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Botanical and mycological research in Bielański Forest in Warsaw (Central Poland) during the 19th century

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Abstract

The Bielański Forest in Warsaw is one of the most valuable natural areas in central Poland. Its royal ownership and the presence of the Camaldolese monastery helped it to maintain high naturalness by the late 18th century. This study presents research carried out in the Bielański Forest, on vascular plants, mosses, lichens, fungi and slime moulds in the 19th century. The initiators of research in the first half of the 19th century were M. Szubert and shortly thereafter W. Jastrzębowski. The first data were published in the second half of the century by, among others, K. Majewski, F. Karo and J. Rostafiński. The majority of research from the Bielański Forest was published in Polish scientific journals *Pamiętnik Fizyjograficzny* and *Wszechświat*, established in the 1880s. At that time, on the initiative of T. Chałubiński, studies of bryophytes and lichens began, carried out by K. Filipowicz, S. Dawid, J. Steinhaus, and F. Błoński, who also researched vascular plants and fungi. Fungi were also studied by S. Chełchowski, slime moulds by J. Aleksandrowicz and J. Rostafiński, and vascular plants by F. Kamieński, H. Cybulski, and K. Łapczyński, who as the first noticed the impoverishment of the Bielański Forest flora. Our analyses allowed us to establish that of the 45 species of vascular plants reported from Bielany by Rostafiński (1872), about 50% of the taxa had not been observed by the 1920s, and nearly 67% by the end of the 20th century. Of the group of 14 species listed by Rostafiński and currently considered as endangered or protected, Kobendza (1929) listed only one. Of the 26 species listed by Błoński (1892), nearly 54% had disappeared by the end of the 20th century. From the group of 30 species of macrofungi recorded at the end of the 19th century, considered now as endangered, only 6 taxa were recorded a century later.

Key words

history of science, transformation of flora, plants, fungi, Pamiętnik Fizyjograficzny, Mazovia

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Introduction

The Bielański Forest in Warsaw is one of the most valuable natural sites in Warsaw and one of the oldest areas where botanical research has been conducted, both in Mazovia and nationwide (Baum and Trojan 1982; Luniak 2010; Obidziński 2023). Several factors contributed to this. First, it was initially the property of the Dukes of Mazovia and then the Kings of Poland – in both cases, serving as a hunting ground. Soon, with the construction of a royal manor and the establishment of the Camaldolese monastery – whose monks wore white habits – the area acquired the name Bielany, as its word root "biel" means "white" in Polish. All of this protected the Forest from being cut down and allowed it to remain in good condition until the end of the Polish-Lithuanian Commonwealth, that is, the late 18th century. Along with the kings, courtiers arrived here, among them were royal physicians who were also botanists. The first of them, Marcin Bernhardi de Bernitz (1625–1682), a physician, librarian and secretary to King John II Casimir Vasa (reign 1648–1668), compiled a list of wild plants growing in the vicinity of Warsaw, including most likely some from the Bielański Forest (Bernhardi 1652). Later, the presence of the royal residence nearby, named Marymont, had an influence on the history of the Forest and its research. During the reign of King Augustus II the Strong (reigned 1697–1733), the physician Christian Henry Erndtel (1670–1734) came here several times. This fact is well documented in his work, which includes a list and descriptions of plants in the vicinity of Warsaw (Erndtel 1730). Erndtel's list, like the earlier one by Bernhardi, was analysed and published in the form of a species list by Hryniewiecki (1954). This author only noted that the main area of research for Erndtel was the vicinity of Marymont and further into Bielany. The list of species for which Erndtel (1730) provided information about their occurrence in the Bielański Forest and in the Bielany area, along with a critical description of them, was prepared only recently (Ciurzycki et al. 2025).

This work continues from the above mentioned publication and focuses on the period of Poland's partitions in the 19th century. During this time, various conditions influenced both research on the Bielański Forest and its overall condition, which in turn affected the results of these studies. One of the positive factors was the establishment of an agricultural and forestry college in the former royal palace in Marymont, entrusting it with the management of a large part of the Forest. This enabled employees and students to embark frequently on botanical trips to Bielany. However, there were also negative impacts on the Forest. Initially, the presence of the Russian army in and around the Forest for several decades, as well as the drainage of the lowest forest area, which began at the turn of the 19th century, had a negative mark. Then, since the mid-19th century, mass recreational use by Warsaw residents had an additional adverse effect on its condition (Ciurzycki et al. 2025).

The aim of this paper is to present the history of botanical research, including mycological studies, in the Bielański Forest during the 19th century, along with a brief reminder of the most distinguished researchers of that period. When discussing selected works, there arose a need to verify, correct and supplement a number of previously published data. Additional attention is paid to the process of species decline in the Forest, particularly regarding rare, endangered, and protected taxa.

Material and methods

The study investigates various taxonomic groups, including plants and fungi, based on all known works from the 19th century that focus on the Bielański Forest. It incorporates a comparative analysis of sources as described in detail by Ciurzycki et al. (2025). The inclusive approach that combines plants and fungi reflects the 19th-century classification of living organisms, which led researchers to study both groups together. During that time, it was also common for various groups, such as bryophytes and lichens, to be described in a single publication. Additionally, this study includes slime moulds, which are now recognised as a separate taxonomic unit, but they were primarily discussed alongside fungi at that time. Botanists who specialised in both bryophytes and vascular plants often conducted research on the above-mentioned groups as well.

In the section on floristics, both bryophytes and vascular plants are included. The mycological section encompasses fungi, lichens and slime moulds.

Throughout the text, species names from the referenced historical works are generally provided in their contemporary form, aligning with the latest critical lists for each taxonomic group published for Poland. The sources for these classifications are as follows: vascular plants (Mirek et al. 2020), liverworts (Szweykowski 2006), mosses (Ochyra et al. 2003), lichens (Fałtynowicz 2003), fungi and slime moulds (Drozdowicz et al. 2003; Wojewoda 2003; Chmiel 2006; Mułenko et al. 2008). Historical names are included in selected cases.

In the tables that present species summaries, both the full historical and contemporary names are provided along with their authors. In the main text, species names are usually mentioned without their authors if there is no dispute regarding their taxonomic classifications. However, if there are any doubts about the classifications or when listing synonyms, the species names are included with their authors.

The object of research in this review is primarily the Bielański Forest. However, in early works, the authors often referred to this area more generally as Bielany. This name usually referred to the Forest but could also encompass its immediate vicinity. However, it did not include neighbouring settlements such as Marymont, Młociny, or Ruda, as these were listed separately. Therefore, both the names Bielański Forest and Bielany are cited in this work.

The Bielański Forest is located in the northern part of Warsaw. It currently covers 151.82 ha, of which 130.35 ha are under reserve protection. It lies on the Vistula River bank, partly on a glacial plain and partly in the river valley. The plain is separated from the valley by an escarpment, up to 15 m high, running through the forest. Below the edge of the plain, there are three valley terraces descending successively towards the Vistula: dune, middle and flood terrace. The current forest communities here are mainly oak-hornbeam forests *Tilio-Carpinetum*, diversified in terms of trophy and moisture, and elm-ash riparian forests *Ficario-Ulmetum*, diversified in the moisture gradient. In the western and north-western parts, outside the reserve, on previously anthropogenically transformed habitats, there are spontaneously developed substitute forest communities with stands dominated mainly by black locust (Jakubowski 1982; Solińska-Górnicka et al. 1997; Chojnacki et al. 2010; Ciurzycki et al. 2025).

Results

The first floristic studies of the 19th century

The first floristic work from the area of Warsaw and its surroundings in the 19th century appeared nearly a hundred years after the last previous work, which was published by Erndtel in 1730. This was already after the significant progress in plant systematics and biological nomenclature that occurred in the 18th century, including the introduction of the modern binomial nomenclature consisting of the genus and species names by Carl Linnaeus (Linnaeus 1753).

At that time, i.e. at the beginning of the 19th century, the third researcher of the flora of Warsaw and its surroundings (after Bernhardi and Erndtel) was Michał Szubert (1787–1861), a professor at the University of Warsaw, the originator (in 1818) and the first director of the Botanical Garden. In 1824, he published the List of Plants of the Royal Botanical Garden of the University of Warsaw, which includes about 10,000 taxa (Szubert 1824). This is not a typical flora, as it also contains numerous names of ornamental species and cultivar taxa. It is important to note that Szubert collected plants for the Garden from the vicinity of Warsaw both on his own and with his students, recording the plant locations. He also collected from Bielany, which, due to its rich flora and short distance from Warsaw, was a convenient subject for visits. Therefore, this extensive catalogue of plants contains the flora of the Warsaw area. Unfortunately, in the final published work, for plants from the capital's vicinity, the author only provides the location generally as 'Around Warsaw' (Szubert 1824). Hryniewiecki (1954) presented this list of plants in a manner similar to that used in the two earlier floras (i.e. of Bernhardi and Erndtel).

Among Szubert's students, Wojciech Jastrzębowski (1799–1882) stood out and contributed significantly to the understanding of the flora of Poland. As a student and assistant, he engaged in floristics and herbarium collection. He was a versatile naturalist, botanist, excellent connoisseur of flora, and an outstanding educator. Since 1836, he worked as a professor at the Agronomic Institute in Marymont, which was later transformed into the Institute of Rural Economy and Forestry. Jastrzębowski taught at this institution until 1858. During this time, he gathered numerous botanical collections. However, he did not publish most of these data, and a significant por-

tion of his herbarium collections was destroyed during the uprising in 1863 (Rostafiński 1883; Köhler 2024). His achievements were partially disseminated later, both through his educational work and through his surviving herbarium collections.

In the second half of the 19th century, a comprehensive work was published containing lectures on agriculture and gardening conducted at the Institute of Rural Economy and Forestry in Marymont, written down by a student of this institution, Karol Majewski. The second volume of this publication, entitled *Natural history of the gentry*, was based on the lectures of W. Jastrzębowski (Majewski 1876). The author does not specify the years when these lectures took place, but considering that he finished his studies there in 1854, it must have concerned the immediately preceding years. The section dedicated to vascular plants, mosses, fungi and lichens does not have the character of a flora. However, it is possible to find a number of species, sometimes with information about their locations, usually from Marymont, Wawrzyszew and Bielany. This text at times takes on the character of Majewski's personal memories, including those from joint botanical excursions with Professor Jastrzębowski, whom the students called Jastrząb (hawk), a nickname derived from the surname. In the description of various ferns, the author writes, among other things: 'Common polypody (*Polypodium vulgare*) growing along the steep bank, for example, of the Vistula near Bielany, which we carefully collected with Jastrząb, to leave live specimens for the next learners'. Further, about *Thelypteris palustris* (listed as *Aspidium thelypteris*), there is information: 'growing in our meadow, for instance, near Potok, just above the Vistula near Marymont'. From these sites, Majewski also mentions *Athyrium filix-femina* as 'growing in swampy forests near Bielany and even, for example, Marymont'. Regarding the now-rare *Botrychium lunaria*, he writes: 'We encountered it around Marymont, in Bielany', and about *Ophioglossum vulgatum*: 'It grows in interforest meadows, which we found during excursions with Jastrzęb. [owski] in the surroundings of Marymont' (Majewski 1876). Among bryophytes, he provided locations for five species of mosses (*Campylium polygamum, Hygrohypnum luridum, Hylocomium splendens, Plagiothecium nemorale* and *Pleurozium schreberi*), stating their presence 'in the surroundings of Marymont'.

In the section dedicated to flowering plants, utilitarian plants are described in greater detail. The others are only listed within taxonomic groups. Vascular plant locations are provided in quite great numbers from all over Poland and from the vicinity of Warsaw, often from Marymont, also with references to excursions with Prof. Jastrzębowski in that area. For example, regarding *Juncus articulatus*, Majewski wrote: 'I have this species in my herbarium, collected in a meadow between Potok and Grosowo, along the Vistula under Marymont, which W. J. taught us to recognise by pulling the leaf between two fingers, and then you can feel the puffs'. There is also information about the now-rare *Iris sibirica*: 'well known to me from the meadows near Opalin and Młociny, in the areas of Bielany and Marymont'. However, the location of Bielany itself is provided only for a few species. Regarding the typically forest grass *Milium effusum*, he specifically recorded: 'in the Bielany grove'. On the other hand, regarding *Festuca rubra*, he included information about the distortions of vegetation due to the presence of the military: 'prevalent everywhere at the camps around Marymont, Bielany'. From Bielany, he also mentioned two cultivated, alien species of plane trees (*Platanus occidentalis* and *P. orientalis*).

Majewski's work (1876) also contains the first information about the macrofungi species from the Bielany area, specifically 'around Młociny beyond Marymont'. It was probably *Sarcodon squamosus*, identified by Wojciech Jastrzębowski, which at the time was not distinguished from *Sarcodon imbricatus* and published under the name *Hydnum imbricatum*. It also includes data on lichens, mainly from the Marymont area, and locations for the two species *Xanthoria parietina* and *Peltigera venosa* are provided for Bielany (Majewski 1876).

Other researchers of the flora around Warsaw, Ferdynand Karo and Józef Rostafiński – colleagues educated at the Warsaw Main School (Szkoła Główna) that existed from 1862 to 1869, often embarked on botanical excursions together (Hryniewiecki 1954). The first, F. Karo (1845–1927), who later became a pharmacist (Majewski 2010), included Bielany in a brief work dedicated to the flora of Warsaw and its surroundings (Karo 1867), listing 11 species of plants from that area. Most of them are common plants found in the Bielański Forest or in the Bielany area also today: *Adoxa moschatellina*, *Asarum europaeum*, *Galeobdolon luteum*, *Impatiens noli-tangere*, *Isopyrum thalictroides*, *Ononis arvensis*,

O. spinosa, *Phyteuma spicatum,* and *Stachys sylvatica* (Sudnik-Wójcikowska 1982, 1987; Solińska-Górnicka and Symonides 1991; Solińska-Górnicka et al. 1997). Among the species that became much rarer afterwards in the areas around Warsaw, he mentioned, for example, *Corydalis cava* and *Viola mirabilis.*

Due to the fact that *Corydalis cava* was not found later, Kobendza (1929) assessed this observation as a probable mistake with *C. solida*, assuredly as he only noted *C. solida* in the Kampinos Forest at that time (Kobendza 1930). Similar doubts were later expressed by Sudnik-Wójcikowska (1982), as no one besides Karo recorded this species here. However, it is worth noting that the general range of *C. cava* does not rule out the possibility of its occurrence in Mazovia, and earlier researchers had also reported this species from the vicinity of Warsaw. Such locations were much later included in the *Atlas of vascular plants distribution in Poland* (Zając and Zając 2001). Erndtel (1730) was the first to report *C. cava* and *C. solida* near Warsaw. The identification of the species he described under the name 'PSEUDOFUMARIA Riv.' is unequivocal. Both species were also listed in Hryniewiecki's (1954) elaboration of Erndtel's lists. Mentioning both species in a single work eliminates the possibility of their confusion. Erndtel did not provide their exact locations, but considering the almost deforested surroundings of Warsaw at that time and that he often worked around Marymont and Bielany, it can be considered highly probable that he could have observed them in those areas.

Both species discussed were later mentioned in his work by Szubert (1824), indicating their occurrence, following the principle adopted throughout the work, as 'Around Warsaw'. Rostafiński (1872) also listed both species, but only for *C. cava* did he note Warsaw as a place of occurrence (after Szubert). He also mentioned another species – *C. intermedia*, indicating Radonie near Grodzisk Mazowiecki as its only confirmed site in the vicinity of Warsaw. This species occurs in Poland in the west and north, but in Mazovia, it is outside of its compact range. The sites listed here were later considered questionable (Zając and Zając 2001). From Warsaw, specifically from Wilanów, two species, namely *C. solida* and *C. cava*, were still reported in the 20th century (Grochowski 1931 after Sudnik-Wójcikowska 1987). In the monograph on the flora of Warsaw (Sudnik-Wójcikowska 1987), both species are also cited with a reference to the work of Kobendza and Kołodziejczyk (1922), although in this case, partially incorrectly, as this work mentioned only *C. solida* from the Bielański Forest. The third species discussed, namely *C. intermedia*, was discovered and confirmed at the beginning of the 21st century in the Bielański Forest (Pawlikowski 2004). This species had previously been observed here in 1904 by J. Muszyński (as documented by a specimen in the Warsaw University Herbarium – WA). However, like most other sites in central and eastern Poland, marking the local southeastern limit of its range (Zając and Zając 2001), this site was considered questionable before being rediscovered and confirmed by Pawlikowski (2004).

Bielany in *Flora of Poland* by Józef Rostafiński

Józef Rostafiński (1850–1928) was a professor of botany at Jagiellonian University and the director of the botanical garden in Kraków. He was the author of the first global monograph on slime moulds, as well as numerous works on the history of botany (Majewski 2010). However, earlier, as a novice researcher, he published in Vienna the work *Florae Polonicae Prodromus* (Rostafiński 1872), which was also released the following year in a separate edition in Berlin (Rostafiński 1873), making it one of the most outstanding floras of that period. In this work, he incorporated data from Schubert's students, including the earlier (from 1847 to 1848) *Polish Flora* by Jakub Waga (1800–1872), as well as part of Wojciech Jastrzębowski's herbarium collections, which were thus preserved for science (Hryniewiecki 1954). In this publication, Rostafiński provided brief descriptions of individual plant species, including their locations, for 45 taxa from Warsaw's Bielany (Rostafiński 1872). The location of Bielany is generally referred to simply as 'Bielany', without specifics as to whether it pertains to Bielański Forest or its surroundings, nor any details regarding habitats.

In a later botanical monograph of Bielany, Kobendza (1929) listed a selection of species mentioned from Bielany by Rostafiński (1872) in the chapter on the history of flora, indicating whether each species was noted by Rostafiński himself or cited from another author. Kobendza also provided the contemporary occurrence, that is, in the 1920s, based on his own observations. However, while presenting Rostafiński's data, Kobendza made some errors in citations. Two of the

listed species were not provided by Rostafiński according to his data (as Kobendza stated), but rather by other authors: *Carex elongata* was cited from Jastrzębowski, and *Senecio fluviatilis* (originally *S. sarracenius*) from Cybulski. On the other hand, Rostafiński cited *Aruncus sylvestris* not from Waga (as stated by Kobendza) but from a much earlier author, namely Erndtel (1730). Rostafiński also referenced this species from other authors, including Kluk and Berdau, as well as Waga, but from different regions of the country where the species is relatively common (as noted by Waga – from Wąchock in southern Poland). The aforementioned errors may seem relatively minor; however, in the last case, namely *A. sylvestris*, the matter is quite significant. It is not just that it pertains to a species that currently does not exist near Warsaw, nor in most of the Mazovia region, but only very rarely on its outskirts (Zając and Zając 2001). In other cases, Rostafiński (1872) cited authors who were approximately contemporaneous, and if earlier, then Waga (at that time about 25 years prior) or at most Szubert (then nearly 50 years earlier). Conversely, the data from Erndtel (1730) originate from over 140 years earlier in the previous century. Erndtel listed around 800 species of vascular plants in his work, whereas Rostafiński generally did not cite this author, mentioning his data only in exceptional cases, a few times. For this reason, these data should essentially be removed from Rostafiński's list if it is deemed to originate from the second half of the 19th century. In any case, it should be noted that in the discussed case, it refers to flora from the first half of the 18th century, thus already historical. Therefore, the citation of a historical site in a later monograph on the flora of Warsaw, where the species is mentioned only according to Rostafiński (1873) with description – 'forests' (Sudnik-Wójcikowska 1987), should also be considered imprecise or incomplete. Szubert (1824) did not mention this species from around Warsaw. He mentioned the species (as *Spiraea Aruncus*), but only for southern Poland ('Galicia'). Currently, the occurrence of the species and its subsequent decline have been discussed in a work by Ciurzycki et al. (2025) that addresses species listed by Erndtel from Bielany.

The fundamental flaw in Kobendza's compilation (1929) is that it is significantly incomplete. Of the 45 species listed by Rostafiński (1872) from Bielany (including the discussed *A. sylvestris*), Kobendza only cites 31 species. Similarly, in the subsequent monograph on the Bielański Forest, in the chapter on flora, it is stated that among the 1325 species mentioned by Rostafiński, 30 have occurrences in Bielany, and the same list of species is provided, with the exception of one woody species from the genus *Salix* (Sudnik-Wójcikowska 1982). The data were certainly provided based on the compilation by Kobendza (1929). Subsequently, Sudnik-Wójcikowska's (1982) incorrect information regarding the 30 species listed from Bielany by Rostafiński (1872) was quoted and repeated even recently by Kapler et al. (2023).

For the above reasons, in this work, we are including a list of all species reported from Bielany by Rostafiński. Below, we present the discussed list of species in order with numbering and names as in the original, maintaining the spelling from that time (Tab. 1). Besides, we provide current names and the current protection and threat status of the species in Poland (Regulation… 2014b; Kaźmierczakowa et al. 2016). In the section concerning occurrence, similar to Kobendza's work (1929), we provide data from Rostafiński's study, with additional notes on whether they are original (marked with the author's initials – JR) or if Rostafiński cited them from another author (the abbreviations of names from the original are provided in full). For the species mentioned by Kobendza, we have cited their occurrence in Bielany, in accordance with the table he developed. Conversely, for the species he omitted, we supplemented the data on their occurrence at that time based on the text of Kobendza's monograph (1929) and the phytosociological relevés contained within it.

Kobendza (1929), in his monograph on Bielany's vegetation history, noted in the chapter based on Rostafiński's (1872) data that 'of these 31 species, 15 have survived to the present day', that is, a little over half have disappeared (52%). As can be seen from the newly compiled data presented here, out of the 45 species listed from Bielany in the 19th century, only 19 were noted in 1929 (Tab. 1).

This would mean that 26 species disappeared at that time, that is, almost 58% of the 45 species listed in the 19th century by Rostafiński (1872). However, Kobendza's (1929) list was incomplete not only in the part concerning historical data but also in contemporary data. His study was only a short sketch, in which he included only 7 phytosociological relevés of forest com-

Table 1. Species listed from Bielany by Rostafiński (1872) and their subsequent occurrence in Bielany, according to Kobendza (1929)

No	No of the species by Rostafiński (1872)	The species name in the work of Rostafiński (1872)	Modern plant name after Mirek et al. 2020	Origin of location in Bielany in Rostafiński (1872)	Occurence in Bielany, according to Kobendza (1929)
1	2	3	4	5	6
1	81	*Carex arenaria* L.	*Carex arenaria* L.	JR	–
2	87	*Carex paradoxa* Willd.	*Carex appropinquata* Schumach.	JR	+
3	89	*Carex brizoides* L.	*Carex brizoides* L.	JR	+
4	94	*Carex elongata* L.	*Carex elongata* L	Jastrzębowski	+
5	130	*Hierochloa odorata* (L. z Th.) Wahlnb.	*Hierochloë odorata* (L.) P. Beauv.	JR	–
6	131	*Hierochloa australis* (Schrad.) R. u. S.	*Hierochloë australis* (Schrad.) Roem. & Schult.	JR	–
7	157	*Calamagrostis arundinacea* (L.) Rth.*	*Calamagrostis arundinacea* (L.) Roth	JR	-
8	165	*Trisetum flavescens* (L.) PB.*	*Trisetum flavescens* (L.) P. Beauv.	JR	+
9	196	*Festuca gigantea* (L.) Vill.	*Festuca gigantea* (L.) Vill.	JR	+
10	213	*Brachypodium silvaticum* (Huds.) PB.*	*Brachypodium sylvaticum* (Huds.) P. Beauv.	JR	–
11	237	*Luzula nemorosa* (Poll. var.) E. Mey.	*Luzula luzuloides* (Lam.) Dandy &Wilmott	JR	–
12	238	*Luzula campestris* (L.) DC.*	*Luzula campestris* (L.) DC.	JR	–
13	239	*Luzula pallescens* (Wahlnb.) Bess.	*Luzula pallescens* Sw.	JR	–
14	256	*Lilium Martagon* L.	*Lilium martagon* L.	JR	–
15	302	*Neottia Nidus avis* (L.) Rich.*	*Neottia nidus-avis* (L.) Rich.	JR	–
16	329	*Aristolochia Clematitis* L.	*Aristolochia clematitis* L.	JR	–
17	330	*Asarum europaeum* L.	*Asarum europaeum* L.	JR	+
18	338	*Trientalis europaea* L.	*Trientalis europaea* L.	JR	+
19	477	*Mentha rotundifolia* L.*	*Mentha rotundifolia* (L.) Huds.	JR	–
20	497	*Dracocephalum Ruyschiana* L.	*Dracocephalum ruyschiana* L.	JR	–
21	502	*Lamium Galeobdolon* (L.) Crtz.	*Galeobdolon luteum* Huds.	JR	+

1	2	3	4	5	6
22	518	*Melittis Melissophyllum* L.	*Melittis melissophyllum* L.	JR	–
23	590	*Phyteuma spicatum* L.	*Phyteuma spicatum* L.	Karo	+
24	671	*Senecio sarracenicus* L.	*Senecio fluviatilis* Wallr.	Cybulski	+
25	714	*Taraxacum vulgare* (Lmk.) b) *paludosum* (Scop. als Art) Schl.	*Taraxacum officinale* s. l.	JR	–
26	780	*Ranunculus lanuginosus* L.	*Ranunculus lanuginosus* L.	JR	+
27	782	*Ranunculus nemorosus* DC.*	*Ranunculus serpens* Schrank subsp. *nemorosus* (DC.) G. López	Szubert	–
28	791	*Isopyrum thalictroides* L.	*Isopyrum thalictroides* L.	JR	+
29	797	*Actaea spicata* L.	*Actaea spicata* L.	JR	–
30	812	*Nasturtium fontanum* (Lk.) Aschs.	*Nasturtium officinale* R. Br.	Jastrzębowski	+
31	831	*Cardamine amara* L.*	*Cardamine amara* L.	Waga	+
32	853	*Diplotaxis tenuifolia* (L.) DC.*	*Diplotaxis tenuifolia* (L.) DC.	JR	–
33	878	*Viola hirta* L.*	*Viola hirta* L.	JR	–
34	881	*Viola silvestris* Lk. Wälder, Haine c) *arenaria* DC. (als Art)*	*Viola rupestris* F. W. Schmidt	JR	+
35	885	*Viola mirabilis* L.	*Viola mirabilis* L.	Karo	+
36	905	*Salix longifolia Host* (nach Wimm.)**	*Salix ×dasyclados* Wimm.	JR	+
37	920	*Hypericum tetrapterum* Fr.	*Hypericum tetrapterum* Fr.	JR	+
38	936	*Impatiens Noli-tangere* L.*	*Impatiens noli-tangere* L.	JR	+
39	1053	*Tunica prolifera* (L.) Scop.	*Petrorhagia prolifera* (L.) P. W. Ball & Heywood	JR	–
40	1113	*Astrantia major* L.	*Astrantia major* L.	JR	–
41	1188	*Daphne Mezereum* L.*	*Daphne mezereum* L.	JR	–
42	1196	*Aruncus silvester* Kosteletzky.	*Aruncus sylvestris* Kostel.	Erndtel	–
43	1219	*Potentilla rupestris* L.*	*Potentilla rupestris* L.	JR	–
44	1231	*Potentilla alba* L.	*Potentilla alba* L.	JR	–
45	1291	*Trifolium rubens* L.	*Trifolium rubens* L.	JR	–

* – species from Rostafiński's work (1872) with the locality from Bielany not provided by Kobendza (1929) and Sudnik-Wójcikowska (1982); ** – species from Rostafiński's work (1872) with the locality from Bielany not provided only by Sudnik-Wójcikowska (1982); JR – occurrence in Bielany reported by Rostafiński (1872) according to his own data; Cybulski, Erndtel, Jastrzębowski, Karo, Szubert, Waga – occurrence in Bielany reported by Rostafiński (1872) according to the cited authors; "+" – species present in Bielany according to Kobendza (1929); "–" species absent in Bielany according to Kobendza (1929).

munities. In the descriptions of all communities, including non-forest ones, he gave quite numerous, but only exemplary, species. This list of flora probably included only about half of its totality. Of the 26 species that we marked in Table 1 as not recorded in Kobendza's work, at the end of the 20th century, Sudnik-Wójcikowska (1982, 1987) and Solińska-Górnicka and Symonides (1991) reported five more (*Brachypodium sylvaticum, Diplotaxis tenuifolia, Hierochloë odorata, Luzula campestris, Taraxacum officinale*). These species probably did not disappear in the 1920s, but were only not listed at the time. If we accept this assumption, then in the 1920s, there would have been 21 species missing, which would constitute about 46% of the full list. However, this estimate may still be incomplete. It's possible that there were species present in 1929 that were not documented at the time and later they disappeared without being recorded at the end of the 20th century.

Regardless of the actual number of species that disappeared during the analysed period, it is worth noting what kind of species they were. Among the taxa listed by Rostafiński, there were 14 species currently listed on the Red list (Kaźmierczkowa et al. 2016) or under protection (Regulation 2014b). Of this group, 13 had not been recorded yet in the 1920s. Of these rarest species, only *Viola rupestris* was recorded in Bielany still by Kobendza (1929).

The extent of flora decline can only be accurately assessed at the end of the 20th century, as the data from that time is considered complete (Sudnik-Wójcikowska 1982, 1987; Solińska-Górnicka and Symonides 1991). Unfortunately, the situation regarding the disappearance of plant species was significantly worse at that time. Of the species mentioned by Rostafiński, only 15 remained in the Forest and its surroundings, which was 33%. Of the species listed by Rostafiński, only 11 (according to the above list numbers: 89, 130, 196, 238, 330, 502, 714, 780, 791, 831, 936) were mentioned in the chapter on vegetation in the then-monograph of the Bielański Forest (Sudnik-Wójcikowska 1982). These were mostly common or relatively frequent species. One somewhat rarer species (590 – *Phyteuma spicatum*) was found a bit later (Solińska-Górnicka and Symonides 1991). More species (21) are generally rarer, but also currently recorded in the area of Warsaw (numbers: 87, 94, 131, 157, 165, 213, 237, 239, 256, 329, 338, 477, 518, 671, 797, 812, 853, 905, 920, 1053, 1231). Three of them (*Brachypodium sylvaticum*, *Diplotaxis tenuifolia*, *Salix* × *dasyclados*), which are rare in the Warsaw area, have populations in the Forest or its close vicinity according to the flora of Warsaw (Sudnik-Wójcikowska 1987). The remaining 12 species (numbers: 81, 302, 497, 782, 878, 881, 885, 1113, 1188, 1196, 1219, 1291) are only found in historical data (Sudnik-Wójcikowska 1987). Among them are species currently having just a few populations in Mazovia, such as *Carex arenaria*, *Potentilla rupestris*, *Trifolium rubens, Viola hirta* and *V. rupestris* (Zając and Zając 2001). One of the rarest in the lowland is the mountain species *Ranunculus nemorosus* (*R. serpens* subsp. *nemorosus*), which Rostafiński recorded, but Sudnik-Wójcikowska (1987) marked with a question mark. However, two populations of this species found near Warsaw were included in the flora of Poland (Zając and Zając 2001). Among the rarest and most interesting species, also on a national scale (a species critically endangered in Poland – CR), is *Dracocephalum ruyschiana* (Kaźmierczakowa et al. 2016). Its former three sites in the suburbs of Warsaw now have historical significance, similar to others in the lower Vistula valley, although it was recently reported from the nearby Kampinos Forest (Adamowski and Wołkowycki 2014). From other species omitted by Kobendza, it is also worth noting the previous occurrences of *Neottia nidus-avis* and *Daphne mezereum* in Bielany. Regarding the latter, Kobendza wrote in another study that it is a very rare species for the Warsaw area, noting it, inter alia, from the Kampinos Forest (Kobendza 1930).

The last two decades of the 19th century – under the care of the Józef Mianowski Fund

Research on Bryophytes

A significant revival of floristic research, including for the first time a broader scope of bryological, lichenological and mycological studies, occurred in the 1880s. The establishment of the Józef Mianowski Fund in Warsaw in 1881 was highly significant as it financed research and scientific publications. In the same year, the Polish scientific journal *Pamiętnik Fizyjograficzny* began publication, with support from this organisation, followed by a popular science journal *Wszechświat* in the following year (Hryniewiecki 1937; Mickiewicz and Sobotka 1973). Both journals featured many valuable works in the last two decades of the 19th century that

contributed to the recognition of Poland's flora. Among the researchers of this period, Tytus Chałubiński (1820–1889) should be the first mentioned. He was an eminent physician and botanist, a professor of medicine at the Warsaw Main School (Szkoła Główna Warszawska; Hryniewiecki 1955). He made significant contributions to the establishment of the Mianowski Fund and became its first president. He also led the editorial committees of the mentioned journals (Majewski 2005, 2010). Tytus Chałubiński was a naturalist by passion and primarily a pioneer of bryology in Poland, as well as a great expert and promoter of the Tatra Mountains, and author of outstanding works dedicated to Tatra bryophytes. He lived and worked in Warsaw, and although his professional duties did not allow him to conduct extensive bryological research in the capital, he collected mosses in various locations, including around Warsaw (Hryniewiecki 1937). The Herbarium of the University of Warsaw preserved, among others, the common rose-moss *Rhodobryum roseum*, collected by him in 1877 in the Bielański Forest (Ciurzycki 2018). However, Chałubiński's main achievement was encouraging younger researchers to undertake comprehensive studies of bryophytes flora in the vicinity of Warsaw. The first of these was Chałubiński's nephew, Dr. Kazimierz Filipowicz (1845–1891), also a physician by profession and a botanist by passion. In the first volume of *Pamiętnik Fizyjograficzny*, his work appeared, containing a list of bryophytes and lichens from selected sites in the Kingdom of Poland (Filipowicz 1881). This was the first such list, and as the author explains in a brief introduction, it was published because almost nothing had been done in this area previously. The list was meant to serve as a guide and encouragement for further work by subsequent researchers. On this list, 'Warsaw' is mentioned in relation to 46 taxa, but only in a few cases is a more detailed location provided, including four species: *Hedwigia ciliata*, *Pleuridium subulatum*, *Rhodobryum roseum,* and *Syntrichia montana*, all from Bielany. Among this small group is a very rare lowland mountain species (*S. montana*) as well as another interesting and rare rock-dwelling species (*H. ciliata*), possibly collected on the walls of a monastery or a similar habitat. Filipowicz likely collected more specimens in Bielany. Unfortunately, for over forty species on the list, their occurrences were reported without specific locations and were labelled as 'common everywhere'.

Three students from the then Imperial University of Warsaw developed the next floras. The first of them was Stanisław Dawid (1861–1917), a later lecturer in natural sciences and agronomy as well as a professor of animal breeding at the Veterinary Institute in Dorpat. In 1884, under the guidance of Chałubiński, he prepared the dissertation *Bryophytes of the Warsaw area* (Hryniewiecki 1937; Majewski 2010). This work included data on 87 species. Unfortunately, it was never published and has not survived. A part of his herbarium, consisting of 35 species, was later found and published along with the information on their locations by Hryniewiecki (1937). The list included, among others, 13 species recorded in Bielany.

The second author is Julian Steinhaus (1865–1922), later a professor at the Institute Meurice and head of the pathology laboratory at the Clinic Saint Jean in Brussels. His work on bryoflora, published in two parts, was prepared under the guidance of Alexander Fisher von Waldenheim (1803–1884), a Russian of German descent, professor of plant morphology and taxonomy, and then director of the Botanical Garden (Hryniewiecki 1937; Majewski 2010). This study encompasses 210 moss taxa, with their habitats specified in the descriptions, and for the first time, with several specific localities indicated. Steinhaus recorded the location of Bielany for 4 liverworts and 47 mosses. The number of species from Bielany could have been greater; however, Steinhaus, like Filipowicz before him, did not provide specific localities for 37 common species (Steinhaus 1887b and c).

The most distinguished botanist and florist among the young researchers of that time was medical student Franciszek Błoński (1867–1910). He studied vascular plants, bryophytes, fungi and lichens, as well as slime moulds. However, he left his most important works as a bryologist. In this field, he not only prepared extensive floristic reports covering materials for the flora of selected sites but also compiled the first complete Polish flora of mosses, which included taxonomy, identification keys, morphological descriptions, habitats and distributions, with numerous specific localities provided. These were published in the *Pamiętnik Fizjograficzny* in the series *Materials for the Flora of National Cryptogams*: *Liverworts of the Kingdom of Poland* (Błoński 1888) and *Mosses of the Kingdom of Poland* – planned in three parts, of which the first part covering plagiotropic mosses appeared in two volumes over the next two years

(Błoński 1889, 1890). The following year, Błoński completed his medical studies, and after starting his professional work in Spiczyńce in Podolia, unfortunately, he never completed his work. In the published sections from Bielany, he listed 47 species, including 33 plagiotropic mosses, 13 liverworts, and 1 slime mould.

A complete list of species of bryophytes from the works of Dawid, Steinhaus and Błoński, along with their locations from Bielany, was recently presented by Ciurzycki (2018). Consequently, the discussion here will focus on a few of the most interesting species only. Among the mosses, one can include representatives of currently rare epiphytic species from the genera *Anomodon* and *Neckera*. They are currently recognised not only as protected species and partially threatened (Żarnowiec et al. 2004) but primarily as indicator species of primary forest (Cieśliński et al. 1996; Stebel and Żarnowiec 2014). From the genus *Anomodon*, both Steinhaus (1887b) and Błoński (1890) reported *A. attenuatus* and *A. viticulosus,* while only Steinhaus (1887b) mentioned *A. longifolius* and the only species from the second genus – *N. pennata*, which is currently endangered in Poland. Both authors also reported *Homalia trichomanoides*, which is also classified as a species of primary forest. The liverwort flora from the above works included a total of 15 species, mostly common. Among the more interesting and rarer ones, *Blepharostoma trichophyllum* can be mentioned, which was only listed once by Steinhaus (1887c) and has not been observed here since, as well as three species from the genus *Riccia* (*R. crystallina*, *R. fluitans*, *R. glauca*) mentioned by Błoński (1888) and also not observed subsequently.

Research on vascular plants

The 1880s were also a time for further research on vascular plants. To begin with, Kazimierz Łapczyński (1823–1892), an engineer and railway official in Warsaw, should be mentioned as one of the most active botanists publishing in the *Pamiętnik Fizjograficzny* (Majewski 2010). This author systematically published various floristic works in each of the first 12 volumes of the *Pamiętnik* (up to his death). His life and contributions were summarised in the journal *Wszechświat* by the publisher of that journal (Ślósarski 1893; Domański 2024). In the last years of his life, Łapczyński published, among other things, an extensive study in the *Pamiętnik* on the ranges of selected plant groups (Łapczyński 1889, 1890, 1891, 1892). Earlier, in the second volume of this yearbook, he published a work titled *On the flowering vegetation of Warsaw surroundings* (Łapczyński 1882). This work is not a catalogue of flora, but rather a type of description, mainly concerning its threats and changes. However, numerous species are referenced in the text alongside various issues, allowing to compile a brief list of species mentioned from Bielany. In the first chapter of this work, Łapczyński discussed anthropogenic 'beneficial and harmful influences on flora'. He also addressed, among other things, the issue of the active protection of flora at that time through the relocation of rare species from threatened or destroyed sites to other, substitute ones. On this matter, he wrote: 'An example may be the two ferns growing in the Bielański Forest: *Polypodium vulgare* L. and *Cystopteris fragilis* Bernh., which are not found anywhere else in the Warsaw area. It is said that they were acclimatised there years ago, just like many other plants, by Jastrzębowski'. Thus, this is valuable information regarding both the locations of these two species and the method of metaplantation applied by Jastrzębowski, presumably during the period from 1836 to 1858, when he worked as a professor at the Agronomic Institute in Marymont. However, regarding *Polypodium vulgare*, it should be noted that this location must have been at least partially natural. This is suggested by Majewski's work (1876), which reveals, somewhat contrary to the previous claim, that the species was collected from Bielany by Jastrzębowski, with simultaneous care for maintaining the site. Furthermore, over 150 years earlier, this species was noted by Erndtel (1730), along with its characteristic habitat as a facultative epiphyte on tree trunks, indicating its natural occurrence. This view was also expressed in a later work by Rostafiński (1886), which is discussed below. However, Jastrzębowski could simultaneously relocate this species, as well as others, to secondary sites. As previously mentioned, in today monograph of Warsaw's flora, *Polypodium vulgare* was not recorded in the Bielański Forest but only from Kabacki Forest in southern Warsaw. By contrast, for *Cystopteris fragilis*, this monograph provides only historical data without any contemporary site listings (Sudnik-Wójcikowska 1987). However, this species was later recorded in another reserve in southern Warsaw, namely Skarpa Ursynowska (Ciurzycki et al. 2018). A significant part of Łapczyński's work (1882)

consists of an analysis of changes in flora compared to the state recorded in Rostafiński's work (1872) as well as a discussion of 'losses in flora' and 'gains in flora'. In the chapter on 'losses' in the description of *Vinca minor,* noted at various other sites (with an interesting comment: 'This plant is too sought after by villagers to be able to reproduce freely in the wild'), there is somewhat of a side note regarding the occurrence of a third species of fern, *Gymnocarpium dryopteris*, in the Bielański Forest. Further dedicated to the Bielański Forest is an entire paragraph, the first part of which, due to its valuable content in the context of this work, is worth quoting in full:

'The Bielański Forest was the capital of vegetation in the Warsaw area, not only rich in numerous species of flowering plants, but also in mosses and ferns. Perhaps the capital will be moved to Babice, to Wygoda on the right bank of the Vistula, or to some other quiet place, because in Bielany, the large population of people is starting to have a harmful effect on the vegetation. Some species have already begun to disappear.'

Next, he listed species that are 'no longer found in Bielany in recent times', including *Astrantia major*, *Aruncus sylvestris*, *Melittis melisophyllum*, *Potentilla rupestris* and *Trifolium rubens*. This list, although short, is valuable as it documents the disappearance of rare species just a decade after the publication of Rostafiński's flora (1872).

In the section dedicated to 'acquisitions', Łapczyński describes two plants. The first is *Poa bulbosa* var. *vivipara*, which he identified to the north and west of the Bielański Forest near military camps, where it thrived in large numbers on sandy soils adjacent to the soldiers' barracks. This taxon was reported and described in the Forest and surrounding areas as well in the 20th century (Kobendza 1929; Sudnik-Wójcikowska 1982, 1987). The second species found between Bielany and Młociny, near the location of *P. bulbosa*, was *Gypsophila paniculata*. At that time, it was a new species not only for Warsaw but also for its surroundings. It had not been reported at all for the Kingdom of Poland or Galicia previously. Łapczyński described the species' range in a later synthesis (1891). Currently, the species has not been recorded from the Bielański Forest (Sudnik-Wójcikowska 1982), but it has been noted in other parts of Warsaw in ruderal habitats (Sudnik-Wójcikowska 1987). Sites near Warsaw, like in the vast majority of Poland, have the status of synanthropic. The natural range of the species is considered only small areas near the eastern border of the country, mainly around the Białowieża Forest. In Poland, the species is classified as endangered – EN (Kaźmierczakowa et al. 2016). Łapczyński (1882) rightly assessed that the species arrived in Bielany from the east, given the previously known eastern sites. The work concludes with a chapter on common species, and since it pertains to plants commonly found, described mainly in the context of their habitats, it no longer contains information about sites, including those from Bielany.

The issue of new species in the Polish flora was also addressed two years later in Volume IV of the *Pamiętnik Fizyjograficzny* by Franciszek Kamieński (1851–1912). He began his natural studies at the Imperial University of Warsaw and continued in Strasbourg and Wrocław. Later, he became an assistant professor at the University of Lviv and eventually a professor at the University in Odessa. He was the author of many popular works in the fields of botany and phytopathology, being also known in the history of botany and mycology as a co-discoverer of the phenomenon of mycorrhiza (Majewski 2010). In his work titled *New addition to the Polish flora* (Kamieński 1884), he described 13 species of synanthropic plants, which had already been partially mentioned and described by Rostafiński (1872) and Łapczyński (1882), supplementing knowledge about their distribution. Kamieński provided several pieces of information about the occurrence of these species, including in Warsaw and its surroundings. Although Bielany was not mentioned, he described the beginning of the expansion of species that would soon appear in Bielany and would be mentioned in subsequent works, such as *Elodea canadensis* (Błoński 1892), and among them later as common species like *Impatiens parviflora* or *Chamomilla suaveolens*.

In the 1880s, research on vascular plants also included studies focused on ferns. In 1885, Franciszek Kamieński published a paper titled *List of domestic ferns* in the *Pamiętnik Fizyjograficzny*. This work was conceptually similar to Filipowicz's first list of mosses and lichens from 1881. In his publication, Kamieński utilised his own data, along with information from the herbarium of Karo and on various other locations provided by Jastrzębowski. However, the author acknowledged that 'these data were very insufficient, and thus

this list is actually only a draft that can serve as a basis for further research'. This list consists of 24 species and focuses on a small taxonomic group within the country. The brief descriptions of each species provide information about their habitats and general distribution, along with details about select locations, including Bielany. Information about Bielany is associated with three of the species. The first is the common species *Polypodium vulgare*, already discussed in this work. The second is the one mentioned above, provided by Łapczyński, *Gymnocarpium dryopteris* (as *Phegopteris dryopteris*). The most interesting is the last taxon, significantly rarer in the country, a mountain species – *G. robertianum* (as *Ph. Robertianum*), described as 'In rocky and mountainous forests, rare. Bielany'. Just a year later, in the sixth volume of the *Pamiętnik Fizyjograficzny*, a much more extensive work was published covering the entire group of ferns, namely: *A critical review of ferns of the Kingdom of Poland* by Rostafiński (1886). In the introduction, the author critically assessed the earlier draft by Kamieński due to the lack of a literature review and the associated absence of species already listed by other authors. He also criticised the lack of analysis of the flora of neighbouring countries and the lack of species that should also be considered in further studies in the country. Therefore, Rostafiński included a comprehensive and detailed literature review in his work. In the systematic list, he included a total of 42 taxa of horsetails, ferns, and clubmosses that were identified within the borders of the Kingdom of Poland at that time, as well as several others that should or could still be found in that area. In the descriptions of individual species, he provided both nationwide distribution and habitat requirements, as well as quite numerous locations for them. However, despite the significantly more extensive data and the inclusion of additional clubmosses and horsetails, the Bielany site was mentioned in the work only for three species already known from there, namely *Polypodium vulgare* (with the comment that Łapczyński's assumption about its metaplantation by Jastrzębowski is unfounded, as this species was mentioned earlier by Erndtel), *Gymnocarpium dryopteris* (though cited not from Łapczyński, who listed the species, but mistakenly from Szubert, who did not mention it), and *G. robertianum* listed after Kamieński (1885). The last of the mentioned species was also included in the literature review, where Rostafiński (1886), concluding with Kamiński's work, mentioned this taxon as the only one in this work as new, previously unrecorded from Poland. In the description of the species itself, Rostafiński expressed the opinion that it 'is certainly more common, only little attention has been paid to it'. He also mentioned, as 'to be found', a hybrid between the two species of the genus *Gymnocarpium*. The next four species (*Lycopodium annotinum, Lycopodiella inundata, Ophioglossum vulgatum, Thelypteris palustris*), not known from Bielany, were provided by Rostafiński from their close vicinity, namely, the areas of Marymont and Młociny.

In both of the aforementioned works (Kamieński 1885; Rostafiński 1886), the most interesting and rare species reported from Bielany is *Gymnocarpium robertianum*. A little later, this species was also discussed by Hipolit Cybulski (1828–1900), a distinguished worker at the Botanical Garden of the Imperial University of Warsaw, where he had begun his practice during the time of its initiator and first director, Michał Szubert, in the late first half of the 19th century (Majewski 2010). Between 1893 and 1897, in six consecutive volumes of *Wszechświat*, Cybulski published a series of works on rare plants collected around Warsaw that had not been previously recorded in Poland. In the last work of this series, he mentioned *G. robertianum* among other species. He described an earlier observation of this species from Bielany as doubtful: 'this fern only grows on limestone rocks, old walls, and in stony forests, thus it cannot grow in Bielany, where the soil is sandy. Only *Phegopteris dryopteris* grows in Bielany' (Cybulski 1897). This observation is fundamentally correct regarding the habitats of the species, but not entirely accurate concerning Bielany. Among the species he described, Cybulski also noted a new location for *G. robertianum* with a description: 'on the wall of the freight ramp of the W-W railway [Warsaw-Vienna railway] in Czyste', indicating a completely synanthropic location, within the present-day western part of Warsaw. Therefore, Kamieński might have found this species not in the natural forest habitat where it indeed cannot grow but on anthropogenic substrata. These could primarily be the walls or other fragments of monastic buildings present in the enclave of the Bielański Forest, but not only that. In the north of the forest at that time, that is, in the 1880s, brick, stone and concrete substrata were also

created while the construction of Fort Bielany. Despite the later almost complete demolition of the fort, the outlines of the moat and fragments of such anthropogenic substrata are still present to this day. On the other hand, Rostafiński's (1886) assumption that the species is more common has proven to be unfounded. In Warsaw, the species was not reported later, and the data from the 19th century are only mentioned as historical (Sudnik-Wójcikowska 1987). Its locations today are very rare, not only in Warsaw and its surroundings or throughout Mazovia, but also in the lowland part of Poland (Zając, Zając 2001).

In the cycle of works on rare plants around Warsaw, Cybulski did not include the Bielański Forest itself. However, he investigated one of the then-existing islands on the Vistula, which he refers to as 'the Vistula island under Bielany (without a name)'. It seems that the description of this area, as a supplement to the flora of Bielany, is in some ways even more valuable than that of the Bielański Forest itself, which has long been studied. In the first paper, Cybulski (1895a) wrote about the island as follows: 'This island is located near the left bank of the Vistula, starting from the fortress of the citadel and stretching towards Bielany, with a length of 2 verste and a width of over 1/2 verste in some places. It is one of the oldest Vistula islands. At low water levels of the Vistula, not exceeding 5 feet, it is accessible from many places along the Bielany road'. Further, he described the trees and shrubs, concluding with the statement: 'The vegetation here is diverse; in 1893 and 1894 I found quite a few rare plants here'. He then listed several rare species, including the horsetail variety '*Equisetum hiemale* L. *ramigerum* A. Br.' (Cybulski 1895a) and the rarely found *Acer campestre* in Warsaw (Cybulski 1895b). He also mentioned *Spiraea salicifolia*, a species that occurs naturally in small numbers only in the southeastern part of the country. Here, likely in a synanthropic habitat, similarly to another foreign species, *Lonicera tatarica*. Among the rare species that occur naturally, attention is drawn to *Scutellaria hastifolia* and *Lithospermum officinale* (Cybulski 1895c). The described area, currently named Kępa Potocka, was later mentioned by this name as one of the interesting natural sites in the interwar Floral guide to the surroundings and parks of Warsaw. However, at that time, only rather common species were reported from there (Kobendza and Kołodziejczyk 1922).

At the beginning of the last decade of the 19th century, the vascular flora was also studied by the previously mentioned, distinguished researcher of mosses, Franciszek Błoński. In the 12th volume of the *Pamiętnik Fizyjograficzny*, he published a work containing materials on vascular flora from several different regions of Poland, including areas around Warsaw (Błoński 1892). This work not only documents numerous species but also lists their locations extensively and in detail. Among them are Bielany, mentioned with 26 species. Many other species were reported from nearby neighbouring locations, such as Marymont and Kaskada to the south, Ruda and Ruda Mintra situated between them and the Bielański Forest; as well as Młociny to the north, and Wawrzyszew to the west, and further west Babice and Wólka Węglowa, which are already on the edge of the Kampinos Forest.

A significant portion of the mentioned species consists of taxa that had not previously been reported from Bielany. From the given 26 taxa, two (*Calla palustris*, *Paris quadrifolia*) were previously mentioned by Erndtel (1730), two (*Adoxa moschatellina, Stachys sylvatica*) by Karo (1967) and two (*Festuca rubra*, *Iris sibirica*) by Majewski (1876). Except for *C. palustris* and *I. sibirica*, the others are also present here today (Sudnik-Wójcikowska 1982, 1987). Among the then newly reported taxa, a group that can still be distinguished today includes the following species: *Armeria elongata*, *Chamaenerion angustifolium, Epipactis latifolia, Holcus lanatus*, *Polygonatum odoratum*, *Sambucus nigra* and *Spergularia rubra*. Some were later also present in Bielany, in close proximity to the Bielański Forest (*Elodea canadensis*) or in other locations in Warsaw (*Anthemis tinctoria, Butomus umbellatus, Equisetum sylvaticum*, *Hottonia palustris*, *Lathyrus vernus*, *Myosotis sparsiflora*, *Neslia paniculata*, *Pulmonaria angustifolia*, *Ranunculus polyanthemos*, *Viscum album*). Among the mentioned species, the ones that draw the most attention are currently the rarest species, namely: *Iris sibirica* (VU) and *Pulmonaria angustifolia* (VU), as well as the rather rare ones: *Myosotis sparsiflora* and the anthropophyte *Neslia paniculata* (NT) (Kaźmierczakowa et al. 2016). On the other hand, noted by Błoński *Lappula squarrosa* (*L. myosotis*) – rather rare in Poland (NT) and *Geranium lucidum*, which has the status of an ephemerophyte (Sudnik-Wójcikowska 1982, 1987), have not been recorded in Warsaw in recent times.

Research on fungi, lichens and slime moulds

The announcement in 1886 by Professor of Botany Alexander Fischer von Waldheim at the University of Warsaw of a competition for research on the basidiomycetes growing around Warsaw encouraged three students: Franciszek Błoński, Stanisław Chełchowski and Julian Steinhaus, to take up mycology. Their systematic research conducted in the capital city and its surroundings as part of the mentioned competition revealed a great richness and diversity of species, among which approximately 300 had not previously been recorded from the Kingdom of Poland (Chełchowski 1888, 1898; Błoński 1896; Steinhaus 1887a, 1888). Chełchowski's work (1888), covering about 550 species of basidiomycetes, and Błoński's work (1896), which includes over 200 species from Warsaw and its vicinity, are fundamental for comparative studies of fungi in present-day Warsaw. Błoński (1896) and Chełchowski (1888, 1898) conducted research, among other locations, in Bielany, where together they identified about 223 species (16 Ascomycota and 207 Basidiomycota). Considering the functional division of fungi into micro- and macroscopic according to contemporary Polish checklist of fungi (Wojewoda 2003; Chmiel 2006; Mułenko et al. 2008), 15 of these species belong to micromycetes and 208 to macromycetes. In a monograph titled *The nature of the Warsaw Bielany* (Luniak 2010), in the chapter *Fungi*, Szczepkowski and Sierota (2010) provided a smaller number, namely, about 150 species of macromycetes recorded from Bielany by Błoński and Chełchowski. Chełchowski (1888, 1898) listed 120 species of basidiomycetes (macroscopic fungi) from Bielany, including 20 species not found by Błoński (1896). Conversely, Błoński (1896) listed 203 species (16 Ascomycota and 187 Basidiomycota), including 15 species of microscopic fungi and 188 species of macromycetes, of which 99 species were not recorded by Chełchowski (1888, 1898). It is worth mentioning that Chełchowski, in his works (1888, 1898), cites data from Berdau (1876a), who also collected fungi in the vicinity of Warsaw, but for only two species, he provided more detailed locations (for *Astraeus higrometricus* – Wólka Węglowa and *Morchella conica* – Mokotów and Królikarnia). Chełchowski also included data on the fungi of Warsaw and its surroundings obtained from other researchers who did not publish their materials, always citing the authors. For instance, although there are no mentions of fungi in Szubert's works, Chełchowski found five species in the 'herbarium of the Warsaw Cabinet' noted by Szubert as being found around Warsaw. A similar discovery was made by Szczepkowski and Obidziński (2016) when they encountered a collection of *Poronia punctata* from the Botanical Garden in Warsaw deposited in the Herbarium of the Faculty of Biology at the University of Warsaw (the label bears the printed name – *Herbarium Szubertianum*). Jerzy Aleksandrowicz provided Chełchowski with a list encompassing 35 species of fungi, including some recorded from Bielany (e.g., *Tricholoma luridum* (Schaeff.) P. Kumm. as *Agaricus luridus* Schaeff.), while Władysław Majchrowski passed on a list of eight species (Chełchowski 1888, 1898).

Among the 223 species of fungi identified by both – Chełchowski and Błoński in Bielany, currently 30 appear on the Red list of macrofungi (Wojewoda and Ławrynowicz 2006) in the categories of threat: endangered (3), vulnerable (10), rare (15), indeterminate (2) and with four of them also under legal protection (Regulation 2014a; Tab. 2).

Among the four taxa currently under species protection, two (*Caloboletus radicans* and *Geastrum fornicatum*) are under strict protection. The first of them was reported from Bielany by Błoński (1896) under the name *Boletus pachypus* Fr. Wojewoda (2003) interprets it as *Boletus calopus* Fr. and lists the localities from 'Warszawa: Bielany and Młociny' without providing the source. Earlier, Skirgiełło (1960) in the monograph *Boletales*, a part of the publishing series *Polish flora. Spore plants of Poland and neighbouring lands. Fungi* also interpreted the species *Boletus pachypus* Fr. as *Boletus calopus* Fr., stating its distribution, including that it is 'rare in central Poland (Mazovia, Greater Poland)', without detailing specific locations and sources. In Index Fungorum, *Boletus pachypus* Fr. is referred to as *Caloboletus radicans* (Pers.) Vizzini = *Boletus radicans* Pers. = *B. pachypus* Fr. The geographical location and types of habitats found in the Bielański Forest are definitely more suitable for *C. radicans* than for *C. calopus* (Pers.) Vizzini (Łuszczyński 2020). The fact that Błoński (1896) found *C. radicans* and not *C. calopus* at Bielany also supports this, as no one has found *C. calopus* in Warsaw, even in Mazovia, or more broadly in Central Poland, for over 130 years to date, as it is a species that occurs in the south and north of our country

Table 2. Fungi species recorded in Bielany by Chełchowski (1888, 1898) and Błoński (1896), which are currently listed on the Red List of macrofungi in Poland

No	Name according to Index Fungorum (2025)	Occurence after Chełchowski (1888, 1898)	Occurence after Błoński (1896)	Treat category after Wojewoda & Ławrynowicz (2006)	**Record of the species location from Bielany by Wojewoda (2003)**	Modern locations in Bielany or in its surroundings, including Kampinos National Park
1	2	3	4	5	6	7
1	*Caloboletus radicans* (Pers.) Vizzini	–	*Boletus pachypus* Fr.	V *	lack	Bielany: lack surroundings: Skomorucha 2024
2	*Ceriporia reticulata* (Hoffm.) Domański	–	*Polyporus farinellus* Fr.	R	„Warszawa" Błoński's work cited	Bielany: lack surroundings: Karasiński et al. 2015
3	*Coprinellus hiascens* (Fr.) Redhead, Vilgalys & Moncalvo	*Agaricus/ Psanthyrella hiascens* Fr.	–	E	lack By Wojewoda (2003), the species listed as *Coprinus hiascens* (Fr.) Quél. Both works of Chełchowski cited	Bielany: lack surroundings: lack
4	*Cortinarius incisus* (Pers.) Fr.	–	*Cortinarius incisus* Pers.	V	lack	Bielany: lack surroundings: lack
5	*Cytidia salicina* (Fr.) Burt	*Corticium cruentum* Pers.	*Corticium cruentum* Pers.	E	„Warszawa: Bielany" All three works cited	Bielany: lack surroundings: Karasiński et al. 2015
6	*Deconica merdaria* (Fr.) Noordel.	*Agaricus/ Stropharia merdarius* Fr.	–	R	„Warszawa" By Wojewoda (2003), the species listed as *Psilocybe merdaria* (Fr.: Fr.) Ricken; The only cited work is Chełchowski (1898), although the species is mentioned in both of his works	Bielany: lack surroundings: Karasiński et al. 2015
7	?*Dendrothele acerina* (Pers.) P.A. Lemke	*Corticium calceum* (Pers.) Fr.	*Corticium calceum* (Pers.) Fr.	R	„Warszawa and vicinity" All three works cited	Bielany: lack surroundings: lack
8	*Entoloma asprellum* (Fr.) Fayod	*Agaricus/Leptonia asprellus* Fr.	*Hyporhodius* (*Leptonia*) *asprellus* Fr.	R	lack	Bielany: lack surroundings: Karasiński et al. 2015
9	*Entoloma lampropus* (Fr.) Hesler	*Agaricus/Leptonia lampropus* Fr.	*Hyporhodius lampropus* Fr.	V	lack	Bielany: lack surroundings: lack

1	2	3	4	5	6	7
10	*Exidia recisa* (Ditmar) Fr.	*Exidia recisa* Fr.	*Exidia gelatinosa* (Bull.) Duby	V	„Warszawa” Wojewoda as a synonim *E. recisa* indicates *E. gelatinosa* (Bull.) Duby. Only Chełchowski's work (1888) was cited; the other two works were omitted.	Bielany: lack surroundings: Karasiński et al. 2015
11	*Exidia thuretiana* (Lév.) Fr.	–	*Exidia albida* Huds. = *Tremella albida* Huds.	R	„Warszawa” Without providing a source	Bielany: lack surroundings: lack
12	*Fistulina hepatica* (Schaeff.) With.	*Fistulina hepatica* (Schaeff.) Fr.	*Fistulina hepatica* Schaeff.	R **	„Warszawa and vicinity” All three works cited	Bielany: Baum, Trojan 1982; Szczepkowski 2020, Szczepkowski and Sierota 2010; Kujawa, Gierczyk 2007 surroundings: Szczepkowski 2008; Karasiński et al. 2015; Piętka and Ciurzycki 2018
13	*Geastrum fornicatum* (Huds.) Hook.	*Geaster fornicatus* (Huds.) Fr.	?*Geaster coronatus* Schaeff. = *G. fornicatus* Fr.	E *	„Warszawa” The work of Chełchowski (1898) is cited, the work of Chełchowski (1888) is omitted, and the work of Błoński is not cited because Wojewoda (2003) presents this taxon differently.	Bielany: lack surroundings: lack
14	*Grifola frondosa* (Dicks.) Gray	–	*Polyporus intybaceus* Fr.= *Polyporus frondosus* Fl. dan.;	V **	„Warszawa and vicinity” Błoński work cited	Bielany: Szczepkowski and Piętka 2008; Szczepkowski and Sierota 2010 surroundings: Szczepkowski and Piętka 2008; Karasiński et al. 2015
15	*Gliophorus psittacinus* (Schaeff.) Herink	–	*Hygrophorus psittacinus* Schaeff.	R	„Warszawa: Bielany” Wojewoda (2003) provided as *Hygrocybe psittacina* (Schaeff.: Fr.) P. Kumm. Błoński work cited	Bielany – lack surroundings: lack
16	*Hypsizygus ulmarius* (Bull.) Redhead	–	*Agaricus*/*Pleurotus ulmarius* Bull.	V	lack	Bielany: Szczepkowski data npbl. surroundings: Szober 1965; Skirgiełło and Domański 1981; Szczepkowski 2016; Szczepkowski data npbl. Warsaw-Ursynów – SGGW campus

1	2	3	4	5	6	7
17	*Inonotus hispidus* (Bull.) P. Karst.	*Polyporus hispidus* (Bull.) Fr.	*Phaeoporus hispidus* Bull.	V	„Warszawa" Only Błoński's work is cited; both of Chełchowski's works are omitted; Chełchowski (1898) did not cite Błoński (1896) here	Bielany: lack surroundings: lack
18	*Ischnoderma resinosum* (Schrad.) P. Karst.	*Polyporus resinosus* (Schrad.) Fr.	*Ochroporus resinosus* Schrad.	V	lack	Bielany: lack surroundings: Szczepkowski et al. 2022
19	*Mycena pelianthina* (Fr.) Quél.	–	*Agaricus denticulatus* Bolt. = *Agaricus pelianthinus* Fr.	I	lack	Bielany: lack surroundings: lack
20	*Oxyporus obducens* (Pers.) Donk	–	*Polyporus obducens* Pers.	R	„N. Warszawa" Błoński work (1887) cited, Błoński work (1896) omitted	Bielany: lack surroundings: Szczepkowski 2016
21	*Perenniporia medulla-panis* (Jacq.) Donk	*Polyporus medulla-panis* (Pers.) Fr.	*Polyporus medulla-panis* Pers.	V	lack	Bielany: lack surroundings: lack
22	*Porodaedalea pini* (Brot.) Murrill	*Trametes pini* (Thore) Fr.	*Ochroporus pini* Thore.	R	lack	Bielany: Szczepkowski, Sierota 2010 surroundings: Karasiński et al. 2015; Szczepkowski data npbl. Warsaw: Młociński Forest, Kabacki Forest reserve, King Jan III Sobieski reserve., Kawęczyn, Natoliński Forest reserve
23	*Plicaturopsis crispa* (Pers.) D.A. Reid	*Trogia crispa* (Pers.) Fr.	*Trogia faginea* Schrad.	R	„N. Warszawa" Wojewoda (2003) provided as *Plicatura crispa* (Pers.: Fr.) Rea Cited works by Chełchowski (1888) and Błoński (1896), omitted work by Chełchowski (1898)	Bielany: lack surroundings: Marciszewska et al. 2020; Szczepkowski data npbl. Warsaw: Olszynka Grochowska reserve, Morysin reserve
24	? *Porostereum spadiceum* (Pers.: Fr.) Hjortstam & Ryvarden	–	*Stereum spadiceum* Pers.	R	lack	Bielany: Szczepkowski data npbl. surroundings: Karasiński et al. 2015; Szczepkowski 2016; Szczepkowski data npbl. Warsaw: Skarpa Ursynowska reserve

1	2	3	4	5	6	7
25	*Phaeotremella foliacea* (Pers.) Wedin, J.C. Zamora & Millanes	*Tremella fimbriata* Pers.	*Ulocolla foliacea* Pers.	I	„Warszawa" Wojewoda (2003) synonymizes *Tremella foliacea* with *T. fimbriata* (in Index Fungorum, there are two distinct species) The cited position of *T. fimbriatum* according to Chełchowski (1888) is omitted in Błoński (1896); Chełchowski (1898) does not provide this species	Bielany: lack surroundings: Karasiński et al. 2015
26	*Sparassis crispa* (Wulf.): Fr.	*Sparassis ramosa* Schaef. Schr.	*Sparassis ramosa* Schaef. (S. crispa)	R	„Warszawa and vicinity" All three works cited	Bielany: lack surroundings: Kujawa and Gierczyk 2007, 2012; Karasiński et al. 2015
27	*Trametes pubescens* (Schumach.) Pilát	–	*Polyporus velutinus* Pers.	R	lack	Bielany: lack surroundings: lack
28	*Typhula filiformis* (Bull.) Fr.	–	*Typhula filiformis* Bull.	R	„Warszawa and vicinity" Wojewoda (2003) synonymizes *T. filiformis* and *Clavariadelphus juncea* (Alb. & Schwein.) Corner (=*Typhula juncea* (Alb. & Schwein.) P. Karst. (in the Index Fungorum, there are two distinct species) The work of Błoński cited	Bielany: lack surroundings: Karasiński et al. 2015 as *Macrotyphula juncea*; Szczepkowski data npbl. Warsaw: Dendrological Park of SGGW at Rakowiecka Street
29	*Typhula fistulosa* (Holmsk.) Olariaga	*Typhula ardenia* Sow. = *Clavaria fistulosa* Holmsk.	*Typhula ardenia* Sowerby = *T. fistulosa* Holmsk	R	„Warszawa and vicinity" Wojewoda (2003) provided as *Clavariadelphus fistulosus* (Holmsk.: Fr.) Corner; Cited works by Chełchowski (1888) and Błoński (1896), omitted work by Chełchowski (1898)	Bielany: lack surroundings: Jezierska, Wosińska 1964; Karasiński et al. 2015 jako *Macrotyphula fistulosa*; Szczepkowski data npbl.: Czarna Struga (leg. Witkowska-Żuk), Zalesie Górne
30	*Xylobolus frustulatus* (Pers. Fr.) P. Karst.	–	*Stereum frustulosum* Fr.	V	„Warszawa: Bielany" All three works cited	Bielany: Szczepkowski and Sierota 2010 surroundings: Karasiński et al. 2015, Piętka 2016

E – endangered, V – vulnerable, R – rare, I – indeterminate; according to Wojewoda and Ławrynowicz (2006); * – under strict protection, ** – under partial protection; according to Regulation… (2014); N. – near.

(Kujawa et al. 2025). On the other hand, *C. radicans* has been contemporarily recorded in Mazovia (Łuszczyński 2020) and most recently in Warsaw, in Skaryszewski Park (Skomorucha 2024).

The second species, which was found at the end of the 19th century at Bielany and is currently strictly protected, is *Geastrum fornicatum*. Chełchowski (1888, 1898) mentions a site of this species from Bielany and one from Łazienki after Aleksandrowicz. Błoński (1896) reported from Bielany and Łazienki (hence exactly from the same places as Chełchowski) '*Geaster coronatus* Schaeff. = *G. fornicatus* Fr.' and Wojewoda (2003) interpreted this taxon, with a question mark, as *G. quadrifidum* Pers.: Pers. In the Index Fungorum, among the synonyms of *G. fornicatum*, names *G. coronatum* J. Schröt. [as *Geaster coronatus*] and *Lycoperdon coronatum* Schaeff are provided. This species has not been confirmed again in Warsaw and Mazovia (Wojewoda 2003; Kujawa 2020).

Two species (*Grifola frondosa* and *Fistulina hepatica*) confirmed at the end of the 19th century at Bielany are now under partial protection and still occur in the Bielański Forest today. The population of *F. hepatica* has been stable in this location for years and even shows a growing trend (Szczepkowski and Sierota 2010; Szczepkowski 2020). Currently, in Warsaw and its surroundings, this species has been reported from many locations (including Szczepkowski 2008; Karasiński et al. 2015; Piętka and Ciurzycki 2018). Recently, several sites of *G. frondosa* have been recorded in Warsaw and its surroundings, including at Bielany (Szczepkowski and Piętka 2008; Karasiński et al. 2015). From 1999 to 2019, basidiomata of *G. frondosa* were observed at the base of four old live pedunculate oaks (one fused at the base with the trunk of *Carpinus betulus*) in the oak-hornbeam forest and in the floodplain ash-elm forest. The number of basidiomata at a single site ranged from 1 to 6; however, they did not appear every year (A. Szczepkowski, unpublished data). According to Jacek Lipka (unpublished data), at the turn of the 20th and 21st centuries, basidiomata of *G. frondosa* also grew on a decayed oak stump in the aforementioned part of the Bielański Forest, indicating that there were a total of five locations in the Bielański Forest. The same author observed *G. frondosa* sites under pedunculate oaks near the village of Czarna Struga (Marki) on the Czarna River and in the historic Briggs Park along the Długa River (Markowski Canal) in Marki (Jacek Lipka, unpublished data). Among the 30 analysed species (Tab. 2), two taxa (*Dendrothele acerina*, *Porostereum spadiceum*) may raise doubts. In the case of the first one, Chełchowski (1888, 1898) lists various deciduous trees as substrates, and that is likely why Wojewoda (2003) interpreted the species as *Dendrothele acerina* rather than *Alloexidiopsis calcea* (Pers.) L.W. Zhou & S.L. Liu = *Corticium calceum*, which occurs on coniferous species. On the other hand, *D. acerina* had not been previously reported by other authors from Warsaw. It was recorded in Warsaw only recently by Szczepkowski (2016, 2021). However, in the nearby Kampinos National Park, Karasiński et al. (2015) reported a different species, producing very similar basidiomata – *Dendrothele alliacea* (Quél.) P.A. Lemke. Assuming that Błoński observed a species from the genus *Dendrothele*, and both species are listed on the Red list of macrofungi (Wojewoda and Ławrynowicz 2006), in the same threat category – R (rare), it is justified to include this taxon in the analysed group, even if it is not certain which species he recorded. According to Wojewoda (2003), *P. spadiceum* (the second species raising doubts) listed by Błoński (1896) as *Stereum spadiceum* –– is likely *Stereum gausapatum* Fr., which cannot be ruled out. On the other hand, in recent years, *P. spadiceum* was identified in the Bielański Forest, on fallen branches of *Robinia pseudoacacia*, by Szczepkowski (unpublished data). Currently, this species has also been noted in other locations in Warsaw, Skaryszewski Park (Szczepkowski 2016), and the Skarpa Ursynowska nature reserve (Szczepkowski unpublished data), as well as in the nearby Kampinos National Park (Karasiński et al. 2015), which may suggest that the species could have been present in the late 19th century at Bielany and was accurately identified by Błoński (1896).

In the Checklist of Polish larger Basidiomycetes (Wojewoda 2003), there is no record from Bielany for 11 out of the 30 species discussed in detail here. Among the 30 species presented, 24 have not been published again from Bielany, and also 10 have not been published from the whole of Warsaw and its surroundings (Tab. 2). This result does not indicate the disappearance of these species from the Bielański Forest, but rather it reflects the lack of systematic, professional mycological research, including macrofungi in this area, as well as throughout the entire Warsaw agglomeration in the 20th and 21st centuries.

From the 19th century also came new, more extensive data on lichens than those available earlier. The first work that documented a significant number of lichen species (24) from Warsaw and its surroundings was the study by Berdau (1876b). Among them, *Caloplaca elegans* (listed as *Placodium elegans*), a rock-dwelling species, was noted as being found 'from the wall of the Bielany monastery'. The previously discussed work by Filipowicz (1881), regarding mosses, also presents 23 lichen species from Warsaw and its vicinity, although without providing more detailed locations, including Bielany. Additionally, Filipowicz merely described several of the most common species as 'common'. Steinhaus (1887c), in the second part of his work, included a list of lichens alongside mosses. This collection likely included a herbarium obtained from K. Filipowicz. Doubts regarding this were described by Hryniewiecki (1937) based on Błoński's report. However, even if Steinhaus utilised Filipowicz's collections, unlike him, he provided quite numerous and specific locations in his work, and thus, the data were presented much more accurately, including records from Bielany. From this location, Steinhaus listed four species (*Usnea barbata* f. *hirta*, *Cladonia gracilis, Evernia prunastri, Physcia caesia*). Lichen collections from the same period also include six species from Bielany (*Cladonia cornuta, Graphis scripta, Parmelia scortea, P. caperata, Peltigera rufescens, Pertusaria amara*), collected by Błoński, and two species from Młociny, which is a bordering area of Bielany (*Stereocaulon incrustatum* and *S. tomentosum*), collected by Jastrzębowski and found over a century later in the Herbarium of the University of Warsaw by Zielińska (1967).

The slime moulds in the Bielański Forest were collected by Jerzy Aleksandrowicz (1818–1894), a professor at the Main School and the Imperial University of Warsaw, director of the Botanical Garden in Warsaw, initiator of the Pomological Garden in Marymont, president of the Warsaw Gardening Society, and director of the Museum of Industry and Agriculture in Warsaw (Majewski 2010). In his Russian-language monograph on the slime moulds of Warsaw and its surroundings (the first work in Poland fully dedicated to slime moulds), he listed 64 taxa at the species and variety level, including 12 from the Bielański Forest (Aleksandrowicz 1872). These included the following species: *Badhamia macrocarpa* (Ces.) Rostaf. as *Physarum macrocarpum* Ces., *Diderma chondrioderma* (de Bary & Rostaf.) Kuntze as *Didymium chondrioderma* de Bary & Rostaf., *Diderma testaceum* (Schrad.) Pers., *Nannengaella contexta* (Pers.) J.M. García-Martín, J.C. Zamora & Lado as *Diderma contextum* Pers., *Diachea leucopodia* (Bull.) Rostaf. as *Diachea elegans* Fr., *Metatrichia vesparia* (Batsch) Nann.-Bremek. ex G.W. Martin & Alexop. as *Trichia rubiformis* Pers., *Hemitrichia clavata* (Pers.) Rostaf. as *Trichia clavata* Pers., *Oligonema favogineum* (Batsch) García-Cunch., J.C. Zamora & Lado as *Trichia turbinata* With., *Trichia chrysosperma* (Bull.) DC., *Hemitrichia serpula* (Scop.) Rostaf. as *Trichia reticulata* Pers., *Reticularia lycoperdon* Bull. as *Reticularia umbrina* Fr., and *Reticularia olivacea* (Ehrenb.) Fr. as *Licea glomerulifera* de Bary & Rostaf. Among them was described a new species for science, *Diderma chondrioderma,* discovered in the Bielański Forest. The formal diagnosis of this species was made by Heinrich Anton de Bary (1831–1888), a German botanist, mycologist and plant pathologist, with his doctoral student Józef Rostafiński (Rostafiński 1874). Until now, this species had only been reported from three locations in Poland (Miśkiewicz and Drozdowicz 1999) and is therefore listed on the *Red list of rare myxomycetes in Poland* (Drozdowicz et al. 2006). From Bielany, four species of slime moulds: *Diachea leucopodia* (Bull.) Rostaf., *Fuligo septica* (L.) F.H. Wigg., *Trichia chrysosperma* (Bull.) DC. and *T. botrytis* (Pers. ex J.F. Gmel.) Pers. were also reported by Błoński (1896). Slime moulds in the vicinity of Warsaw were also collected by F. Kamieński and then given to Rostafiński, who expressed his gratitude for this contribution in his 1874 work. However, Rostafiński (1874) usually did not provide locations, making it unclear where exactly Kamieński's collections originated from.

Discussion and conclusions

In the previous study (Ciurzycki et al. 2025), which focused primarily on the species listed from Bielany over 300 years ago by Erndtel (1730), a picture of profound changes in the flora of the surrounding areas of Warsaw emerged. The analysis revealed that of the 35 species reported from Bielany in 1730, only 15 remain today, and these only belong to common taxa. Notably, among those that have disappeared are rare and extremely rare

species that have never been recorded again across the entire Mazovia region.

The most significant work from the 19th century for understanding the history of the flora of the Bielański Forest and Bielany is the work by Rostafiński (1872), in which he listed 45 taxa with the location 'Bielany'. Just 10 years after the publication of Rostafiński's work, based on this publication, Kazimierz Łapczyński (1882) noted the decline of rare and valuable plants in Bielany. He also aptly stated that the Bielański Forest, which had previously been the 'capital of vegetation' in the vicinity of Warsaw, would likely soon lose this status.

Roman Kobendza evaluated this process in the third decade of the 20th century. Although his compilation was incomplete, the loss of species (from the pool mentioned by Rostafiński), as determined by Kobendza's data, amounts 52%. The comparison of Rostafiński's (1872) and Kobendza's (1929) studies shows a loss of about half (46%–58% depending on the way of counting) of the species. Of the group of 14 species listed by Rostafiński, and currently considered as endangered or protected, Kobendza listed only one. This change occurred over the span of somewhat more than half a century (as shown by their studies) almost 100 years ago. The comparison of Rostafiński's data (1872) with data from the end of the 20th century (Sudnik-Wójcikowska 1982, 1987; Solińska-Górnicka and Symonides 1991) shows a decrease of nearly 67% in the number of species. An analogous comparison for Błoński's work (1892) showed a decline from 26 to 14 species, which is almost 54%.

A comprehensive study of the changes in the flora of Bielany requires a separate report that includes data from both the 18th century and the 19th century, taking into account all works that contain information about rare species.

The changes in flora from ancient times to the present can be so profound that they sometimes seem unbelievable today. This applies, for example, to older records of species that are currently rare and are questioned based on current knowledge of their distribution. An example can be the documented history of *Corydalis cava* and *C. intermedia*. The former has been reported several times from the vicinity of Warsaw (including from the current area of Warsaw), so it seems that it may have also existed in the Bielański Forest in the past. Therefore, the record by Karo (1867) can probably be considered plausible, despite earlier doubts expressed in this regard. On the other hand, *Corydalis intermedia*, recently found in the Bielański Forest and recorded 100 years earlier in herbarium materials (Pawlikowski 2004), was also reported in the 19th century from nearby areas of Warsaw, near Grodzisk Mazowiecki (Rostafiński 1872). This currently detached site from the compact range of the species in Mazovia, previously considered questionable (Zając and Zając 2001), could therefore also be regarded as credible.

In the work of Rostafiński (1872), as well as in the much earlier work of Erndtel (1730), discussed in a separate paper (Ciurzycki et al. 2025), there are data on the occurrence of even much rarer species in Bielany and the surrounding areas of Warsaw. The changes in flora over the past three centuries in this region can therefore certainly be regarded as significant.

Out of 30 fungi species recorded in the 19th century in the Bielański Forest that are now considered endangered, only 6 of them were recorded there at the turn of the 20th and 21st centuries. Considering data from closer and more distant surroundings of Warsaw including the neighbouring Kampinos National Park, contemporary studies (or the unpublished data provided here) contain information about 19 species. This is a slightly higher percentage than that of the above-discussed group of vascular plant species. The diversity of macrofungi species in Bielany (the Bielański Forest) reported by Chełchowski and Błoński, at about 200 taxa, is not a large number for a forest considered a remnant of natural forests. However, the results of mycological research by Błoński (1896) and Chełchowski (1888, 1898) in the 19th century significantly enhanced the knowledge of species diversity of fungi not only in Warsaw but also in the Kingdom of Poland, and to this day, they remain the richest source on macrofungi data of the capital, playing a fundamental role in comparative studies of fungi in contemporary Warsaw and its surroundings.

The importance of the Bielański Forest for floristic and mycobiota research is also evidenced by the fact that in the first 16 volumes of the *Pamiętnik Fizyjograficzny* publications, which are essential for understanding the flora and mycobiota of Poland, appeared in 11 of them.

Floristic research involves not only field observations but also long-term and precise compilation of extensive lists of species and their locations. In this

process, it is easy to make various types of oversights and errors. Experience shows that this happens quite frequently, even to distinguished botanists. An example of such a situation can be found in the first compilation of the historical work by Erndtel (1730), prepared by Hryniewiecki (1954). Similarly, the plant list from Bielany published by Kobendza (1929), cited after Rostafiński (1872), and subsequently reiterated in later studies, contains errors, including some that are quite significant. Currently, compiling historical works is far easier. With access to them online in digital libraries and databases, it is possible to search for species and locations and compile them using various computer tools. This situation is much easier than that in the times when authors manually transcribed data while reviewing the originals in libraries. Consequently, it enables significant supplementing and correcting to previously published syntheses, which may open a new phase of research on changes in flora composition.

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