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## The condition and resources of *Vaccinium uliginosum* (Ericaceae) in an isolated population on the peat bog “Bagna” near Chlebowo (Wielkopolska)

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**Abstract:** *Vaccinium uliginosum* L., as a species associated with raised bogs and marshy coniferous forests, belongs to rare and endangered species in Wielkopolska. This paper presents results of research on the resources and condition of the population of this species on the isolated site within the “Bagna” near Chlebowo in northern Wielkopolska (western Poland). The results indicate that this population is declining.

**Additional key words:** bog bilberry, ecology, plant geography, population, peat, bog

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### Introduction

The genus *Vaccinium* includes about 450 species worldwide (Mabberley 1997). *Vaccinium uliginosum* (bog blueberry or bog bilberry or whortleberry) is characterized by its extensive, round-the-pole range. It covers Europe, Asia and North America. The extreme sites of this species cross 80° of the northern latitude. Within this huge range, *Vaccinium uliginosum* shows a great diversity, which resulted in the distinguishing of many infraspecific units (varieties or subspecies), sometimes regarded as separate species (Meusel et al. 1978).

In Poland, three *Vaccinium* species occur naturally: *V. uliginosum*, *V. vitis-idaea* and *V. myrtillus*. *Vaccinium uliginosum* is a polymorphic species, either tetraploid or diploid, represented by several subspecies or varieties, which are sometimes regarded as separate species. In the lowlands of Poland, the bog bilberry oc-

curs in the typical tetraploid form *V. uliginosum* subsp. *uliginosum* (Young 1970, Gugnacka-Fiedor 1994). Some authors consider *V. uliginosum* subsp. *microphyllum*, which occurs in the mountains, as a separate species *V. gaultherioides* (Mirek et al. 2002). In our country, *V. uliginosum* is found mostly in the Lakelands, in Podlasie, Polesie Lubelskie and in the Central Highlands and Submontane Valleys. In the Wielkopolsko-Kujawska Lowland, Mazowsze, Silesia and in the mountains, it is rather rare (Zajac, Zajac 2001). Ritschl (1850), Pfuhl (1896) and Szulczewski (1951) regarded *Vaccinium uliginosum* as a rare species in Wielkopolska. Żukowski and Jackowiak (1995) included the bog bilberry in the list of species that are threatened in this region (category V = vulnerable). Until now, only 64 sites of the bog bilberry were found in Wielkopolska, 51 of which were confirmed after 1951. Most of them occur in the southeastern part of the region. In the northern part of Wielko-

polska, the “Bagna” near Chlebowo is the only one existing nowadays (Fig. 1), except the “Kuźnik” reserve near Piła (Żukowski et al. 2001). The aim of this study was to analyze the resources and condition as well as the distribution and developmental trends of the isolated population of *Vaccinium uliginosum* in the “Bagna” peat bog complex near Chlebowo.

## Material and methods

The subject of our observations was the population of *Vaccinium uliginosum* in the “Bagna” (“Swamps”) near Chlebowo (Wielkopolska region, western Poland). The local population can be defined as all individuals of bog bilberry occurring within the studied complex (cf. Falińska 1998). However, in the conditions of the study area it was impossible to estimate population abundance by using individuals or ramets as units (Shevtsova et al. 1995), so we counted clumps as units. We regarded as a clump an aggregation of shoots, irrespective of its size. Clearly distinguished aggregations, which were not connected by means of underground shoots, were considered as separate

clumps, irrespective of the distance between them. Apparently separate aggregations, which were connected by underground shoots, were treated as sister clumps.

During the field research carried out in June and August 2002, the number and size of clumps were determined. Additional comparative research was performed in 2004 and 2005. All clumps of the bog bilberry, after localizing them, were marked on a map scaled 1:2500. The size of studied clumps was determined on the basis of the measurements in the field. They included the maximum width and length of the clump close to the ground and at the level of shoots, as well as its height and the maximum length of shoots. The sizes of small shrubs, consisting of one or several shoots, were not taken into account. Besides, numbers of flowers and fruits were determined. Moreover, in order to investigate the developmental trends of the bilberry, two of the clumps were dug out. On the basis of them, a scheme of the layout of underground shoots was made (see Fig. 5). The first clump was taken from a dry place (causeway), while the other was a sister clump growing in the area of regenerating cutover peatland.

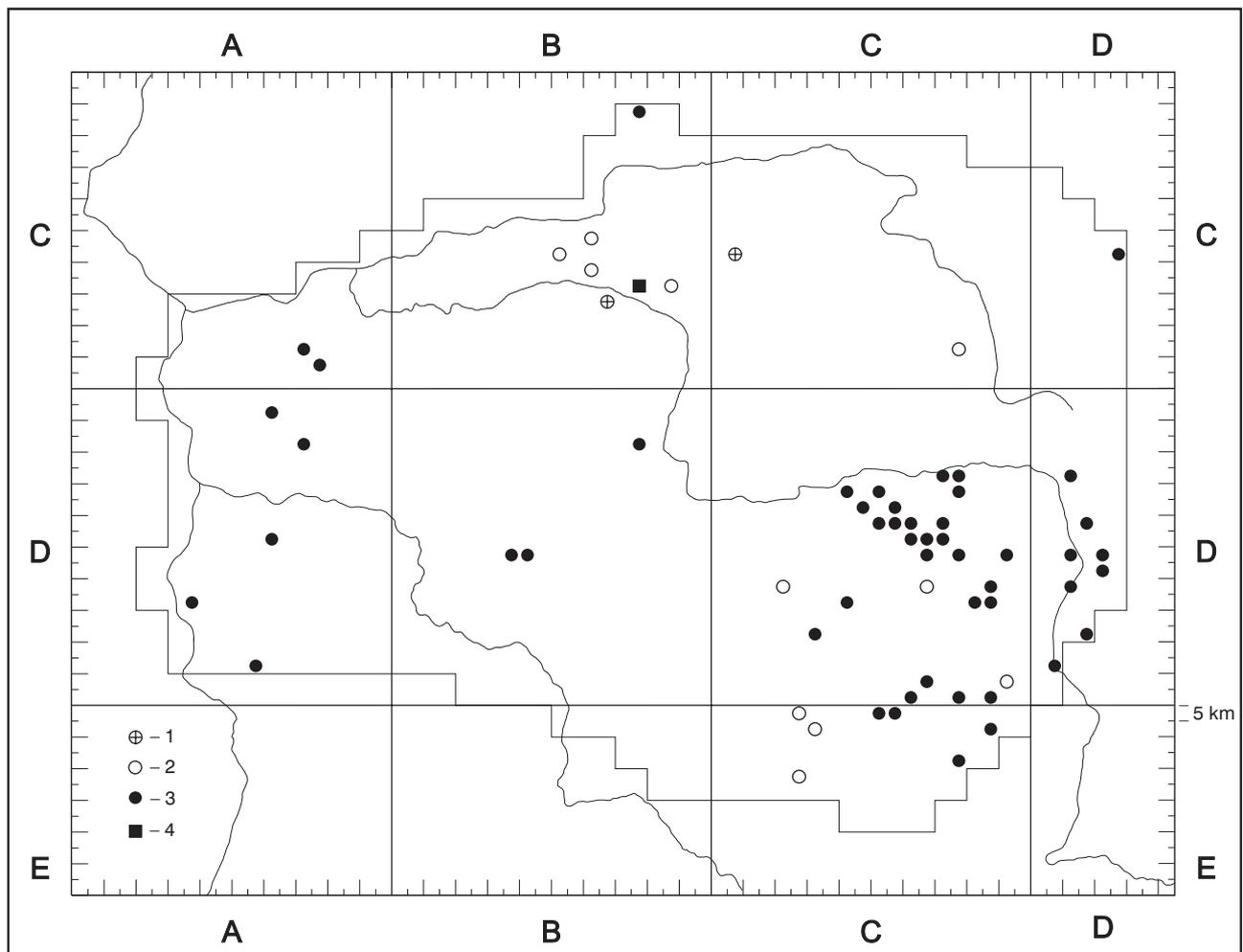


Fig. 1. Distribution of *Vaccinium uliginosum* in Wielkopolska (according to Żukowski et al. 2001)

1 – last observed in the 19<sup>th</sup> century (1900 included), 2 – last observed between 1901 and 1951, 3 – last observed after 1951, 4 – study site

## Results

The “Bagna” peat bog complex is the largest peatland of this type in the Wielkopolska region. The exploitation of peat, lasting since the 19<sup>th</sup> century, has led to a strong transformation of the ground. Despite those changes, the flora of the study area is still rich and includes over 300 species. The succession observed after stopping the exploitation in the cutover bog does not result in restoration of the previously existing plant communities. Nevertheless, it leads to the formation of conditions in which some species typical for raised peat bogs, e.g. *Eriophorum vaginatum*, *Oxycoccus palustris*, *Drosera rotundifolia* or *Ledum palustre*, may occur and flourish. Field observations show that in cutover patches *Vaccinium uliginosum* does not occur, but it is present on the adjacent remnants of former roads, called also causeways, by which the extracted peat was transported. In the Chlebowo complex, the bog bilberry occurs exclusively in the northeastern part (Fig. 2), where peat was extracted in the first period of exploitation (19<sup>th</sup> century).

During this study, 70 clumps of *Vaccinium uliginosum* were noted. Taking into account the size of clumps, the following three groups were distinguished: small (consisting of 1–2 shoots or covering an area of up to 1m<sup>2</sup>), medium (1–2 m<sup>2</sup>), and large (over 2 m<sup>2</sup>). The majority of clumps (48) were small (Fig. 4). *Vaccinium uliginosum* usually forms homogeneous groups. However, in 25% of its clumps also *V. myrtillus* is present. Less frequently, *V. uliginosum* is accompanied by *Ledum palustre*, *Calluna vulgaris*, *Oxycoccus palustris*, *Frangula alnus* and *Betula pubescens*. One of the clumps grows on a pine stump. In another clump, an ant-hill of 1.3 m × 2 m in area was observed in 2002. In 2004 and 2005, ants were not found, since they moved their colony a few meters away. *Vaccinium uliginosum* in the Chlebowo complex rarely blossoms and bears fruit. In 2002, only 25 clumps produced flowers (out of them just 4 had more than 10 flowers per clump), and only 13 bore fruit (out of those, only 3 numerously). In the majority of cases, flowers and fruits were observed on large

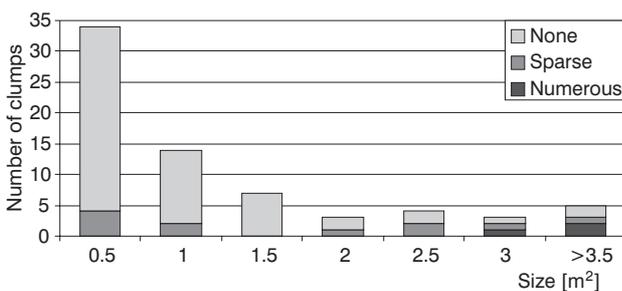


Fig. 3. Proportions of fruits found on clumps of various size

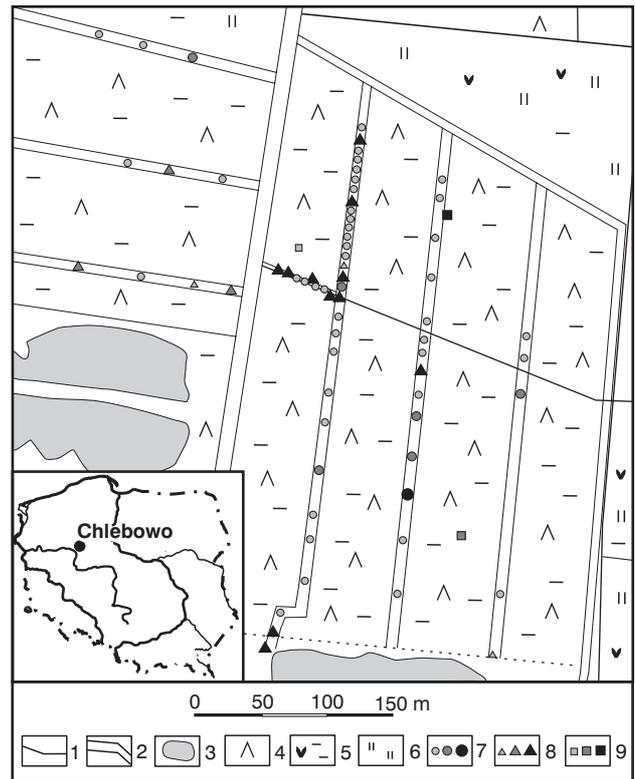


Fig. 2. Distribution of *Vaccinium uliginosum* on the “Bagna” peat bog complex near Chlebowo (smaller map: location of the study site in Poland)

1 – waterways, 2 – roads, 3 – cutover bog, 4 – forests, 5 – swamps, 6 – meadows, 7–9 – clumps of *V. uliginosum* (small, medium, large): on the causeway (7), on the edge of the causeway (8), on the cutover bog (9)

clumps (Fig. 3). In the successive years of the study these proportions have changed only slightly.

Considering the mode of distribution of *Vaccinium uliginosum* clumps in the study area, it is interesting that the bilberry is strongly connected with the causeways located between the cutover patches. It is where 67 clumps grow (96% of all). About 24% of all clumps are related to the edge of the causeways (17 specimens), and only three of them enter the peat holes (Fig. 4). The procumbent stems, overgrown by peat moss, enter the cutover patches to a distance of 0.5 to 1.3 m. The cutover bogs are covered with thickets

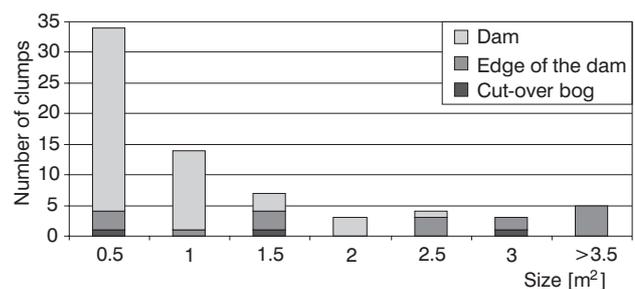


Fig. 4. Proportions of clumps of various size in various habitats

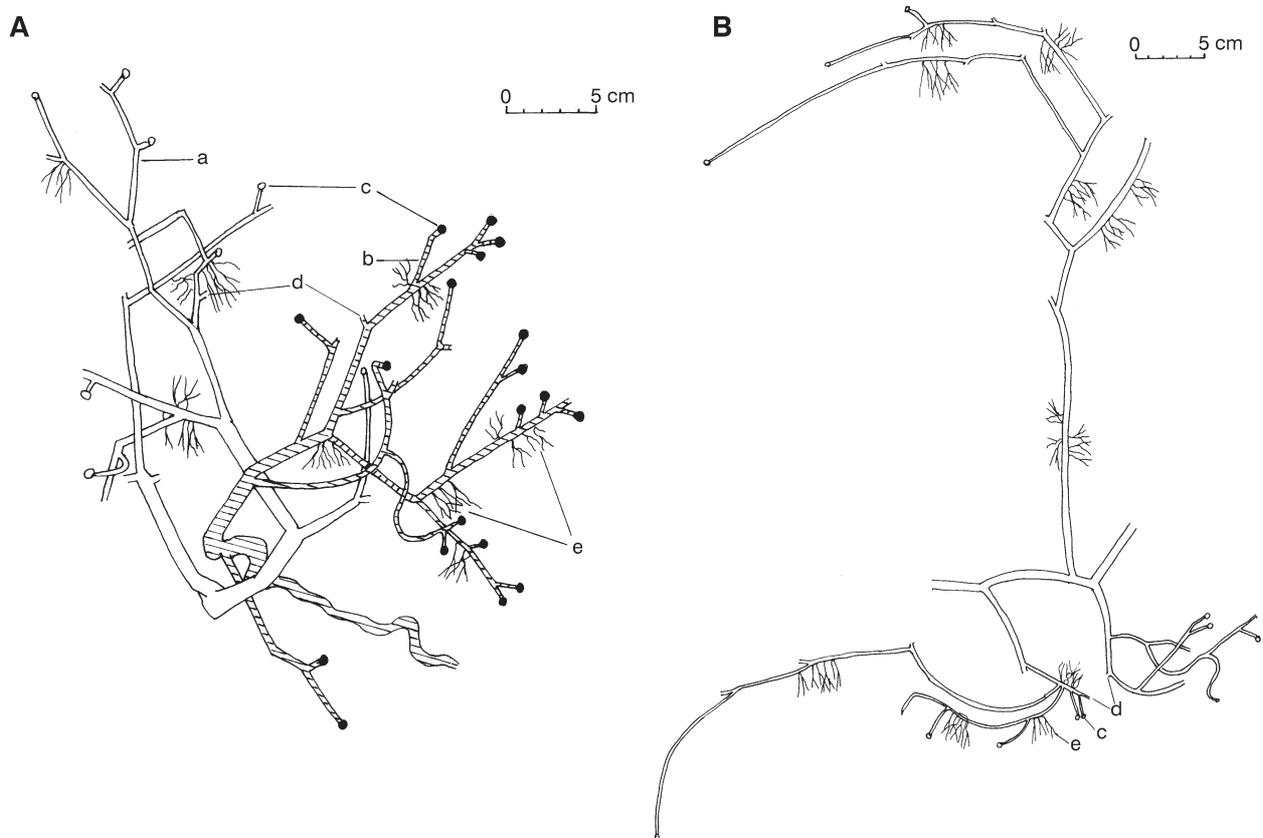


Fig. 5. Spatial arrangement of underground shoots of *Vaccinium uliginosum*

A – dry place (causeway); B – humid place (cutover bog); a, b – 2 specimens from a dry place (causeway); c – erect leafy shoots; d – removed or dry shoots; e – adventitious roots

consisting mainly of *Betula pubescens* and *Pinus sylvestris*, and in the undergrowth, *Eriophorum vaginatum*, *Ledum palustre* and *Oxycoccus palustris*. In such habitats, only three clumps of *Vaccinium uliginosum* were found. The first one is situated in a peat hole, on a block of peat separated from the causeway, only 3 m away from the causeway. The second clump is situated in the center of the cutover patch, in a distance of several meters from the causeway. It grows on a lump of peat overgrowing the stump of an old pine and presumably it is a remnant of the former bog forest. The whole clump occupies the surface of a few square meters. Both clumps have long, ascending shoots, often overgrown with peat mosses. The last of the clumps in question consists of only 6 shoots, loosely dispersed on the surface of 1.5 m<sup>2</sup>. It is overgrown with peat moss and shoots of *Eriophorum vaginatum*. In its vicinity, no presence of old shoots was observed. The origin of this clump can be explained in two ways. One hypothesis assumes that the shrub has developed from seed in a favorable place (alive peat moss). The closest fruiting clump is situated on the causeway at a distance of several meters. However, despite the lack of old shoots, it cannot be excluded that the clump is a remnant of a former clump.

## Discussion and conclusions

*Vaccinium uliginosum* is a small shrub or a dwarf-shrub, whose shoots are erect or partly ascending. Unlike *V. myrtillus* and *V. vitis-idaea*, the bog bilberry does not form underground rhizomes. The most common form, widespread on peat bogs and in bog forests, is a loose shrub with long, erect stems, whose central axis in favorable conditions lives for up to 13–15 years. Shoots grow sympodially, each year forming the main and lateral shoots. In the 4<sup>th</sup> or 5<sup>th</sup> year of life, secondary shoots grow from the lateral buds at the base of the main shoot, and they also live for 13–15 years. Next, new shoots grow, forming a loose shrub. At the same time, lower fragments of shoots are covered by a growing moss layer, in which numerous adventitious roots are formed. The rooting tertiary and successive shoots become sister shrubs (Gugnacka-Fiedor 1994, Jacquemart 1996). Within the Chlebowo complex, *Vaccinium uliginosum* only in some cases has the characteristic growth form of loose shrub with creeping, long shoots. Nevertheless, as opposed to the conditions prevailing on peat bogs or in bog forests, which are typical habitats for the bog bilberry (Young 1970, Boratyńska, Boratyński

1979, Jacquemart 1996, Matuszkiewicz 2001), in the Chlebowo complex the bog bilberry grows, except for three clumps, on dry causeways without the moss layer. In such conditions, the typical rooting of shoots does not occur and sister clumps are not formed. Secondary, tertiary and successive shoots arise at the base of the main shoot, very close to one another, so the shrub is increasingly dense. On the causeways, one clump was sometimes composed of a few individuals (Fig. 5A). The typical growth form of *Vaccinium uliginosum* was represented in our study area by only the three clumps mentioned above, with shoots overgrown with peat moss, thanks to which they formed adventitious roots (Fig. 5B).

*Vaccinium uliginosum* generally forms pure stands in the study area. In about 25% of clumps, specimens of *V. myrtillus* were also found. Only rarely the bog bilberry was accompanied by *Ledum palustre*, *Calluna vulgaris* or *Oxycoccus palustris*. The coexistence of *V. uliginosum* with other dwarf shrub species was observed in small clumps. Thus no positive interactions between the species were noticed, in contrast to the findings of Gerdol et al. (2000) or Shevtsova et al. (1995).

The first published data concerning the occurrence of *Vaccinium uliginosum* in the Chlebowo complex come from the prewar period (Ożminówna 1933). The information contained in a paper about raised bogs of Wielkopolska (Czubiński, Świtalska 1937) draws attention to the decrease in the abundance of the bog bilberry, which used to be common in the Chlebowo complex. Our observations, carried out after more than 50 years, confirm the tendency of the species to retreat from this peat bog. During this research, we found only 70 clumps of the bog bilberry, which were located mainly on the relatively dry remains of former roads (causeways). The deterioration of water conditions of the constantly drained complex and the regularly recurring draughts (every few years) negatively influence the condition of the population. The bog bilberry in our study area does not show any tendency to spread. The remnants of the population of *Vaccinium uliginosum* persist on the causeways, which are the sites of its former occurrence, and some specimens are ageing and start to die. This trend is clearly evident in small specimens, having 1 or 2 shoots (16 clumps). Such shoots grow from the bulb-like root crown. Such a swelling is formed as a result of the development of multiple lateral shoots almost in the same place. It happens when the moss layer is missing, when shoots do not have suitable conditions to form adventitious roots. Large, developing clumps are rare in the study area now. On some causeways, used contemporarily as roads, specimens of the bog bilberry are also mechanically injured as a result of human activity. In the whole population we did not find any undoubtedly self-sown young individuals of this species.

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## References

- Boratyńska K., Boratyński A. 1979. *Vaccinium uliginosum* L. – Borówka bagienna. In: Atlas rozmieszczenia drzew i krzewów w Polsce. Browicz K. (ed.). 27: 21–24. PWN, Warszawa–Poznań.
- Czubiński Z., Świtalska H. 1937. Torfowiska mszarne Wielkopolski i ich ochrona. Wydawnictwo Okręgowego Komitetu Ochrony Przyrody na Wielkopolskę i Pomorze 7: 38–57.
- Falińska K. 1998. The frameworks for plant population biology. In: Falińska K. (ed.). Plant population biology and vegetation processes. P. 10–22. W. Szafer Institute of Botany, Polish Academy of Sciences, Kraków.
- Gerdol R., Brancaloni L., Menghini M., Marchesini R. 2000. Response of dwarf shrubs to neighbour removal and nutrient addition and their influence on community structure in a subalpine heath. *Journal of Ecology* 88: 256–266.
- Gugnacka-Fiedor W. 1994. Zmienność morfologiczna i chemiczna europejskich gatunków rodzaju *Vaccinium* L. 146 pp. Uniwersytet Mikołaja Kopernika, Rozprawy. Toruń.
- Jacquemart A.-L. 1996. *Vaccinium uliginosum* L. *Journal of Ecology* 84: 771–785.
- Mabberley D.J. 1997. *The Plant-Book*. 858 pp. Cambridge University Press.
- Matuszkiewicz W. 2001. Przewodnik do oznaczania zbiorowisk roślinnych Polski. *Vademecum Geobotanicum* 3: 1–540. Wyd. Nauk. PWN, Warszawa.
- Meusel H., Jäger E., Rauschert S., Weinert E. 1978. *Vergleichende Chorologie der zentraleuropäischen Flora*. II. Karten (421 pp.), Text (418 pp.). Gustav Fischer Verlag, Jena.
- Mirek Z., Piękoś-Mirkowa H., Zając A., Zając M. 2002. Flowering plants and pteridophytes of Poland. A checklist. *Biodiversity of Poland* 1: 1–442. W. Szafer Institute of Botany, Polish Academy of Sciences, Kraków.
- Ożminówna W. 1933. Przyczynek do znajomości flory powiatu obornickiego. *Wydawnictwo Okręgowego Komitetu Ochrony Przyrody na Wielkopolskę i Pomorze* 4: 68–74.
- Pfuhl F. 1896. Die bisher in der Provinz Posen nachgewiesenen Gefässpflanzen. *Zeitschrift der Botanischer Abteilung Naturwissenschaftlicher Verein der Provinz Posen* 3 (1): 1–70.
- Ritschl G. 1850. *Flora des Grossherzogtums Posen, im Auftrage des naturhistorischen Vereins zu*

- Posen. Ss. 291. Druck und Verlag von E. S. Mittler und Sohn, Berlin.
- Shevtsova A., Ojala A., Neuvonen S., Vieno M., Haukioja E. 1995. Growth and reproduction of dwarf shrubs in a subarctic plant community: annual variation and above-ground interactions with neighbours. *Journal of Ecology* 83: 263–275.
- Szulczewski J. W. 1951. Wykaz roślin naczyniowych w Wielkopolsce dotąd stwierdzonych. PTPN, Prace Komisji Biologicznej 12 (6): 1–128.
- Young S.B. 1970. On the taxonomy and distribution of *Vaccinium uliginosum*. *Rhodora* 72: 439–459.
- Zajac A., Zajac M. (eds.). 2001. Distribution Atlas of Vascular Plants in Poland. 716 pp. Edited by Laboratory of Computer Chorology, Institute of Botany, Jagiellonian University, Cracow.
- Żukowski W., Celka Z., Chmiel J., Jackowiak B., Latowski K., Szkudlarz P. 2001. Distribution of Selected Species of Threatened Plants in Wielkopolska. Publications of the Department of Plant Taxonomy of Adam Mickiewicz University in Poznań 12: 1–68.
- Żukowski W., Jackowiak B. 1995. List of endangered and threatened vascular plants in Western Pomerania and Wielkopolska (Great Poland)]. In: Endangered and threatened vascular plants of Western Pomerania and Wielkopolska. Żukowski W., Jackowiak B. (eds.). Publications of the Department of Plant Taxonomy of Adam Mickiewicz University in Poznań 3: 9–95.