

ENDANGERED AND THREATENED VASCULAR PLANTS OF THE FORESTS OF CENTRAL POLAND AND THE PROBLEMS OF THEIR CONSERVATION

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Abstract: On the basis of the data from the literature, herbarium collections (Herbarium LOD) and the author's own materials, a list of the 74 most valuable species, protected and endangered, found in woodland of central Poland was compiled. For the rarest species, the list of sites with sources were included. The level of threat for species and their sites was also determined for the region. The most important issues of protection of these plant species associated with changes in the environment as well as with changes in woodland communities were presented. This study sums up the result of research carried out by botanists from Łódź over the last five decades, regarding selected woodland plant species. It also provides new data on the distribution of the most valuable vascular plant taxa in Poland.

Key words: list of endangered species, woodland, central Poland.

INTRODUCTION

The process of the extinction of species under pressure from human activities, which intensified in the last century, contributes to the increasing rate of reduction of biodiversity on the scale of regions, countries and continents (Kornaś 1981; Kornaś and Medwecka-Kornaś 1986).

Professor Jan Kornaś (1976) set out "an urgent and important task..." for Polish botanists, namely, "...monitoring changes in our flora, warning of the threats facing it, and creating a solid scientific foundation for practical work in the field of its protection". Despite the growing interest in the issue of extinction and threats to the native flora of Poland (Michalik 1979, 1988; Kornaś 1976, 1981; Faliński 1976; Hereźniak 1976; Olaczek 1976, 1985; Olaczek and Sowa 1976; Olaczek and Ławrynowicz 1986), developing lists of endangered species within the national territory and regions (Jasiewicz 1981; Zarzycki 1986; Zarzycki and Szeląg 1992; Żukowski and Jackowiak 1995; Parusel, Wika and Bula 1996; Spałek 1997, Jakubowska-Gabara and Kucharski 1999), and the publishing of the Polish Red Book of Plants (eds. Zarzycki and Kaźmierczakowa 1993, eds. Kaźmierczakowa and Zarzycki 2001), the task set by Professor Kornaś, is still current and likely to remain so for a long time to come.

A proper assessment of the process of the extinction of

plants and the degree of threat to the flora is not possible without the comprehensive knowledge of the distribution of species. The basic floristic data are quite often incomplete, even for reserves (Kornaś 1970; Kurowski 1986). The level of knowledge on the vascular flora of central Poland at the end of the 1950s and later towards the end of 1970s is presented in the works of Mowszowicz (1960, 1978). Intensive floristic and phytosociological research in recent decades has provided an ample body of data on new species and sites.

The aim of this study is to sum up the knowledge accumulated in five decades of research by the botanists from Łódź, with respect to the distribution of the most valuable, protected and endangered, vascular plant species in the woodlands of central Poland and to assess generally the degree of threat to them. The intention of the author is to contribute data to the general database needed to draw up the list of endangered and vulnerable plant species for central Poland and the whole of the country.

STUDY AREA

The area described as central Poland in terms of geobotany (Szafer 1977) is located within two subsections: the belts of the Central Uplands and the Great Valleys. The northern borderline of this region is demarcated by the limits of dis-

tribution of important woodland-forming species: fir, beech and spruce, running close to Łódź.

Under the classification defined in the physical geography of Poland (Kondracki 1998), the area includes the following macro-regions: south Mazovian mounds, portions of the central Mazovian and south Wielkopolska uplands. The southern part of central Poland is cut through by the limits of the Central Polish Uplands, the central Malopolska Upland and the Kraków-Częstochowa Upland.

The study area covers the borderland between uplands and lowlands. It encompasses portions of the Pilica, Bzura and Warta river basins (Fig. 1). The relief is quite diversified, as shown by differing relative elevations. The highest point is the Chełmo mount at 323 m a.s.l. while the terrain around Łowicz is only 90 m a.s.l. Influencing the vegetation is the fact that the area is situated in the zone of overlapping influences of the continental climate from the east and the Atlantic climate from the west.

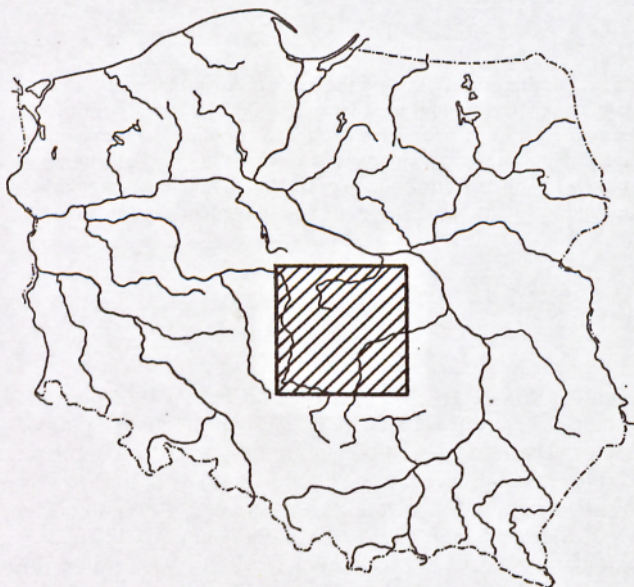


Fig. 1. Location of study area.

Under the current administrative system, the study area covers the Łódź voivodship and portions of the adjacent Mazovian and Wielkopolska voivodships on its northeast and northwest sides, respectively.

In central Poland the predominant landscape is farmland with small patches of woodlands. The overall forest cover is ca. 20%. Relatively larger woodland complexes survived in the valleys of major rivers: the Warta, Pilica, Rawka and Widawka. The southern portion has a higher proportion of woodlands compared with the northern portion.

In the total area occupied by woodlands, plant communities that are disturbed or shaped outright by logging activities by man, predominate. There is also a great proportion of woodland phytocoenoses now planted in the areas pre-

viously used as farmlands. The best-preserved, near-natural forest communities are protected in many reserves.

The largest forest complexes of the area are now situated within the borders of several landscape parks: the Załęczański, Sulejowski, Bolimowski, Spalski, and Przedborski Landscape Parks as well as the Łódź Hills Landscape Park and Międzyrzecze Warty i Widawki Landscape Park.

The forest vegetation of central Poland shows remarkable diversity both in geographical and ecological terms. In river valleys some small patches of carrs, with alder carr *Circaeo-Alnetum* occur most often, whereas the phytocoenoses of elm-ash carr *Ficario-Ulmetum*, and willow-poplar *Salici-Populetum* occur very rarely. Fairly sporadically, and only in the southern part of the area, patches of submountain carrs *Carici remotae-Fraxinetum* are present. At many places, within river valleys and in local depressions there are still some patches of bog alder woods *Ribeso nigri-Alnetum* and *Sphagno-Alnetum*.

The greatest proportion of the forested areas of central Poland is covered by pine forest communities, classified into several associations and subassociations in line with the moisture gradient. The mixed coniferous forests and degenerated forms of deciduous forests of similar appearance are also very common throughout the area. Deciduous forests occupy less of the area, the most important association among these being subcontinental oak-hornbeam forest *Tilio-Carpinetum*. It shows certain ecological diversity, and can be divided into four subassociations and several varieties. Another interesting association, fairly common throughout the area, is heliophilous oak wood *Potentillo albae-Quercetum*, which is distinct for its rich species composition and the presence of many valuable species, mainly thermo- and heliophilous ones. Rarely, in the western and southern parts of the area, there are patches of acidophilous oak wood *Calamagrostio-Quercetum* and acidophilous beech forest *Luzulo pilosae-Fagetum*.

The geographical diversity among the woodland associations of central Poland is manifested by the presence in this region of the following associations:

- two vicarious association of fresh coniferous forests: *Leucobryo-Pinetum* and *Peucedano-Pinetum*,
- two geographical varieties of oak-hornbeam forest *Tilio-Carpinetum*, of Mazovia-Podlasie and Malopolska regions and two varieties associated with elevation: lowland and upland;
- oak forests and mixed forests with fir and beech, as well as sites with broad-leaved lime and yew in the southern portion of the area; and
- distribution limits of: beech woods, mixed forests with fir, acidophilous oak woods, sub-continental and sub-Atlantic oak-hornbeam forests and submountain carr.

The plant species termed as interesting, valuable and vulnerable occur particularly often in the heliophilous oak woods *Potentillo albae-Quercetum* phytocoenose and in carrs, as well as in oak-hornbeam forests on fertile and moist soils. The group of species associated with pine forests is much smaller.

MATERIAL AND METHODS

The basis of the study was provided by the floristic data, mostly from published papers. The collection of the Department of Botany, University of Łódź (LOD) and some unpublished materials were also used.

The study covers the species which are endangered and vulnerable either throughout the national territory or in the region as well as rare protected species. The list of species includes those taxa for which the number of stations reported in central Poland does not exceed 24. Apart from typical woodland species, the list includes also the taxa representing meadow and grassland communities of *Molinio-Arrhenatheretea*, *Festuco-Brometea*, and *Sedo-Scleranthea* classes (e.g. *Gladiolus imbricatus*, *Asperula tinctoria*, *Arenaria graminifolia* and *Koeleria grandis*). They were included based on two premises. Firstly, these are plants which often constitute part of the combination of species characteristic of some woodland communities, such as heliophilous oak woods *Potentillo albae-Quercetum*. The second, more important premise is the fact that recent stations of these species survived in central Poland above all if not solely, in woodland communities, e.g. the only known station of *Arenaria graminifolia* was found in *Leucobryo-Pinetum* (Jakubowska-Gabara 1989).

The nomenclature of species was adopted after Mirek et al. (1995), and the systematic system – after Szafer, Kulczyński and Pawłowski (1986). In the list, the name of taxa are followed by the number of stations. In the case of stations provided on the basis of herbarium data, the particulars of the author and the date of collection are provided.

With respect to some species and stations data has also been made available on the extinction or vulnerability of species in the study area. These data came from a few publications (Olaczek 1963, 1968; Czyżewska and Jakubowska-Gabara 1985; Jakubowska-Gabara 1991, 1993) and from the author's own observations. These data were used to classify these stations as either extinct or vulnerable. The stations considered vulnerable were those represented by very small populations (one to several individuals), those threatened by human activity, such as the huge coal extraction and power generation operations at Bełchatów and those disappearing in the course of the confirmed process of the regeneration of the close-canopy deciduous woods replacing the phytocoenoses of heliophilous oak wood *Potentillo albae-Quercetum*.

The names of stations are preceded by the following designated symbols: [●] – found or confirmed after 1972; [⊗] – not confirmed after 1973; [⊕] – vulnerable; [○] – extinct.

The following abbreviations were adopted for the names of authors:

And. – Andrzejewski, Bł. – Błaszczuk, Cz. – Czyżewska, Dry. – Drymmer, Ejs. – Ejsmond, Fag. – Fagasiewicz, Fil. – Filipiak, Fr. – Frey, Gol. – Golonka, Her. – Hereźniak, Hr. – Hryniewicz-Sudnik, Jak. – Jakubowska-Gabara, Jas. – Jastrzębowski, Jos. – Jost-Jakubowska, Kar. – Karo, Kob. – Kobendza, Kot. – Kotkowski,

Krz. – Krzemińska-Freda, Krzy. – Krzywański, Kuch. – Kucharski, Kul. – Kulesza, Kur. – Kurowski, Ku. – Kurzac, Le. – Lembke, Łap. – Łapczyński, Ław. – Ławrynowicz, Ma. – Maciak, Mam. – Mamiński, Mow. – Mowszowicz, Ni. – Niedziałkowski, Ojrz. – Ojrzyńska, Ol. – Olaczek, Pa. – Pachulska, Pac. – Pacyniak, Pis. – Pisarek, Pl. – Plackowski, Po. – Polak, Rut. – Rutowicz, Ros. – Rostański, Sic. – Siciński, So. – Sowa, Sz. – Szafer, Szt. – Sztampke, Ur. – Urbanek, Wit. – Witosławski, Wn. – Wnuk, Voc. – Vocke, Za. – Załuski, Zar. – Zaręba.

THE LIST OF SPECIES AND STATIONS

***Huperzia selago* (L.) Bernh. ex Schrank & Mat.** – 21 stations: [⊗] Rąbień near Aleksandrów (Fag. 1956 unpubl., Jak. Jos. 1978); [●] Janinów (Kur. 2000); [●] Błogie, lg. M. Ku. 1979, LOD (Ku. Kuch. 1996); [●] Bąkowa Góra (Wit. 1988a); [●] Czarna Różga near Przedbórz (Ol. Wn. 1990); [⊗] Jasień (Ur. 1960); [●] Lubiaszów (Ur. 1959, Kur. 1990); [⊗] Lubiec (Krzy. 1967); [●] Łąznów (Jos. 1979); [○] Pytowice (Jak. 1989 a); [●] Słostowice (Rut. Kur. 1980); [●] Wielkopole (Ol. 1978b); [⊗] Zarzęcin, lg., Fag. 1972, LOD (Jak. Jos. 1978); [⊗] Zuzowy, lg. J. Le. 1948, LOD (Fag. 1972); [⊗] Rozwady, [⊗] Teodorów (Ejs. 1885); [⊕] Ruda-Chlebacz (Jak. 1987); [⊕] Sokule (Jak. 1998 unpubl.); [●] Dobroń (Kur. Mam. 1990); [●] Jamno, lg. R.Ol. 1974, LOD (Kuch. Ku. 1995); [●] Kluski near Załęcze Wlk. (Cz. 1979, Fag. et al. 1986).

***Osmunda regalis* L.** – 11 stations: [●] Żytno (Jak. Pis. 1997); [⊕] Kamień, [⊕] Osina near Kluki, [⊕] Święte Ługi (Jak. 1989 a); [●] Lubień (Kur. 1973); [●] Lubiec (Kur. 1975); [●] Dobroń (Kur. Mam. 1990); [●] Pawlikowice, [●] Mogilno (Ojrz. 1987); [●] Wielki Las near Złoczew (Pa. 1994 unpubl.); [●] Ugoda Barczewska (Kur. 1975).

***Oreopteris limbosperma* (Bellardi ex All.) Holub** – 3 stations: [●] Dąbrowa Pawlikowicka (Krz. 1979); [⊗] Kobile Wielkie (Fag. Szt. 1960); [⊗] Doliska near Rogów (Zar. 1971).

***Polystichum aculeatum* (L.) Roth.** – 1 locality: [⊗] Modrzewina near Mała Wieś (Kob. 1925).

***Blechnum spicant* (L.) Roth.** – 5 stations: [⊕] Kamień (Jak. 1989 a); [⊗] Kobile Wielkie (Fag. 1959); [●] Mogilno (Ojrz. 1987); [⊗] Rogów (Ni. 1930); [⊗] Rawka near Skierniewice (Mow. 1960).

***Taxus baccata* L.** – 5 stations: [●] Jasień (Kul. 1918–1919, Ur. 1960, Ol. 1978b); [●] Piskorzaniec (Ol. Wn. 1990); [●] Stróża (Kur. 1986); [●] Pyszków (Ol. 1978a); [⊗] Wola Wiązowa (Mow. 1960).

***Cucubalus baccifer* L.** – 7 stations: [●] Daszyna (Ol. 1974); [⊗] Orłów, [⊗] Dobrzelin, [⊗] Krośniewice, [⊗] Gołębiew (Mow. 1960); [⊗] Piątek (So. 1967); [●] Rykały (Jak. 1978).

***Dianthus gratianopolitanus* Vill.** – 5 stations: [⊗] Białączów (Ejs. 1885); [○] Chorzenice, [⊕] Magdalenów near Szczerców (Jak. 1989 a); [⊕] Niebieskie Źródła (Mow. 1960, Ol. 1974); [⊕] Unewel (Ol. 1974).

***Dianthus arenarius* L.** – 13 stations: [⊗] Jatno (Ur. 1969); [●] Kaleń, [●] Taraska (Ol. 1978 b); [⊗] Opoczno,

[⊗] Drzewica (Ejs. 1885); [●] Gostomia near Nowe Miasto (Ol. 1974); [●] Tomczyce, [●] Świdno (Jak 1978); [○] Siwica near Nieborów (Ol. 1974); [●] Jarzębie (Fag. et al. 1986); [●] Niżankowice (Ku. 1986); [●] Pawlikowice, [●] Kolumna (Ojrz. 1987).

Arenaria graminifolia Schraed. – 1 locality: [⊕] Dąbrowa near Kamieńsk (Jak. 1989 a).

Trollius europaeus L. – 24 stations: [⊗] Dębowiec (Mow. et al. 1967); [⊗] Kalinów (Mow. 1960, Ol. 1963); [●] Las Łagiewnicki (Wit. et al. 2000); [⊗] Gałków (Ol. 1963); [●] Babczów (Pis. 1993); [⊗] Jaksonek (Kul. 1934); [⊗] Kobile Wielkie (Mow. 1960, Ol. 1963); [●] Lubiaszów (Fag. 1976, Kur. 1981 b); [⊗] Moszczenica (Kul. 1934, Mow. 1960); [●] Rochna (Ol. 1971); [●] Sułków (Ol. 1978 b); [⊗] Tomaszów Maz. (Kul. 1918–1919, Mow. 1960); [●] Wojciechów (Kur. 1981 a); [●] Bąkowa Góra (Wit. 1988a); [●] Zuzowy (Ol. 1978 b); [⊕] Skuły-Wschód (Jak. 1987); [○] Trębaczew (Mow. et al. 1963); [⊗] Wilczy Dół (Zar. 1971); [●] Chorzew (Kur. 1981 a); [⊗] Kamionka, lg. D. Krzy. 1969, LOD (Fag. 1976); [⊗] Podłężyce (Dry. 1891, Mow. 1960); [⊕] Ruda-Dunaj, [⊕] Woźniki (Jak. 1990 b); [●] Zalesie (Zań. 1974).

Cimicifuga europaea Schipcz. – 14 stations: [●] Bukowa Góra (Kur. 1986); [●] Dobromierz (Bł. 1959, Ol. Wn. 1990); [●] Jaksonek (Kul. 1918–1919, Kur. 1981 b); [●] Lubiaszów (Ur. 1959, Kur. 1981 b); [●] Owczary (Mow. 1960, Kur. 1981 b); [●] Prócheńsko (Kur. 1981 a); [⊗] Spała, [⊗] Teofilów (Ol. 1963); [⊗] Sulejów (Kul. 1918–1919, Mow. 1960); [⊗] Nowe Miasto, [⊗] Nieborów (Ros. 1872); [⊗] Rogów (Ni. 1930); [⊗] Wilczy Dół (Ni. 1930, Zar. 1971); [○] Trębaczew (Mow. et al. 1963).

Pulsatilla patens (L.) Mill. – 13 stations: [○] Szczawin near Zgierz (Fil. Kur. 1978); [⊗] Wiączyń, [⊗] Chrusty (Mow. 1960); [⊗] Gałków (Sz. 1923, Mow. 1960); [●] Smardzewice (Kur. 1981 b); [⊗] Głuchów (Zar. 1971); [⊗] Łowicz (Mow. 1960); [⊗] Nieborów (Voc. 1857, Mow. 1960); [⊗] near Skierniewice (Łap. 1892); [⊗] Niewiesz, [⊗] Ralewice, [⊗] Rożdżały, [⊗] Zapolice (Dry. 1891, Mow. 1960).

Pulsatilla pratensis (L.) Mill. – 15 : [⊗] Konewka lg. A. Sobolewska 1956, LOD (Fag. 1976); [●] Lubień (Kur. 1981 b); [⊗] Wolbórz (Kul. 1918–1919, Mow. 1960); [●] Smardzewice (Kur. 1981 a); [⊕] Przedbórz, lg. S. Lappe 1970, LOD (Fag. 1976); [⊕] Świdno (Jak. 1978); [⊗] Arkadia (Ol. 1963); [⊗] near Skierniewice, [⊗] Nieborów (Mow. 1960); [⊗] Bartochów, [⊗] Męka, [⊗] Małków, [⊗] Kościelna Góra, [⊗] Podłężyce (Dry. 1891, Mow. 1960); [⊗] Izidorów (Ol. 1968).

Pulsatilla vernalis (L.) Mill. – 14 : [●] Rogowiec near Bełchatów (Her. et al. 2001); [⊗] Glinnik, [○] Lućmierz (Ros. 1872, Kur. 1976 b); [○] Szczawin (Fil., Kur. 1978); [⊗] Folwarki, [⊗] Piotrków (Mow. 1960); [⊗] Gałków (Sz. 1923, Mow. 1960, Ol. 1963); [⊗] Jasiień (Kot. 1932); [⊗] Zakrzówek (Kot. 1932, Mow. 1960); [⊗] Nieborów (Voc. 1875, Mow. 1960); [⊗] Poddebice, [⊗] Ralewice, [⊗] Rożdżały (Dry. 1891); [⊗] Wieluń (Mow. 1960).

Ranunculus serpens subsp. *nemosus* (DC.) G. Lopez – 3 stations: [⊗] Grotniki, lg. H. Bednarek 1967,

LOD; [⊗] Łódź-Józefów, lg. W. Pilniak 1952, LOD; [⊗] Kamionka, lg. D. Kmiecik 1969, LOD, (Jak. Jos. 1978).

Corydalis cava Schweigg. & Körte – 6 stations: [⊗] Gałków, [⊗] near Łowicz (Mow. 1960); [⊕] Słok (Kur. 1984); [⊕] Stróża (Jak. 1989 a); [⊕] Wola Wydrzyna (Kur. 1984, Jak. 1989 a); [●] Walewice (Ol. 1972 a, 1974);

Dentaria bulbifera L. – 2 stations: [⊗] Dębowiec (Mow. et al. 1967); [⊗] Zwierzyniec near Skierniewice (Hry. 1962).

Dentaria enneaphyllos L. – 3 stations: [●] Sługocice, lg. M. Ław., K. Cz. 1974, LOD (Jak. Jos. 1978); [⊕] Stróża (Jak. 1989 a); [⊕] Wola Wydrzyna (Kur. 1984, Jak. 1989 a).

Cardamine impatiens L. – 6 stations: [●] Dębowiec (Ol. So. 1981); [⊗] Niebieskie Źródła (Mow. Ol. 1961); [●] Spała (Ol. 1963, 1978b); [⊕] Stróża (Jak. 1989 a); [●] Wilkowiec near Bąkowa Góra, lg. P. Wit. 1985, LOD; [●] Tomczyce (Jak. 1978)

Aruncus sylvestris Kostel. – 6 stations: [●] Bąkowa Góra (Kur. 1986, Wit. 1988a); [●] Kaleń (Kur. 1981 a, b); [⊗] Doliska, [⊗] Rogów (Ni. 1929); [○] Trębaczew (Mow. et al. 1963); [●] Wielka Wieś (Kur. 1981 a).

Potentilla micrantha Ramond ex DC. in Lam. & DC – 1 station: [●] Modrzewina near Mała Wieś (Zajac A., Zajac M. 2001, reported earlier by Kobendza (1925) as *P. sterilis* L.

Chamaecytisus ruthenicus (Fisch. Ex Woł.) Klask. – 9 stations: [●] Jaksonek lg. H. And. 1981, LOD; [●] Niechcice (Ol. 1974); [⊗] Owczary (Kul. 1925); [⊗] Rokiciny (Sz. 1923); [⊗] Górki, [⊗] Wilczy Dół (Ni. 1930); [⊗] Głuchów (Zar. 1971); [●] Radziejowice (Jak. 1989 b); [⊗] Trębaczew (Mow. et al. 1963).

Vicia sylvatica L. – 5 stations: [⊗] Wiączyń (Ol. 1962); [●] Góra Chełmo (Ol. 1978 b); [⊗] Modlica (Fag. 1959); [⊗] near Przedbórz (Mow. 1960); [⊕] Stróża (Jak. 1989 a).

Lathyrus montanus Bernh. – 9 stations: [⊗] Górki, [⊗] Lipce (Ni. 1930); [⊗] Pszczonów, [⊗] Rogów, [⊗] Zacywilki, [⊗] Bukowiec (Zar. 1971); [●] Bażantarnia (Jak. 1990 a); [●] Kliczków, [●] Oraczew Mały (Kur. 1979, 1981 a).

Trifolium lupinaster L. – 16 stations: [●] Grotniki (Kur. 1976a); [⊗] Gałków, [⊗] Lućmierz (Sz. 1923); [●] Molenda, lg. J. Krz. 1976, LOD; [⊗] near Dłutów (Ros. 1872); [⊗] Żakowice, lg. A. Wira 1964, LOD; [●] Gomonice (Pl. 1986–1987); [●] Lubień, [●] Podlubień (Kur. 1976 a); [○] Rogowiec, [⊕] Sadulaki (Jak. 1989 a); [○] Pytowice, [⊕] Stróża (Kur. 1984, Jak. 1989 a); [●] Wojciechów (Kur. 1976 a, 1981 a, b); [●] Wierzchlas (Ol. 1978 b); [●] Janinów (Rut. So. 1976).

T. rubens L. – 11 stations: [⊗] Niwiska Górne (Ol. 1963); [⊕] Dąbrowice (Jak. Pis. 1997); [⊗] Lućmierz (Fag. 1959); [⊗] Lubiaszów (Kul. 1918–1919); [⊗] Modlica (Fag. 1959); [○] Trębaczew (Mow. et al. 1963); [⊗] Ralewice (Dry. 1891); [●] Niżankowice (Ku. 1986); [⊕] Piaski (Jak. 1990 b); [●] Stoczki (Kur. 1979, 1981 a); [⊗] Wielka Wieś (Ol. 1968).

Geranium sylvaticum L. – 14 stations: [⊗] Niwiska

Górne (Ol. 1968); [⊗] Lućmierz, lg. L. Fag. 1959, LOD; [●] Lubień, [●] Podlubień (Kur. 1981b); [⊗] Lubiaszów, lg. H. Ur. 1956, LOD; [⊗] Modlica (Fag. 1959); [⊗] Jaksonek (Kul. 1925, Kur. 1981b); [●] Bolimów (Jak. 1990 a); [●] Budziszewice, lg. M. Najmanowicz 1972, LOD; [⊗] Lipce, [⊗] Rogów (Ni. 1930); [○] Trębaczew (Mow. et al. 1963); [⊗] Dobroń, lg. Sierzchała 1968, LOD; [●] Starzenica (Fil. Sic. So. 1992).

Euphorbia angulata Jacq. – 7 stations: [⊗] Dobromierz (Bł. 1959); [⊕] Rykały, [⊕] Stryków-Brzostowiec, [⊕] Kaleń, [⊕] Las Jeruzalski, [⊕] Rawski Las (Jak. 1978); [○] Trębaczew (Mow. et al. 1963).

Viola epipsila Ledeb. – 6 stations: [⊗] Modlica, lg. H. Witkowska 1955, LOD; [⊗] Poddębina, lg. M. Wiśniewska 1970, LOD; [⊗] Kobile Wielkie (Mow. 1960); [⊕] Stróża (Jak. 1989 a); [⊗] Wolbórka, lg. J. Bartel 1957, LOD; [●] Chojne (Kuch. Ku. 1998).

Chaerophyllum hirsutum L. – 11 stations: [●] Dębowiec, [●] Jasień (Ol. 1974); [⊗] Gorzkowice (Kar. 1881); [●] Gomunice, lg. M. Lesiak 1988 (Fag. 1998); [○] Kmieczna (Her. 1971, Jak. 1989 a); [●] Kobile Wielkie (Fag. 1984); [○] Pytowice, [●] Słostowice (Jak. 1989 a); [⊗] Regny (Mow. 1960); [●] Rogów (Mow. 1978); [●] Dobroń (Ojrz. 1987).

Laserpitium latifolium L. – 8 stations: [⊗] Niwiska Górne, [⊗] Wola Wydrzyna (Ol. 1968); [⊗] Jaksonek (Kul. 1925); [⊗] Popień, [⊗] Zacywilki (Zar. 1971); [⊗] Rogów, [⊗] Wilczy Dół (Ni. 1930); [○] Trębaczew (Mow. et al. 1963).

L. prutenicum L. – 9 stations: [⊗] Bujny (Ol. 1971); [⊗] Wola Wydrzyna, lg. J. Gózdź 1965, LOD (Fag. 1984); [⊗] Ruda (Gol. 1926); [○] Trębaczew (Mow. et al. 1963); [●] Bolimów (Jak. 1998 unpubl.); [⊗] Męcka Wola, lg. M. Kieszniewska 1964, LOD (Fag. 1984); [⊕] Ruda-Dunaj, [⊕] Woźniki, [⊕] Zagrodziska (Jak. 1990 b).

Moneses uniflora (L.) A. Gray – 18 stations: [●] Dębowiec (Ol. So. 1981); [⊗] Lućmierz (Fag. 1959); [●] Bąkowa Góra (Wit. 1988a); [●] Lubiaszów, [●] Wojciechów (Kur. 1981 b); [●] Lubień (Kur. 1973); [⊗] Modlica (Fag. 1959); [●] Stobnica (Kur. 1981 a); [⊕] Stróża (Jak. 1989a); [⊗] Wolbórz (Kul. 1925); [○] Żądłowice (Mow. et al. 1969); [⊗] Rogów (Ni. 1930); [○] Trębaczew (Mow. et al. 1963); [○] Żurawie (Jak. 1978); [●] Dobroń (Ojrz. 1987); [●] Niżankowice (Ku. 1986); [⊗] Podłężyce, [⊗] Rożdżały (Dry. 1891).

Pyrola media Swartz. – 10 stations: [●] Lućmierz (Mow. 1978); [⊗] Gałkówek, [⊗] Tuszyn (Mow. 1960); [⊗] Piotrków Tryb. (Kul. 1918–1919); [●] Pszczonów, [●] Radziejowice (Jak. 1990 a); [⊗] Rogów (Ni. 1930); [⊗] Trębaczew (Mow. et al. 1963); [⊗] Borek Lipiński, [⊗] Brząszewice (Mow. 1960).

P. rotundifolia L. – 17 stations: [●] Dębowiec (Ol. So. 1967, 1981); [⊗] Jasień, [⊗] Lućmierz, [⊗] Masłowice, [⊗] Miedźno (Mow. 1960); [⊗] Sulejów (Ejs. 1885); [⊗] Stróża (Jak. 1989 a); [⊗] Wolbórz (Kul. 1925, Mow. 1960); [●] Jeleń (Mam. 1984); [●] Łękińsko (Rut. Kur. 1980); [⊗] Żądłowice (Mow. et al. 1969); [⊗] Brudzewice, [⊗] Wysokinin (Ejs. 1885); [⊗] Trębaczew (Mow. et al.

1963); [⊗] Wilczy Dół (Ni. 1930); [●] Miedniewice (Jak. 1997 unpubl.); [⊗] Podłężyce (Dry. 1891).

Pulmonaria angustifolia L. – 13 stations: [⊗] Zimna Woda (Fag. 1959); [●] Konewka (Kur. 1986); [⊗] Modlica, lg. K. Owskiński 1948, LOD (Fag. 1987); [●] Bolimów (Jak. 1990 a); [⊗] Głuchów, [⊗] Popień (Zar. 1971); [●] Duży Las (Jak. 1988 unpubl.); [●] Radziejowice (Jak. 1987); [●] Sokule (Jak. 1990 a); [○] Rykały (Jak. 1978); [⊗] Małków (Dry. 1891); [⊕] Ruda-Dunaj (Fag. 1987, Jak. 1990 b); [●] Napoleonów (So. Fil. Sic. 1980, Jak. 1993).

Myosotis sparsiflora Pohl. – 5 stations: [●] Dzierzbice (Ol. 1974); [⊗] Spała (Ol. 1963); [●] Ziemiary, lg. B. Pyczak 1983, LOD (Fag. Wit. 1991); [⊗] Bartochów (Krzy. 1971); [⊗] Małków (Ol. 1968).

Asperula tinctoria L. – 5 stations: [●] Perna, lg. K. Cz. 1983, LOD; [○] Rykały (Jak. 1978); [●] Ruda (Jak. 1987); [●] Góra Zelce, [●] Góra Krzemionki (Fag. Cz. Ol. 1986).

Galium rivale (Sibth. & Sm.) Griseb. – 9 stations: [●] Świdno (Jak. 1978); [●] Błędów, [●] Grabskie Budy (Jak. 1990 a); [●] Mroga, [●] Rogów (Jak. Pis. 1997); [●] Machnarka (Jak. 1989 unpubl.); [●] Białogórne lg. Adamczyk 1991, LOD; [⊗] Sobota, [⊗] Rożdżały (Mow. 1960).

Galium saxatile L. – 2 stations: [●] Kluki near Szczerców (Jak. Pis. 1997); [⊕] Nieborów (Jak. 1990 a).

Salvia glutinosa L. – 1 station: [●] Lubiaszów, lg. R. Ol. 1984, LOD (Kur. 1986).

Linnaea borealis L. – 10 stations: [●] Bąkowa Góra (Wit. 1988b); [●] Jaksonek (Kur. 1978 a, b); [○] Pytowice (Jak. 1985); [⊗] Górki (Mow. 1962, Zar. 1986); [⊗] Lipce (Mow. 1963, Zar. 1971); [⊕] Petrykozy (Jak. 1973); [⊗] Nieborów (Jak. Pis. 1997); [⊗] Ruda, [⊗] Lisna (Jak. Ziel. 2000); [●] Troniny (Ku. 1998).

Veronica montana L. – 5 stations: [●] Łódź-Helenówek (Jak. Pis. 1997); [●] Wiączyń, lg. Chalcarz 1979, LOD; [⊗] Stróża (Jak. 1989 a); [●] Komarówka, [●] Nowa Wieś (Kur. 1986).

Campanula bononiensis L. – 8 stations: [⊗] Barkowice, [⊗] Inowłódz (Ol. 1963); [⊗] Sulejów (Ejs. 1885); [●] Świdno, [●] Tomczyce (Jak. 1978); [⊗] Wysokinin (Ejs. 1885); [⊗] Małków (Dry. 1891); [⊗] Wielka Wieś (Ol. 1968).

C. cervicaria L. – 18 stations: [⊗] Perna (Ur. 1969); [●] Grotniki (Kur. et al. 1986); [●] Jaksonek, [●] Owczary (Kur. 1981 b); [⊗] Lubiaszów (Mow. 1960); [⊗] Sulejów (Kul. 1925, Mow. 1960); [⊕] Dąbrowa, [⊕] Rawski Las, [⊕] Stryków-Brzostowiec (Jak. 1978); [⊗] Wysokinin (Ejs. 1885); [●] Duży Las (Jak. 1988 unpubl.); [○] Trębaczew (Mow. et al. 1963); [⊗] Rogów (Mow. 1960); [⊗] Czepów (Mow. 1960); [⊗] Niewiesz (Dry. 1891); [●] Stoczki (Kur. 1979); [⊕] Woźniki, [⊕] Zagrodziska (Jak. 1990 b).

Adenophora liliifolia (L.) Besser – 10 stations: [●] Grotniki (Kur. et al. 1986); [●] Owczary (Kur. 1981 b); [●] Prócheńsko Nowe (Kur. 1981 a); [⊗] Żdźary (Ros. 1872), [⊕] Kaleń (Jak. 1978), [○] Trębaczew (Mow. et al. 1963); [⊗] Wilczy Dół, [⊗] Zacywilki (Zar. 1971); [●] Mierzyce (Ku. 1984), [⊕] Woźniki (Jak. 1990 b).

Centaurea phrygia L. – 5 stations: [⊗] Zimna Woda

near Ozorków, lg. J. Paulińska 1955, LOD; [⊗] Przyglów, [⊗] Kobile Wielkie (Mow. 1960); [●] Łódź-Janów (Wit. 1991); [●] Woźniki (Jak. 1990 b).

Inula salicina L. – 8 stations: [⊕] Dąbrowice (Jak. 1990 b); [⊗] Gołębiew, [⊗] Orlów (Dry. 1885, Mow. 1960); [●] Perna (Jak. Pis. 1997); [⊗] Bełchatów, lg. J. Marchewka 1975, LOD; [●] Bukowa Góra, lg. L. Fag. 1973, LOD; [⊗] Milejów (Mow. 1960); [●] Wielkopole, lg. K. Żanet 1983, LOD.

Hypochoeris maculata L. – 14 stations: [●] Świnice (Ol. 1974); [⊕] Spała (Ol. 1974); [⊕] Rykały, [⊕] Chojnata, [⊕] Żurawie (Jak. 1978); [●] Radziejowice (Jak. 1989 b); [⊗] Kościelna Góra, [⊗] Łysa Góra, [⊗] Małków, [⊗] Męcka Wola (Dry. 1891, Mow. 1960); [⊕] Ruda Dunaj, [⊕] Woźniki (Jak. 1990 b); [●] Kuźnice Wielkie, [●] Stolec (Fil. et al. 1992).

Senecio fuchsii C. C. Gmel. – 8 stations: [●] Jedlno (Jak. 1989 a); [●] Siedlec (Jak. Pis. 1997); [⊗] Justynów, [⊗] Romanów (Mow. 1960); [○] Wola Grzymalina, [⊕] Wola Wydrzyna (Kur. 1984); [●] Mierzyce (Ku. 1984); [●] Niżankowice (Ku. 1986).

Hieracium cymosum L. – 4 stations: [●] Sokule (Jak. 1990 a); [●] Bolimów (Jak. 1998 unpubl.); [●] Joachimów, lg. J. Ma. 1997, LOD; [⊕] Ruda-Dunaj (Jak. 1990 b).

H. caespitosum Dumort. – 15 stations: [○] Sokoły, [⊕] Stanisławów II, [⊕] Stróża, (Jak. 1989 a); [⊗] Modrzewina (Kob. 1925), [⊕] Stryków-Brzostowice, [⊕] Dąbrowa near Mogielnica, [⊕] Tomczyce, [⊕] Las Jeruzalski, [⊕] Wiatrowiec, [⊕] Zawada (Jak. 1978); [●] Radziejowice, [●] Sokule (Jak. 1987), [○] Trębaczew (Mow. et al. 1963); [●] Piaski, [●] Woźniki (Jak. 1990 b).

Streptopus amplexifolius (L.) DC. – 4 stations: [●] Jasień (Ol. 1974); [●] Słostowice (Rut. Kur. 1980); [●] Stróża, [●] Wola Grzymalina (Her. (1982), 1984).

Polygonatum verticillatum (L.) All. – 13 stations: [⊗] Dębowiec (Mow. et al. 1967); [⊗] Domaniew, [⊗] Jatno, [⊗] Okrąglik (Ur. 1968, 1969); [⊗] Chelmy (Fag. 1956); [⊗] Lućmierz (Kur. 1981 a); [●] Grotniki (Kur. 1976 b); [●] Szczawin (Fil. 1976); [●] Las Łagiewnicki (Wit. et al. 2000); [⊗] near Łęczycza (Jas. 1829); [●] Wielkopole (Kur. 1990); [⊗] Zabrody (Bł. 1959); [⊗] Popień (Zar. 1971).

Gladiolus imbricatus L. – 10 stations: [⊗] Moszczenica (Mow. 1960); [●] Ostrowy-Bażantarnia (Kur. 1986); [⊗] Nowe Miasto (Ros. 1872); [●] Bolimów (Ol. 1974); [●] Grabina, [●] Wielenin (Jak. Pis. 1997); [●] Kolumna, [●] Dobroń (Ojrz. 1987); [⊗] Podłężyce (Dry. 1981); [●] Woźniki (Jak. 1990 b).

Luzula luzuloides (Lam.) Dandy & Wilmot – 8 stations: [●] Łódź-Chojny (Ol. 1974); [●] Łódź-Bałuty (Wit. 1991); [●] Bąkowa Góra (Wit. 1988a); [⊗] Spała, [⊗] near Zgierz (Mow. 1960); [●] Nagórzyce (Kur. 1978); [●] Wólka Łasiecka (Ol. 1974); [●] Nieborów (Jak. 1998 unpubl.).

Glyceria nemoralis (R. Uehtr.) R. Uehtr. & Körn. – 3 stations: [⊗] Jasień, [⊗] Złoczew (Mow. 1960); [⊗] Spała (Ol. 1978b).

Hierochloë odorata (L.) Beauv. – 6 stations: [●] Niebieskie Źródła (Ol. 1974); [⊗] Spała (Mow. 1960); [●] Zarzęcin, lg. J. Her., T. Za. 1972, LOD; [●] Grabina, [●] Sierakowice (Pis. 1989); [●] Nieborów (Jak. Pis. 1997).

Koeleria grandis Besser – 24 stations: [●] Grotniki (Kur. et al. 1986); [●] Fryszlerka near Inowłódz (Ol. 1974); [⊗] Gałków (Sz. 1923); [●] Taraska, lg. H. And. 1982, LOD; [●] Smardzewice, [●] Łęczno (Kur. 1981 a); [⊕] Nowy Świat, [⊕] Parzniewice, [○] Pytowice (Jak. 1989a); [⊗] Żądłowice, lg. J. Jak. 1967, LOD; [●] Tomczyce, [○] Chojnata, [⊕] Głuchów, [⊕] Rawski Las (Jak. 1978); [●] Grabina, [●] Pszczonów (Jak. 1990 a); [⊗] Trębaczew (Mow. 1963); [⊗] Rogów (Ni. 1929); [⊗] Zacywilki (Zar. 1971); [●] Szymaniszki, lg. M. Mam. 1975, LOD; [●] Mierzyce (Ku. 1984); [⊗] Raciszyn (Ol. 1968); [⊕] Ruda-Dunaj (Jak. 1990 b); [●] Stoczki (Kur. 1979).

Festuca amethystina L. subsp. *ritschlii* – 20 stations: [⊕] Jedlno, [⊕] Piekary, [⊕] Dąbrowice, [⊕] Las Łagiewnicki, [⊕] Grotniki, [⊕] Jaksonek, [●] Reczków, [⊕] Zielona Góra (Jak. 1994); [⊕] Stryków-Brzostowice, [⊕] Bolimów, [●] Głuchów, [⊕] Popień, [⊕] Radziejowice, [●] Rawski Las, [⊕] Szymaniszki, [○] Trębaczew, lg. J. Jak. 1970, LOD; [⊕] Borszewice, [●] Gostków, [●] Napoleonów, [⊕] Ruda-Dunaj (Jak. 1994).

F. heterophylla Lam. – 10 stations: [●] Perna (Jak. Pis. 1997); [●] Daszyna, [●] Byszew (Ol. 1972 a); [⊗] Lubiaszów (Ur. 1959); [⊗] Niebieskie Źródła (Mow. Ol. 1961); [●] Woźniki (Jak. 1990 b); [●] Niżankowice (Ku. 1986); [⊗] Złoczew (Mow. 1960); [⊗] Zduny (Mow. 1960), [●] Karsznice (Ol. 1972a).

Avenula planiculmis (Schr.) W. Sauer & Chmelitschek – 6 stations: [●] Jaksonek (Fr. 1991, Jak. Pis. 1997); [●] Głuchów, [●] Szymaniszki (Jak. Pis. 1997); [●] Mierzyce, [●] Niżankowice, [●] Rogów (Fr. 1991).

Carex vaginata Tausch. – 5 stations: [●] Puszcza Mariańska, [●] Sokule, [●] Ulaski (Jak. 1988); [●] Miedniewice, [●] Nieborów (Jak. 1998 unpubl.).

Carex pilosa Scop. – 9 stations: [●] Babsk (Ol. Ku. 1995); [●] Puszcza Mariańska, [●] Radziejowice (Jak. 1987); [●] Skulski Las, [●] Sokule (Jak. 1990 a); [⊗] Głuchów, [⊗] Lipce (Zar. 1971); [⊗] Nowa Wieś (Pac. 1964); [●] Złoczew (Pa. 1994 unpubl.).

Carex umbrosa Host. – 11 stations: [●] Bolimów, [●] Wielenin, [●] Jaksonek, [●] Lubiaszów (Jak. Pis. 1997); [●] Meszcze lg. S. Po. 1986, LOD (Fag. 1990); [●] Świdno (Jak. 1978); [⊗] Trębaczew (Mow. in. 1963); [⊗] Zacywilki (Ni. 1930, Mow. 1960); [●] Sokule (Jak. 1998 unpubl.); [●] Woźniki (Jak. 1990b).

Platanthera chlorantha (Custer) Rchb. – 11 stations: [⊗] Borek, lg. H. Ur. 1960, LOD (Fag. 1986); [⊗] Dębowiec, lg. B. Kaczmarek 1963, LOD (Fag. 1986); [⊗] Gołębiew, lg. T. Lewandowska 1970, LOD (Fag. 1986); [●] Meszcze, lg. S. Polak 1986, LOD (Fag. 1986); [●] Wolbórka, [●] Lubiaszów (Kur. 1986); [●] Teofilów near Szczerców (Jak. Pis. 1997); [●] Nowa Wieś, lg. H. Ur.

1960, LOD (Fag. 1986); [⊗] Komasówka, lg. P. Sokołowska 1960, LOD (Fag. 1986); [⊕] Sokule, [⊕] Ulaski (Jak. 1990 a).

***Neottia nidus-avis* (L.) Rich.** – 20 stations: [●] Dębowiec (Ol. So. 1981); [●] Krogulec, [●] Szczawin (Fil. 1984); [●] Las Łagiewnicki (Wit. et al. 2000); [⊗] Perna (Ur. 1969); [●] Gołębiew, lg. H. Rut. 1976, LOD (Fag. 1986); [⊗] Piotrków (Mow. 1960); [⊗] Jaksonek (Kul 1925); [●] Łuszczanowice, lg. E. Łaskiewicz 1978, LOD (Fag. 1986); [●] Bielawy-Mroga (Ol. 1974); [●] Głowno, lg. M. Mam. 1975, LOD (Fag. 1986); [●] Puszcza Mariańska, [●] Radziejowice, [●] Skuły-Wschód (Jak. 1990 a); [●] Bolimów, lg. I. Ma. 1997, LOD; [⊗] Nowa Wieś (Ur. 1963); [⊗] Podłężyce (Dry. 1891); [●] Mokry Las, lg. M. Pejaska, 1983, LOD; [⊗] Komasówka (So. 1964); [⊕] Ruda-Dunaj (Jak. 1990 b).

***Epipactis atrorubens* (Hoffm.) Besser** – 10 stations: [⊗] Łódź-Zdrowie, lg. E. Olszewska 1975, LOD (Fag. 1986); [⊗] Białobrzegi (Ros. 1872, Ol. 1978 b); [⊕] Dębina near Kamień (Jak. 1989 a); [⊗] Jaksonek (Kul. 1934); [⊗] Konewka (Ros. 1872, Ol. 1978 b); [⊗] Przedbórz, lg. J. Lem. 1948, LOD (Fag. 1986); [●] Piskorzaniec, [●] Dobromierz (Ol. Wn. 1990); [⊗] Wysokinin (Ejs. 1885, Ol. 1978 b); [●] Mierzyce (Ku. 1984).

***Cephalanthera damasonium* (Miller) Druce** – 7 stations: [●] Ostrowy-Bażantarnia (Kur. 1986); [●] Bukowa Góra (Ol. 1978b); [⊗] Rączki, lg. J. Le. 1948, LOD (Fag. 1986); [⊗] Wymysłów, lg. M. Wn. 1968, LOD (Fag. 1986); [●] Wierzchlas (Mow. 1978); [●] Piskorzaniec (Ol. Wn. 1990); [●] Tomczyce (Jak. 1978).

***C. longifolia* (L.) Fritsch** – 2 stations: [●] Bukowa Góra (Kur. 1986); [●] Piskorzaniec (Ol. Wn. 1990).

***C. rubra* (L.) L. C. M. Richard** – 13 stations: [⊗] Domaniew, [⊗] Jatno (Ur. 1968, 1969); [⊕] Dąbrowice (Jak. Pis. 1997); [●] Grotniki, lg. Z. Wojciechowski 1967, LOD (Kur. 1986); [●] Szczawin (Fil. 1984); [⊗] Pawlikowice (Mow. 1960); [●] Bąkowa Góra (Wit. 1988a); [●] Bratków, lg. W. Kicińska 1978, LOD (Fag. 1986); [⊗] Wola Wydrzyna, lg. J. Gózdź 1965, LOD (Fag. 1986); [●] Dobromierz, [●] Piskorzaniec (Ol. Wn. 1990); [⊕] Bukowa Góra (Bł. 1959); [⊕] Petrykozy (Jak. 1978).

***Corallorhiza trifida* Chatel** – 3 stations: [●] Las Łagiewnicki (Wit. et al. 2000); [●] Bukowa Góra (Ol. 1978 b); [●] Piskorzaniec (Ol. Wn. 1990).

***Goodyera repens* (L.) R. Br.** – 1 station [⊗] Przedbórz, lg. J. Le. 1949, LOD (Fag. 1986).

PROTECTION OF SPECIES FACING EXTINCTION AND VULNERABLE SPECIES

In the recent decades, adverse changes in woodland communities have intensified that entail shrinking and disappearance of the habitats of many species, particularly those of a narrow ecological spectrum. The woodland flora is

subject to the effects of generally operating, well-known factors which contribute to the disappearance or extinction of species in various ecological groups (Olaczek 1976; Kornaś 1976, 1981; Michalik 1979, 1988).

The ever intensifying changes in the environment which occur on a global-scale, such as air pollution, represent a major threat to plants, irrespective of whether their stations are in reserves or outside any protected areas. The most vulnerable to extinction are those stations which appear on the borders of distribution areas or those located close to the sources of impact. One of the examples is *Abies alba*, still well-preserved in the southern part of central Poland, but which has already disappeared from the Polesie Konstantynowskie nature reserve (Olaczek and Sowa 1976), and whose last individuals vanished from the Spała reserve.

In view of recent changes in woodland communities and threats to the flora associated herewith, one cannot neglect such an important factor as climate change. The warming of the climate accelerates the regression of coniferous species and the expansion of the deciduous species replacing them. With the assumption that the direction of changes is not reversed in future, there will be a large-scale disappearance of not only coniferous trees but also the species of the herb layer of coniferous forest. The withdrawal of many species of the herb layers has been detected in many regions, *inter alia* in the Ojców National Park (Kornaś 1990).

Prime attention should be given to the heliophilous and thermophilous species which have been eliminated in recent decades with an extremely high rate, from various plant communities including woodland communities. A large group of these valuable and interesting plants in the Polish flora (Kornaś 1981) disappear as a result of the overgrowing and afforestation of grasslands as well as of the transformation of open deciduous and mixed forests (Ceynowa-Gieldon 1986; Herbich 1986; Jakubowska-Gabara 1991, 1993).

The results of studies repeatedly prove that in some cases, woodland communities undergo the secondary succession, resulting in changes undermining the reasons for which the reserves have been established in the first place (Olaczek and Ławrynowicz 1986). One example is the Trębaczew reserve where 50% of the plant species have disappeared in less than three decades, including such interesting species as *Platanthera bifolia*, *Trollius europaeus*, *Galium rotundifolium*, and *Laserpitium latifolium*. The existence of the Polish larch, the species for which this protected area was declared, is evidently threatened there (Mowszowicz et al. 1963; Jakubowska-Gabara 1991).

There has been increasingly more facts supporting the opinion that traditionally understood reserves (strict reserves) do not provide sufficient protection for the gene pool of vegetation, particularly for species occurring on a small number of stations as small populations. To preserve the genetic resources of many species, particularly heliophytes, active measures of protection are needed.

Thus, despite the fact that many vascular woodland species in central Poland are protected in nature reserves (Kurowski 1986), the effectiveness of this protection is far

from certain if conservation plans for the reserves do not include active protection schemes for these species. Moreover, only part of the stations of rare and valuable species are within the reserves (only 32% of the stations mentioned in this paper for 74 of the rarest species are located in protected areas). In addition, some interesting and valuable species e.g. *Arenaria graminifolia*, *Galium saxatile*, and *Hieracium cymosum* have been recorded only from sites not covered by any protection measures. It should also be noted that only some of the rare or vulnerable taxa are included in the list of protected species. Among 74 species covered in this study, only 22 i.e. 30% are protected plant species.

The protection of endangered and vulnerable species is associated closely with the very timely issue of biological diversity. From the viewpoint of the maintenance of biodiversity, the forms of protection applied to-date are neither sufficient nor effective (Gliwicz 1992). Retaining the biological diversity in all three levels, i.e. the species, gene pools and ecosystems, implies the need for comprehensive nature conservation, which represents an important task for the future.

As of today, the most urgent and feasible in the short term is the preservation of the existing biological diversity. Applying suitable methods of active protection measures and so-called "silent protection" (Olaczek and Ławrynowicz 1986) can provide the right conditions for the durable existence of many vulnerable taxa. It is important that all or at least most of the stations are covered irrespective of their location in or outside reserves. Particular care should be taken of single stations of valuable species especially those represented by small populations. There is also a need to maintain observations of the resource status of these stations, biology of species and impending threats. The stations of some endangered and vulnerable species in central Poland should be included in permanent studies of a monitoring type.

SUMMARY AND CONCLUSIONS

This paper presents the state of knowledge on the distribution of the most valuable and interesting elements of the vascular flora of the woodlands in central Poland. It also indicates a group of species which have not been treated as rare or vulnerable to-date but which, because of the rapidly shrinking number of stations resulting from the transformations of some woodland phytocoenoses, that should be considered vulnerable, if not now but in the nearest future.

The study also provides new data on stations not known previously, and on species new to the area (cf. Mowszowicz 1963, 1978; Kurowski 1986 and references there). The basis for any efforts to preserve the diversity of the endangered and vulnerable elements of vegetation is the full knowledge of the stations, not only in the reserves and natural habitats. A group of 74 taxa is presented in this paper, including 31 border taxa which occur in central Poland on the edges of their distribution areas or on island stations, 22 protected species with a small number of stations and 21

species which are very rare throughout the region and the whole of Poland.

In the group of species reaching the limits of their distribution in the territory of Poland, there is a significant representation of the mountain element. Most of mountain species occur in central Poland in island stations (Fig. 2). More than 24 stations were identified with respect to such mountain species as *Abies alba*, *Anthriscus nitida*, *Galium rotundifolium*, and *Senecio rivularis*. Continental, boreal and sub-Atlantic species are represented by low numbers and on few stations (Figs. 3, 4).

The total number of known stations of the species under consideration in this study is 663, with as much as 50 species occurring only on 1–10 stations, including 24 species occurring on a mere 1–5 stations. On the basis of some data from the literature (Olaczek 1963, 1968; Czyżewska and Jakubowska-Gabara 1985; Jakubowska-Gabara 1991, 1993) and the Authors own observations, 32 stations (i.e. some 5% of the total number) have been regarded as extinct within the last three decades, whereas 84 stations (13%) are deemed liable to become extinct in the near future. A significant number i.e. as many as 247 (38%) represent stations which have not been confirmed for at least 25 years. A large proportion of these may be treated as no longer in existence, particularly with respect to such taxa as species of the genus *Pulsatilla* (Fig. 5).

According to the categories of threat and the most recent lists of endangered and vulnerable species in Poland (Zarzycki and Szela 1992; Zarzycki and Kaźmierczakowa 1993), within the group of plants presented there are two species nearing extinction: *Cephalanthera rubra* and *Viola epipsila* and nine vulnerable species *Adenophora liliifolia*, *Carex vaginata*, *Cephalanthera longifolia*, *Corallorhiza trifida*, *Festuca amethystina*, *Osmunda regalis*, *Potentilla micrantha*, *Pulsatilla patens*, and *P. vernalis*.

It is worthy noting the great diversification in the number of stations in central Poland for the species which have been treated as one category in national assessment. Thus, within the group of vulnerable taxa (V) are the species known only from one station e.g. *Potentilla micrantha* and also those which occur on more than 24 stations e.g. *Dianthus superbus*, *Dryopteris cristata*, *Dactylorhiza fuchsii*, and *D. maculata*.

The data collected indicate that in the vascular flora of the woodlands of central Poland the utmost danger faces the species occurring on one or two stations, such as *Arenaria graminifolia*, *Potentilla micrantha*, *Galium saxatile*, *Hieracium cymosum*, and *Taxus baccata*. The species occurring on several marginal or island sites which most often disappear first are: *Blechnum spicant*, *Dentaria enneaphyllos*, *Streptopus amplexifolius*, *Thelypteris limbosperma* and the species endangered or vulnerable throughout Poland, such as: *Adenophora liliifolia*, *Cephalanthera rubra*, *Dianthus gratianopolitanus*, *Osmunda regalis*, *Pulsatilla patens*, *P. vernalis*, and *Viola epipsila*.

Apart from the 74 species considered in this study, those woodland plants that should also be considered vulnerable are those, which although still found on a number of sta-

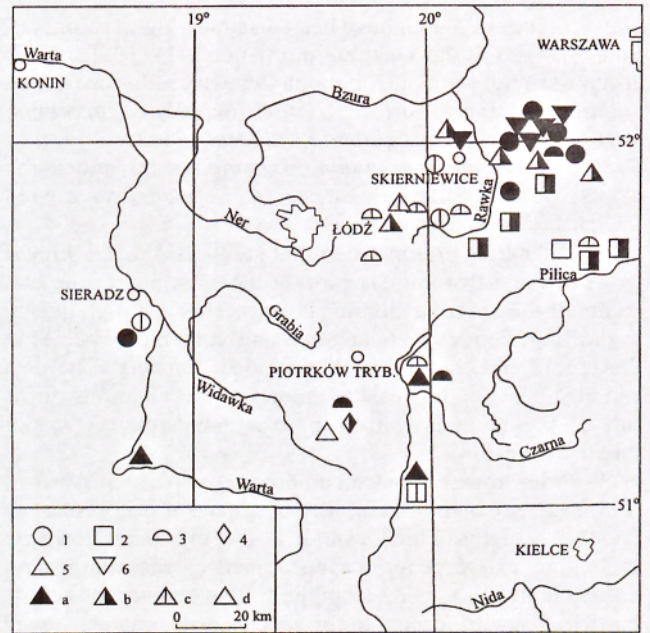
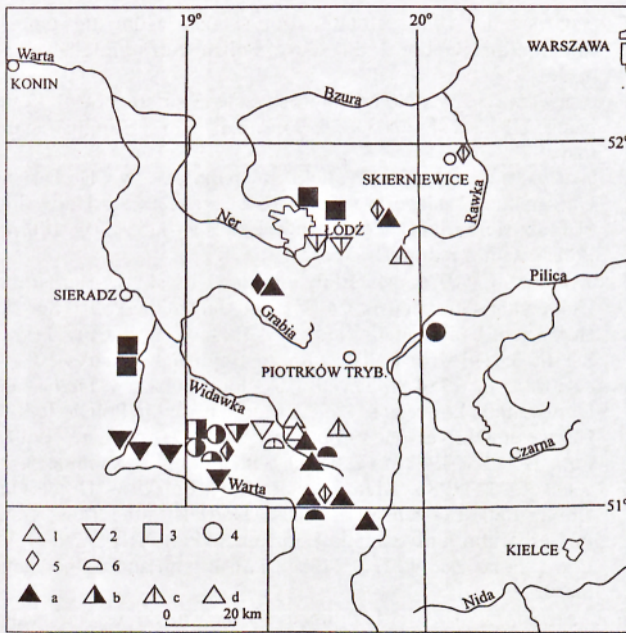


Fig. 2. Distribution of some mountain species. 1 – *Chaerophyllum hirsutum*, 2 – *Senecio fuchsii*, 3 – *Veronica montana*, 4 – *Dentaria enneaphyllos*, 5 – *Blechnum spicant*, 6 – *Streptopus amplexifolius*; localities: a – discovered or confirmed after 1972, b – endangered, c – not confirmed since at least 1973 and probably extinct, d – extinct.

Fig. 3. Distribution of some boreal and continental species. 1 – *Carex pilosa*, 2 – *Euphorbia angulata*, 3 – *Chamaecytisus rutenicus*, 4 – *Arenaria graminifolia*, 5 – *Linnaea borealis*, 6 – *Carex vaginata*. a–d – as in Fig. 1.

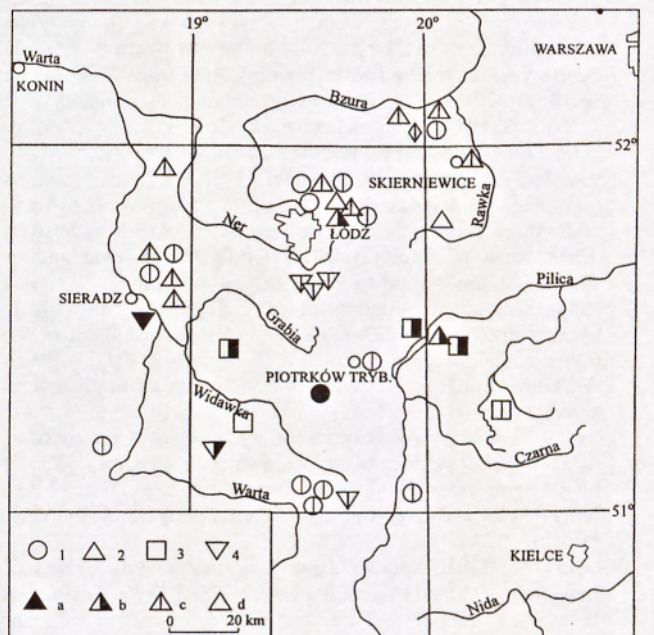
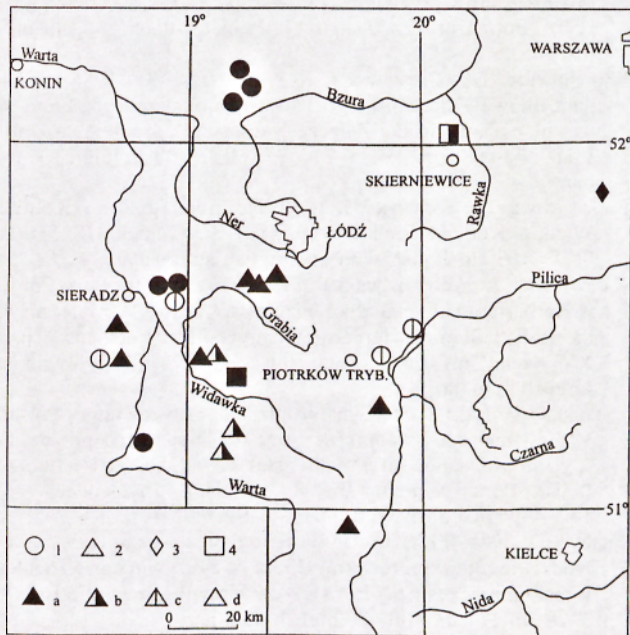


Fig. 4. Distribution of some subatlantic species. 1 – *Festuca heterophylla*, 2 – *Osmunda regalis*, 3 – *Potentilla micrantha*, 4 – *Galium saxatile*. a–d – as in Fig. 1.

Fig. 5. Distribution of some the most endangered species. 1 – *Pulsatilla vernalis*, 2 – *Pulsatilla patens*, 3 – *Dianthus gratianopolitanus*, 4 – *Viola epipsila*. a–d – as in Fig. 1.

tions in central Poland, have been disappearing in recent decades (Jakubowska-Gabara and Kucharski 1999). This group definitely includes heliophytes which disappear due to the transformation of *Potentillo albae-Quercetum* phytocoenoses (e.g. *Aquilegia vulgaris*, *Digitalis grandiflora*, *Hypericum montanum*, *Primula veris*) and some plants of the coniferous forests (e.g. *Antennaria dioica*, *Ledum palustre*, *Pyrola chlorantha*).

The material presented in this study add to the knowledge of the distribution regarding the most interesting elements of the vascular flora of Poland. This is a prerequisite to drafting the list of endangered and vulnerable species in the region and throughout the national territory. The data can also provide the basis of studies and evaluations of the rate of extinction as well as the recent and future levels of threat to the flora.

In order to assess more comprehensively the process of disappearance and vulnerability of species it is necessary to conduct research which would, in the first place, confirm either the existence or disappearance of the stations recorded in the past. The second important task for the future, particularly with respect to the species occurring on a small number of stations would be to closely monitor their abundance on these stations and the changes thereof.

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