Floristic features of the Naryksky State Nature Reserve

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Abstract. Naryksky Reserve is located on lands within the boundaries of the Belovsky, Novokuznetsk, and Prokopyevsky municipal districts of Kemerovo Oblast. Three large mining companies are located near the reserve: LLC Resurs, LLC UK Kuzbassrazrezugol, and LLC Razrezdobycha Kuzbass. Studies have shown that 345 species from 204 genera and 67 families grow on the territory. The synanthropization coefficient of the flora is low and averages 3.9%. Four species are classified as invasive with status 2: *Amoria hybrida, Conium maculatum, Pastinaca sativa, Plantago lanceolata*. Three species grow on the territory of the reserve, included in the 3rd edition of the Red Book of the Kemerovo Oblast: *Asarum europaeum, Erythronium sibiricum, Drosera rotundifolia* L.

1 Introduction

Naryksky State Natural Botanical Reserve was established on December 27, 2023, with a total area of 214,635 hectares [1] (Fig. 1). The reserve is located on lands within the boundaries of the Belovsky, Novokuznetsky, and Prokopyevsky municipal districts. Part of the territory is located within the boundaries of the Naryksko-Ostashkinskoe deposit of the South Kuznetsk group of coal deposits of the licensed area KEM 14700 NR for the extraction of coal seam methane.

The unique feature of the territory is its proximity to the borders of five major mining companies: UK Kuzbassrazrezugol PJSC, UK Resurs LLC, UK Taltek LLC, UK Salek LLC, and UK Striyservis JSC (Fig. 1).

Coal mining operations in the reserve began less than 10 years ago, and the destructive impact of open-pit coal mining activities on the surrounding ecosystems is so far practically negligible within the reserve's territory.

The vegetation cover is characterized by transitional features from the lowland areas of the Kuznetsk Basin to the mountainous uplifts of the Kuznetsk Alatau. Here, the subtaiga belt is distinguished with a predominance of black coniferous, small-leaved, and mixed forests (birch and aspen) with a developed herbaceous cover, which form the appearance of the eastern periphery of the Kuznetsk Basin [2–4].

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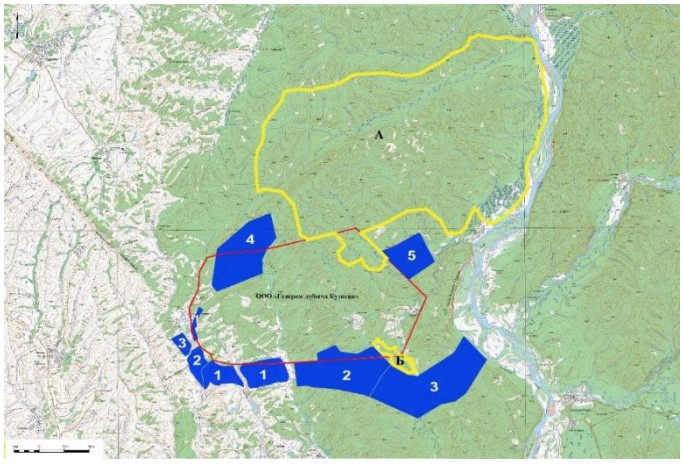

Fig. 1. Schematic map of the location of the "Naryksky" reserve:
А – "Naryksky" reserve; Б – "Chernovoy Naryk" reserve;
1 –UK Kuzbassrazrezugol PJSC, 2- UK Resurs LLC, 3 - UK Taltek LLC, 4 - UK Salek LLC, 5 - UK Striyservis JSC

2 Materials and Methods

Floristic studies in the Naryksky reserve were conducted using the route-expedition method, during which the territory in the basin of the B. Naryk and other rivers was examined in 2021-2023. A total of 43 geobotanical descriptions were made in various ecotopes: spruce-fir forests, fir forests, birch-aspen forests, cranberry swamps, etc. During the work, the spring, summer and autumn aspects of vegetation were recorded. On forest-occupied plots, the description area was 625 m^2, on sites with herbaceous cover, the area of the experimental plot was 100 m^2. The synanthropization coefficient was calculated according to the formula proposed by E.P. Prokopyev et al. [5].

The materials were processed using the IBIS software [6]. Plant identification was carried out in the laboratory conditions of the Institute of Human Ecology of the Siberian Branch of the Russian Academy of Sciences. For plant identification, the plant identifier of the Kemerovo Region [7] and the "Flora of Siberia" [8] were used. In the analysis of the features of the floristic composition, the Red Book of the Kemerovo Oblast-Kuzbass [9] and the Black Book of the Flora of Siberia [10] were used.

3 Results and Discussion

The total list of plants in the Naryksky Reserve includes 345 species, 204 genera, and 67 families.

DIVISION EQUISETOPHYTA. Family Equisetaceae Rich. ex DC.: *Equisetum fluviatile* L., *E. hyemale* L, *E. pratense* Ehrh., *E. sylvaticum* L.

DIVISION POLYPODIOPHYTA. Onocleaceae Pichi-Sermoli: *Matteuccia struthiopteris* (L.) Tod.; **Hypolepidaceae** Pichi-Sermoli: *Pteridium pinetorum* C. N. Page et R. R. Mill.; **Thelypteridaceae** Pichi-Sermoli: *Phegopteris connectilis* (Michx.) Watt., *Thelypteris palustris* (Salisb.) Schott.; **Athyriaceae** Ching: *Athyrium filix-femina* (L.) Roth; **Dryopteridaceae** Ching: *Dryopteris carthusiana* (Vill.) H. P. Fuchs., *D. filix-mas* (L.) Schott., *Gymnocarpium dryopteris* (L.) Newm.

DIVISION PINOPHYTA, OR CONIFEROPHYTA. Pinaceae Lindl.: *Abies sibirica* Ledeb., *Larix sibirica* Ledeb., *Picea obovata* Ledeb., *Pinus sibirica* Du Tour., *P. sylvestris* L.

DIVISION MAGNOLIOPHYTA. Class MAGNOLIOPSIDA, OR DICOTYLEDONES. Aristolochiaceae Juss.: *Asarum europaeum* L.; **Ranunculaceae** Juss.: *Aconitum anthoroideum* DC., *A. septentrionale* Koelle, *A. volubile* Pall. ex Koelle, *Actaea erythrocarpa* Fisch., *A. spicata* L., *Anemonoides altaica* (C.A. Mey.) Holub, *A. caerulea* (DC.) Holub, *Caltha palustris* L., *Cimicifuga foetida* L., *Delphinium elatum* L., *Ranunculus acris* L., *R. grandifolius* C. A. Mey., *R. monophyllus* Ovcz., *R. polyanthemos* L., *R. propinquus* C. A. Mey., *R. repens* L., *R. sceleratus* L., *Thalictrum flavum* L., *Th. minus* L., *Th. simplex* L., *Trollius asiaticus* L.; **Paeoniaceae** Rudolphi: *Paeonia anomala* L.; **Fumariaceae** DC.: *Corydalis bracteata* (Steph.) Pers.; **Caryophyllaceae Juss.:** *Cerastium davuricum* Fisch. ex Spreng., *C. pauciflorum* Stev. ex Ser., *Dianthus superbus* L., *Melandrium album* (Mill.) Garcke, *Oberna behen* (L.) Ikonn., *Stellaria bungeana* Fenzl, *S. dahurica* Willd. ex Schltdl., *S. graminea* L.; **Chenopodiaceae** Vent.: *Atriplex patula* L., *A. sagittata* Borkh., *Chenopodium album* L.; **Polygonaceae** Juss.: *Aconogonon alpinum* (All.) Schur., *Bistorta vivipara* (L.) S. F. Gray, *Fallopia convolvulus* (L.) A. Löve, *Persicaria amphibia* (L.) Gray, *P. hydropiper* (L.) Spach., *P. lapathifolia* (L.) Gray, *Polygonum aviculare* L., *Rumex pseudonatronatus* (Borb.) Borb. ex Murb, *R. thyrsiflorus* Fingerh.; **Betulaceae** Gray: *Betula pendula* Roth, *B. pubescens* Ehrh.; **Hypericaceae** Juss.: *Hypericum ascyron* L., *H.elegans* Stephan ex Willd.; **Ericaceae** Juss.: *Pyrola minor* L., *P. rotundifolia* L., *Andromeda polifolia* L., *Chamaedaphne calyculata* L.) Moench, *Oxycoccus palustris* Pers.; **Primulaceae** Vent.: *Androsace filiformis* Retz., *Primula macrocalyx* Bunge, *P. pallasii* Lehm., *Lysimachia vulgaris* L., *Naumburgia thyrsiflora* (L.) Rchb., *Trientalis europaea* L.; **Violaceae** Batsch: *Viola biflora* L., *V. canina* L., *V. mirabilis* L., *V. uniflora* L.; **Salicaceae** Mirb.: *Populus laurifolia* Ledeb., *P. nigra* L., *P. tremula* L., *Salix alba* L., *S. bebbiana* Sarg., *S. caprea* L., *S. cinerea* L., *S. dasyclados* Wimm., *S. pentandra* L., *S. pyrolifolia* Ledeb., *S. rorida* Laksch., *S. triandra* L., *S. viminalis* L.; **Brassicaceae** Burnett (Cruciferae Juss.): *Arabis pendula* L., *Bunias orientalis* L., *Camelina microcarpa* Andrz., *Capsella bursa-pastoris* (L.) Medikus, *Cardamine macrophylla* Willd., *Descurainia sophia* (L.) Webb. ex Prantl, *Draba sibirica* (Pall.) Thell., *Hesperis sibirica* L., *Neslia paniculata* (L.) Desv., *Rorippa amphibium* (L.) Bess., *R. palustris* (L.) Besser.; **Cannabaceae** Endl.: *Humulus lupulus* L.; **Urticaceae** Juss.: *Urtica dioica* L.; **Euphorbiaceae** Juss.: *Euphorbia lutescens* Ledeb., *Eu. virgata* Waldst. & Kit., **Thymelaeaceae** Juss.: *Daphne mezereum* L.; **Saxifragaceae** Juss.: *Saxifraga aestivalis* Fisch. & C.A.Mey., *S. cernua* L., *S. sibirica* L.; **Grossulariaceae** DC.: *Ribes atropurpureum* C. A. Mey., *R. nigrum* L.; **Parnassiaceae** S. F. Gray: *Parnassia palustris* L.; **Droseraceae** Salisb.: *Drosera rotundifolia* L.; **Rosaceae** Juss.: *Agrimonia pilosa* Ledeb., *Alchemilla vulgaris* L., *Comarum palustre* L., *Cotoneaster melanocarpus* Fisch. ex Blytt, *Crataegus sanguinea* Hedl., *Filipendula stepposa* Juz., *F. ulmaria* (L.) Maxim., *Fragaria vesca* L., *F. viridis* (Duchesne) Weston, *Geum aleppicum* Jacq., *G. rivale* L., *Padus avium* Mill., *Potentilla anserina* L., *P. chrysantha* Trevir., *P. fragarioides* L., *P. norvegica* L., *Rosa. majalis* Herrm., *Rubus arcticus* L., *R. idaeus* L., *R. saxatilis* L., *Sanguisorba officinalis* L., *Sorbus sibirica* Hedl., *Spiraea chamaedryfolia* L., *S. media* Schmidt.; **Lythraceae** J. St.-Hil.: *Lythrum virgatum* L.; **Onagraceae** Juss.: *Chamaenerion angustifolium* (L.) Scop., *Circaea alpina* L., *Epilobium montanum* L., *Epilobium palustre* L.; **Fabaceae** Lindl.: *Amoria hybrida* (L.) C. Presl,, *Caragana arborescens* Lam., *Caragana frutex* (L.) K. Koch, *Lathyrus gmelinii* Fritsch, *L. pisiformis* L., *L. pratensis* L., *L. sylvestris* L., *Medicago lupulina* L., *Melilotoides platycarpos* (L.) Sojak, *Trifolium pratense* L., *Vicia amoena* Fisch., *V. cracca* L., *Vicia multicaulis* Ledeb., *V. sylvatica* L.; **Oxalidaceae** R. Br. : *Oxalis acetosella* L.; **Geraniaceae** Juss.: *Geranium albiflorum*

Ledeb., *G. bifolium* Patrin, *G. krylovii* Tzvel., *G. pratense* L., *G. sylvaticum* L.; **Balsaminaceae** A. Rich.: *Impatiens noli-tangere* L.; **Cornaceae** Dumort.: *Swida alba* (L.) Opiz.; **Apiaceae** Lindl.: *Aegopodium alpestre* Ledeb., *Ae. podagraria* L., *Angelica decurrens* (Ledeb.) B.Fedtsch., *Anthriscus sylvestris* (L.) Hoffm., *Bupleurum aureum* Fisch. ex Hoffm., *Cenolophium denudatum* (Hornem.) Tutin, *Conium maculatum* L., *Kadenia dubiua* (Schkuhr) Lavrova er V.N.Tichom., *Heracleum dissectum* Ledeb., *Pastinaca sylvestris* Mill., *Peucedanum morisonii* Bess. ex Spreng., *Pimpinella saxifraga* L., *Pleurospermum uralense* Hoffm.; **Caprifoliaceae** Juss.: *Linnaea borealis* L.; **Viburnaceae** Dumort.: *Viburnum opulus* L.; **Sambucaceae** Link: *Sambucus sibirica* Nakai; **Adoxaceae** Trautv.: *Adoxa moschatellina* L.; **Campanulaceae** Juss.: *Adenophora lilifolia* (L.) A. DC., *Campanula. trachelium* L.; **Asteraceae** Dumort.: *Achillea asiatica* Serg., *Alfredia cernua* (L.) Cass., *Arctium tomentosum* Mill., *Artemisia dracunculus* L., *A. gmelinii* Ledeb., *A. macrantha* Ledeb., *A. vulgaris* L., *Bidens tripartita* L., *Carduus crispus* L., *Centaurea scabiosa* L., *Cirsium helenioides* (L.) Hill, *C. incanum* (S. G. Gmel.) Fisch., *C. serratuloides* (L.) Hill, *C. setosum* (Willd.) Besser, *Crepis lyrata* (L.) Froel., *C. sibirica* L., *Erigeron acris* L., *Gnaphalium norvegicum* (Gunnerus) Sch. Bip. & F.W.Schultz, *Hieracium umbellatum* L., *Jacobaea nemorensis* (L.) E. Wiebe, *Leucanthemum vulgare* Lam., *Ligularia glauca* (L.) O.Hoffm., *Matricaria perforata* Merat., *Parasenecio hastatus* (L.) H. Koyama, *Picris davurica* Fisch., *Ptarmica impatiens* (L.) DC., *Senecio fluviatilis* Wallr, *Saussurea latifolia* Ledeb., *Serratula coronata* L., *Solidago virgaurea* L., *Sonchus arvensis* L., *Tanacetum vulgare* L., *Taraxacum officinale* F.H.Wigg., *Tephroseris integrifolia* (L.) Holub, *Tussilago farfara* L., **Rubiaceae** Juss.: *Cruciata krylovii* (Iljin) Pobed., *Galium boreale* L., *G. mollugo* L., *G.mollugo* L., *G. odoratum* (L.) Scop., *G. palustre* L., *G. uliginosum* L.; **Menyanthaceae** Dumort.: *Menyanthes trifoliata* L.; **Solanaceae** Juss.: *Solanum kitagawae* Schonbeck-Temesy; **Convolvulaceae** Juss.: *Calystegia sepium* (L.) R. Br., *Convolvulus arvensis* L.; **Polemoniaceae** Juss.: *Polemonium caeruleum* L.; **Boraginaceae** Juss.: *Brunnera sibirica* Steven, *Myostis imitata* Serg., *M. krylovii* Serg., *M. scorpioides* (L.) L., *Pulmonaria mollis* Wulfen ex Hornem.; **Scrophulariaceae** Juss.: *Linaria vulgaris* Mill., *Odontites vulgaris* Moench, *Pedicularis sibirica* Vved., *Scrophularia nodosa* L., *Rhinanthus crista-galli* L., *Veronica beccabunga* L., *V. anagallis-aquatica* L., *V. chamaedrys* L., *V. krylovii* Schischk, *V. longifolia* L.; **Hippuridaceae** Link: *Hippuris vulgaris* L.; **Plantaginaceae** Juss.: *Plantago lanceolata* L., **Lamiaceae** Lindl.: *Dracocephalum. nutans* L., *Glechoma hederacea* L., *Lamium album* L., *Lycopus europaeus* L., *Phlomoides tuberosa* (L.) Moench, *Prunella vulgaris* L., *Scutellaria galericulata* L., *Stachys sylvatica* L.

Class LILIOPSIDA. Butomaceae L. C. Rich.: *Butomus umbellatus* L.; **Alismataceae** Vent.: *Alisma plantago-aquatica* L.; **Melanthiaceae** Batsch: *Veratrum lobelianum* Bernh., *V. nigrum* L.; **Liliaceae** Juss.: *Erythronium sibiricum* (Fisch. et C. A. Mey.) Kryl., *Lilium pilosiusculum* (Freyn) Miscz.; **Alliaceae** J. Agardh.: *Allium microdictyon* Prokh.; **Convallariaceae** Horaninow: *Maianthemum bifolium* (L.) F. W. Schmidt.; **Trilliaceae** Lindl.: *Paris quadrifolia* L.; **Orchidaceae** Adans.: Dactylorhiza fuchsii (Druce) Soa, D. incarnata (L.) Soa; **Juncaceae** Juss.: *Juncus alpino-articulatus* Chaix, *J. articulatus* L., *Luzula pallescens* Sw.; **Cyperaceae** Juss.: *Carex acuta* L., *C. appropinquata* Schum., *C. arnellii* Christ, *C. atherodes* Spreng., *C. brunnescens* (Pers.) Poir., *C. canescens* L., *C. curaica* Kunth, *C. elongata* L., *C. enervis* C.A. Mey., *Carex lasiocarpa* Ehrh., *Carex juncella* (Fries) Th. Fries, *Carex limosa* L., *C. macroura* Meinsh., *C. muricata* L., *Carex ovalis* Good., *C. pallescens* L., *Carex pauciflora* Lightf., *C. rhynchophysa* C.A.Mey., *C. rostrata* Stokes, *C. sylvatica* Huds., *C. vesicaria* L., *Eleocharis palustris* (L.) Roem. & Schult., *E. acicularis* (L.) Roem.et Schult., *E. austriaca* Hayek, *E. mamillata* Lindb. fil., *Eriophorum vaginatum* L., *Scirpus radicans* Schkuhr, *S. sylvaticus* L., **Poaceae** Barnhart: *Agrostis gigantea* Roth, *A. stolonifera* L., *A. tenuis* Sibth., *Alopecurus arundinaceus* Poir.

A. pratensis L., *Brachypodium pinnatum* (L.) Beauv., *B. sylvaticum* (Huds.) Beauv., *Bromopsis inermis* (Leyss.) Holub, *Calamagrostis arundinacea* (L.) Roth, *C. epigeios* (L.) Roth, *C. langsdorfii* (Link) Trin., *C. obtusata* Trin., *C. pavlovii* Roshev., *C. phragmitoides* Hartm., *C. purpurea* (Trin.) Trin., *Dactylis glomerata* L., *Elymus caninus* (L.) L., *Elytrigia repens* (L.) Nevski, *Festuca gigantea* (L.) Vill., *F. altissima* All., *F. pratensis* Huds., *F. rubra* L., *Melica nutans* L., *Milium effusum* L., *Phalaroides arundinacea* (L.) Rausch., *Phleum pratense* L., *Phragmites australis* (Cav.) Trin. ex Steud., *Poa nemoralis* L., *P. palustris* L., *P. pratensis* L., *P. remota* Forsell., *Scolochloa festucacea* (Willd.) Link.; **Araceae** Juss.: *Calla palustris* L.; **Sparganiaceae** Rudolphi: *Sparganium erectum* L., *S. glomeratum* (Laest.) Neum., *S. rotertii* Tzvel., **Typhaceae** Juss.: *Typha latifolia* L.

Within the family-species spectrum, 11 leading families account for 215 species, representing 62.3% of the flora's species composition. The set of leading families is generally characteristic of most boreal floras. The Asteraceae family ranks first with 36 species (10.4%), followed by Poaceae with 33 species (9.6%), Cyperaceae with 28 species (8.1%), and Rosaceae with 24 species (7.0%). The flora of the reserve constitutes 36.5% of the entire flora of the Kuznetsk Alatau floristic region [11] and almost completely repeats the spectrum of the Kuznetsk Alatau floristic region (Table 1).

Table 1. Family-level species spectrum of the studied area

Family	Location	Quantity		Number of species in the Kuznetsk Alatau [11]		
		Species	%	Location	Species	%
Asteraceae	I	36	10,4	I	115	11,9
Poaceae	II	33	9,6	II	82	8,5
Cyperaceae	III-	28	8,1	III	61	6,3
Rosaceae	IV	24	7,0	IV	54	5,6
Ranunculaceae	V- VI	19	5,5	V	41	4,3
Salicaceae	V- VI	19	5,5	X	28	2,9
Fabaceae	VII	14	4,1	IX	35	3,6
Apiaceae	VIII- IX	11	3,2	XI	27	2,8
Scraphulariaceae	VIII- IX	11	3,2	VII	38	3,9
Brassicaceae	X- XI	10	2,9	VIII	36	3,7
Polygonaceae	X- XI	10	2,9	IX	35	3,6
Total		215	62,3		541	57,3
Other 56		130	37,7	Other 95	429	42,7
Total	67	345	100	113	964	100

The coefficient of synanthropization is extremely low, ranging from 1.3 to 5.5% (Table 2). This is due to the overall inaccessibility of the territory (a single road leading to the semi-abandoned village of Ust-Naryk), with most tourists basing themselves on the banks of the Tom River and not venturing far from the shore. Mountain mining operations by coal companies are not carried out within the reserve.

Table 2. Anthropogenic transformation of flora

Ecotope	Total number of species	Number of weed species	Synanthropy coefficient, %
Spruce-fir forests	64	3	4,7
Fir forests	74	3	4,1
Birch-aspen forests	55	3	5,5
Cranberry swamp	78	1	1,3

Within the boundaries of the protected area, four plant species listed in the Red Data Book of Siberian Flora [10] have been documented. These species include: *Amoria hybrida*

(status 2); *Pastinaca sativa* (status 2); *Conium maculatum* (status 2); and *Plantago lanceolata* (status 2).

Within the boundaries of the protected area, three species listed in the 3rd edition of the Red Book of the Kemerovo Region [9] are found: *Asarum europaeum, Erythronium sibiricum*, and *Drosera rotundifolia*.

4 Conclusion

Within the Naryksky State Natural Botanical Reserve, 345 species from 204 genera and 67 families thrive. Due to minimal anthropogenic and technogenic impacts, the synanthropy coefficient remains low, averaging 3.5%. Out of the 12 weed species identified within the reserve, four species - *Amoria hybrida, Conium maculatum, Pastinaca sativa,* and *Plantago lanceolata* - are listed in the Black Book of Siberian Flora [10]. The reserve also harbors three species included in the 3rd edition of the Red Data Book of the Kemerovo Oblast [9]: *Asarum europaeum, Erythronium sibiricum, and Drosera rotundifolia*.

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