

Last but not least we thank the officials of the Polish Academy of Sciences and the Rübel Foundation for financial contributions for general expenses.

Krakow and Zürich

K. Zarzycki  
E. Landolt  
J.J. Wojcicki

Veröff.Geobot.Inst.ETH, Stiftung Rübel, Zürich, 107 (1992), 19-39

## General information on Poland

Jan J. WÓJCICKI and Kazimierz ZARZYCKI

### 1. INTRODUCTION

Poland, with an area of 312'683 km<sup>2</sup> and a population of 38 million, is the seventh largest country in Europe, both in size and population. It is situated in

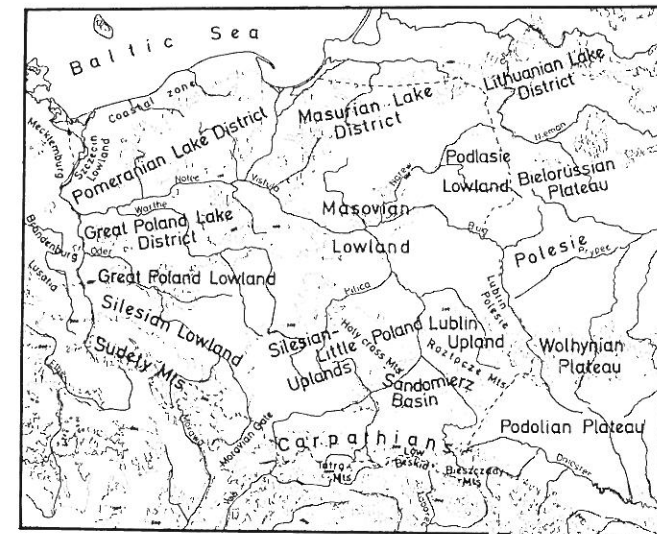


Fig. 1. Map of Poland with the more important geographical names used in the volume. (RALSKA-JASIEWICZOWA 1983).

the transitional area between the peninsula of Western Europe and the continental platform of Eastern Europe. The territory of Poland is delimited by two natural barriers: the Baltic sea to the north and the Carpathian and Sudety Mountains to the south and south west respectively (Fig. 1). The middle and northern parts of the country are open to the west and east.

The morphogenic relief of the landscape has a zonal pattern, with zones running roughly parallel to the latitudes (Fig. 12). The general climate of Poland is temperate, but influenced by the maritime climate from the north-west and the continental climate from the east. The climate also varies from the north southwards, following both latitude and relief. As a result of these intercrossing patterns, many of the climate phenomena are transitional (Figs. 2, 3, 4).

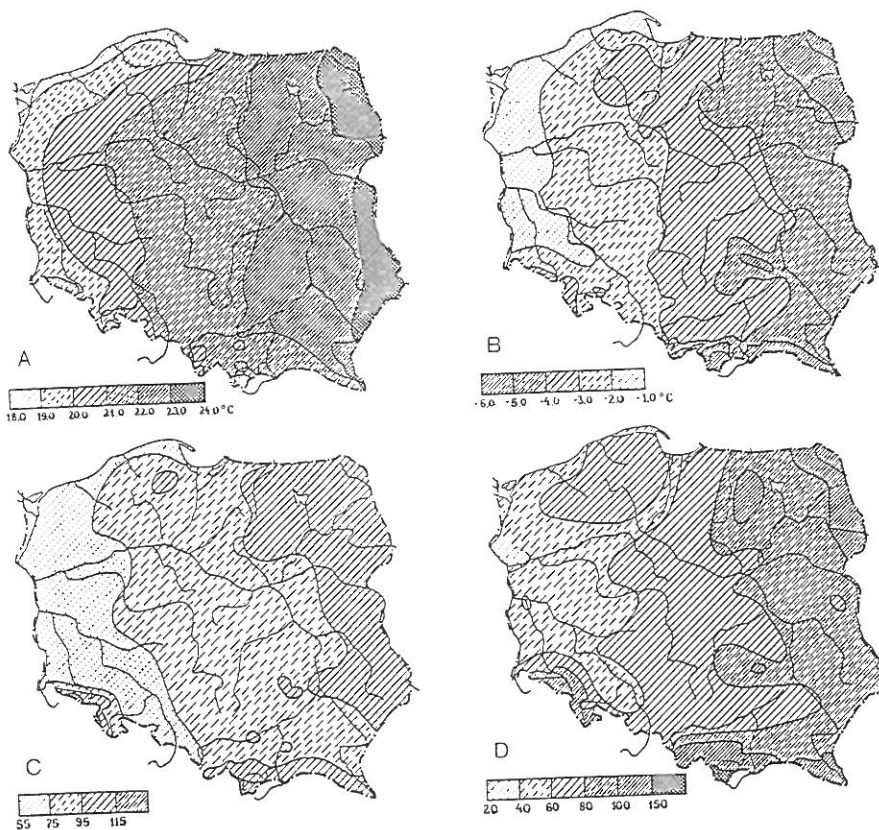


Fig. 2. Climate in Poland (MATUSZKIEWICZ 1984, slightly modified).  
A - average yearly temperature amplitudes, B - isotherms of January, C - average days with temperature >0°C, D - days of snow cover durability.

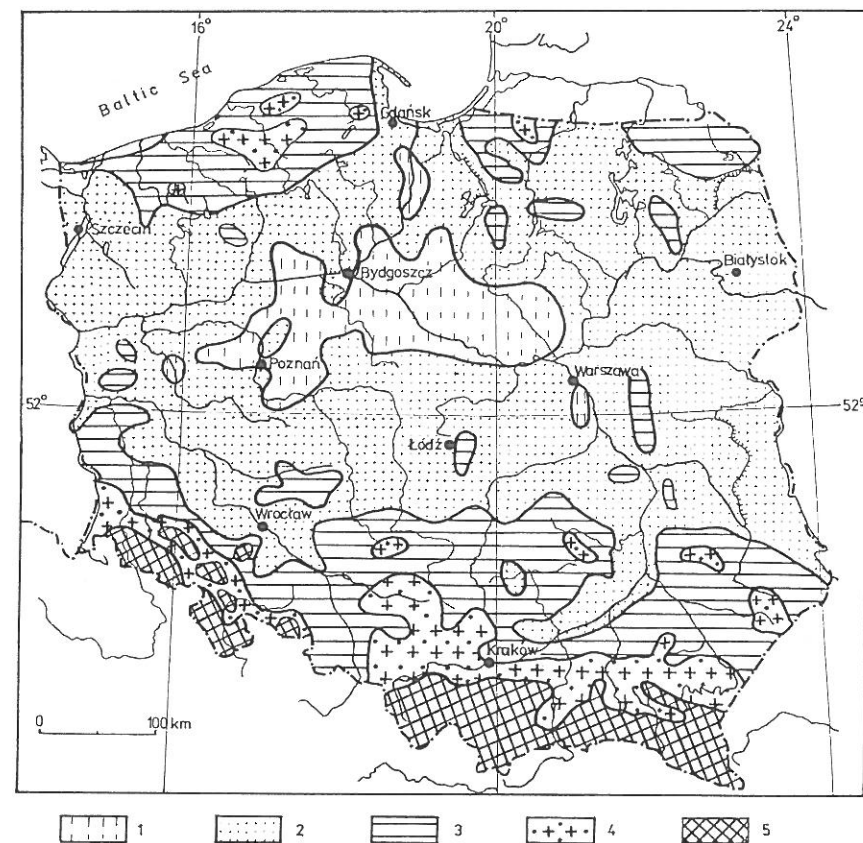


Fig. 3. Yearly precipitation in Poland (ENCYKLOPEDIA Powszechna 1975, modified).  
1 - <500 mm, 2 - 500-600 mm, 3 - 600-700 mm, 4 - 800-900 mm, 5 - 900->1200 mm.

The most important soil types distinguished in Poland are the following: brown soil and podsol, rendzina, chernozem, swamp soil, black earth and alluvial soil (Fig. 5). Originally, forest soils were dominant but their natural development became impeded or reversed by human activity.

On the geobotanical map, Poland belongs almost completely to the Central European Province (Euro-Siberian Region) of the Holarctic Sub-Kingdom (Fig. 6). Only a small fragment of Poland belongs to another province (Fig. 7). The geobotanical division of Poland is as follows:

Central European Province  
 Lowland-Highland Subprovince  
 Baltic Division  
 Northern Division  
 Mountain Subprovince  
 Carpathian Division  
 Sudetic Division  
 Pontic-Pannonian Province  
 Pontic Division

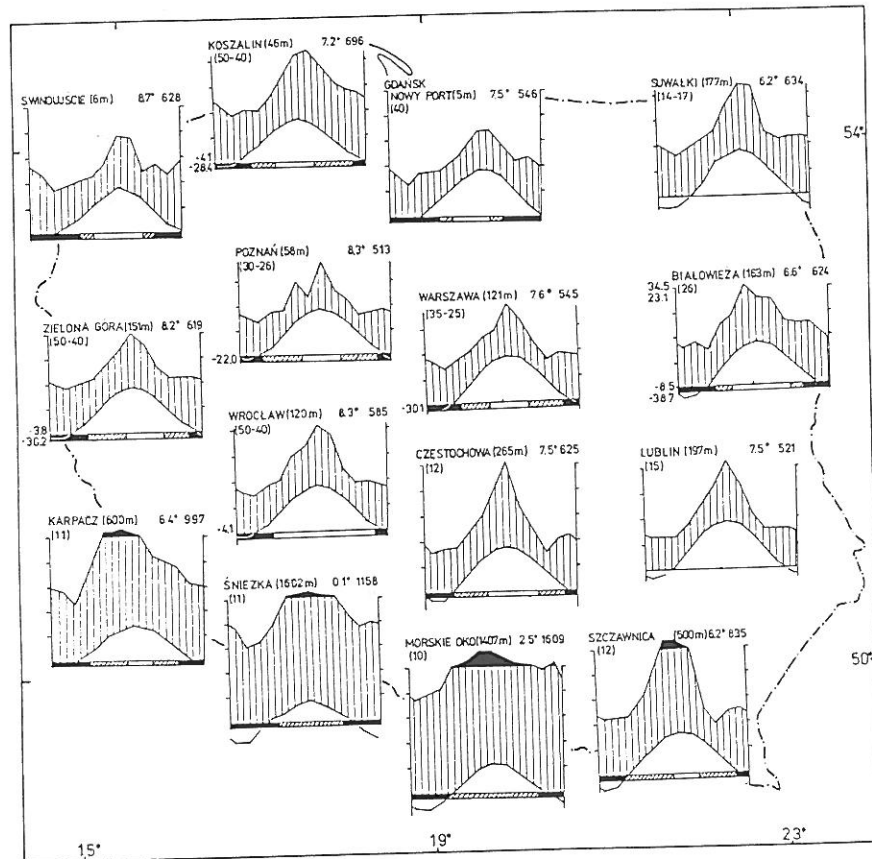


Fig. 4. Climatic diagrams for selected sites in Poland according to WALTER and LIETH (1961-1967) and other sources.

## 2. FLORA AND VEGETATION

The Quaternary glaciations (Fig. 8) determined the current flora and vegetation of Poland. Supposed migration routes, the distribution of some geographic elements and main trees and shrubs are described in Figs. 9-14. The contemporary vascular flora of Poland comprises 2250-2300 species. Many of the species are at their limit of distribution in Poland.

Poland lies within the vegetational zone of nemoral (deciduous) forests, except for the north-easternmost part which belongs to the zone of subboreal forests. The lowland and upland parts of Poland are dominated by *Pino-Quercetum*, *Dicrano-Pinetum* or *Peucedano-Pinetum* and *Tilio-Carpinetum* forests. In NW Poland, *Luzulo-Fagion* and *Melico-Fagetum* are also widespread but in NE Poland, where the *Picea abies* contribution is important,

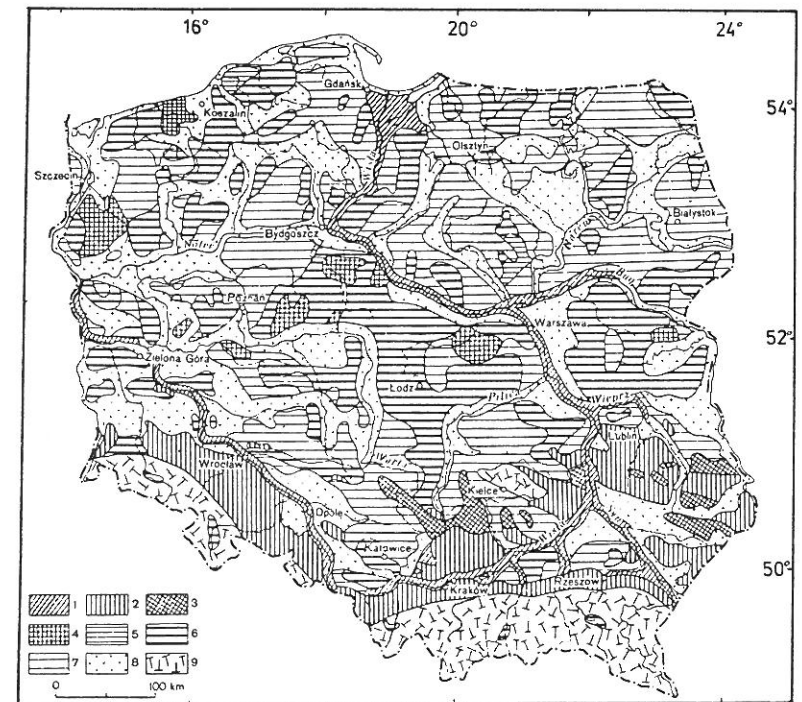


Fig. 5. Soil map of Poland (MEDWECKA-KORNAS 1966, slightly modified).

1 - mud, 2 - soil overlying loess, chernozem, 3 - rendzina, 4 - black bog soil, 5 - heavy clay soil, 6 - podsol overlying clay and silt, 7 - sandy soil, 8 - valley sand, peat bog, 9 - mountain soil.

*Sphagno girgensohnii-Piceetum* forests are typical. *Dentario glandulosae-Fagetum* and *Abieti-Piceetum* forests occur in the uplands of S. Poland, they also form the lower forest belt in the mountains. The upper montane belt consists of *Plagiothecio-Piceetum* and *Polysticho-Piceetum* and in the subalpine belt, *Pinetum mughi-carpaticum* communities occur. Azonal riverside woods of the *Carici elongatae-Alnetum glutinosae* and *Alnetum incanae* are distrib-

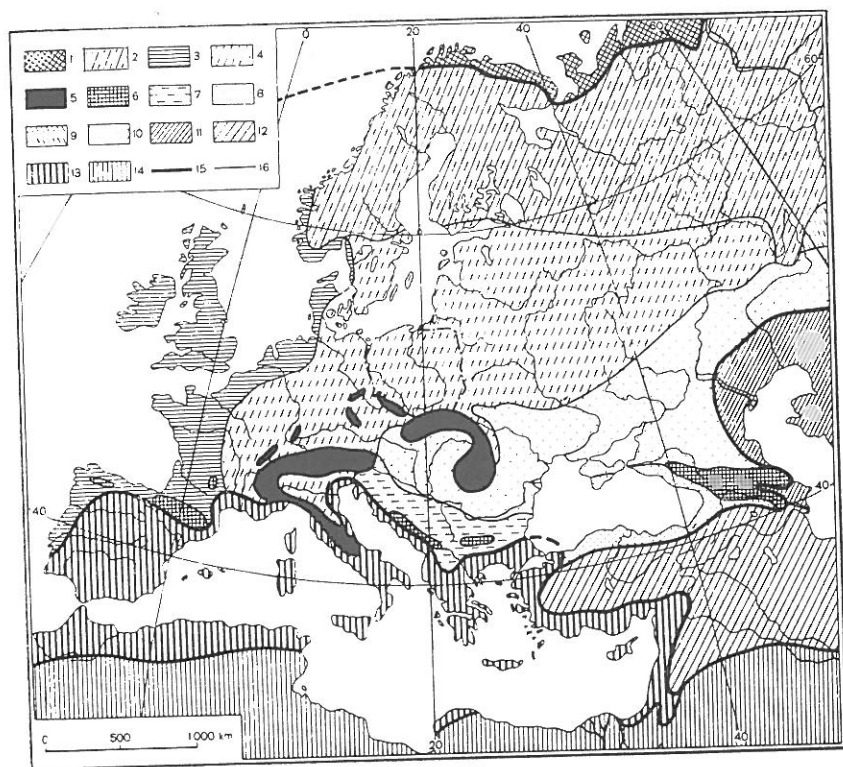


Fig. 6. Poland on the geobotanical map of Europe. (MEDWECKA-KORNAS 1977; according to different authors).

Holarctic Sub-Kingdom: 1 - Arctic Region. Euro-Siberian Region: 2 - Northern (Boreal) Province, 3 - Atlantic Province, 4 - Central European Lowland-Highland Province, 5 - Central European Mountain Province, 6 - other mountain provinces, 7 - Illyrian Province, 8 - Pontic-Pannonian Province, 9 - South-Siberian Province, 10 - Ponto-Hircan Province. Irano-Turanian Sub-Kingdom, Irano-Turanian Region: 11 - Turanian (Aralo-Caspian) Province, 12 - Iranian Province. 13 - Mediterranean Sub-Kingdom: Mediterranean Region. 14 - Saharo-Sindian Sub-Kingdom, Saharo-Sindian Region; 15 - boundaries between the sub-kingdoms and regions, 16 - boundaries between provinces.

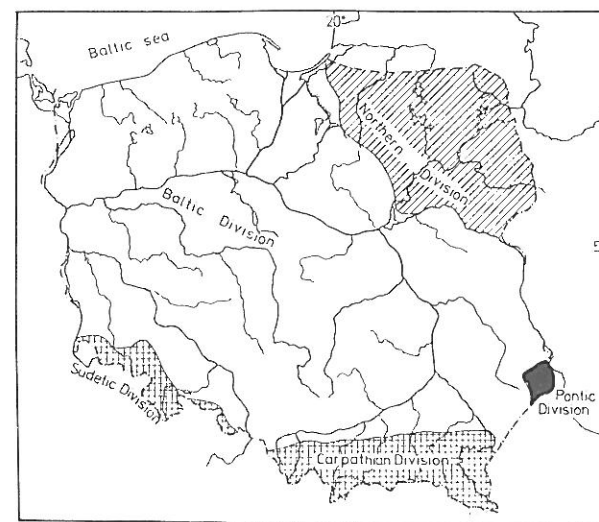


Fig. 7. Sketch-map of the boundaries of geobotanical divisions in Poland (SZAFER 1966, slightly modified).

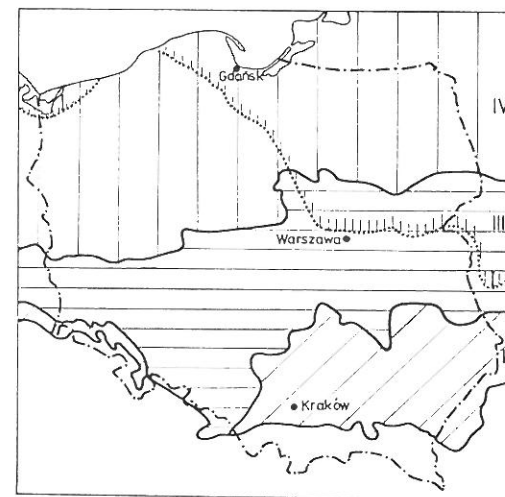
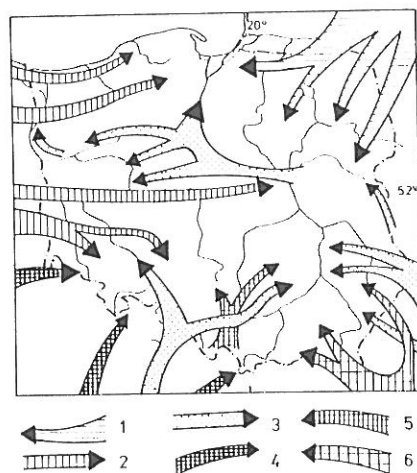
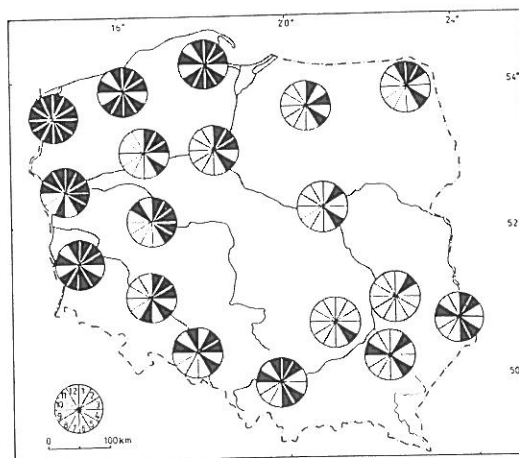


Fig. 8. Limits of the glaciations in Poland (ROZYCKI 1972, slightly modified). I - Oldest Glaciation (Günz), II - Cracow Glaciation (Mindel), III - Middle-Poland Glaciation (Riss), IV - Baltic Glaciation (Würm).



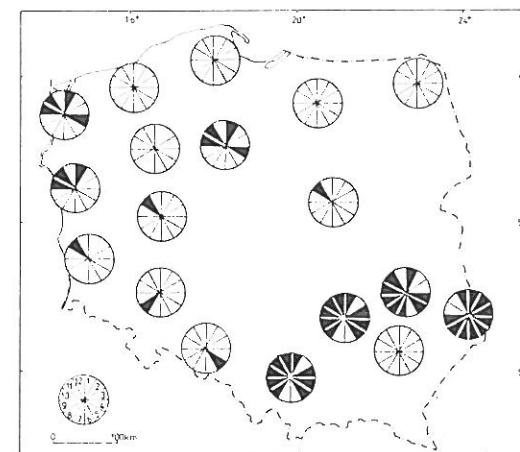
**Fig. 9.** Migration routes of the Polish flora elements (MATUSZKIEWICZ 1984, slightly modified).

1 - Boreal element, 2 - Atlantic element, 3 - Continental elements (mainly pontic-pannonian and numerous sarmatic), 4 - Alpine element, 5 - West-Carpathian element, 6 - East-Carpathian element.



**Fig. 10.** Distribution of plants occurring mainly in Atlantic climate conditions (GUZIK in SZAFER 1977).

1 - *Cladium mariscus*, 2 - *Drosera intermedia*, 3 - *Erica tetralix*, 4 - *Helosciadium repens*, 5 - *Hydrocotyle vulgaris*, 6 - *Litorea uniflora*, 7 - *Lonicera periclymenum*, 8 - *Myrica gale*, 9 - *Oenanthe lachenalii*, 10 - *Rhynchospora fusca*, 11 - *Schoenus nigricans*, 12 - *Utricularia ochroleuca*.



**Fig. 11.** Distribution of plants typical of continental climate and dry soils in Poland (GUZIK in SZAFER 1977).

1 - *Adonis vernalis*, 2 - *Ajuga chia*, 3 - *Carlina onopordifolia*, 4 - *Prunus fruticosa*, 5 - *Cirsium pannonicum*, 6 - *Cytisus albus*, 7 - *Echium rubrum*, 8 - *Iris aphylla*, 9 - *Linum flavum*, 10 - *Stipa capillata*, 11 - *Stipa pennata* s.l., 12 - *Thymus pannonicus*.

uted in the Polish lowlands and mountains, respectively (Fig. 15).

The vegetation of Poland, in many cases, indicates the west-east transitional character that is well expressed in the differentiation of forest communities (Fig. 16).

### 3. CHANGES AND PROTECTION

Poland's natural plant cover has been greatly altered by man's multifold activity. Less than 25% of the country has natural or semi-natural vegetation. More than 70% Poland's natural vegetation has been totally destroyed and replaced by anthropogenic vegetation (Fig. 17). The number of threatened native plant species has increased (Table 1) and, at the same time, many newcomers increased in number and distribution (Fig. 18).

Poland is under strong air pollution stress from industrial sources. This is responsible for the poor condition of the forests (Fig. 19) as well as for the relatively heavy contamination of plants by heavy metals, even within protected areas (Fig. 20).



Also, man unintentionally intervenes in various processes of wild plant evolution which e.g. has resulted in spontaneous hybridization between autochthonic and allochthonic taxa (Fig. 21).

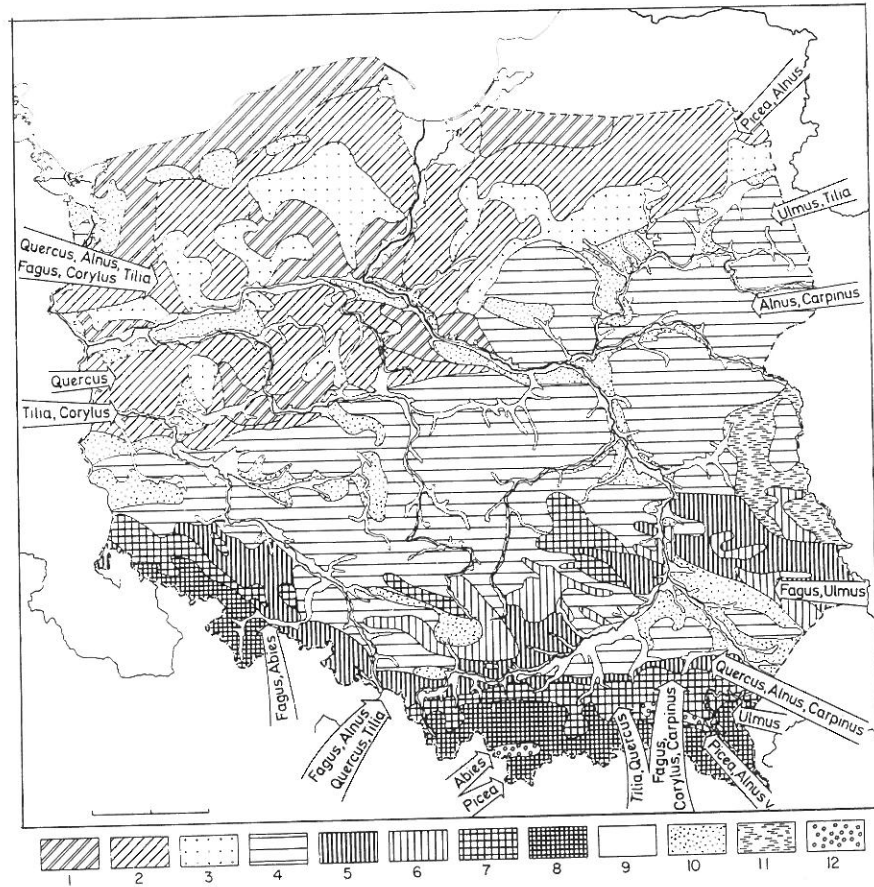


Fig. 12. The supposed migration routes of some tree and shrub species (RALSKA-JASIEWICZOWA 1983) and main types of natural landscapes in Poland (KONDRACKI in Narodowy Atlas Polski, 1973-1976).

Young glacial (Vistulian) landscapes: 1 - morainic plains, 2 - hilly lakelands, 3 - sandy lakelands, 4 - periglacial plains. Upland landscapes: 5 - loess areas, 6 - carbonate bedrock areas, 7 - silicate bedrock areas. Montane landscapes: 8 - lower and upper montane and alpine zones. Landscapes of valleys and accumulation plains: 9 - river valleys, 10 - inland dunes and dune terraces, 11 - lake-mire plains, 12 - intramontane plains. Scale bar = 100 km.

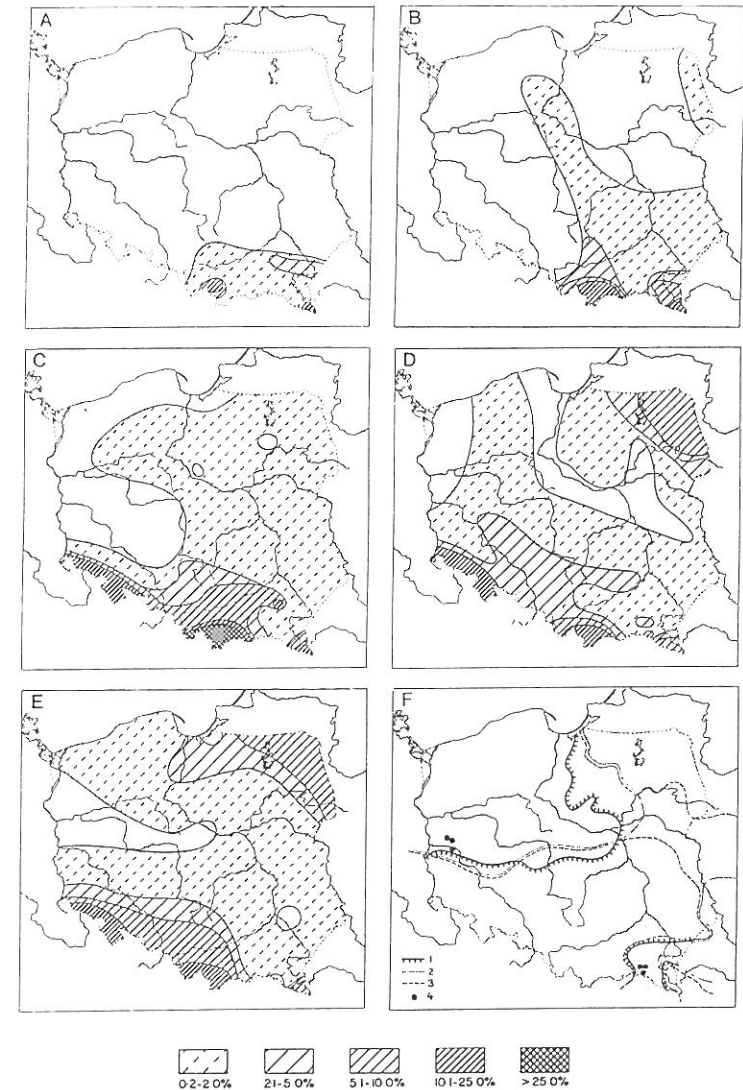


Fig. 13. Isopollen maps of *Picea* for Poland.

A - 11'000 B.P., B - 9'000 B.P., C - 7'000 B.P., D - 2'000 B.P., E - 0 B.P. (Pollen frequency in %) (RALSKA-JASIEWICZOWA 1983, slightly modified). F - recent distribution of *Picea abies* in Poland: 1 - BORATYNSKA et al. 1980, generalized, 2 - SRODON 1967, 3 - SZAFAER 1959, 4 - sites outside the continuous distribution.

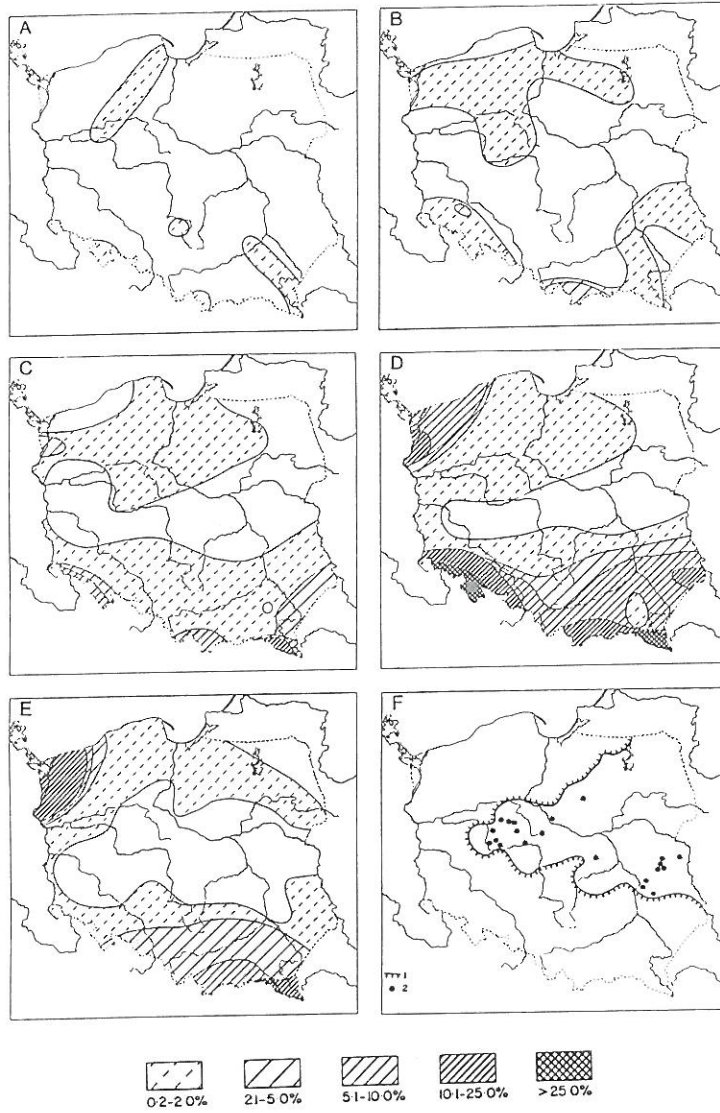


Fig. 14. Isopollen maps of *Fagus sylvatica* for Poland. A - 7'000 B.P., B - 5'000 B.P., C - 4'000 B.P., D - 2'000 B.P., E - 0 B.P. (Pollen frequency as in Fig. 13; RALSKA-JASIEWICZOWA 1983, slightly modified). F - recent distribution of *Fagus sylvatica* in Poland: 1 - GOSTYNSKA-JAKUSZEWSKA and ZIELINSKI 1976, generalized), 2 - sites outside the continuous distribution.

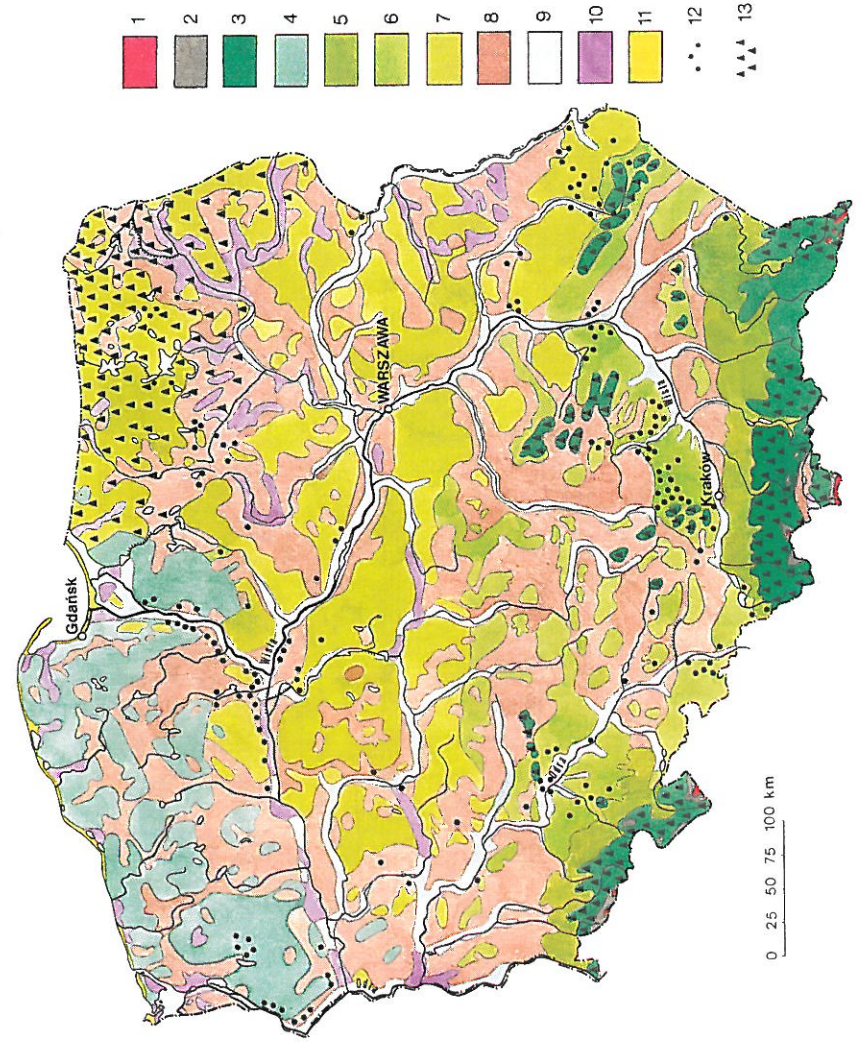


Fig. 15. Natural vegetation of Poland.  
1 - alpine meadows (*Cari-  
cetalia curvulae*, *Seslerie-  
talia varia*) and mountain  
pine scrub (*Pinion mughii*),  
2 - spruce forests of the up-  
per montane zone (*Vaccini-  
o-Piceion*), 3 - fir-spruce  
forests (*Vaccinio-Piceion*)  
and beech-fir forests (*Fagi-  
on*) in the lower montane  
zone and in the southern  
highlands, 4 - beech forests  
(*Fagion* and other associa-  
tions with beech) in NW  
Poland, 5-7 - oak-hornbeam  
forests (*Carpinion*) in: 5 -  
submontane zone, 6 - south-  
ern highlands, 7 - lowlands,  
8 - pine forests (*Dicrano-  
Pinion*) and mixed oak-pine  
forests (*Pino-Quercion*) on  
sandy soils, 9 - riverside fo-  
rests (*Salicion*), 10 - swamp  
communities (*Phragmite-  
talia*, *Carietalia fuscae*)  
and alder woods (*Alnetalia  
glutinosae*), 11 - associa-  
tions of coastal dunes (*Am-  
mophiletalia*), 12 - xero-  
thermic grasslands (*Festu-  
cetalia valesiacae*), 13 -  
significant share of spruce  
in the forests (MEDWECKA-  
KORNAS 1974, modified).



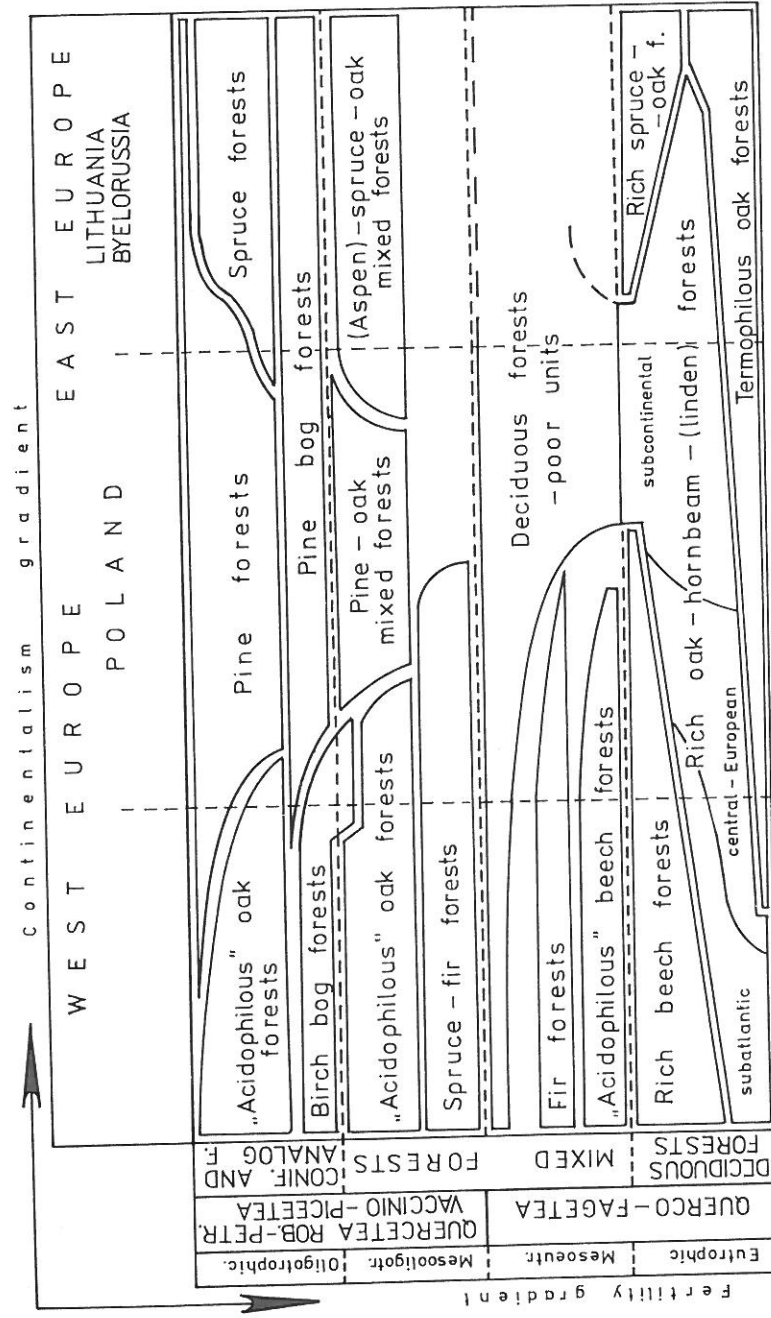


Fig. 16. Regional differentiation of forests in Poland and neighbouring countries (MATUSZKIEWICZ 1984, supplemented by FALINSKI 1986, slightly modified).

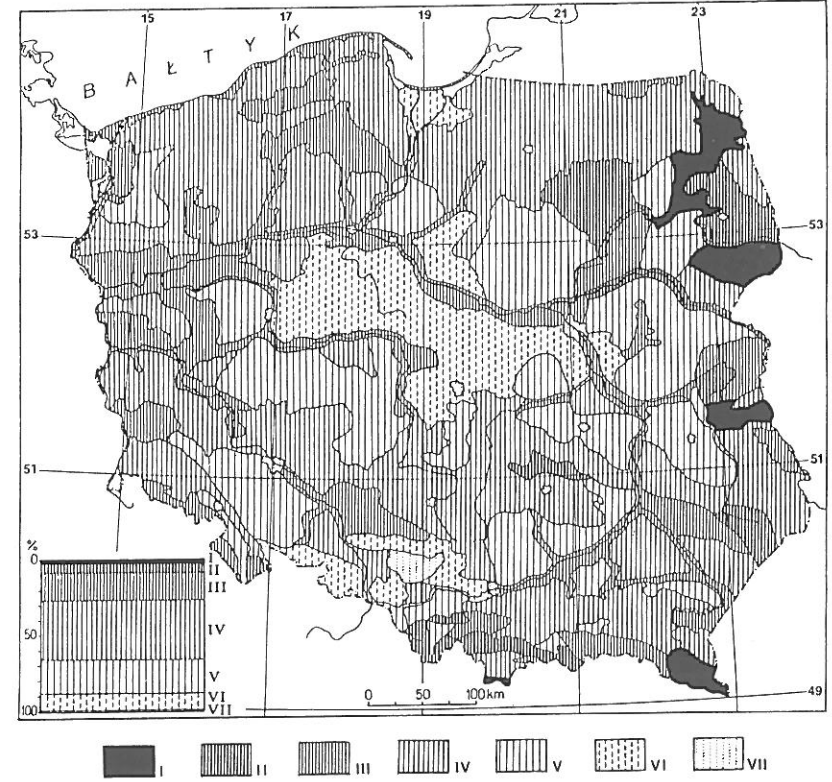


Fig. 17. Map of anthropogenic changes of the vegetation of Poland (FALINSKI 1986, slightly modified).

I - Territory with large, unsegmented natural vegetation complexes including communities of primary origin; seminatural and synanthropic vegetation has many primitive traits.

II - Territory with large complexes of natural vegetation with predominance of communities with changed structure or of secondary origin; seminatural and synanthropic vegetation with numerous primitive traits.

III - Territory with fragments of natural vegetation left only on sites extremely inaccessible to agriculture and habitation; on most sites natural vegetation has been substituted by seminatural vegetation of forest substituent or grassland communities.

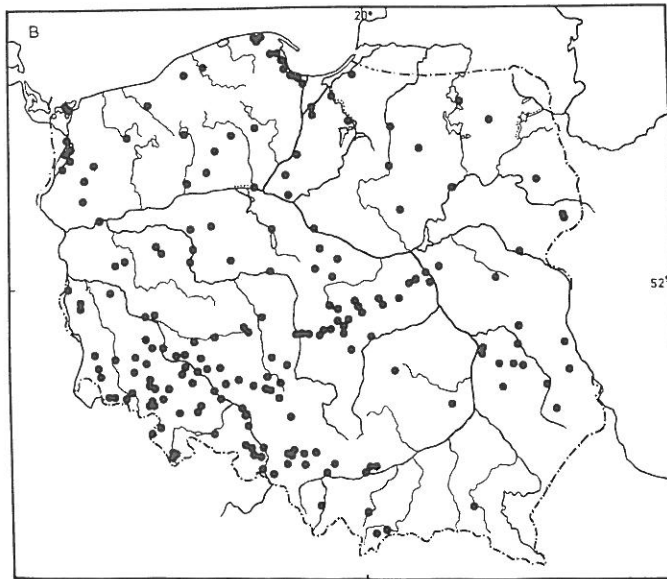
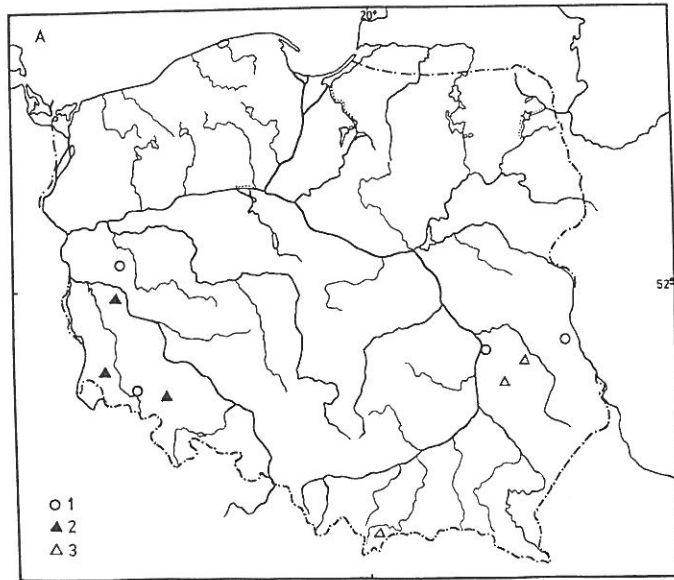
IV - Territory with fragments of natural vegetation left only on sites extremely inaccessible to agriculture and habitation; on most sites natural vegetation has been substituted by synanthropic vegetation.

V - Territory on which natural vegetation has been almost completely substituted by synanthropic vegetation.

VI - Territory on which synanthropic vegetation replaces natural vegetation and is undergoing anthropogenically induced degeneration.

VII - Territory with intensively cultivated vegetation, recultivated postindustrial wastes and fragments of spontaneous ruderal vegetation or areas devoid of plant cover.





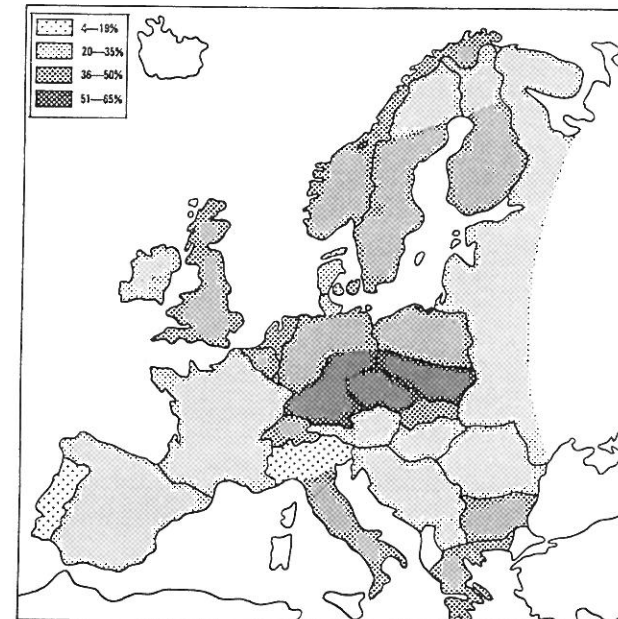
**Fig. 18.** Distribution of *Solidago canadensis* s.l. in Poland (GUZIKOWA and MAYCOCK 1986, slightly modified).  
A: 1 - before 1900, 2 - 1901-1914, 3 - 1915-1939; B - present distribution.

To save the most valuable nature objects in Poland, a system of legally protected areas consisting of national parks, nature reserves (Fig. 22), regions of protected landscapes and landscape parks has been established. These protected areas have been continually expanding and by the end of 1989 amounted to over 5.5 million hectares i.e., c. 18% of the country's total area.

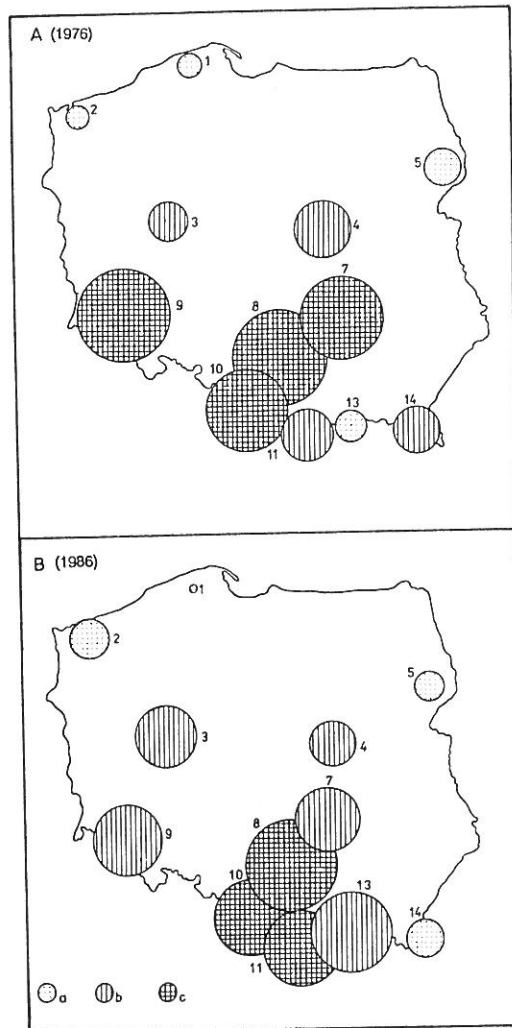
**Table 1.** Threatened plant species in Poland (ZARZYCKI et al. 1992).

Ex - extinct and probably extinct, E - endangered, V - vulnerable, R - rare, I - indeterminate.

Taxonomic group	Red Data Book Categories					Total threatened	% of Polish flora
	Ex	E	V	R	I		
Algae	29	21	84	93	29	256	c. 40
Slime moulds	24			13	51	88	
Macrofungi	71	172	188	296	286	1013	
Lichens	60	180	120	127	115	602	
Liverworts		26	5	14	5	50	
Mosses	4	17	45	29	41	136	
Vascular plants	40	54	142	146	36	418	18



**Fig. 19.** Distribution of forest injuries in Europe (% of injured trees) (REPORT 1991).



**Fig. 20.** Pollution index values for the Polish national parks defined as a sum of standardized contents of heavy metals (Cd, Cr, Ni, Pb, Zn) in the mosses, *Hylocomium splendens* and *Pleurozium schreberi* in 1976 (A) and 1986 (B).  
a - relatively clean parks, b - moderately polluted parks, c - heavily polluted parks. (GRODZINSKA 1990).

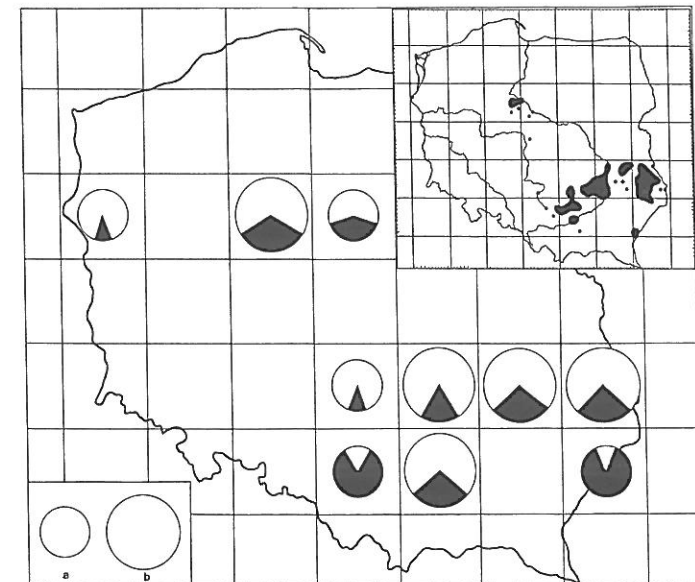
National Parks: 1 - Slowinski, 2 - Wolin, 3 - Wielkopolski, 4 - Kampinos, 5 - Bialowieza, 7 - Swietokrzyski, 8 - Ojcow, 9 - Karkonosze, 10 - Babia Gora, 11 - Tatra, 13 - Pieniny, 14 - Bieszczady.

## SUMMARY

A short information is presented, with many self-explanatory figures for the better understanding of contributions in the volumes of the "Proceedings of the 19th International Phytogeographic Excursion (IPE), 1989, through Poland".

## REFERENCES

- BORATYNSKA K., BORATYNSKI A. and HANTZ J., 1980: 3. *Picea abies* (L.) Karsten. In: BROWICZ K. (ed.), Atlas of distribution of trees and shrubs in Poland. PWN, Warszawa-Poznan. 30, 5-14 and map.
- DENISIUK Z., PILIOWICZ W. and PRZYBYLSKI J., 1990: Evaluation of the present state of nature reserves. (In Polish with English summary). In: DENISIUK Z. (ed.), Reserve protection in Poland. Actual state and directions of development. Stud.Nat., ser. A 35, 17-29.
- FALINSKI J.B., 1986: Vegetation dynamics in temperate lowland primeval forests. Ecological studies in Bialowieza forest. Geobotany 8. Junk, Dordrecht/Boston/Lancaster. 537 p.
- GOSTYNSKA-JAKUSZEWSKA M. and ZIELINSKI J. 1976: 25. *Fagus silvatica* L. In: BROWICZ K. (ed.), Atlas of distribution of trees and shrubs in Poland. PWN, Warszawa-Poznan. 18, 15-20 and map.
- GRODZINSKA K., 1990: Long-term ecological monitoring in the national parks of Poland. In: GRODZINSKI W., COWLING E.B. and BREYMEYER A.I. (eds.), Ecological risks. Perspectives from Poland and the United States. Acad.Press, Washington, D.C. 232-246.



**Fig. 21.** Distribution map of *Prunus fruticosa* and frequency of *P. fruticosa* x *P. cerasus* hybrids in Poland within 100x100 km. (WOJCICKI 1988, modified).  
Black part of circle = % of the hybrids. a - <50, b - ≥50 herbarium sheets.

- GUZIKOWA M. and MAYCOCK P.F., 1986: The invasion and expansion of three North American species of goldenrod (*Solidago canadensis* L. s.l., *S. gigantea* Ait. and *S. graminifolia* [L.] Salisb.) in Poland. *Acta Soc.Bot.Pol.* 55(3), 367-384.
- MATUSZKIEWICZ W., 1984: Die Karte der potentiellen natürlichen Vegetation von Polen. *Braun-Blanquetia* 1, 1-99.
- MEDWECKA-KORNAS A., 1966: Factors affecting the geographical distribution of plants in Poland. In: SZAFAER W. (ed.), *The vegetation of Poland*. Pergamon Press, Oxford, and PWN-Polish Sci.Publ., Warszawa. 21-96.
- MEDWECKA-KORNAS A., 1974: Vegetation of natural landscapes. (In Polish). In: GORSKI H. and CUKIERSKA Z. (eds.), *Powszechny Atlas Swiata*. PPWIC, Warszawa. 31.

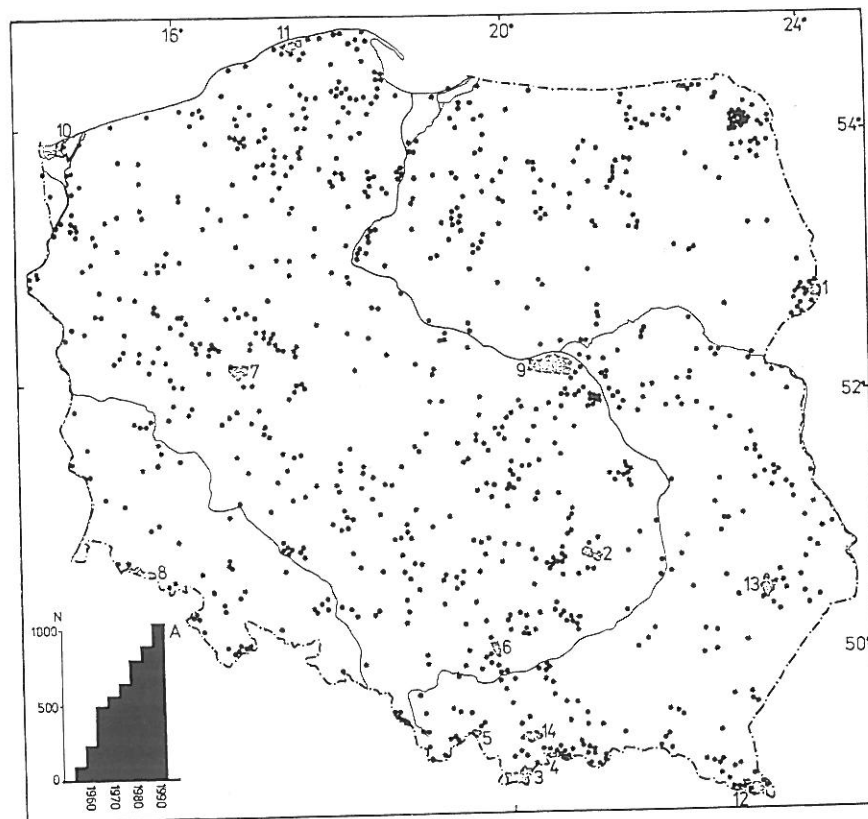


Fig. 22. Distribution of national parks (1-14) and nature reserves (dots) in 1990, and quantitative development of the nature reserves in Poland between 1952-1990 (A). (DENISIUK et al. 1990, modified).

National Parks: 1 - Bialowieza, 2 - Swietokrzyski, 3 - Tatra, 4 - Pieniny, 5 - Babiogorski, 6 - Ojcow, 7 - Wielkopolski, 8 - Karkonoski, 9 - Kampinos, 10 - Wolin, 11 - Slownski, 12 - Bieszczady, 13 - Roztocze, 14 - Gorce.

- MEDWECKA-KORNAS A., 1977: Natural factors affecting the geographical distribution of plants in Poland. (In Polish). In: SZAFAER W. and ZARZYCKI K. (eds.), *Vegetation of Poland*. (3th ed.). PWN, Warszawa. 35-94.
- RALSKA-JASIEWICZOWA M., 1983: Isopollen maps for Poland: 0-11'000 years B.P. *New Phytol.* 94, 133-175.
- REPORT, 1991: Report on the threat to and nature protection. Materials and statistical analyses. (In Polish). Główny Urząd Statystyczny, Warszawa. 357 p.
- ROZYCKI S.Z., 1972: Pleistocene of the Middle Poland. (In Polish). PWN, Warszawa. 315 p.
- SRODON A., 1967: The common spruce in the Quaternary of Poland. (In Polish with English summary). *Acta Palaeobot.* 8, 3-59.
- SZAFAER W., 1959: Geographical distribution of more important trees, shrubs and shrublets in Poland. In: SZAFAER W. (ed.), *Vegetation of Poland*. (In Polish). PWN, Warszawa. Map 1.
- SZAFAER W., 1966: Foundations of a geobotanical division of Poland. In: SZAFAER W. (ed.), *The vegetation of Poland*. Pergamon Press, Oxford, and PWN-Polish Sci.Publ., Warszawa. 640-653.
- SZAFAER W., 1977: Plant cover of the Lowland Poland. (In Polish). In: SZAFAER W. and ZARZYCKI K. (eds.), *Vegetation of Poland*. (3th ed.). PWN, Warszawa. 17-188.
- WALTER H. and LIETH H., 1961-1967: *Klimadiagramm-Weltatlas*. Fischer, Jena.
- WOJCICKI J.J., 1988: Variability of *Prunus fruticosa* Pallas. (In Polish). Ph.D. Thesis. Institute of Botany, Polish Acad. of Sciences, Krakow. 205 p.
- ZARZYCKI K., WOJEWODA W. and HEINRICH Z. (eds.), 1992: List of threatened plants in Poland. (2nd ed.). (In Polish with English summary). W. Szafer Institute of Botany, Polish Acad. of Sciences, Krakow. 98 p.

Address of the authors: Dr. Jan J. WOJCICKI  
 Prof. Dr. hab. Kazimierz ZARZYCKI  
 W. Szafer Institute of Botany  
 Polish Academy of Sciences  
 Lubicz 46  
 31-512 Krakow, Poland