

Rock vascular plant species of the Kraków-Częstochowa Uplands

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Abstract: The present work is based on results of own field studies carried out in the area of Kraków-Częstochowa Uplands in the period 1999-2004 as well as on data from other authors, derived from literature, herbarium collections and the current database of Distribution Atlas of Vascular Plants in Poland (ATPOL). Distribution of species was presented using the cartogramme method – the study area was divided according to ATPOL principles into 660 basic study fields (2 km by 2 km squares). The flora of Kraków-Częstochowa Uplands includes 1441 species of permanently naturalised vascular plants. This is the region with the high number of rock plant species (Tab. 1). Most of them belong to *Lamiaceae* and *Rosaceae*. They are mostly grassland (*Festuco-Brometea*) or rock cervices (*Asplenietea rupestris*) species, mainly hemicryptophytes and herbaceous chamaephytes. Rock species of the study area generally prefer full light, warm climate conditions and dry soils. The highest concentration of their localities was recorded from the southern part of Kraków-Częstochowa Uplands, especially within the territory of Ojców National Park.

Keywords: rock species, epilithic plants, lithophytes, petrophytes, chomophytes, chasmophytes, vascular plants, distribution, phytogeography, Kraków-Częstochowa Uplands, Poland

Introduction

Rock species are among the more interesting elements of the flora. They occur predominantly in mountainous areas, but many of them can be found as well in upland areas or even on lowlands. Vegetation on rocks depend on several factors like altitude, composition of the rock, slope of the surface and water conditions.

In general rock plants are called lithophytes. They are Cryptogams (Algae, Lichens, Mosses) and vascular plants which are all typically xerophytes. Moreover among rock plant species chomophytes and chasmophytes are sometimes distinguished (HORWOOD 1919, PODBIELKOWSKI 1995). Chomophytes are plants that occur on the surface rocks where detritus has accumulated whereas chasmophytes are crevice plants. It's difficult to divide the two groups because these pass into one another (TANSLEY 1965).

The Kraków-Częstochowa Uplands, also known as Kraków-Częstochowa Jura, is a region with an especially rich vascular flora. This is caused chiefly by its location on the watershed which divides Odra and Vistula rivers in direct vicinity of the Carpathians and at the same time not very distant from the Sudeten. A floristic monograph of Kraków-Częstochowa Uplands has recently been published (URBISZ 2004), prepared on the basis of an ample (more than 200 thousand records) database which was used for the present study as well. The aim of the study is to present the diversity of rock species and the characteristics of their distribution within the study area.

Study area

The Kraków-Częstochowa Uplands is located in southern Poland, occupying an area of 2615 km² (KONDRACKI 1988). A characteristic landscape element in this area are limestone rocky outcrops and inselbergs of various shapes. The average elevation in this area is ca. 350-400 m a.s.l. The highest points are Góra Zamkowa with the ruins of Ogródzieniec Castle on top of it (515.5 m a.s.l.) and hilltop rocks near Jerzmanowice (512.8 m a.s.l.). Poor podsol soils derived from sands and clays occur in the greater part of Kraków-Częstochowa Uplands, with more fertile brown soils developing on loess dominant only in the centre and east of the area. Calcareous rendzinas are also often encountered here, usually accompanying limestone rocks (MUSIEROWICZ 1961). The Kraków-Częstochowa Uplands is located on the watershed divides of main Polish rivers. Due to the occurrence of karst phenomena and high ground permeability, the density of waterways is very low here. There is a large diversity of climatic conditions – in the northern part of the area, the average annual rainfall is 600-700 mm, while in the southern part it is 700-800 mm. In comparison with neighbouring regions (Silesian Uplands, Nida Syncline), the climate is slightly cooler, with a higher average rainfall.

Methods

The cartogramme method was used to present the distribution of species – the study area was divided according to the principles of ATPOL (ZAJĄC 1978) into 660 basic study fields (2 km by 2 km squares). As rock plants were included species which occur on the rocks in majority of its localities. The concentration of localities of rock species in the investigated area was presented using circles with their diameter proportional to the number of species occurring in each cartogram unit. The names of species and systematical affiliation were adopted from “*Flowering Plants and Pteridophytes of Poland a Checklist*” (MIREK et al. 2002). For particular species information concerning their taxonomy (family), phytosociological class (MATUSZKIEWICZ 2001), number of localities, life form and chosen ecological indicator values (ZARZYCKI et al. 2002) were included.

Results and discussion

Rock plants (59 species) are a very important group of plants which determine the floristic peculiarity of Kraków-Częstochowa Uplands. The percentage share of this group of species in the native flora of Kraków-Częstochowa Uplands is 4%. Compared to the adjacent regions (Silesian Uplands and Nida Syncline) 16 rock species differentiate the study area: *Allium montanum*, *Asplenium viride*, *Carex pediformis*, *Cotoneaster integerrimus*, *C. niger*, *Festuca pallens*, *Galium cracoviense*, *Hieracium bifidum*, *H. caesium*, *Jovibarba sobolifera*, *Melica transsilvanica*, *Phyllitis scolopendrium*, *Saxifraga paniculata*, *S. tridactylites*, *Thymus praecox* and *Valeriana tripteris* (URBISZ 2008).

A full listing of rock species in the investigated area with their characteristics is provided in Tab. 1. Most of them belong to *Lamiaceae* (10 species), *Rosaceae* (8), *Aspleniaceae* (4), *Crassulaceae* (3), *Poaceae* (3), *Rubiaceae* (3) and *Violaceae* (3) families and represent 8 phytosociological classes. They are most often grassland species (*Festuco-Brometea* – 35, *Seslerietea varia* – 5, *Koelerio glaucae-Corynephorsetea canescentis* – 3, *Trifolio-Geranietaea sanguinei* – 1) or rock cervices and debris plants (*Asplenieta rupestris* – 8, *Thlaspieta rotundifolii* – 1); more rarely forest and shrubland plants (*Quercus-Fageteta* – 3, *Rhamno-Prunetea* – 3). Lithophytes are mostly hemicryptophytes (35) and herbaceous chamaephytes (12); less often nanophanerophytes (5), geophytes (4) and therophytes (3). Most of rock species are frequent (17), very frequent (15) and scattered (12). Majority of them are light-demanding species (Fig. 1.), preferring warm climate conditions (Fig. 2.) and dry soils (Fig. 3.).

Many of rock species reach their northern geographic range boundary in Kraków-Częstochowa Uplands. For some species this extends as far as Warta Gorge (*Asplenium viride*, *Cotoneaster integerrimus*, *Phyllitis scolopendrium*), for others the boundary is formed by Smoleń-Niegowonice Hill Chain (*Campanula rotundifolia*, *Thesium alpinum*) or the hill chain located along the line Wolbrom-

Krzeszowice (*Allium montanum*, *Festuca pallens*, *Melica transsilvanica*, *Thesium linophyllum*, *Thymus kosteleckyanus*, *T. marschallianus*). A few species (*Knautia kitaibelii*, *Saxifraga paniculata*, *Valeriana tripteris*) were also recorded here which outside of the study area occur in Poland exclusively in the mountains (URBISZ 2008).

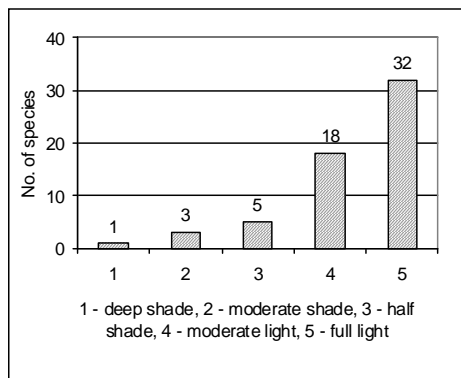


Fig. 1. Rock species – light values

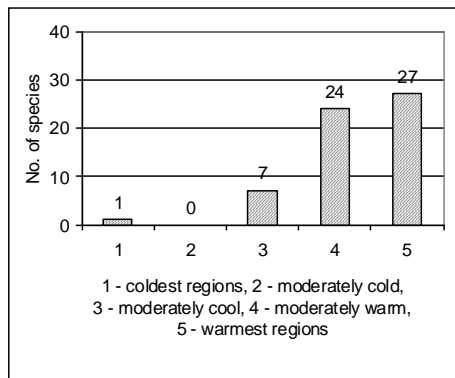


Fig. 2. Rock species - temperature value

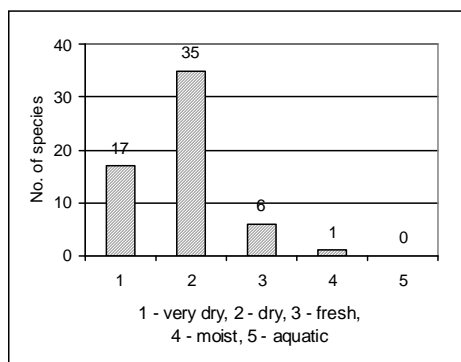


Fig. 3. Rock species - soil moisture value

It's significant that among this species 5 (*Carex pediformis*, *Cerasus fruticosa*, *Dianthus gratianopolitanus*, *Galium cracoviense* and *Thymus praecox*) were included in the *Polish red data book of plants* (KAŻMIERCZAKOWA, ZARZYCKI (eds.) 2001) and 14 in the *Red list of plants and fungi in Poland* (MIREK et al. (eds.) 2006).

It has been established that the highest concentration of localities of rock species occurs in the southern part of the Uplands, especially within the area of Ojców National Park (Fig. 4.). They become conspicuously more scarce towards the north – there are, however, significant concentrations near Olsztyn, in the Parkowe, Góra Zborów, Smoleń nature reserves and in the vicinity of Niegowonice.

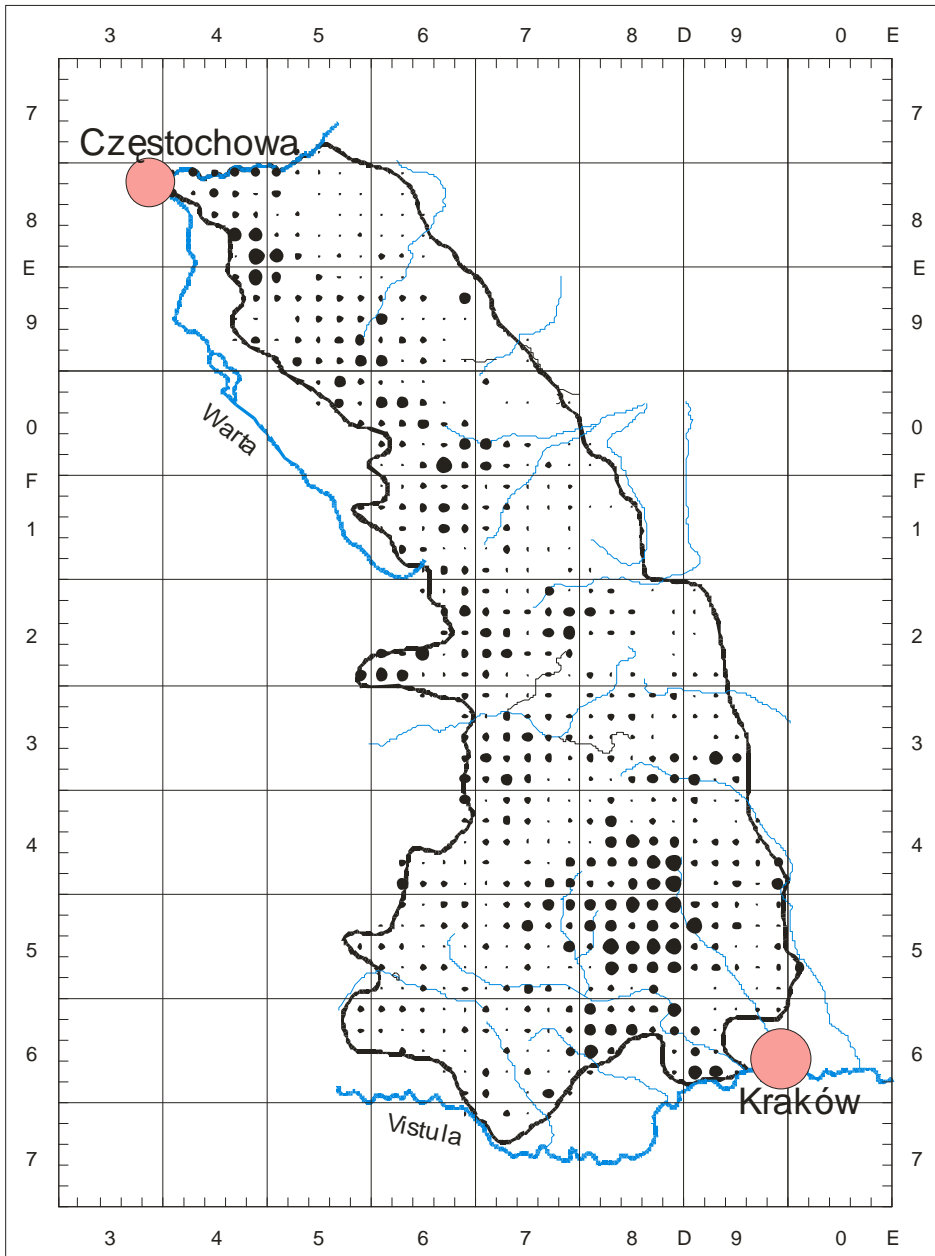


Fig. 4. Concentration of localities of rock plants in the study area (size of circles is proportional to number of species occurring in specific square)

Tab. 1. Rock species of the Kraków-Częstochowa Uplands.

| Species name | I | II | III | IV | V |
|-------------------------------------------------|---------|-----|----------|-----|-----|
| <i>Acinos arvensis</i> (Lam.) Dandy | Lam. | H T | Fest.Br. | VI | 189 |
| <i>Ajuga genevensis</i> L. | Lam. | H | Fest.Br. | V | 109 |
| <i>Alchemilla glaucescens</i> Wallr. | Ros. | H | Fest.Br. | III | 29 |
| <i>Allium montanum</i> F. W. Schmidt | Alliac. | G | Fest.Br. | IV | 52 |
| <i>Anthericum ramosum</i> L. | Anth. | G | Tri.Ger. | IV | 68 |
| <i>Arabis hirsuta</i> (L.) Scop. | Bras. | H | Fest.Br. | V | 107 |
| <i>Asperula cynanchica</i> L. | Rub. | H | Fest.Br. | V | 155 |
| <i>Asperula tinctoria</i> L. | Rub. | H | Fest.Br. | III | 25 |
| <i>Asplenium ruta-muraria</i> L. | Aspl. | H | Asp.Rup. | V | 141 |
| <i>Asplenium trichomanes</i> L. | Aspl. | H | Asp.Rup. | V | 142 |
| <i>Asplenium viride</i> Huds. | Aspl. | H | Asp.Rup. | III | 24 |
| <i>Campanula rotundifolia</i> L. | Cam. | H | Kg.Cc. | VI | 177 |
| <i>Carex pediformis</i> C. A. Mey. | Cyp. | H | Fest.Br. | I | 4 |
| <i>Cerasus fruticosa</i> Pall. | Ros. | N | Rh.Prun. | II | 13 |
| <i>Cotoneaster integerrimus</i> Medik. | Ros. | N | Rh.Prun. | IV | 47 |
| <i>Cotoneaster niger</i> (Thunb.) Fr. | Ros. | N | Rh.Prun. | IV | 38 |
| <i>Cystopteris fragilis</i> (L.) Bernh. | Wood. | H | Asp.Rup. | V | 125 |
| <i>Dianthus gratianopolitanus</i> Vill. | Car. | C | Fest.Br. | I | 1 |
| <i>Epilobium collinum</i> C. C. Gmel. | Onag. | H | Asp.Rup. | IV | 50 |
| <i>Erysimum odoratum</i> Ehrh. | Bras. | H | Fest.Br. | III | 28 |
| <i>Euonymus verrucosa</i> Scop. | Cel. | N | Q.Fag. | VI | 219 |
| <i>Festuca pallens</i> Host | Poac. | H | Fest.Br. | IV | 43 |
| <i>Galium cracoviense</i> Ehrend. | Rub. | H | Fest.Br. | I | 5 |
| <i>Gymnocarpium robertianum</i> (Hoffm.) Newman | Dryop. | G | Thl.Rot. | IV | 41 |
| <i>Hieracium bifidum</i> Kit. ex Hornem. | Ast. | H | Ses.Var. | III | 24 |
| <i>Hieracium caesium</i> (Fr.) Fr. | Ast. | H | Ses.Var. | II | 13 |
| <i>Jovibarba sobolifera</i> (Sims) Opiz | Cras. | C | Ses.Var. | V | 91 |
| <i>Knautia kitaibelii</i> (Schult.) Borbás | Dips. | H | Ses.Var. | I | 2 |
| <i>Libanotis pyrenaica</i> (L.) Bourg. | Apiac. | H | Fest.Br. | IV | 71 |
| <i>Melica transsilvanica</i> Schur | Poac. | H | Fest.Br. | III | 22 |
| <i>Phleum phleoides</i> (L.) H. Karkw. | Poac. | H | Fest.Br. | V | 114 |
| <i>Phyllitis scolopendrium</i> (L.) Newman | Aspl. | H | Q.Fag. | III | 17 |
| <i>Polypodium vulgare</i> L. | Polyp. | H | Asp.Rup. | V | 89 |
| <i>Potentilla arenaria</i> Borkh. | Ros. | H | Fest.Br. | IV | 71 |
| <i>Potentilla collina</i> Wibel s. l. | Ros. | H | Fest.Br. | IV | 63 |
| <i>Potentilla heptaphylla</i> L. | Ros. | H | Fest.Br. | IV | 61 |
| <i>Potentilla neumanniana</i> Rchb. | Ros. | H | Fest.Br. | III | 29 |
| <i>Primula veris</i> L. | Prim. | H | Fest.Br. | VI | 192 |
| <i>Ribes alpinum</i> L. | Gros. | N | Q.Fag. | V | 109 |
| <i>Saxifraga paniculata</i> Mill. | Sax. | C | Asp.Rup. | II | 7 |
| <i>Saxifraga tridactylites</i> L. | Sax. | T | Fest.Br. | IV | 48 |
| <i>Sedum acre</i> L. | Cras. | C | Kg.Cc. | VI | 328 |
| <i>Sedum sexangulare</i> L. | Cras. | C | Kg.Cc. | V | 121 |
| <i>Seseli annuum</i> L. | Apiac. | H | Fest.Br. | V | 125 |
| <i>Stachys recta</i> L. | Lam. | H | Fest.Br. | V | 87 |

Tab. 1. – cont.

| Species name | I | II | III | IV | V |
|--------------------------------------|--------|------|----------|-----|-----|
| <i>Teucrium botrys</i> L. | Lam. | H T | Fest.Br. | IV | 44 |
| <i>Thesium alpinum</i> L. | Sant. | H pp | Ses.Var. | I | 5 |
| <i>Thesium linophyllon</i> L. | Sant. | G pp | Fest.Br. | III | 21 |
| <i>Thymus austriacus</i> Bernh. | Lam. | C | Fest.Br. | IV | 36 |
| <i>Thymus glabrescens</i> Willd. | Lam. | C | Fest.Br. | IV | 37 |
| <i>Thymus kosteleckyanus</i> Opiz | Lam. | C | Fest.Br. | IV | 24 |
| <i>Thymus marschallianus</i> Willd. | Lam. | C | Fest.Br. | IV | 34 |
| <i>Thymus praecox</i> Opiz | Lam. | C | Fest.Br. | I | 5 |
| <i>Thymus pulegioides</i> L. | Lam. | C | Fest.Br. | VI | 437 |
| <i>Valeriana tripteris</i> L. | Valer. | H | Asp.Rup. | III | 24 |
| <i>Veronica spicata</i> L. | Scr. | C H | Fest.Br. | V | 118 |
| <i>Viola collina</i> Besser | Viol. | H | Fest.Br. | IV | 55 |
| <i>Viola hirta</i> L. | Viol. | H | Fest.Br. | V | 92 |
| <i>Viola rupestris</i> F. W. Schmidt | Viol. | H | Fest.Br. | III | 24 |

Explanations:

I - Families: *Alliac.* – Alliaceae, *Anth.* – Anthericaceae, *Apiac.* – Apiaceae, *Aspl.* – Aspleniaceae, *Ast.* – Asteraceae, *Bras.* – Brassicaceae, *Cam.* – Campanulaceae, *Car.* – Caryophyllaceae, *Cel.* – Celastraceae, *Cras.* – Crassulaceae, *Cyp.* – Cyperaceae, *Dips.* – Dipsacaceae, *Dryop.* – Dryopteridaceae, *Gros.* – Grossulariaceae, *Lam.* – Lamiaceae, *Onag.* – Onagraceae, *Poac.* – Poaceae, *Polyp.* – Polypodiaceae, *Prim.* – Primulaceae, *Ros.* – Rosaceae, *Rub.* – Rubiaceae, *Sant.* – Santalaceae, *Sax.* – Saxifragaceae, *Scr.* – Scrophulariaceae, *Valer.* – Valerianaceae, *Viol.* – Violaceae, *Wood.* – Woodsiaceae.

II - Life forms: C. – herbaceous chamaephytes, H. – hemicryptophytes, G. – geophytes, N. – nanophanerophytes, T. – therophytes, pp. – semi-parasites.

III - Phytosociological classes: *Asp.Rup.* - *Asplenieta rupestris*, *Fest.Br.* - *Festuco-Brometea*, *Kg.Cc.* - *Koelerio glaucae-Coryneporetea canescentis*, *Q.Fag.* - *Quercu-Fagetea*, *Rh.Prun.* - *Rhamno-Prunetea*, *Ses.var.* - *Seslerietea varia*, *Thl.rot.* - *Thlaspietea rotundifolii*, *Tri.Ger.* – *Trifolio-Geranietea sanguinei*.

IV - Categories of frequency: I – very rare (1-5 localities), II – rare (6-15), III - scattered (16-35), IV - frequent (36-75), V - very frequent (76-155), VI - common (>155).

V - Number of localities (cartogramme units).

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