Taxonomic analysis of the Akmola region flora of Northern Kazakhstan

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Abstract. A taxonomic analysis of the flora list of Akmola region is presented. The results are based on field research, literature analysis and revision of herbarium materials. According to the data obtained, it was established that the flora of the Akmola region includes 1121 species of higher vascular plants from 449 genera and 96 families. On the territory of the Akmola region grow 18 species of rare plants included in the Red Book of the Republic of Kazakhstan, and 7 endemics of Kazakhstan are registered. In the Akmola region, 86 species of alien plants from 29 families and 73 genera were identified.

1 Introduction

Akmola region is located in the steppe natural zone of Northern Kazakhstan. This region occupies the western edge of the Kazakh folded country between the Ulytau mountains in the southwest and the Kokshetau heights in the north, with an area of 146,219 thousand km^2. In the south, Akmola region borders with Karaganda region, in the north with North Kazakhstan region, in the west with Kostanay region and in the east with Pavlodar region [1].

The Akmola region is located at the intersection of the borders of the Kokchetav and Irtysh (Pavlodar Irtysh region) floristic regions with the Western small hills. In this territory, the boundaries of the forest-steppe belt of the Kokchetav Upland and zonal strips of arid forb-grass, dry soddy-grass and complex desert steppes converge [2].

The history of studying the flora of the Akmola region continues for more than 300 years. The first greatest contribution to the study of the flora of the Akmola region (within the boundaries of the administrative division of that time) was made by V.F. Semenov. [3]. Later, famous botanists A.Ya. Gordyagin, P.L. Gorchakovskiy, L.N. Gribanov, L.V. Denisova, A.M. Zharkova, Z.V. Karamysheva, V.F. Semenov, E.I. Rachkovskaya, M.M. Siyazov, V.N. Sukachev, T.V. Sidorova, A.N. Kupriyanov, G.Zh. Sultangazina worked on this territory. Based on the results of the work of these scientists, fundamental reports were published: “Botanical geography of the steppe part of Central Kazakhstan” [2]; “Forest oases of the Kazakh Uplands” [4]; “Flora of the “Burabay” National Nature Park” [5]; “Sosudistye rasteniya Kurgaldzhinskogo zapovednika” [6]. Of key importance for the study of the flora of the Akmola region is the publication by Pavlov N.V. of the three-volume

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guide "Flora of Central Kazakhstan" [7, 8, 9]. As a result of summarizing the floristic data accumulated over almost 200 years of botanical study, as well as 40 years of experience of expeditionary trips through the territory of Central Kazakhstan, A.N. Kupriyanov compiled a "Synopsis of the flora Kazakh Uplands", containing information about 2102 species of vascular plants [10]. Since the creation of the Astana Botanical Garden in 2018, we have been conducting research on the flora of Central and Northern Kazakhstan [11, 12, 13, 14, 15]. The main purpose of this article is to analyze the list of flora of the Akmola region based on field research, literature analysis and revision of herbarium materials.

2 Materials and methods

The research was carried out from 2018 to 2024 using the route reconnaissance method. Expeditionary research was carried out on the basis of the Astana Botanical Garden. The results are based on field research and revision of herbarium collections: AA, NUR, KSPI, KG, LE, MW, TK, and KUZ. In addition, materials from the GBIF, iNaturalist and Plantarium platforms were used. Life forms are given according to "Flora of Kazakhstan" [16]. The nomenclature of each taxon mostly follows "Plants of the World Online" [17].

3 Results and discussions

Based on the results of the research, a list of the flora of the Akmola region was compiled. According to the data obtained, the flora of the Akmola region includes 1121 species of higher vascular plants from 449 genera and 96 families.

The largest families in the study region are: Asteraceae (175 species), Poaceae (87 species), Brassicaceae (65 species), Fabaceae (63 species), Amaranthaceae (58 species), Cyperaceae (52 species), Rosaceae (49 species), Caryophyllaceae (43 species), Apiaceae (36 species), Plantaginaceae (33 species), Ranunculaceae (32 species), Lamiaceae (31 species), Boraginaceae (27 species), Polygonaceae (23 species), Salicaceae (16 species), Orobanchaceae (15 species), Potamogetonaceae (14 species), Caprifoliaceae (12 species), Orchidaceae (12 species), Rubiaceae (11 species).

The flora of the Akmola region includes the largest genera: *Carex* - 41 species, *Artemisia* - 29 species, *Astragalus* - 26 species, *Ranunculus* - 17 species, *Potentilla* - 15 species, *Silene* - 15 species, *Lepidium* - 13 species, *Veronica* - 13 species, *Allium* – 11 species, *Galium* – 11 species, *Potamogeton* – 10 species, *Juncus* – 9 species, *Viola* – 9 species, *Stipa* – 8 species, *Equisetum* – 7 species.

Analysis of the life forms of the species composition of the Akmola region flora showed that the region is dominated by perennials - 746 species, annuals - 198 species, biennials - 63 species, shrubs - 54 species, trees – 24 species, subshrubs - 16 species, dwarf semishrub - 12 species, semishrub - 8 species.

In the Akmola region, 87 species of alien plants from 29 families and 73 genera were identified: *Acer campestre* L., *A. negundo* L., *A. tataricum* L., *Agropyron cristatum* (L.) Gaertn., *Amaranthus blitoides* S. Wats., *A. retroflexus* L., *Amelanchier spicata* (Lam.) C. Koch, *Anisantha tectorum* (L.) Nevski, *Artemisia sieversiana* Ehrh. ex Willd., *A. tournefortiana* Reichenb., *Atriplex hortensis* L., *Avena fatua* L., *Bassia scoparia* (L.) A.J.Scott, *Berberis vulgaris* L., *Brassica juncea* (L.) Czern., *B. rapa* L., *Bunias orientalis* L., *Camelina sativa* (L.) Crantz, *Cannabis sativa* L., *Capsella bursa-pastoris* (L.) Medik., *Carduus acanthoides* L., *Carum carvi* L., *Centaurea diffusa* Lam., *C. stoebe* L., *Cerastium holosteoides* Fries, *Cerinthe minor* L., *Cichorium intybus* L., *Clematis mandshurica* Rupr., *Clinopodium acinos* (L.) Kuntze, *Conium maculatum* L., *Cornus alba* L., *Cota tinctoria* subsp. *tinctoria*, *Cuscuta approximata* Bab., *C. europaea* L., *Cyclachena xanthiifolia*

(Nutt.) Fresen., *Dianthus chinensis* L., *Echinochloa crus-galli* (L.) P. Beauv., *Echinops sphaerocephalus* L., *Echium vulgare* L., *Elaeagnus angustifolia* L., *E. commutata* Bernh. ex Rydb., *Elymus violaceus* (Hornem.) J.Feilberg, *Erigeron canadensis* L., *Euonymus europaeus* L., *Fraxinus pennsylvanica* Marshall, *Fumaria officinalis* L., *Galeopsis bifida* Boenn., *G. ladanum* L., *Grindelia squarrosa* (Pursh) Dunal, *Gypsophila vaccaria* (L.) Sm., *Helianthus annuus* L., *Hippophae rhamnoides* L., *Hordeum jubatum* L., *Impatiens glandulifera* Royle, *Isatis tinctoria* L., *Lepidium densiflorum* Schrad., *Rhaponticum repens* (L.) Hidalgo, *Malus baccata* (L.) Borkh., *M. domestica* Borkh., *Malva pusilla* Smith, *Matricaria chamomilla* L., *M. discoidea* DC., *Medicago sativa* L., *Panicum miliaceum* L., *Pastinaca sativa* L., *Plantago lanceolata* L., *Portulaca oleracea* L., *Prunus tomentosa* Thunb., *Pseudopodospermum hispanicum* (L.) Zaika, Sukhor. & N.Kilian, *Reseda lutea* L., *Rhamphospermum arvense* (L.) Andrz. ex Besser, *Salix acutifolia* Willd., *Silene csereii* Baumg., *Solanum dulcamara* L., *S. nigrum* L., *Sonchus oleraceus* L., *Stellaria media* (L.) Vill., *Symphytum officinale* L., ×*Sorbaronia fallax* (C.K.Schneid.) C.K.Schneid., *Trifolium pratense* L., *T. repens* L., *Tripleurospermum inodorum* (L.) Sch.Bip., *Turgenia latifolia* (L.) Hoffm., *Ulmus laevis* Pall., *U. pumila* L., *Viola arvensis* Murr., *Xanthium strumarium* L.

The distribution of the species composition of the flora of the Akmola region by economic groups is presented as follows: medicinal plants - 385 species, food plants - 204 species, honey plants - 172 species, forage plants - 361 species, ornamental plants - 324 species.

According to the conducted research, it was established that 18 species of rare plants, included in the Red Book of the Republic of Kazakhstan, grow on the territory of the Akmola region [16]: *Huperzia selago* Bernh. ex Schrank et Mart., *Adonis vernalis* L., *A. villosa* Ledeb., *A. volgensis* Steven ex DC., *Pulsatilla patens* (L.) Mill., *Alnus glutinosa* (L.) Gaertn., *Drosera rotundifolia* L., *Chimaphila umbellata* (L.) W.P.C. Barton., *Nymphoides peltata* (S.G. Gmel.) O. Kuntze, *Tulipa sylvestris* subsp. *australis* (Link) Pamp., *T. biflora* Pall., *T. patens* C.Agardh, *T. suaveolens* Roth, *Ornithogalum fischerianum* Krasch., *Cypripedium calceolus* L., *Dactylorhiza fuchsii* (Druce) Soó, *Epipactis palustris* (L.) Crantz, *Stipa pennata* L. According to our data, the following species do not require state protection: *Tulipa patens*, *T. sylvestris* subsp. *australis*, *Chimaphila umbellata*, *Stipa pennata*, *Adonis volgensis*. It is recommended to include the following plant species in the next edition of the Red Book of Kazakhstan: *Corallorhiza trifida* Châtel., *Gymnadenia conopsea* (L.) R.Br., *Hemipilia cucullata* (L.) Y.Tang, H.Peng & T.Yukawa, *Liparis loeselii* (L.) Rich., *Spiranthes australis* (R.Br.) Lindl [13, 15]. In this article, we exclude Cypripedium macranthon Sw. from the flora of the Akmola region, since over the past 20 years there has been no reliable evidence of the presence of this species on the Kokchetav hill. We have not found herbarium materials for this species inthis species from the Akmola region.

In the study region, 7 endemics of Kazakhstan were registered, such as: *Clausia robusta* Pachom., *Astragalus chaetolobus* Bunge, *A. juvenalis* Delile, *Zygophyllum subtrijugum* C.A. Mey., *Myosotis kazakhstanica* O.D. Nikif., *Thymus crebrifolius* Klokov and *Achillea* × *kasakhstanica* Kupr. et Alibekov [19].

Currently, in order to preserve rare and endangered plants of the Akmola region, it is necessary to study the state of populations and numbers of the following species: *Diphasiastrum complanatum* (L.) Holub, *Botrychium lunaria* (L.) Sw., *Caltha palustris* L., *Botrychium multifidum* (S.G. Gmel.) Rupr., *Dryopteris carthusiana* (Vill.) H.P. Fuchs, *Drosera anglica* Huds., *Vaccinium oxycoccos* L., *V. myrtillus* L., *Viola mirabilis* L., *Astragalus juvenalis* Delile, *Lysimachia europaea* (L.) U.Manns & Anderb., *Brachanthemum kasakhorum* Krasch.

Based on the results of our research, we found 2 new species for the flora of the Akmola region: *Grindelia squarrosa* (Pursh) Dunal, *Viscaria vulgaris* Bernh. Herbarium collections of these species are stored in NUR. According to the analysis of the scientific works of Knyazev M.S, we included the following species in the list of flora of the Akmola region: *Hedysarum schellianum* Knjaz., *Astragalus depauperatus* Ledeb., *A. kasachstanicus* Golosk. [20, 21]. Also included in the list of flora of the Akmola region is *Kalidium juniperinum* Sukhor. et Lomon. [22].

Undoubtedly, further research will reveal new plant species for this region, including alien ones.

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