring below this altitude: *Sambucus racemosa*, *Lonicera nigra*, *Rosa pendulina*, *Betula ×petraea*, *Abies alba*.
- c) **locally montane** of peatbogs, which grows mainly in Wielkie Torfowisko Batorowskie with some additional localities on sandstone's of Skalniak and Szczeliniec Massif: *Oxycoccus palustris* (710), *Ledum palustre* (710), *Andromeda polifolia* (710), *Pinus ×rhaetica* (710–850), *Vaccinium uliginosum* (710–905), *Empetrum nigrum* (710–910). The same kind of relationship was found in Western Sudetes (Boratyński 1991), when the peatbog species occurs only in the montane belt.

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