THREATENED VASCULAR PLANTS OF THE SUDETEN MOUNTAINS

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ABSTRACT

The authors present a list of extinct, dying out and threatened species of vascular plants of the Sudeten Mts. (south-western Poland), based on their own field studies carried out since 1972, historical literature data, and herbarial collections. The list comprises 584 taxa, i.e. almost 33% of the Sudeten vascular flora. Sixty species were recognized as extinct and disappeared, 93 – as critically endangered, 161 – as endangered, 224 – vulnerable, and 12 – near threatened species. No definite kind of threat was ascribed to 34 taxa. Thus they were included in the group of „data deficient” species. The paper presents also a quantitative analysis of all the species from the particular threat categories at the background of basic phytosociological groups. Besides, exemplary maps of the distribution of some of the Sudeten plants are given.

KEY WORDS: Sudeten Mts., red list, vascular flora, categories of threatened species.

INTRODUCTION

The recently escalating phenomenon of dying out of plants as a result of the progressing degradation of the natural environment is one of the most apparent manifestations of the „civilization” influence of man. At the same time, the process of dying out is among the most often undertaken topics of scientific investigations. They concern the dying out of particular species, specific ecological or phytocoenotic groups, or the whole vascular flora – from regional to global. The problem of the decreasing species diversity of analysed areas is evidenced in so-called „red lists” (Lucas and Walters 1976; Council of Europe 1983; Niklefield 1986; Weed et al. 1990; Ingelög et al. 1993; Maglocký and Feráková 1993; Oltean et al. 1994; Korneck et al. 1996; Schnittler and Günther 1999; Holub and Procházka 2000, among others). However, apart from pure statistical listing, it is also important to indicate the most anthropopression-susceptible group of plants, which in further prospect should make a basis for studies of their behaviour in natural conditions – active preservation (reintroduction, metaplastation etc). Among others, for these reasons it is particularly significant to make an evaluation of the real threat of species in their habitats. Regional „red lists” were elaborated most of all in European countries and in the United States of America (e.g. Zimmermann and Kniely 1990; Welsh and Chatterley 1985; Murray and Lipkin 1987; Feráková 1988; Benkert and Klemm 1990; Fukarek 1992; Siwinski and Lightfoot 1992; Tibor 2001).

In Poland, apart from countrywide elaborations (Jasiewicz 1981; Zarzycki and Szlag 1992; Zarzycki et al. 2000) important regional lists of threatened taxa were published (Bróz 1990; Mirek and Piękos-Mirkowa 1992; Kucharczyk and Wójcik 1993; Żukowski and Jackowiak 1995; Rutkowski 1997). In the case of the Sudeten Mts., so far only an initial list of extinct and dying out species has appeared (Fabiszewski and Kwiatkowski 1997). The intensive field investigations, carried out recently, have answered a number of questions concerning the distribution of many vascular plants. New sites of species recognized as dying out, or even extinct were found, showing differences in comparison with the former elaboration (Fabiszewski and Kwiatkowski 1997). The authors hope, that this imperfect list will make a starting point for more intense floristic and chorological studies in that part of Poland, and exerions concerning the active protection of dying out populations.

INVESTIGATED AREA AND METHODS

The present elaboration concerns the Sudeten Mts. in a broad meaning, i.e. higher mountain ranges forming the Polish part of the Sudeten Mts., together with Sudeten Pla-
teau and the Sudeten Foreland. Its western boundary is set by the valley of the Lusatian Neisse (Nysa Łużycka), adjacent to the German territory (from Sieniawa, in the south to the town Pięśnik in the north). The northern and eastern border of this area runs NW-SE, connecting the towns: Pięśnik – Bolesławiec – Złotoryja – Jawor – Strzegom – Sobótka – Strzelin – Głucholazy, separating the Sudeten Plateau and the Sudeten Foreland from the neighbouring Silesian Lowland. Finally, the southern border of the territory is the national border of the Czech Republic. The region delimited in this way covers an area of 9335 km² (Fig. 1). The highest mountain range is the Karkonosze Mts. (Giant Mountains) (1602 m above sea level), where the climatic-floristic zones are best developed (most of all the subalpine and alpine zones). They are characterized by a high contribution of alpine plants, and particularly by the occurrence of endemic taxa (e.g. Hieracium corvanticum, Saxifraga mutschata subsp. basaltica). On the other hand, the area of the Izerskie Mts. is distinguished by the highest concentration of mountain-peat bogs. Finally, the Kaczawskie Mts. and the Śnieżnik Massif with numerous limestone outcrops, as well as the Kaczawskie Plateau, Strzegomskie and Niemczańsko-Strzelciski Hills, with preserved outcrops particularly of volcanic rocks, make habitats for the development of floristically diversified, xerothermic grasslands. In the Śleza Massif the peculiar flora, with the contribution of fissure ferns of the genus Asplenium, finds suitable habitats on the serpentine rocks unique in Poland.

Studies of the distribution of threatened species in the Sudeten Mts. were carried out by means of the topographic method in the years 1972-2002. In order to classify correctly to the particular threat categories, the results of our own field investigations were compared with data included in herbarial collections (KRA, KRAM, KTU, POZ, WRAB, WRSL – compare: Mirek et al., 1997) and in botanical literature. In particular the monographies of German florists from the 19th and 20th centuries were referred to (e.g. Wimmer 1857; Fiek 1881; Winkler 1881; Schube 1903; Pux 1928; Limprecht 1942, 1944a, 1944b), as well as floristic notes published in “Jahresberichte der Schlesiischen Gesellschaft für vaterländische Cultur”, edited by Schube and Schalow until 1945, or the data from the 60-ties, published in the „Atlas rozmieszczenia roślin naczyniowych na Śląsku” edited by J. Madalski. Among contemporary works the series of elaborations of rare components of the dendroflora of the Sudeten, edited by A. Boratyński, and the monographs of vascular flora of some mountain ranges (e.g. Šorek 1969; Szelag 2000), are especially worth to notice. Moreover, all the publications concerning both taxonomy and distribution of vascular plant species (among others: Hrodua and Marhold 1993; Chrtk 1997; Kwiatkowski 1999, 2000), as well as data included in phytosociological elaborations (e.g. Pender 1990; Pender and Macicka-Pawlík 1996) were used. The distribution of selected taxa is presented in point maps (Fig. 2). The nomenclature of species was accepted according to the elaboration of Mirek et al. (1995).

In order to qualify a species to a particular group of threat, the following criteria were considered: ecological criteria (degree of preservation of habitats and plant communities), biotope threats, chorological criteria (area of occurrence, number of localities and degree of their diffusion,
Fig. 2. The distribution of selected species in the Sudeten Mountains. Both localities recently confirmed by the authors (solid dots) and old, unconfirmed localities (empty dots) are shown.
contribution of endemic and relic taxa), population criteria (size and dynamics of population, number of mature individuals), and the present and anticipated influence of man.

In the present work six threat categories were accepted, according to the latest recommendations of IUCN (2001) and elaborations of Palmer et al. (1997) and Cøyvan et al. (1999). The category EXTINCT (EX) includes taxa that are completely extinct. The last specimens of these species were observed, in most cases, over 50 years ago, and some of them even in the 19th century. Most of the species occurred on single localities — e.g., Allium strictum on the Kazowski Plateau, Carex michelii on the Niemczanski Hills, Gymnadenia odoratissima in the Karkonosze Mts., Hymenopoa paludosus in the Kamienni Mts., Potentilla sterilis on the Izerkowski Plateau. Despite numerous trials, we failed in confirming their occurrence during the last 30 years. Into this group also species of the category EX — missing were included, which are probably extinct. Taxa of this group are marked in our list with an asterisk. This applies among others to the representatives of the genus Orsobanche. In this case there still exists a certain possibility of their localities confirmation.

The category of CRITICALLY ENDANGERED (CR) taxa includes plants which meet, among others, one of the following criteria: The area of their initial occurrence diminished recently, or shall diminish in the nearest future by at least 80% (e.g., Botrychium matricariifolium, Carex pulicaris, Gentianella campestris). They are frequently limited to only a single, isolated place of occurrence (Carex vaginata, Orchis ustulata, Saxifraga nivalis), or their very small localities are considerably distracted (Anemone sylvestris, Mehdago nititana, Stachys germanica). Finally, also plants, the number of mature specimens of which does not exceed 250 (Alchemilla coracorica, Leucorchis albida, Trifolium striatum etc) belong here. In the nearest future these taxa will probably become completely extinct.

ENDANGERED (EN) taxa, of high extinction probability in the near future. To this group species which area of occurrence will get reduced (or has already been reduced) at least by a half belong (e.g., Arnica montana, Cypripedium calceolus, Listera cordata). These are taxa with very dispersed and not abundant sites (Anthericum ramosum, Crepis pumascens, Potentilla reptans), or those known from not more than five localities (Cardaminopsis arenosa subsp. borbasii, Delphinium elatum, Gentianella germanica). A species belongs to the category also if the number of mature specimens does not exceed 250 — Carex magelanica, Cephalanthera damasonium, Oxyccocus microcarpus. For species of this category a reduction in number by at least 20% is foreseen in the next five years, or during two generations.

VULNERABLE (VU) taxa are relatively least threatened from so far mentioned categories, though the risk of their extinction is very high. This is true especially in the case when the impact of anthropogenic factors will persist. This category includes, among other, species known exclusively from less than ten sites (Diphasiastrum alpinum, Helleborus viridis, Ophiopogon scrophularioides), or from a greater number of dispersed localities (Eriophorum latifolium, Gymnadenia conopsea subsp. conopsea, Melitiss melissophyllum), including altogether less than 10,000 mature individuals (Allium sibiricum, Cephalanthera longifolia, Sorbus torminalis), and finally if their area of occurrence may get reduced in the future at least by 20% (Galanthus nivalis, Phyteuma orbiculare, Salvia verticillata).

In the present elaboration only some of the evaluated species were classified into the category of NEAR THREATENED (NT) taxa. This group includes only such taxa, which in our country have either their centre of occurrence only in the Sudeten (e.g., Chrysosplenium oppositifolium, Leucojum vernum subsp. vernum, Poa supina) and are at present not directly threatened by extinction, or species commonly regarded as rare plants or legally protected in Poland, but occurring commonly in the Sudeten Mts. — Carex bigelovii subsp. rigida, Epipactis helleborine group.

The last category includes DATA DEFICIENT (DD) taxa, for which the data are not sufficient for a direct or indirect determination of extinction risk. This group, rather numerous in the Sudeten Mts., includes plants with sites mentioned in the literature, several dozen of years old, or included in herbarial collections (e.g., Chenopodium vulvaria, Rosa jundzilli, Urticaria intermedia). It is difficult to determine unambiguously whether the given species is extinct or whether it is still represented by some small populations. Those are frequently species occurring ephemeral — particularly in lime-soil communities of the class Isoetio-Nanojuncetalia (among others Cyperus flavescens, genus Elatine, Lindernia procumbens), or weed associations in cereal crops of the class Secaletea — Anagallis foemina, Galium tricornutum, Kickxia spuria. Thus, there is frequently the possibility of finding them again. This remark concerns many other species belonging to this category of threat.

THE LIST OF THREATENED VASCULAR PLANTS OF THE SUDETEN MTS

Extinct (Ex) and missing (probably extinct* — ?Ex) taxa

Adenophora liliifolia (L.) Besser
Allium strictum Schrad.
Anacamptis pyramidalis (L.) Rich.
Arctostaphylos usua-ursi (L.) Spreng.
Botrychium multifidum (S.G. Gmel.) Rupr.
Bupleurum falcatum L.
Bupleurum rotundifolium L.
Camelina alyssum Thell.
Carex bukii Wimm.*
Carex chordorrhiza L.
Carex diotica L.
Carex michelii Host
Carex pediformis C.A. Mey.
Carex nigricata Huds.
Caucalis platycarpus L.
Chamaecycitis natusbonensis (Schaeff.) Rothm.*
Chimaphila umbellata (L.) W.P.C. Barton
Cladium mariscus (L.) Pohl
Cnidium dubium (Schkuhr) Thell.
Conioselinum tataricum Hoffm.
Conringia orientalis (L.) Dumort.
Cuscata epilimum (L.) L. s.s.
Cystopteris sudetica A. Braun & Milde
Dianthus speciosus Rail*
Diphasiastrum tristachyum (Pursh) Holub
Eriophorum gracile W.D.J. Koch
Euphorbia villosa Walstedt & Kit. ex Willd.
Gentianella uliginosa (Willd.) Börner
Geranium boehemicum L.*
Gymnadenia odoratissima (L.) Rich.
Hippuris vulgaris L.
Humulus paludosa (L.) Kuntze
Iris aphylla L.
Lindernia procumbens (Krook.) Borbás
Linnaea borealis L.
Lolium retortum Schrank
Lunularia nana (L.) Raf.
Nymphoides peltata (S.G. Gmel.) Kuntze
Orchis cornuta L.
Orchis palustris Jacq.
Orobancha alatavica Kirsch.*
Orobancha arenaria Borh.*
Orobancha flava Mart. et F.W. Schultz
Orobancha pumila F.W. Schultz
Potentilla sterilis (L.) Garcke*
Prunella laciniata (L.) L.
Pulsatilla vulgaris Mill.
Rhynchospora fusca (L.) W.T. Aiton
Salix myrsinifolia Salisb.
Salix myrtilloides L.*
Scorzonera purpurea L.
Spiranthes spiralis (L.) Chevall.*
Stellaria pullica (Dumort.) Piré*
Spergula pentandria L.
Tofieldia calycata (L.) Wahlenb.
Vaccaria hispanica (Mill.) Rauschert*
Veronica bellidioides L.*
Viola pumila Chaix
Viola stagnina Kit.
Woodia ilvensis (L.) R. Br.

Critically threatened (CR) taxa
Achillea stricta Schleich.
Adonis aestivalis L.
Aira praecox L.
Alchemilla coronica Plocek
Alchemilla obtusa Buser
Alchemilla reniformis Buser
Allium victoriae L.
Androscage obtusifolia All.
Anemone sylvestris L.
Arabis alpina L. subsp. alpina
Ameris maritima (Mill.) Willd. subsp. halleri (Wallr.) Å.
Löve & D. Löve
Asperula cynanchica L.
Asplenium onopteris L.
Astragalus cicer L.
Avenella planiculmis (Schrad.) W. Sauer & Chmelitschek
Botrychium matricariifolium (Retz.) A. Braun ex W.D.J.
Koch
Bupleurum longifolium L.
Cardamine resedifolia L.
Carex buxbaumii Wahlenb.
Carex capillaris L.
Carex humilis Leyss.
Carex pulicaris L.
Carex vaginata Tausch
Cephalanthera rubra (L.) Rich.
Cerastium fontanum Baumg.
Cirsium acaule Scop.
Coeloglossum viride (L.) Hartm.
Cyclamen purpurascens Mill.
Dactylorhiza incarnata (L.) Soó
Diaphasiastrum complanatum (L.) Holub
Elatine hydropiper L. em. Oeder
Epipogium aphyllum Sw.
Erica tetralix L.
Euphorbia lucida Waldst. & Kit.
Euphrosia micrantha Rechb.
Euphorbia minima Jacq.
Euphorbia pica Wimm.
Euphorbia tatarica Wettst.
Festuca versicolour Tausch
Galium anisophyllum Vill.
Galium sudeticum Tausch
Gentiana pneumonanthe L.
Gentianella baltica (Murb.) Börner
Gentianella campestris (L.) Börner
Gladus paluster Gaudin
Goodenia repens (L.) R. Br.
Helianthemum nummularium (L.) Mill. subsp. nummularium
Hieracium schmidtii Tausch
Hierochloë australis (Schrad.) Roem. & Schult.
Hierochloë odorata (L.) P. Beauv.
Isoetes lacustris L.
Lathyrus heterophyllus L.
Ledum palustre L.
Leucorchis albida (L.) E. Mey.
Linopyrum vulgare Cass.
Lythrum hyssopifolium L.
Malaxis monophylla (L.) Sw.
Medicago minima (L.) L.
Moneses uniflora (L.) A. Gray
Muscaria comosum (L.) Mill.
Ononis repens L.
Orchis militaris L.
Orchis morio L.
Orchis ustulata L.
Orobanche eliator Sutton
Orobanche purpurea Jacq.
Phyllis scolopendrium (L.) Newman
Pimpinella reptens Weide
Pinguicula vulgaris L. subsp. vulgaris
Poa bulbosa L.
Polygala amarella Crantz
Polytchistichum lonchitis (L.) Roth
Potamogeton trichoides Cham. & Schldl.
Pulmonaria angustifolia L.
Pyrola media Sw.
Rosa gallica L.
Salix herbacea L.
Saxifraga bryoides L.
Saxifraga decipiens Ehrh.
Saxifraga moschata Wullen subsp. basaltica Braun.-Blanq.
Saxifraga nivalis L.
Saxifraga oppositifolia L.
Scabiosa lucida Vill.
Sedum villosum L.
Selaginella selaginoides (L.) P. Beauv. ex Schrank & Mart.
Sesleria tatrae (Degen) Deyl
Sparganium minimum Wallr.
Stachys germanica L.
**Endangered (EN) taxa**

*Agrostemma githago L.*

*Alchemilla conivensis* Buser

*Alchemilla cymatophylla* Juz.

*Allium angulosum* L.

*Allium scorodoprasum* L.

*Amenone narcissiflora* L.

*Anthericum ramosum* L.

*Aphanes micracarpa* (Boiss. & Reut.) Rothm.

*Aralis planifolia* (Rehb.) Pers.

*Arnica montana* L.

*Arnoseris minima* (L.) Schweigg. & Körte

*Arun alpinum* Scott & Kotschy

*Asperula tinctoria* L.

*Asplenium adiantum-nigrum* L.

*Asplenium adhumerinum* Milde

*Asplenium cuneifolium* Viv.

*Asplenium viride* Huds.

*Baeothryon alpinum* (L.) T.V. Egorova

*Bartsia alpina* L.

*Betula nana* L.

*Bromus arvensis* L. subsp. arvensis

*Bromus racemosus* L.

*Calla palustris* L.

*Campanula barbata* L.

*Campanula cervicaria* L.

*Campanula bohemica* Hruby in Polivka, Domin & Podp.

*Cardamine trifolia* L.

*Cardaminopsis arenosa* (L.) Hayek subsp. borbasi Zipai.

*Carex atrata* L. agg.

*Carex davalliana* Sm.

*Carex magellanica* Lam.

*Cephalaria damasonium* (Mill.) Druce

*Centaurium brachypetalum* Pers.

*Centranthera minor* L.

*Chrysanthemum segetum* L.

*Corydalis trifida* Châtel.

*Cotonaster niger* Fries

*Cotula rigidipetala* Gand. var. *hindmanii* (Hrâšbêrovâ)

K.I. Chr.

*Crepis coryzifolia* (Gouan) Dalla Torre

*Crepis praemorsa* (L.) Tausch

*Crocus ciscum* L. alpiflorus Kit. & Schultz.

*Cynoglossum calceolus* L.

*Dactylorhiza purpurella* (Schlechter) Holub ex Soó

*Dactylorhiza sambucina* (L.) Soó

*Delphinium elatum* L.

*Drumus amereza* L.

*Drumus superbus* L. s.s.

*Dipsasiastrum isselerti* (Rouy) Holub

*Drosera anglica* Huds.

*Drosera intermedia* Hayne

*Echium ovatum* (Roth) Roem. & Schult.

*Empetrum hernandodium* Hagerup

*Empetrum nigrum* L. s.s.

*Epilobium alpinum* Vill.

*Epilobium anagallidifolium* Lam.
Oxyccoccus microcarpus Turcz. ex Rupr.
Parnassia palustris L.
Pedicularis palustris L.
Pedicularis sudaetica Willd.
Platanthera chlorantha (Custer) Rehb.
Pleuronanthus austriacum (L.) Hoffm.
Polystichum braunii (Spenn.) Fée
Potentilla collina Wibel s.s.
Potentilla riparia L.
Prunella grandiflora (L.) Scholler
Pyrola chlorantha Sw.
Rhodiola rosea L.
Rosa micrantha Borrer ex Sm.
Rubus chamaemorus L.
Sagina ciliata Fr.
Sagina saginoides (L.) H. Karts.
Salvia glutinosa L.
Scabiosa columbaria L. s.s.
Scorzonera humilis L.
Scrophularia scopolii Hoppe
Sedum alpestre Vill.
Sessile annuum L.
Silene gallica L.
Stachys alpina L.
Stachys annua (L.) L.
Stachys arvensis (L.) L.
Stachys recta L.
Stephanolea pinnata L.
Swertia perennis L. subsp. alpestris (Baumg. ex Fuss) Simon.
Tanacetum corymbosum (L.) Sch. Bip. subsp. corymbosum
Tanacetum micranthum (Kit.) Rehb. (sect. Alpestris Soest.)
Thalictrum flavum L.
Thalictrum minus L.
Thlaspi perfoliatum L.
Thymus alpestris Tausch ex A. Kern
Trinasteirera globosa (L.) Rchb.
Trifolium ochroleucon Huds.
Verbascum blattaria L.
Verbascum phoeniceum L.
Veronica prostrata L.
Vicia cassubicia L.
Viola collina L.
Viola hiflora L.
Vulpia myuros (L.) C.C. Gmel.

**Threatened (VU) taxa**

Abies alba Mill.
Achillea collina Becker ex Rchb.
Acornum variegatum L.
Acaia carphophylla L.
Alchemilla crinita Buser
Alchemilla fissal Günther & Schummel
Alchemilla glaucescens Walhr.
Alchemilla plicata Buser
Alchemilla propinqua H. Lindb.
Alchemilla subcrenata Buser
Alchemilla walsartii Pawl.
Allium montanum F.W. Schmidt
Allium sibiricum L.
Angelica archangelica L. subsp. archangelica
Antirrhis vulneraria L. subsp. polyphylla (Ser.) Nyman
Aquilegia vulgaris L.
Artemisia campestris L. subsp. campestris
Aruncus sylvestris Kostel.
Atropa belladonna L.
Avenula pratensis (L.) Dumort.
Baeothryon caespitosum A. Dietr.
Batrachium fluitans (Lam.) Wimm.
Batrachium penicillatum Dumort.
Betula x oyocorensis Besser
Blechnum spicant (L.) Roth
Botrychium lunaria (L.) Sw.
Bromus commutatus Schrad.
Bromus ramosus Huds.
Bromus secalinus L.
Calla angustifolia (Timm) Koeler
Callitriche hamulata Kütz. ex W.D.J. Koch
Camelina microcarpa Andrz. subsp. sylvestris (Wallr.) Hit.тонен
Campyanula glomerata L.
Campyanula latifolia L.
Cardamine amara L. subsp. opizii (J. Presl & C. Presl)
Čelak.
Cardamine flexuosa With.
Carduus nutans L.
Carex bohemica Schreb.
Carex hostiana DC.
Carex lepidocarpa Tausch
Carex linnosa L.
Carex montana L.
Carex pallescens L. var. corontica Jenik
Carex pumila Lightf.
Carex pendula Huds.
Carex tenuifolia L.
Carex umbrosa Host
Carlina acutula L. subsp. simplex (Waldst. & Kit.) Nyman
Carlina intermedia Schur
Carlina longifolia Rchb.
Catabrosa aquatica (L.) P. Beauv.
Centaraee axylepis (Wimm. & Grub.) Hayek
Centaraee phylgia L.
Centaraee pseudoaplygria C.A. Mey.
Centaraee piguetellum (Sw.) Druce
Cephalanthera longifolia (L.) Fritsch
Cerastium macrocarpum Schur. em. Güntr.
Cerastium pulchellum Curtis agg.
Chamaezyritis supinus (L.) Link
Cirsium helenoides (L.) Hill
Comarum palustre L.
Corydalis intermedia (L.) Mérat
Cotoneaster integerrimus Medik.
Crepis suaveflora (All.) Tausch
Cryptogramma crispa (L.) R. Br.
Cuscuta epithymum (L.) s.s.
Cuscuta lupuliformis Krock.
Cyperus fuscus L.
Dactylorhiza fuchsii (Druce) Soó
Dactylorhiza maculata (L.) Soó
Dactylorhiza majalis (Rchb.) P.F. Hunt & Summerh.
Daphne mezereum L.
Dentaria enneaphylllos L.
Dipsacstrum alpinum (Rouy) Holub
Doronicum austriacum Jacq.
Drusena rotundifolia L.
Dryopteris cristata (L.) A. Gray
Eleocharis acicularis (L.) Roem. & Schult.
Eleocharis quinqueflora (Hartman) O.Schwarz
Epilobium alpestre (Jacq.) Krock.
Epilobium collinum C.C. Gmel.
Epipactis atrorubens (Hoffm.) Besser
Equisetum hyemale L.
Equisetum telmateia Ehrh.
Eriophorum latifolium Hoppe
Euphorbia exigua L.
Euphorbia nemorosa (Pers.) Wallr.
Falcaria vulgaris Bernh.
Festuca heterophylla Lam.
Gagea arvensis (Pers.) Dumort.
Galanthus nivalis L.
Gentiana cruciata L.
Gentianella acaulis L.
Gentianella sanguinea L.
Glyceria nemoralis (R. Uechtr.) R. Uechtr. & Körn.
Glaphyrium supinum L.
Gymnadenia conopsea (L.) R. Br. subsp. conopsea
Gymnospermatum robertianum (Hoffm.) Newman
Helleborus viridis L.
Hieracium alpinum L.
Hieracium arvicolae Nägeli & A. Peter
Hieracium chlorocephalum R. Uechtr.
Hieracium diaphanophorum Lindeb.
Hieracium flagelare Willd.
Hieracium floribundum Winn. & Grab.
Hieracium lactuceella Willr.
Hieracium nigrescens Willd.
Hieracium prenanaeum Willd.
Hiperzia selago (L.) Bernh. ex Schrank & Mart.
Isoplexis setacea (L.) R. Br.
Isopyrum thalictroides L.
Jovibarba sobolifera (Sims) Opiz
Juncus acutiflorus Ehrh. ex Hoffm.
Juncus bulbosus L.
Juncus tenaceus (Ehrh.
Juniperus communis L. subsp. alpina (Suter) Čelak.
Juniperus communis L. subsp. communis
Koeleria gula (Spreng.) DC.
Koeleria macrantha (Ledeb.) Schult.
Lappula squarrosa (Retz.) Dumort.
Laserpitium laefilium L.
Lavatera thuringiaca L.
Lembotropis nigricans (L.) Griseb.
Libanotis pyrenaea (L.) Bourg.
Lonicerapericlymenum L.
Luzula sedecina (Willd.) DC.
Lycopodium annotinum L.
Lycopodium clavatum L.
Melampyrum arvense L.
Mellitis melissophyllum L.
Menon athamanticum Jacq.
Monorapis hypoptis L. s.s.
Montia fontana L. subsp. amaritana Sennen
Mutellina purpurea (Poir.) Thell.
Nasturtium officinale R. Br.
Nototrichium nigricans (L.) Rich.
Nestia paniculata (L.) Desv.
Nigella arvensis L.
Onoploides scrophuloides (Haenke) Schrank
Onoschis vicicifolia Scop.
Ononis spinosa L.
Orcis muscula (L.) L. subsp. signifera (Vest) Soó
Omithogalium umbellatum L.
Ophryoglossum secunda (L.) House
Paddus petraea Tausch
Pedicularis sylvatica L.
Petasites kubukianus Tausch ex Bercht.
Petrosechia prolifera (L.) P.W. Ball & Heywood
Peucedanum cervaria (L.) Lapeyr.
Phleum phleoides (L.) H. Karst.
Phyteuma orbiculare L.
Pinus x rhaetica Brügger
Platanthera bifolia (L.) Rich.
Poa chaixii Vill.
Poa laxa Haeneke
Potentilla aurea L.
Potentilla heptaphylla L.
Potentilla inclinata Vill.
Primula minima L.
Pulsatilla alba Rchb.
Pyrola minor L.
Pyrola rotundifolia L.
Ranunculus arvensis L.
Ranunculus casubicus L. s.l.
Ranunculus serpens Schrank subsp. nemorosus (DC.) G. López
Rhinanthus alpinus Baumg.
Rhychnospora alba (L.) Vahl
Ribes petraeum Wulfen
Rosa agrestis Savi
Rosa inodora Fr.
Rosa scherardii Davies
Rubus cheiranthoides Spreng.
Rubus cheiranthoides Sagorski & W. Schultz
Rubus constrictris P.J. Müller. & Lefèvre
Rubus fasciculatus P.J. Müller
Rubus francoicus H.E. Weber
Rubus glaviceps
Rubus gothicus Frd. & Gelert ex E.H.L. Krause
Rubus graciceps Mourier
Rubus hennici-egonis Holub
Rubus macrophyllus Weihe & Nees
Rubus nemoralis P.J. Müller
Rubus nemorosus Hayne & Willd.
Rubus radula Weihe
Rubus saxatilis L.
Rubus seaber Weihe
Rubus senticosus Köhler ex Weihe
Rubus wahlbergii Arrh.
Salix lapponum L.
Salix repensa L. subsp. repensa
Salix rosmarinifolia L.
Salvia verticillata L.
Saxifraga tridactylites L.
Scheuchzeria palustris L.
Scirpus radicans Schkuhr
Scirpus polycarpus L.
Sedum reflexum L.
Senecio rivularis (Wallst. & Kit.) DC.
Silene nutans L. subsp. glabra (DC.) Rothm.
Sorbus torminalis (L.) Crantz
Stellaria longifolia Muhl. ex Willd.
Stellaria neglecta Weihe
Teucrium botrys L.
**Lithospermum officinale** L.
*Polygala amara* L. subsp. *brachypiera* (Chodat) Hayek
*Rosa jundzilli* Besser
*Rosa majalis* Herrm.
*Scabiosa canescens* Waldst. & Kit.
*Scandix pecten-veneris* L.
*Thalictrum simplex* L.
*Trapa natans* L. s.s.
*Urticaria australis* R. Br.
*Urticaria intermedia* Hayne

**THREAT ASSESSMENT OF VASCULAR PLANTS IN THE SUDETEN MOUNTAINS**

The vascular flora of the Polish Sudeten Mts. comprises slightly more than 1800 taxa of vascular plants, disregarding the small, apomictic taxa of the genera *Epipactis* or *Taraxacum*, and hybrids. The present „red list” of threatened plants includes 584 species, i.e., almost 33% of the Sudeten vascular flora. The degree of threat of the local flora is definitely the highest in Poland. For example, the index of threat for the Polish Carpathian Mts. is 26% (Mirek and Piękos-Mirkowa 1992), and for the Świętokrzyski Region 15% (Bróz 1990). On the other hand, there are regions in Europe, where almost a half of the vascular flora is threatened – e.g. the area of Brandenburg (Benkert and Klemm 1990).

During the field studies and analysis of the available materials 60 taxa were recognized as totally extinct or missing (Ex, ?Ex). This is a relatively high number in comparison with other Polish regions for which local „red lists” were elaborated. From this group *Allium strictum* and *Veronica bellidioides* are worth to be mentioned. They had the only localities in our country in the Sudeten Mts. Most of the species recognized as extinct had single localities, and the reason of disappearance of their populations were most of all the habitat changes, like: drainage of meadows and bogs (e.g. *Eriophorum gracile*, *Tofieldia calyculata*, *Viola stagnina*), overgrowth of xerothermic grasslands (*Carex michelii*, *Iris aphylla*, *Scorzonera purpurea*), disappearance of appropriate water sites (*Hippuris vulgaris*, *Lindernia procumbens*, *Nymphoides peltata*), or the intensification of agriculture (*Camelina alyssum*, *Caucalis platycarpus*, *Cynara epithymum*), and forest cultivation (*Arctostaphylos uva-ursi*, *Dipsacstrum trifachyum*).

As much as 93 taxa of vascular plants were included into the group of critically endangered (CR), which members will soon die out, if no limitation of anthropopressure will take place. Unfavourable is the fact of the presence in the CR group of species, currently known in Poland only on several mountain ranges in the Sudeten Mts. This concerns among others *Alchemilla corconica*, *Asplenium onopteris*, *Cardamine resedifolia*, *Cyclamen purpurascens*, *Galiun sudeticum*, *Pimpinella rupestris*, *Saxifraga nivalis*, *Trifolium striatum*, and *Viola collina* subsp. *porphyrea*. Their possible extinction would be a loss for the whole vascular flora of Poland. Of importance is also the fact that 1/3 of all the Orchidaceae species growing in the Sudeten Mts. belong to the CR group, and the very high number of grassland, meadow, and bog species in this group.

As endangered (EN) taxa 161 species were recognized, a dozen or so of which are limited in their occurrence exc-
lusively to the Sudeten, e.g. Asplenium adiantum-nanum, A. cuneifolium, Campanula barbata, C. bohemica, Carex magellanica, Hieracium schmidtii, Melica ciliata, Pedicularis sibirica. They are in majority connected with the specific rocky habitats, especially with the serpentine or basaltic bedrocks, unique in our country, and high mountain ecosystems.

The group of vulnerable (VU) taxa, the most numerous among all of the analysed groups from the „red list”, consists of 224 species. Beside taxa known only from the Sudeten Mts., like Alchemilla fissa, Bartschium penicillatum, Carex pulicaris var. corocontica, Cryptogramma crispa, Helleborus viridis, Meunia athamanticum, the group also includes plants having their centre of distribution in our country, e.g. Cephalaria longiflora, Cirsium helenioides, Padus petraeae, Sativus laevigatus, Thlaspi caerulescens.

The group of near threatened (NT) taxa, comprising merely 12 taxa, includes plants having numerous localities in the Sudeten Mts., but at the same time very rare in Poland or recorded only in some of its regions. These species are represented by populations of hundreds, or even thousands of individuals, which are stable or, in many cases, dynamic. This concerns for example Leucopogon vernum subsp. vernum, which is in fact growing in every mountain range of the Sudeten, or Carex bigelowii subsp. rigida, showing recently an unusual expansion in the subalpine communities of the Karkonosze Mts. and the Śnieżnik Massif.

Finally, 34 taxa were classified to the data deficient (DD) category, i.e., plants without current data on their occurrence, or their definite extinction. As mentioned before, some of them make an ephemeral component of communities from the class Isoëto-Nano-juncetalia, or Secalietalia, or they inhabit aquatic ecosystems, e.g. Bidens radiata, Eleocharis uniglumis, Trapa natans, Urticaria sp. Intensive investigations should be devoted to this group in future.

Furthermore, the analysis of endangered taxa in the Sudeten Mts. allows us to draw several interesting conclusions. Above all, noteworthy is the high frequency of some of the systematic groups, i.e., the ferns (in particular Asplenium, Lycopodiaceae), monocotyledonous plants mainly from the family Orchidaceae (the list includes all of their representatives), Cyperaceae, Lilaceae, and the ecologically specialized genera and families, among others Gentianella, Orobanche, Saxifraga, Pyrolaceae. Next, the contribution of the particular syngegetic groups in all the threat categories is strongly differentiated (Table 1). It can be concluded from data included in this Table, that the most endangered are stenothermal plants belonging to grasslands and xerothermic scrub. Remarkably, these ecological groups are the most frequently represented in all the threat groups. Species of meadow ecosystems and those representing the alpine vegetation are endangered to a similar extent. Altogether, the xerothermic, meadow and alpine species make up over 40% of the analysed flora. A high degree of threat is shown also by species of wet, marshy and bog habitats. Another important fact is the rather high contribution of the segetal flora, particularly the archaeophytes.

In general, it can be assumed, that every type of ecosystem in the Sudeten Mts. is more or less changed, or frequently badly deteriorated. This implies the high losses and the threat of species. The most quickly changing types of vegetation are undoubtedly the seminatural plant communities, particularly those of grasslands and meadows. For the latter, the decline of agricultural activities (pasturage, mowing, moderate fertilization, controlled burning out, etc.), which used to stimulate their persistence, becomes re-

<table>
<thead>
<tr>
<th>Biotopes</th>
<th>Ex</th>
<th>CR</th>
<th>EN</th>
<th>VU</th>
<th>NT</th>
<th>DD</th>
<th>Σ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xerothermic grasslands and scrub (Festuca-Bromio-Phleum, Trifolium-Geranium sanguinei)</td>
<td>11</td>
<td>15</td>
<td>30</td>
<td>29</td>
<td>2</td>
<td>4</td>
<td>90</td>
</tr>
<tr>
<td>Sand communities (Koelerio-Corynephoretea)</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>15</td>
<td>0</td>
<td>1</td>
<td>28</td>
</tr>
<tr>
<td>Wet, humid and fresh hay-meadows (Meliloto-Asplenietea, Calluna-Ulicetea)</td>
<td>6</td>
<td>13</td>
<td>20</td>
<td>29</td>
<td>2</td>
<td>2</td>
<td>72</td>
</tr>
<tr>
<td>Aquatic vegetation (Lemnoetea, Potamogetono-Ulvarietea)</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>Peat-bogs, fens, calcareous marshes (Oxyacco-Phragmitea, Schoenocereco-Caricetea, Phragmitetea)</td>
<td>11</td>
<td>5</td>
<td>16</td>
<td>18</td>
<td>2</td>
<td>2</td>
<td>54</td>
</tr>
<tr>
<td>Slime-covered shores of water (Isoëto-Nano-Juncetalia)</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>7</td>
<td>0</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>Deciduous forests (Quercus pubescens, Carpinion betuli, Tilio-Acerion, Fagion sylvaticae)</td>
<td>3</td>
<td>7</td>
<td>20</td>
<td>25</td>
<td>2</td>
<td>2</td>
<td>59</td>
</tr>
<tr>
<td>Coniferous and mixed forests (Piceo-Pinetalia, Quercetalia robur-petraea)</td>
<td>5</td>
<td>8</td>
<td>4</td>
<td>15</td>
<td>0</td>
<td>2</td>
<td>34</td>
</tr>
<tr>
<td>Riparian forests (Alno-Ulmion, Alneto glutinosae, Salicetea purpureae)</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>13</td>
<td>2</td>
<td>1</td>
<td>22</td>
</tr>
<tr>
<td>Scrub communities (Rhamno-Pinion)</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>20</td>
<td>0</td>
<td>2</td>
<td>26</td>
</tr>
<tr>
<td>Segal activities (Sclatio)</td>
<td>7</td>
<td>2</td>
<td>12</td>
<td>5</td>
<td>1</td>
<td>5</td>
<td>32</td>
</tr>
<tr>
<td>Vegetation of rocks and walls (Asplenietea reptilia, Thlaspietalia runnfolidae)</td>
<td>1</td>
<td>9</td>
<td>6</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>21</td>
</tr>
<tr>
<td>Vegetation of subalpine and alpine belts (Blyso-Seslerietalia, Carexetalia arvenseae, Betulo-Alno-Caricetalia, Pinion mutchii)</td>
<td>5</td>
<td>19</td>
<td>25</td>
<td>27</td>
<td>1</td>
<td>0</td>
<td>77</td>
</tr>
<tr>
<td>Spring-heat communities (Montio-Cardaminetea, Salicetea herbacea)</td>
<td>0</td>
<td>4</td>
<td>10</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>19</td>
</tr>
<tr>
<td>Others (Bidentetalia tripartitii, Clemanodo-epilobietalia, Epilobietalia angustifoliae, Arctoni-Festucetalia, Galeo-Ulicetea, Violetea calaminariae etc.)</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>7</td>
<td>0</td>
<td>4</td>
<td>15</td>
</tr>
<tr>
<td>Total</td>
<td>60</td>
<td>93</td>
<td>161</td>
<td>224</td>
<td>12</td>
<td>34</td>
<td>584</td>
</tr>
</tbody>
</table>
cently characteristic. It has its implications in the presented list of threatened plants of the Sudeten Mts. The intention of creating such lists should above all be to make the basis for undertaking substantial actions in the aid of protection of the most precious components of the vascular flora in that area. Considering the status of threat, species growing in Poland exclusively in the Sudeten Mts., or those showing here a distinct concentration of localities, should be regarded as species of particular care in the Sudeten Mts. Their conservation should depend on preservation of habitats specific for them, and in the case of small, isolated and frequently endemic or relic populations a proper programme of active protection should be applied.

ACKNOWLEDGEMENTS

The authors wish to express their gratitude to Prof. K. Zarzycki (Cracow) and Dr. F. Krachulec (Prubonice near Prague) for their critical remarks concerning the list of taxa, to Prof. J. Zielinski (Kornik) for the critical revision of the threatened taxa from genera Cetraceae, Rosa and Rubus, and to Dr. K. Swierkosz (Wrocław) and Dr. Szczepański (WiePol) for their valuable information on distribution of some of the species of the Sudeten flora.

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STRESZCZENIE

W oparciu o własne badania terenowe prowadzone od 1972 roku z uwzględnieniem historycznych danych z literatury i zbiorów zielnikowych przedstawiono wykaz wymarłych, ginących i zagrożonych gatunków roślin naczyniowych Sudetów (południowo-zachodnia Polska). Lista nasza obejmuje 584 taksony, tj. blisko 33% flory naczyniowej tych gór. Za wymarłe i zaginione uznano 60 gatunki, krytycznie zagrożone – 93, zagrożone – 161, na-
razone – 224, o niskim ryzyku wyginięcia – 12. Dla 34 taksonów nie podano konkretnego rodzaju zagrożenia, stąd zaliczono je do grupy „brak danych”. Przedstawiono również analizę ilościową wszystkich gatunków w poszczególnych kategoriach zagrożenia na tle podstawowych grup fitosocjologicznych oraz pokazano przykładowo obraz rozmieszczenia niektórych roślin w Sudetach.

SŁOWA KLUCZOWE: Sudety, czerwona lista, flora naczyniowa, kryteria gatunek zagrożonych.