ABS ACTA BIOLOGICA SIBIRICA
A journal on the biodiversity of Siberia and the adjacent lands

Acta Biologica Sibirica 12: 1655–1668 (2026)
doi: 10.5281/zenodo.24307955
http://journal.asu.ru

RESEARCH ARTICLE

Analysis of biodiversity data for the Polypodiophyta department of the Kemerovo Oblast in herbarium collections, published scientific sources, and records from open access resources (GBIF, iNaturalist)

Svetlana A. Sheremetova[1, 2], Irina A. Khrustaleva[1, 3], Oleg A. Kuprijanov[1, 4], Rashit T. Sheremetov[1], Egor M. Zyuzin[3], Sergey L. Luzyanin[3]

1 *Federal Research Center of Coal and Coal Chemistry, Siberian Branch of the Russian Academy of Sciences, 10 Leningradskij Ave., 650065, Kemerovo, Russia*
2 *Kuzbass State Agrarian University named for V.N. Poleczkov, 5 Markovtseva St., 650056, Kemerovo, Russia*
3 *Kemerovo State University, 6 Krasnaya St., 650000, Kemerovo, Russia*
4 *Federal Research Center for Information and Computing Technologies, Kemerovo branch, 21 Rukavishnikova St., 650025, Kemerovo, Russia*

Corresponding author: Svetlana A. Sheremetova (ssheremetova@rambler.ru)

Academic editor: A. Matsyura | Received 30 August 2026 | Accepted 29 October 2026 | Published 19 November 2026

http://zoobank.org/54C62F3A-2013-4535-925E-9441D534E215

Citation: Sheremetova SA, Khrustaleva IA, Kuprijanov OA, Sheremetov RT, Zyuzin EM, Luzyanin SL (2026) Analysis of biodiversity data for the Polypodiophyta department of the Kemerovo Oblast in herbarium collections, published scientific sources, and records from open access resources (GBIF, iNaturalist). Acta Biologica Sibirica 12: 1655–1668. https://doi.org/10.5281/zenodo.24307955

Abstract

This paper investigates the biodiversity of ferns (Polypodiophyta) in Kemerovo Oblast – Kuzbass. These plants constitute an essential component of plant communities and serve as indicators of favourable environmental conditions. The high species diversity of the division Polypodiophyta in Kuzbass is attributable to the considerable proportion of forest communities, which occupy approximately 60 % of the region's area. The study presents a comprehensive analysis of all available data on the distribution of pteridophytes within Kemerovo Oblast. Specimens from herbarium collections were examined, along with records from published scientific sources and open-access databases, namely GBIF and iNaturalist. The completeness of these data and their contribution to the overall understanding of fern

Copyright Svetlana A. Sheremetova et al. This is an open access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

biodiversity in Kuzbass were assessed. It was established that the pteridoflora of Kemerovo Oblast comprises 13 families, 18 genera, and 42 species. The Red Data Book of Kuzbass (2021) includes 18 fern species, which are considered rare and subject to protection within the region. The analysis undertaken enabled a revision of the rarity status categories for certain species. In particular, it is proposed to change the category for *Cryptogramma stelleri* and *Cystopteris altajensis*. The inventory of specimens provided additional information on the localities of pteridophytes, with precise geographic coordinates. Materials have been compiled for updating the Global Biodiversity Information Facility (GBIF) database.

Keywords
Biodiversity, ferns, herbarium collection, Kuzbass, observations, occurrence

Introduction

Despite over 300 years of botanical research in Kemerovo Oblast – Kuzbass (Flora of Kemerovo Oblast 2023), the degree of floristic knowledge remains highly uneven, not only with respect to particular territories but also concerning individual systematic groups of plants. Ferns (Polypodiophyta) are typically considered in conjunction with vascular plants; however, they merit separate attention. They occur in a wide range of landscapes, occupy diverse ecological niches, and serve as indicators of favourable environmental conditions. A considerable number of species within this division are classified as rare or endangered within Kemerovo Oblast and are subject to protection (Red Book of Kuzbass 2021).

Kemerovo Oblast is situated in the centre of Eurasia, between Western and Eastern Siberia, at the junction of the West Siberian Plain and the mountains of Southern Siberia, within latitudes 52–56° N and longitudes 84–89° E (Fig. 1). The oblast covers an area of 95700 km², making it the smallest among the regions of Western Siberia; however, in terms of population density, Kuzbass ranks first in the Asian part of Russia. Its geographical position, the presence of orographic barriers (the Salair Ridge to the west, the Kuznetsk Alatau to the east, and Mountain Shoria to the south), as well as climatic peculiarities, account for considerable landscape diversity.

The territory is characterized by a heterogeneous relief, ranging from the plain expanses of the Kuznetsk Depression (absolute elevations 160–220 m, dropping to 90–100 m in river valleys) to the mid-mountain ranges of the Kuznetsk Alatau and Mountain Shoria, where elevations reach 1500–2178 m (Udodov 2012; Evtushik et al. 2017). Zonal community types (forest-steppe, sub-taiga, southern taiga), extrazonal types (mire, aquatic, semi-aquatic, and petrophytic communities), and altitudinal belts – from forest-steppe to bald-mountain (mountain tundra) – are all represented here. Distinctive features of the vegetation cover of Kuzbass include: the significant role of fir–aspen black forests (chernevye lesa), which have no zonal analogues on the plains; the widespread occurrence of tall-herb communities; and

the combination of plain West Siberian and mountain Altai-Sayan floristic elements (Flora of Kemerovo Oblast 2023).

Forest communities occupy approximately 60% of the oblast's area, creating favourable conditions for the growth of a diverse range of forest fern species. Moreover, the position of Kuzbass at the boundary between two floristic provinces – the West Siberian and the Altai-Sayan – accounts for the heterogeneity of the vegetation cover and the relative floristic richness of its pteridoflora. At the same time, ferns are almost entirely absent from anthropogenically disturbed areas, underscoring their indicator role in assessing the degree of technogenic transformation of vegetation.

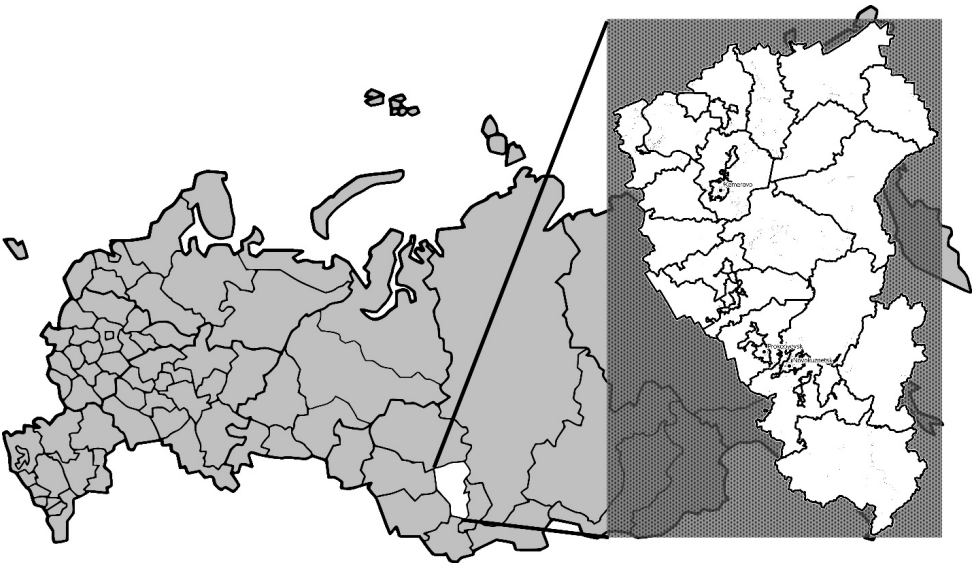


Figure 1. The location of the Kemerovo Oblast in the south of Western Siberia.

The location of Kuzbass at the interface of two floristic provinces – the West Siberian and the Altai-Sayan – determines the heterogeneity of the vegetation cover, which in turn underpins the relative floristic richness of the ferns in this territory. They are found in various ecotopes, with the exception of anthropogenically disturbed sites, which further highlights their role as indicators of the degree of anthropogenic vegetation disturbance. Furthermore, features such as the predominance of forest communities, covering about 60% of the region's area, enable the existence of a wide variety of forest fern species across the territory.

In this study, we consolidate all currently available data on the distribution of ferns in Kemerovo Oblast, synthesising herbarium specimens, information from published scientific sources, and records from open-access resources (GBIF, iNaturalist). The resulting inventory has yielded additional occurrence records with precise geographic coordinates and has provided material to augment the Global Biodiversity Information Facility (GBIF).

The aim of this research is to provide a comprehensive assessment of the species diversity of the division Polypodiophyta in Kuzbass, based on original herbarium materials, open online resources (GBIF, iNaturalist), and published sources.

Materials and methods

The dataset for analyzing the biodiversity of Polypodiophyta representatives and the specifics of their distribution in Kemerovo Oblast was compiled based on original herbarium collection data. Here and throughout, unique herbarium acronyms follow the international Index Herbariorum system, which maintains records of active herbarium collections worldwide; access to Index Herbariorum is provided via the New York Botanical Garden website. The following herbaria were consulted: ALTB – Altai State University, Barnaul; BRNU – Department of Botany and Zoology, Masaryk University, Brno; KEM – Kemerovo State University, Kemerovo; KUZ – Federal Research Center of Coal and Coal Chemistry, Siberian Branch of the Russian Academy of Sciences, Kemerovo; LE – Botanical Institute of the Russian Academy of Sciences, St. Petersburg; MW – Moscow State University, Moscow; NS and NSK – Central Siberian Botanical Garden, Siberian Branch of the Russian Academy of Sciences, Novosibirsk; PE – Chinese National Herbarium, Beijing; TK – Tomsk State University, Tomsk; ZT – Swiss Federal Institute of Technology, Zurich. In addition, all currently available published scientific sources in the public domain were analyzed, including records from the Global Biodiversity Information Facility (GBIF) portal and research-grade observations from iNaturalist. To date, this work represents the most comprehensive synthesis of data on fern biodiversity and distribution patterns within Kemerovo Oblast.

During the revision of the KEM and KUZ herbarium collections, in cases where locality data were absent from specimen labels, geographical coordinates were determined in accordance with the Darwin Core standard (see http://rs.tdwg.org/dwc/terms/index.htm#coordinateUncertaintyInMeters).

Latin species names follow the compendium by Czerepanov (1995) and have been updated according to electronic plant nomenclature databases (IPNI: The International Plant Names Index; Tropicos). The taxonomic composition of genera, as well as the circumscription and interpretation of species, follow the system proposed by A.I. Shmakov (2009). Species names and delimitations adopted herein are in accordance with Gureeva and Page (2008) and Klimov and Proshkin (2023). Records for *Athyrium filix-femina* (L.) Roth include *A. monomachii* (Kom.) Kom. and *A. sinense* Rupr., while *Dryopteris expansa* (C. Presl) Fraser-Jenk. & Jermy includes *D. dilatata* (Hoffm.) A. Gray.

To visualize spatial distribution patterns, heat maps were generated based on data from the KUZ and KEM herbaria separately for each collection. This approach allowed for an assessment of collection representativeness and identification of areas with insufficient sampling coverage. The analysis was performed for all species

collectively, as well as separately for rare taxa included in the Red Book of Kuzbass (2021), with the aim of evaluating their actual occurrence and revising their rarity categories based on current evidence.

Results and discussion

The most representative datasets on the ferns of Kemerovo Oblast are concentrated in two herbarium collections – KUZ and KEM. In total, these repositories house 1243 herbarium specimens. The collections were amassed over different periods and with varying intensity, reflecting the history of botanical research in the region.

In the KEM collection (481 specimens), the bulk of the material dates to an earlier period. More than half of the specimens (over 54%) were collected during the 1980s. Approximately 20% date to the late 1970s, while about 11% were collected in the 2000s. Specimens from the 1960s, as well as those from 2010 to the present, account for less than 3% of the total number of specimens. The earliest specimen in this collection dated to 1935.

In contrast, the KUZ herbarium (762 specimens) is dominated by more recent collections. The earliest specimen here dates to 1980. More than half of the collection consists of specimens collected in the 2000s. About 20% of the specimens were collected in the 2010s, over 16% date to the 1990s, and no less than 12% have been collected from 2020 to the present. Thus, the two collections complement each other well in terms of temporal coverage.

The distribution of herbarium specimens by family is presented in Table 1. In the KUZ collection, the highest number of specimens belongs to the families Dryopteridaceae and Cystopteridaceae. In the KEM herbarium, the family Dryopteridaceae also predominates; however, a significant number of specimens belong to the families Thelypteridaceae and Onocleaceae. In both collections, the lowest number of specimens was recorded for the family Ophioglossaceae. Integrating data from the two largest herbarium repositories of Kemerovo Oblast enables a more comprehensive understanding of the region's ferns and their spatial distribution.

Table 1. Number of herbarium specimens of fern families in the collections KUZ and KEM

Family	Herbarium	
	KUZ	KEM
Aspleniaceae	21	5
Athyriaceae	140	43
Botrychiaceae	22	10
Cryptogrammaceae	21	3
Cystopteridaceae	195	34
Dryopteridaceae	201	204

Family	Herbarium	
	KUZ	KEM
Hypolepidaceae	18	12
Onocleaceae	11	40
Ophioglossaceae	3	5
Polypodiaceae	22	14
Salviniaceae	3	27
Thelypteridaceae	17	54
Woodsiaceae	88	30
Total herbarium sheets	762	481

An analysis of records published on the GBIF portal has revealed that herbarium collections contain a total of 890 specimens from the territory of Kemerovo Oblast. These are distributed among the following repositories: ALTB – 42 specimens, BRNU – 13, MW – 25, NS – 100, NSK – 107, ZT – 1, PE – 6, and KUZ – 596, since digitization work is being carried out to this day, the number of records in GBIF is currently less than samples in KUZ collections. In addition, data not associated with herbarium specimens, including species checklists, photographs, iNaturalist observations, and other sources, were examined. These materials yielded 848 additional records, of which 391 belong to the MW database, 380 to iNaturalist, and 76 to other observational data. Thus, the total number of available records of ferns in Kuzbass currently amounts to 1,738.

The scientific literature reports varying numbers of fern species for Kemerovo Oblast. According to the Flora of Western Siberia (Krylov 1927), 24 species are recorded there. The Flora of Siberia (1988) lists 26 species. The Key to Plants of the Kemerovo Oblast (2001) presents 37 species. Flora Altaica (Shmakov 2005) enumerates 26 species. The work by Klimov and Proshkin (2023) reports 40 species. Finally, the Flora of Kemerovo Oblast (2023) provides 41 species. Such considerable discrepancies are attributable both to the accumulation of new data and to differences in the source materials employed.

In preparing the Key to Plants of the Kemerovo Oblast (2001), the collections of the herbaria TK, NSK, LE, and MW were used, along with specimens from the KEM herbarium. These same materials formed the basis of the first volume of the Flora of Siberia (1988). In the 21st century, work commenced on the monograph Flora of Kemerovo Oblast (2023), during which a substantial body of new data was gathered, including on the pteridoflora. The final version of the monograph incorporated materials from the KUZ herbarium; however, data from the KEM herbarium collected from the 20th century onward were not included. Records from open-access resources (GBIF and iNaturalist) were also omitted; the present study addresses this gap.

As a result of this work, an up-to-date checklist of Polypodiophyta taxa recorded from the territory of Kemerovo Oblast to the present time has been compiled (Table 2). We have analysed the contributions of various data sources. Of particular interest is the comparison of observations available in GBIF with the materials of the KUZ herbarium – the largest repository of Kuzbass ferns, of whose 762 specimens 596 have already been uploaded to this platform. Our analysis demonstrates that GBIF provides an additional 287 occurrence records of ferns within the oblast. Notably, it is on the basis of GBIF data that *Woodsia acuminata* has been documented – a species never previously reported for the territory of Kuzbass.

Comparative analysis of data from various sources (Table 2) reveals that the iNaturalist platform contains records of five fern species. The KEM herbarium comprises 32 species, while the KUZ herbarium includes 41 species. The GBIF database accounts for the highest number, with 42 species. However, when the KUZ herbarium data are excluded, the GBIF platform provides information on only 24 fern species of Kemerovo Oblast. This indicates that a substantial portion of the data on the region's species diversity is available largely owing to the digitisation of the KUZ collection.

Table 2. Biodiversity of the division Polypodiophyta in the Kemerovo Oblast: data from herbarium collections and open-access resources

Taxa		Herbarium		Open-access resources		
Family	**Species**	**KUZ**	**KEM**	**iNaturalist**	**GBIF**	**GBIF without KUZ data**
Aspleniaceae	*Asplenium ruta-muraria* L.	+	+	+	+	+
	Asplenium sajanense Gudoschn. & Krasnob.	+	-	-	+	-
	Asplenium septentrionale (L.) Hoffm.	+	-	+	+	-
	Asplenium trichomanes L.	+	+	-	+	-
	Asplenium viride Huds.	+	+	-	+	-
Athyriaceae	*Athyrium distentifolium* Tausch ex Opiz	+	+	+	+	+
	Athyrium filix-femina (L.) Roth	+	+	+	+	+
	Diplazium sibiricum (Turcz. ex Kunze) Sa. Kurata	+	+	+	+	+
Botrychiaceae	*Botrychium lunaria* (L.) Sw.	+	+	-	+	-
	Botrychium multifidum (S.G. Gmel.) Rupr.	+	+	-	+	-
	Botrychium virginianum (L.) Sw.	+	+	-	+	-

Taxa		Herbarium		Open-access resources		
Family	**Species**	**KUZ**	**KEM**	**iNaturalist**	**GBIF**	**GBIF without KUZ data**
Cryptogrammaceae	*Cryptogramma stelleri* (S.G. Gmel.) Prantl	+	+	-	+	-
Cystopteridaceae	*Cystopteris altajensis* Gureeva	+	-	-	+	+
	Cystopteris dickieana R. Sim.	+	-	-	+	+
	Cystopteris fragilis (L.) Bernh.	+	+	-	+	+
	Cystopteris montana (Lam.) Bernh. ex Desv.	+	+	-	+	-
	Cystopteris sudetica A. Braun et Milde	+	+	-	+	+
	Gymnocarpium continentale (Petrov) Pojark.	+	-	-	+	-
	Gymnocarpium dryopteris (L.) Newman	+	+	-	+	+
	Gymnocarpium jessoense (Koidz.) Koidz.	+	+	-	+	+
	Gymnocarpium robertianum (Hoffm.) Newman	+	+	-	-	-
Dryopteridaceae	*Dryopteris carthusiana* (Vill.) H.P. Fuchs	+	+	-	+	+
	Dryopteris cristata (L.) A. Gray	+	-	-	+	+
	Dryopteris expansa (C. Presl) Fraser-Jenk. & Jermy	+	+	-	+	+
	Dryopteris filix-mas (L.) Schott	+	+	-	+	+
	Polystichum braunii (Spenn.) Fee	+	+	-	+	+
	Polystichum lonchitis (L.) Roth	+	+	-	+	-
Hypolepidaceae	*Pteridium pinetorum* C.N. Page et R.R. Mill	+	+	-	+	+
Onocleaceae	*Matteuccia struthiopteris* (L.) Tod.	+	+	-	+	+
Ophioglossaceae	*Ophioglossum vulgatum* L.	+	+	-	+	-
Polypodiaceae	*Polypodium sibiricum* Sipliv.	+	+	-	+	-

Taxa		Herbarium		Open-access resources		
Family	Species	KUZ	KEM	iNaturalist	GBIF	GBIF without KUZ data
	Polypodium vulgare L.	+	+	-	+	-
Salviniaceae	*Salvinia natans* (L.) All.	+	+	-	+	-
Thelypteridaceae	*Oreopteris limbosperma* (All.) Holub	+	+	-	+	+
	Phegopteris connectilis (Michx.) Watt	+	+	-	+	+
	Thelypteris palustris Schott	+	+	-	+	+
Woodsiaceae	*Woodsia acuminata* (Fomin) Sipliv.	-	-	-	+	+
	Woodsia asiatica Shmakov et Kiselev	+	-	-	+	-
	Woodsia calcarea (Fomin) Shmakov	+	-	-	+	-
	Woodsia glabella R. Br.	+	-	-	+	+
	Woodsia ilvensis (L.) R. Br.	+	+	-	+	-
	Woodsia pinnatifida (Fomin) Shmakov	+	+	-	+	+

In particular, for the species *Gymnocarpium robertianum* in the "Plant Identifier of the Kemerovo Region" (Krasnoborov and Krapivkina 2001) it was indicated that the species “possibly” grows in the region, but there were no herbarium specimens confirming the location of the fern in the region by that time. When processing herbarium materials at the time of writing "Flora of Kemerovo Oblast" (2023), samples were found, we defined as *Gymnocarpium robertianum*, the data were published as additions in the flora of the Kemerovo Region (Sheremetova et al. 2026).

It should be noted that the GBIF database contains data on 15 rare fern species, based exclusively on digitised specimens from the KUZ herbarium. These species are: *Asplenium sajanense*, *A. trichomanes*, *A. viride*, *A. septentrionale*, *Botrychium lunaria*, *B. multifidum*, *B. virginianum*, *Cryptogramma stelleri*, *Cystopteris montana*, *Gymnocarpium continentale*, *Polystichum lonchitis*, *Ophioglossum vulgatum*, *Woodsia asiatica*, *W. calcarea*, *W. ilvensis*. Without these materials, the information on the distribution of the listed species would be incomplete.

Observations hosted on the iNaturalist platform make a comparatively modest yet meaningful contribution. They supplement data on four species that are generally not considered rare for Kuzbass: *Asplenium ruta-muraria*, *Athyrium distentifolium*, *Athyrium filix-femina*, *Diplazium sibiricum*. Regarding *Asplenium septentrionale*, the data were obtained during our expedition; specimens from the specific locality have been deposited on iNaturalist (https://www.inaturalist.org/observations/19984075) and on the Plantarium website (Ebel 2009). Thus, even for non-

rare species, open-access platforms can serve as a valuable supplementary source of information.

Hence, according to current data, the pteridophyte flora of Kemerovo Oblast comprises 13 families, 18 genera, and 42 species.

To assess the spatial coverage of pteridophyte collections within the Kemerovo Oblast territory, a locality map was constructed based on specimen data from the KUZ and KEM herbaria (Fig. 2). This visualisation facilitated an assessment of the collection coverage across the territory and enabled the identification of areas characterized by insufficient sampling intensity. In the KEM herbarium (481 specimens), 60 distinct collection localities were identified. Precise geographic coordinates were successfully determined for 430 specimens. For 47 specimens (constituting 9.7% of the total KEM holdings), coordinate assignment proved unfeasible, primarily owing to insufficiently detailed field descriptions of the collection sites. Additionally, four specimens possess coordinates that fall outside the administrative boundaries of Kemerovo Oblast, corresponding instead to the territory of the Republic of Khakassia. It is noteworthy that 43% of all KEM specimens (210 sheets) originate from only three localities – sites traditionally used for student field training expeditions. This pattern underscores the pronounced unevenness of collecting efforts and highlights the necessity for broader geographic coverage in future research.

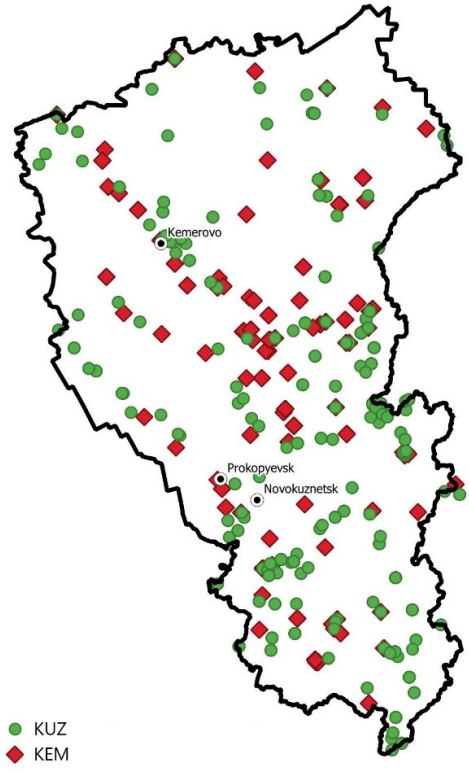


Figure 2. Fern collection locations according to KUZ and KEM herbarium data.

The KUZ herbarium (762 specimens) yielded 111 recorded localities. The majority of these occurrences are concentrated in mountainous areas, specifically the Kuznetsk Alatau and Mountain Shoria ranges. Overall, the KUZ collection exhibits considerably greater locality diversity compared to the KEM collection and provides a more comprehensive representation of fern distribution across the region.

The Red Data Book of Kuzbass (2021) includes 18 species of ferns. Of these, 5 species are designated as Category 1 (threatened with extinction), 1 species as Category 2 (declining in population size or geographic range), while the remaining 12 species are classified under Category 3 (rare) (Table 3).

Table 3. Rare fern species included in the Red Book of Kuzbass (2021)

Species	Rarity categories	KUZ herbarium sheets / locations	KEM herbarium sheets / locations	GBIF, excluding KUZ records
Asplenium sajanense	1	4/1	-	-
Asplenium septentrionale	1	3/1	-	-
Asplenium trichomanes	1	1/1	1/1	-
Asplenium viride	3	3/3	2/2	-
Botrychium lunaria	3	7/7	8/4	-
Botrychium multifidum	3	9/7	1/1	-
Botrychium virginianum	3	6/4	1/1	-
Cryptogramma stelleri	1	21/10	1/1	-
Cystopteris altajensis	1	8/4	-	3
Polystichum braunii	3	36/12	18/5	25
Polystichum lonchitis	2	4/3	2/1	-
Ophioglossum vulgatum	3	3/3	5/2	-
Polypodium sibiricum	3	16/9	3/2	-
Polypodium vulgare	3	6/3	11/5	-
Salvinia natans	3	3/2	27/9	-
Oreopteris limbosperma	3	10/6	3/3	4
Woodsia calcarea	3	11/5	-	1
Woodsia pinnatifida	3(2)	9/6	-	-

Analysis of GBIF data, excluding records from the KUZ herbarium collection, indicates that open-access resources supplement information on four rare species: *Cystopteris altajensis*, *Oreopteris limbosperma*, and *Woodsia calcarea*. The most numerous observations pertain to *Polystichum braunii*, with 25 recorded occurrences. These data may prove valuable for refining the current distribution ranges of the aforementioned species.

Of particular interest is the analysis of rarity categories. Based on data concerning the prevalence of species assigned the first category of rarity status, we propose a revision of their status. Specifically, *Cryptogramma stelleri* is known from 10 localities in the KUZ herbarium and one in KEM, indicating a relatively wide distribution. *Cystopteris altajensis* has been recorded at four sites in the KUZ collection and at an additional three localities in GBIF data. Accordingly, we propose downgrading the rarity category of *Cystopteris altajensis* to Category 2, and that of *Cryptogramma stelleri* to Category 3.

According to all analyzed data, the rarest species within Kemerovo Oblast remain three members of the genus *Asplenium*: *A. sajanense*, *A. septentrionale*, and *A. trichomanes*. Each of these taxa is known from only a single locality within the region (Fig. 3). These species warrant particular attention and conservation measures.

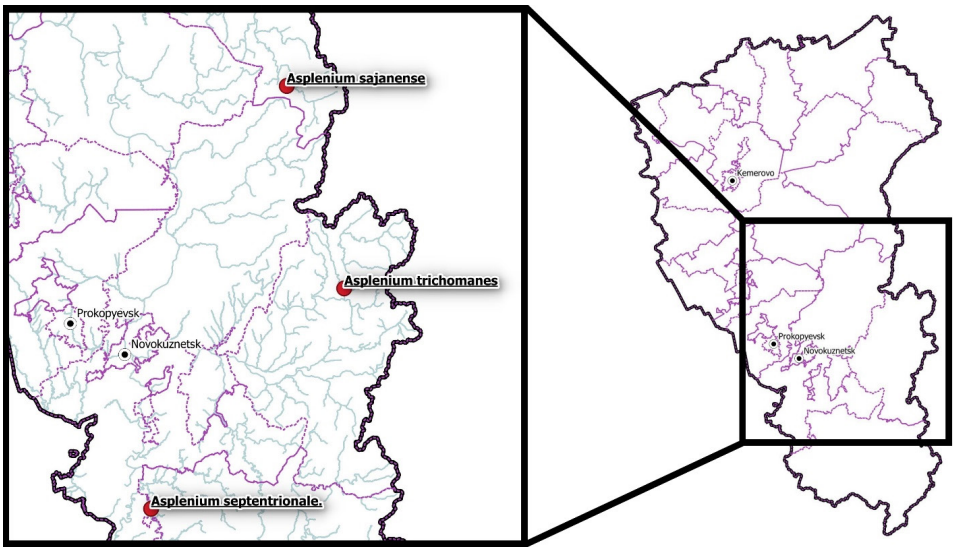


Figure 3. Locations of the rarest fern species in the Kemerovo Oblast.

Thus, the present analysis not only provides an updated picture of pteridophyte biodiversity in Kuzbass but also helps identify data gaps, refine the statuses of rare species, and determine priority directions for future field investigations.

Conclusion

As part of this study, a comprehensive inventory of biodiversity data on ferns and lycophytes (pteridophytes) of Kemerovo Oblast was carried out. The most complete information on the distribution of this plant group was found to be concentrated in

the two largest regional herbarium collections – KUZ and KEM – which together comprise 1243 specimens collected between 1935 and 2026.

By synthesising all available sources – herbarium funds, scientific publications, GBIF data, and iNaturalist observations – the most up-to-date and complete picture of the pteridoflora of Kuzbass to date was obtained. According to the results, the flora includes 13 families, 18 genera, and 42 species, thereby refining and supplementing previously published data.

Heat maps were used to visualise the spatial distribution of records, revealing poorly studied areas that require further field investigations.

An analysis of rare species listed in the Red Data Book of Kuzbass indicated the necessity of revising their threat categories: for *Cryptogramma stelleri* and *Cystopteris altajensis,* a downgrade to Category 3 and Category 2, respectively, is proposed. The most vulnerable remain three species of the genus *Asplenium*, each known from only a single locality.

During the work, the geographic coordinates of many localities were refined, and materials were prepared for updating the GBIF database. The results of this study update the current understanding of the pteridoflora of Kemerovo Oblast and provide a foundation for monitoring rare species and planning conservation measures.

Acknowledgements

This work was carried out within the framework of the state assignment on the topic "Assessment of the state of terrestrial ecosystems under anthropogenic and technogenic impacts and development of technologies for their restoration in situ and ex situ" (No. 126030318254-5), with the use of the collection of the Unique Scientific Facility (USU) No. USU 508667. The authors express their sincere gratitude to the administration of Kemerovo State University for supporting the inventory and digitisation of the scientific herbarium KEM.

References

Czerepanov SK (1995) Vascular plants of Russia and neighboring states. St. Petersburg, 990 pp. [In Russian]

Ebel AL (2009) Image of *Asplenium septentrionale* (L.) Hoffm. Plantarium. Plants and lichens of Russia and neighboring countries: open online galleries and plant identification guide. Available at: https://www.plantarium.ru/lang/en/page/image/id/25798.html (Accessed on 21 Jul 2026).

Evtushik NG, Bagmet GN, Dyachenko NK, Egorova NT, Verkhozina MV (2017) Workshop on physical geography of the Kemerovo Oblast: textbook. Novokuznetsk branch of Kemerovo State University, Novokuznetsk, 83 pp. [In Russian]

Flora of Kemerovo Oblast (2023) SB RAS, Novosibirsk, 520 pp. [In Russian]

Flora of Siberia (1988) Vol. 1. Polypodiophyta. Siberian branch of "Science", Novosibirsk, 48–75. [In Russian]

Gureeva II, Page KN (2008) The genus *Pteridium* (Hypolepidaceae) in Northern Eurasia. Botanical Journal 93(6): 915–934. [In Russian]

Key to plants of the Kemerovo Oblast (2001) Publishing House of SB RAS, Novosibirsk, 477 pp. [In Russian]

Klimov AV, Proshkin BV (2023) Synopsis of Ferns of Kemerovo Oblast – Kuzbass. Botanical Journal 108(5): 443–454. https://doi.org/10.31857/S000681362305006X [In Russian]

Krasnoborov IM, Krapivkina ED (2001) Polypodiophyta. In: Key of plants of the Kemerovo Region. SB RAS, Novosibirsk, 85–99. [In Russian]

Krylov PN (1927) Flora of Western Siberia. Vol. 1. Tomsk, 138 pp. [In Russian]

Red Book of Kuzbass (2021) Rare and endangered species of plants and fungi. Vol. 1. Kemerovo, 240 pp. [In Russian]

Sheremetova SA, Khrustaleva IA, Ebel AL, Kupriyanov1 AN, Ebel TV (2026) New plant species for the flora of different regions of Siberia (Altai Territory, Kemerovo and Novosibirsk Regions, Republic of Khakassia). Turczaninowia 29(2): 85–91. https://doi.org/10.14258/turczaninowia.29.2.8

Shmakov AI (2005) Polypodiophyta. In: Kamelin RV (Ed.) Flora Altaica. Vol. 1. Barnaul, 158–255. [In Russian]

Shmakov AI (2009) Sinopsis of the ferns of North Asia. Turczaninowia 12(3–4): 88–148.

Udodov VP (Ed.) (2012) Kemerovo Oblast: collective monograph. Novokuznetsk, 255 pp. [In Russian]