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Article

Apophytes among the synanthropic flora of Tobolsk (Tyumen Oblast, Russia): main characteristics and their analysis

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Abstract. The results of the study of the urban flora of the city of Tobolsk, conducted in 2019–2023 using the route-excursion method and herbarium materials, are presented. A summary of apophytes in the flora has been compiled, comprising 124 species from 88 genera and 28 families. In relation to geographical distribution, Eurasian and Holarctic groups are dominant, while the Boreal and plurizonal species are dominant in the zonal distribution. Biomorphological analysis has revealed a relatively wide range of plant life-forms. According to the moisture factor, the most abundant ecological group is mesophytes (40%). A significant proportion of species occupy an intermediate position (33%). The ecological-cenotic analysis showed the predominance of meadow (35%), forest (20%) and coastal aquatic (20%) groups of plants.

Keywords: flora summary, urban flora, apophytic species, vascular plants, taxonomic analysis, geographical structure, biomorphological spectrum, cenotic group

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Научная статья

Апофитная фракция синантропного элемента флоры г. Тобольск (Тюменская область): основные характеристики и их анализ

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Аннотация. Приводятся результаты исследования урбанофлоры г. Тобольска, проведенные в 2019–2023 гг. маршрутно-экскурсионным методом, а также с использованием гербарных материалов. Составлен конспект апофитного компонента флоры, насчитывающий 124 вида из 88 родов и 28 семейств. В географической структуре выявлено лидирующее положение евразийских и голарктических групп, в зональной структуре – преобладание бореальных и плюризональных видов. Биоморфологический анализ выявил достаточно широкий спектр жизненных форм растений. Среди экологических групп по фактору увлажнения самыми многочисленными являются мезофиты (40%). Значительную часть составляют виды, занимающее промежуточное положение (33%) В результате эколого–ценотического анализа нами выявлено преобладание луговых (35%), лесных (20%) и прибрежноводных (20%) групп растений.

Ключевые слова: конспект флоры, урбанофлора, апофитные виды, сосудистые растения, таксономический анализ, географическая структура, биоморфологический спектр, ценотическая группа

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Introduction

The study of urban floras is a current focus of research. The genesis of such urban floras serves as a striking example of changes in the natural composition of vegetation, leading to depletion of plant species diversity, expansion of adventitious plant species, an increase in the proportion of apophytes, disruption of natural plant communities, the rapid formation of synanthropic vegetation, etc. All these processes require careful study, since their negative consequences for the environment have not been predicted with sufficient probability or for a long period of time (Kapitonova, 2023; Shmaraeva et al., 2019).

The process of synanthropization of the vegetation cover of urbanized areas has been widely studied (Brandes, 1984, 1987; Fath-Chavanne, 1989; Naegeli and Thellung, 1905; Otte and Ludwig, 1987; Rossi and Lippolis, 1984; Sukopp, 1978; Tretyakov, 1990; Trzcinska-Tacik, 1978). In Russia N.G. Ilminskikh made a significant contribution to the study of urban flora. He developed the methodology and techniques for its study, improved a number of analysis techniques, and compiled complete plant lists for the cities of Kirov, Glazov, Sarapul, Kazan, Izhevsk and Elabuga (Ilminskikh, 1981, 1982, 1989, 2014; Khozyainova, 2004). Targeted studies of the vegetation cover of Siberian cities – Omsk, Tomsk, Novosibirsk, etc. – only began in the last decades of the 20th century (Budanova, 2001; Drachev, 2010; Ebel, 2010; Glazunov et al., 2020; Lashchinsky et al., 2010; Zaripov and Budanova, 2001; Zykova, 2019). They began with works on the study of the urban flora of the Tyumen region. Field studies were carried out in the cities of Labytnangi (Trotsenko, 1990), Surgut (Bordey and Shepeleva, 2011), Ishim (Sheremetov, 2004), Yalutorovsk (Naumenko, 2003), Tyumen (Khozyainova, 2004).

Although Tobolsk, another city in the Tyumen region, was the administrative center of Siberia, its flora remained poorly studied for a long time. Many famous naturalists, whose expeditions were aimed at studying the flora of Eastern Siberia and the Far East, passed through this city without stopping (Kuzmin, 2015). For these reasons, information about the historical flora of Tobolsk is fragmentary, and for most of the 20th century, the flora of Tobolsk was not studied. Interest in this topic arose only in the mid-1980s thanks to the research of Kharitontsev (1998, 2000). Existing publications contain incomplete information about the flora of this area, covering only its individual components (Allayarova, 2023; Kapitonova, 2022; Kharitontsev, 2000). The main objective of this work is to present information about the apophytes among the synanthropic plants of Tobolsk and the characteristics of each plant type studied.

Materials and methods

Synanthropic species are local and non-local plants, which benefit in communities with increasing anthropogenic loads (Baranova et al., 2018; Khozyainova, 2004). Apophytic species are plants of the local (native) flora that, in anthropogenic environments, have an advantage over other species in their distribution and settlement (Baranova et al., 2018). The study of the urban flora of Tobolsk was carried out from 2019 to 2023 using the route-excursion method. The flora of all main types of synanthropic habitats was studied: wastelands, lawns, roadsides, courtyards, green areas near private houses, slopes of railway embankments. During walking tours, geobotanical descriptions were made, floristic lists of vascular plants were compiled, and a herbarium was collected. A total of 45 geobotanical descriptions were made. The herbarium material collected by the author is housed in the Collective Use Center "Biological Collections of the Tobolsk Complex Scientific Station of the Ural Branch of the Russian Academy of Sciences (TCNS UB RAS)", Tobolsk (TOV). In addition to the author's plant collections (1450 herbarium specimens), 8943 herbarium specimens from the Tobolsk Historical and Architectural Museum-Reserve, 11518 herbarium specimens from the TCNS UB RAS, 5862 herbarium specimens of higher plants from the V.L. Komarov Botanical Institute of the Russian Academy of Sciences (St. Petersburg) (BIN RAS, LE) and 92 herbarium specimens from the collection of the Institute of Plant and Animal Ecology Museum in Yekaterinburg were studied and used (Allayarova, 2023).

In the summary below, the arrangement of flowering plants of the family level and higher follows the Angiosperm Phylogeny Group (APG) IV system (Chase et al., 2016). Genera and species are listed in alphabetical order. The nomenclature of vascular plants follows that of S.K. Cherepanov (1995) and later publications (Allayarova, 2023; Glazunov et al. 2017; Mayevsky, 2014).

The species in the list below are numbered in consecutive order followed in brackets by sequential numbers within the family. After the Latin and Russian names of the species, its characteristics are

given. The lifespan, biomorphological type, assignment to an ecological group according to the moisture factor, geographical element, cenotic group, main types of habitats within the city, and frequency of occurrence are listed. Specific locations are indicated for singly-found and rare species. The frequency of occurrence within the study area was estimated according to the following scale (Kapitonova, 2022): very rare – the species known from two or fewer localities in the study area; rare – up to 10 localities; sporadic – the species is scattered, may be included in 40% of lists or fewer; common – the species is found in about half of the descriptions; frequent – the species is given in most lists; very frequent – a background species, present in 80–100% lists (Allayarova, 2023).

The analysis of the taxonomic structure of the flora followed classical methods (Khozyainova, 2004; Tolmachev, 1974). The biomorphological structure was analyzed according to I.G. Serebryakov (1962). Ecological groups according to the attitude of plants to the moisture factor were identified taking into account the anatomical and morphological features of species, as well as their typical habitats (Khozyainova, 2004; Matveyev, 2006; Papchenkov, 2001). The analysis of the ecological-cenotic and geographical spectrum was carried out in accordance with N.N. Matveyev's (2006) methodological recommendations.

Results

List of apophytes in the synanthropic flora of Tobolsk, Tyumen Oblast

Division POLYPODIOPHYTA Reveal – FERNS

Class Equisetidae Warm. – Horsetails

Order Equisetales DC. – Horsetails

FAMILY 1. EQUISETACEAE Michx. – HORSETAILS

1. (1) ***Equisetum arvense* L. – Field horsetail.** Herbaceous perennial mesohydrophyte. Boreal Holarctic. Meadow. Roadsides, embankments, vegetable gardens, banks of reservoirs. Common.

Division SPERMATOPHYTA – SEED PLANTS

Class Magnoliopsida Brongn. – Angiosperms

Order Alismatales R. Br. ex Bercht. et J. Presl – Alismatales

FAMILY 2. ARACEAE Juss. – AROIDS

2. (1) ***Lemna minor* L. – Common duckweed.** Herbaceous perennial free-floating frond hydrophyte (pleistophyte). Cosmopolitan. Aquatic. Reservoirs, river backwaters, flooded areas of swamps. For the city of Tobolsk, O.A. Kapitonova cites (TOB3245, TOB3270, TOB3273, TOB3276, TOB3731, TOB3733).

3. (2) ***L. trisulca* L. – Star duckweed.** Herbaceous perennial free-floating frond hydrophyte. Cosmopolitan. Aquatic. Stagnant and slow-flowing water bodies, river backwaters, flooded ditches. Frequent (Kapitonova, 2022).

4. (3) ***L. turionifera* Landolt – Turion duckweed.** Herbaceous perennial free-floating foliated hydrophyte (pleistophyte). Plurizentral East European-Asian-North American. Aquatic. Reservoirs, watercourses, flooded quarries, drainage channels. Very frequent.

5. (4) ***Spirodela polyrrhiza* (L.) Schleid. – Common duckmeat.** Herbaceous perennial free-floating foliated hydrophyte (pleistophyte). Cosmopolitan. Aquatic. In stagnant and slow-flowing water bodies. Frequent.

FAMILY 3. ALISMATACEAE Vent. – WATER-PLANTAIN

6 (1) ***Alisma plantago-aquatica* L. – Common water-plantain.** Herbaceous perennial helophyte with racemose roots. Plurizentral Eurasian. Coastal and aquatic. Along the banks of reservoirs, in swampy areas, along roadside ditches. Sporadic.

Order Poales Small – Grasses

FAMILY 4. TYPHACEAE Juss. – BULRUSHES or CATTAILS

7 (1) ***Typha incana* Kapit. et Dyukina – Gray bulrush.** Herbaceous perennial long-rhizome helophyte. Boreal East European-West Asian. Coastal-marsh. Flooded quarries, roadside puddles, water accumulations in relief depressions. Rare.

8. (2) ***T. latifolia* L. – Broadleaf cattail.** Herbaceous perennial long-rhizome helophyte. Plurizentral Holarctic. Marsh. Puddles, drainage ditches, worked-out flooded quarries, in stagnant and running water. Frequent.

9. (3) *T. linnaei* Mavrodiev et Kapit. – *T. angustifolia* auct. non L. – **Linnaeus Cattail**. Herbaceous perennial long-rhizome helophyte. Cosmopolitan. Aquatic. Floodplain reservoirs, worked-out flooded quarries, roadside puddles. Rare.

FAMILY 5. JUNCACEAE Juss. – RUSHES

10. (1) *Juncus bufonius* L. – **Toad rush**. Herbaceous annual racemose root hygrophyte. Plurizentral Holarctic. Coastal water meadow. Banks of reservoirs, damp dirt roads. Rare.

11. (2) *J. compressus* Jacq. – **Round fruited rush**. Herbaceous perennial short-rhizome hygrophyte. Plurizentral Eurasian. Meadow-marsh. River banks, floodplain meadows, roadsides, roadside ditches. Common.

FAMILY 6. POACEAE Barnhart – GRASSES

12. (1) *Agrostis gigantea* Roth – **Black bent**. Herbaceous perennial long-rhizome mesohygrophyte. Plurizentral Eurasian. Meadow. Meadows, forest margins, roadsides. Sporadic.

13. (2) *A. stolonifera* L. – **Creeping bent**. Herbaceous perennial long-rhizome hygrohelophyte. Boreal Eurasian. Coastal water-meadow. Wet floodplain and swampy meadows, marshes, banks of reservoirs, river sandy and pebble shallows, damp forest edges, along roadsides. Frequent.

14. (3) *A. tenuis* Sibth. – **Common bent**. Herbaceous perennial long-rhizome mesohygrophyte. Boreal European-West Asian. Meadow. Dry and floodplain meadows, river banks, riverside sands and pebbles, forest edges, roadsides. Frequent.

15. (4) *Alopecurus aequalis* Sobol. – **Shortawn foxtail**. Herbaceous annual racemose root hygrophyte. Plurizentral Holarctic. Coastal-marsh. Damp meadows, banks of reservoirs, roadside ditches, roadsides. Common.

16. (5) *Beckmannia syzigachne* (Steud.) Fernald – **Sloughgrass**. Herbaceous perennial long-rhizome hygrophyte. Boreal Asian. Meadow-marsh. Banks of reservoirs, damp and swampy areas, roadsides, lawns. Frequent.

17. (6) *Calamagrostis epigejos* (L.) Roth – **Bushgrass**. Herbaceous perennial long-rhizome mesohygrophyte. Boreal Eurasian. Meadow-forest. Wastelands, pastures, road slopes, vegetable gardens. Frequent.

18. (7) *Dactylis glomerata* L. – **Orchard grass**. Herbaceous perennial long-rhizome mesohygrophyte. Plurizentral Eurasian. Meadow. Forest park zones, wastelands, lawns, slopes and roadsides. Sporadic.

19. (8) *Elytrigia repens* (L.) Nevski – **Couch grass**. Herbaceous perennial long-rhizome mesohygrophyte. Plurizentral Eurasian. Meadow. Glades, meadows, vegetable gardens, roadsides. Common.

20. (9) *Festuca pratensis* Huds. – **Meadow fescue**. Herbaceous perennial long-rhizome mesohygrophyte. Plurizentral Eurasian. Meadow. Meadows, slopes of the indigenous bank of the Irtysh River, banks of reservoirs, roadsides. Common.

21. (10) *F. rubra* L. – **Red fescue**. Herbaceous perennial long-rhizome hygromesophyte. Plurizentral Holarctic. Meadow. Lawns, roadsides. Frequent.

22. (11) *Phalaris arundinacea* L. – **Reed canary grass**. Herbaceous perennial long-rhizome hygrophyte. Boreal Holarctic. Coastal meadow. Damp and marshy floodplain meadows, banks and shallows of reservoirs, ditches and cuvettes. Common.

23. (12) *Phleum pratense* L. – **Timothy grass**. Herbaceous perennial long-rhizome mesophyte. Boreal Eurasian. Meadow. Pastures, wastelands, lawns, roadsides. Frequent.

24. (13) *Phragmites australis* (Cav.) Trin. ex Steud. – **Common reed**. Herbaceous perennial long-rhizome helophyte. Cosmopolitan. Coastal-marsh. River banks, roadside ditches. Frequent.

25. (14) *Poa angustifolia* L. – **Narrow-leaved Meadow-grass**. Herbaceous perennial long-rhizome mesophyte. Forest-steppe Eurasian. Meadow-steppe. Steppe slopes of the indigenous bank of the Irtysh River, roadsides. Frequent.

26. (15) *P. annua* L. – **Annual bluegrass**. Herbaceous annual racemose root mesohygrophyte. Cosmopolitan. Erosiophilous. Riverine sands and pebbles, forest park areas, squares, lawns, roadsides, habitats subject to trampling. Frequent.

27. (16) *P. palustris* L. – **Fowl bluegrass**. Herbaceous perennial long-rhizome hygrophyte. Boreal Holarctic. Meadow-marsh. Forest park zones, riverine sands and pebbles, ditches, roadsides. Common.

28. (17) *P. pratensis* L. – **Common meadow-grass**. Herbaceous perennial long-rhizome hygromesophyte. Plurizontal Holarctic. Meadow. Squares, lawns, roadsides. Common.

29. (18) *P. supina* Schrad. – **Supine bluegrass**. Herbaceous perennial long-rhizome hygrophyte. Boreal European-West Asian. Erosiophilous. Roadsides, field edges, near housing. Frequent.

Order Ranunculales Juss. ex Bercht. et J. Presl – Buttercups

FAMILY 7. PAPAVERACEAE Juss. – POPPIES

30. (1) *Chelidonium majus* L. – **Greater celandine**. Herbaceous perennial taproot mesophyte. Plurizontal Eurasian. Meadow-forest. Vegetable gardens, forest parks, roadsides, railway embankments, near housing. Frequent.

FAMILY 8. RANUNCULACEAE Juss. – BUTTERCUPS

31. (1) *Ranunculus polyanthemos* L. – **Multiflowered buttercup**. Herbaceous perennial racemose-rooted hygromesophyte. Plurizontal European-West Asian. Meadow. Along roads and embankments. Common.

32. (2) *R. repens* L. – **Creeping buttercup**. Herbaceous perennial racemose root aboveground stolon-forming hygrophyte. Plurizontal Holarctic. Meadow-marsh. Pastures, forest roads, muddy river banks, ditches, puddles. Common.

Order Fabales Bromhead – Legumes

FAMILY 9. FABACEAE Lindl. – LEGUMES

33. (1) *Astragalus danicus* Retz. – **Purple milk-vetch**. Herbaceous perennial taproot hygromesophyte. Forest-steppe Eurasian. Meadow-steppe. Floodplain and dry meadows, steppe meadows, roadsides. Rare.

34. (2) *A. contortuplicatus* L. – **Hungarian milk-vetch**. Herbaceous annual taproot mesohygrophyte. Steppe Eurasian. Coastal water meadow. Sands in river valleys, sand quarry, pastures. Rare.

35. (3) *Lathyrus pratensis* L. – **Meadow pea**. Herbaceous perennial short-rhizome mesophyte. Boreal Eurasian. Meadow. Forest park zones, wastelands, pastures, steppe slopes, roadsides, railway embankments. Common.

36. (4) *Trifolium medium* L. – **Zigzag clover**. Herbaceous perennial long-rhizome mesophyte. Boreal Eurasian. Meadow. Lawns, roadsides, slopes of railway embankments. Frequent.

37. (5) *T. pratense* L. – **Red clover**. Herbaceous perennial short-rhizome mesophyte. Plurizontal Eurasian. Meadow. Meadows, river and stream banks, roadside ditches, roadsides. Common.

38. (6) *T. repens* L. – **White clover**. Herbaceous perennial aboveground creeping mesophyte. Plurizontal Eurasian. Meadow. Dry and floodplain meadows, pastures, banks of reservoirs, roadsides, near housing, vegetable gardens. Common.

39. (7) *Vicia cracca* L. – **Cow vetch**. Herbaceous perennial long-rhizome mesophyte. Plurizontal European-West Asian. Meadow. Meadows, steppe slopes, wastelands, pastures, lawns, roadsides. Frequent.

40. (8) *V. sepium* L. – **Bush vetch**. Herbaceous perennial long-rhizome mesophyte. Plurizontal Eurasian. Forest. Wastelands, banks of reservoirs, railway embankments, along roads, near housing. Common.

41. (9) *V. tetrasperma* (L.) Schreb. – **Smooth vetch**. Herbaceous annual taproot hygromesophyte. Plurizontal Eurasian. Meadow. Meadows, fallow lands, fields, roadsides. Rare.

Order Rosales Bercht. et J. Presl – Rosales

FAMILY 10. ROSACEAE Juss. – ROSES

42. (1) *Agrimonia pilosa* Ledeb. – **Hairy agrimony**. Herbaceous perennial short-rhizome hygromesophyte. Boreal Eurasian. Meadow. Dry meadows, forest edges, wastelands, steppe slopes, roadsides. Common.

43. (2) *Geum aleppicum* Jacq. – **Yellow avens**. Herbaceous perennial short-rhizome hygromesophyte. Boreal Eurasian. Forest. Forest park zones, banks of reservoirs, roadsides, near housing. Rare.

44. (3) *Padus avium* Mill. – **Bird cherry**. Deciduous tree, hygrophyte. Boreal Eurasian. Forest. Abandoned garden plots, river banks, forests, used in urban landscaping. Frequent.

45. (4) *Potentilla anserina* L. – **Common silverweed**. Herbaceous perennial short-rhizome-taproot aboveground stolon mesohygrophyte. Plurizontal Holarctic. Meadow. Floodplain meadows, field edges, fallow lands, roadsides, backfills, railway embankments, lawns, vegetable gardens, near housing. Frequent.

46. (5) *P. argentea* L. – **Silver cinquefoil**. Herbaceous perennial short-rhizome-taproot mesophyte. Plurizontal Eurasian. Meadow. Dry meadows, fields, roadsides, lawns, embankments. Sporadic.

47. (6) *P. norvegica* L. – **Norwegian cinquefoil**. Herbaceous annual or biennial taproot mesohygrophyte. Plurizontal Holarctic. Meadow. Squares, lawns, roadsides, banks of reservoirs, near housing. Frequent.

48. (7) *P. tobolensis* Th. Wolf ex Pavlov – **Shrubby hybrid cinquefoil**. Herbaceous perennial short-rhizome-taproot mesohygrophyte. Forest-steppe West Siberian. Meadow. Disturbed habitats, roadsides, near housing, railway embankments. Common.

49. (8) *Rubus caesius* L. – **Dewberry**. Shrub, hygromesophyte. Boreal-nemoral European-West Asian. Forest. River banks, wastelands, floodplain willow thickets, abandoned garden plots, roadsides. Rare.

50. (9) *R. idaeus* L. – **Raspberry**. Common. Root-suckering subshrub, mesohygrophyte. Boreal Euro-Siberian. Forest. Abandoned garden plots, near private residential buildings. Cultivated as food, may disappear from culture.

51. (10) *Sanguisorba officinalis* L. – **Great burnet**. Herbaceous perennial short-rhizome mesophyte. Boreal Eurasian. Meadow. Wastelands, steppe slopes, embankments and roadsides. Common.

52. (11) *Sorbus aucuparia* L. – **Mountain-ash**. Perennial deciduous tree, mesohygrophyte. Boreal European-West Asian. Forest. Clearings, forest edges, wastelands, used in landscaping. Common.

FAMILY 11. URTICACEAE Juss. – NETTLES

53. (1) *Urtica dioica* L. – **Common nettle**. Herbaceous perennial long-rhizome hygromesophyte. Plurizontal Holarctic. Erosiophilous. Banks and shallows of reservoirs and watercourses, ditches, lawns, roadsides. Frequent.

Order Fagales Engl. – Beeches

FAMILY 12. BETULACEAE Gray – BIRCHES

54. (1) *Betula pendula* Roth – **Silver birch**. Perennial deciduous tree, mesohygrophyte. Boreal European-West Siberian. Forest. Forest park zones, used in landscaping. Common.

Order Malpighiales Juss. ex Bercht. et J. Presl – Malpighiales

FAMILY 13. SALICACEAE Mirb – WILLOWS

55. (1) *Populus tremula* L. – **Common aspen**. Perennial deciduous tree, mesohygrophyte. Boreal Eurasian. Forest. Forest park zones, squares, wastelands, used in landscaping. Common.

56. (2) *Salix gmelinii* Pall. – **Gmelin's willow**. Shrub or low tree, hygrophyte. Boreal East European-Siberian. Coastal-marsh. Swampy areas, floodplains, ditches along roads, banks of reservoirs. Common.

57. (3) *S. pentandra* L. – **Bay willow**. Shrub or low tree, hygrophyte. Boreal European-West Siberian. Coastal. Banks of reservoirs, ditches along roads. Sporadic.

58. (4) *S. triandra* L. – **Almond willow**. Shrub or low tree, hygrophyte. Boreal Eurasian. Coastal-aquatic. Near water bodies, damp floodplain meadows, ditches. Sporadic.

59. (5) *S. viminalis* L. – **Basket willow**. Shrub, mesohygrophyte. Boreal Eurasian. Coastal-aquatic. Banks of reservoirs, swampy areas, floodplains, roadside ditches. Sporadic.

FAMILY 14. EUPHORBIACEAE Juss. – EUPHORBIAS

60. (1) *Euphorbia virgata* Waldst. et Kit. – **Leafy spurge**. Herbaceous perennial taproot root-suckering mesophyte. Plurizontal Eurasian. Meadow. Dry meadows, steppe slopes, roadsides, wastelands. Sporadic.

Order Geraniales Juss. ex Bercht. & J. Presl – Geraniums

FAMILY 15. GERANIACEAE Juss. – GERANIUMS

61. (1) *Geranium pratense* L. – **Meadow geranium**. Herbaceous perennial short-rhizome mesophyte. Boreal Eurasian. Meadow. Meadows, fields, pastures, roadsides. Rare.

62. (2) *G. sibiricum* L. – **Siberian geranium**. Herbaceous perennial taproot mesophyte. Boreal Siberian. Meadow-forest. Weedy habitats, near housing and roads. Rare.

Order Myrtales Juss. ex Bercht. et J. Presl – Myrtles

FAMILY 16. ONAGRACEAE Juss. – EVENING PRIMROSES

63.(1) *Chamaenerion angustifolium* (L.) Scop. – **Rosebay willowherb, fireweed**. Herbaceous perennial long-rhizome root-suckering xeromesophyte. Boreal Holarctic. Forest. Forest edges, clearings, burnt areas, wastelands, roadsides. Common.

64. (2) *Epilobium nervosum* Boiss.– **Nervous willowherb**. Herbaceous perennial taproot hygrophyte. Boreal European-West Asian. Erosiophilous. Areas with disturbed vegetation cover. Rare.

Order Brassicales Bromhead – Brassicales

FAMILY 17. BRASSICACEAE Burnett – BRASSICALES

65. (1) *Arabis pendula* L. – **Pendulous rockcress**. Herbaceous biennial taproot mesophyte. Boreal Eurasian. Forest. River banks, disturbed forests, forest edges, paths. Rare.

66. (2) *Barbarea arcuata* (Opiz ex J.C. Presl) Reichenb. – **Wintercress**. Herbaceous annual taproot mesophyte. Boreal European. Meadow. Meadows, forest edges, banks of reservoirs, lawns, roadsides. Rare.

67. (3) *Rorippa palustris* (L.) Besser – **Marsh Yellow-cress**. Herbaceous biennial taproot hygrophyte. Plurizentral Holarctic. Coastal meadow. Banks of reservoirs, ditches, roadsides. Common.

Order Caryophyllales Juss. ex Bercht. et J. Presl – Carnations

FAMILY 18. POLYGONACEAE Juss. – KNOTWEED

68. (1) *Persicaria lapathifolia* (L.) Delarbre – **Willow weed**. Herbaceous annual taproot hygrophyte. Plurizentral Holarctic. Erosiophilous. Sandy embankments, garbage sites, banks of reservoirs, roadsides, near housing. Common.

69. (2) *P. maculosa* Gray – **Redshank**. Herbaceous annual taproot mesohygrophyte. Plurizentral Holarctic. Coastal. Shores of reservoirs, damp shallows, floodplain meadows. Rare. TOB788, TOB11168.

70. (3) *P. scabra* (Moench) Moldenke – **Curlytop knotweed**. Herbaceous annual taproot mesohygrophyte. Plurizentral Holarctic. Coastal meadow. Banks of reservoirs, ditches, cuvettes, roadsides, fields. Common.

71. (4) *Polygonum aviculare* L. – **Common knotgrass**. Herbaceous annual taproot mesophyte. Cosmopolitan. Erosiophilous. Pastures, river banks, roadsides, near housing, vegetable gardens. Frequent.

72. (5) *Rumex acetosella* L. – **Sheep's sorrel**. Herbaceous perennial taproot root-suckering mesophyte. Boreal Holarctic. Meadow-forest. Meadows, glades, slopes, vegetable gardens, roadsides. Frequent.

73 (6) *R. confertus* Willd. – **Russian Dock**. Herbaceous perennial taproot mesophyte. Boreal Eurasian. Meadow. Meadows, banks of reservoirs, roadsides. Rare.

74. (7) *R. crispus* L. – **Curled Dock**. Herbaceous perennial taproot mesophyte. Boreal Holarctic. Meadow. Wet meadows, banks of reservoirs, vegetable gardens, slopes, roadsides. Frequent.

75. (8) *R. maritimus* L. – **Golden Dock**. Herbaceous annual taproot mesophyte. Forest-steppe circumpolar. Coastal. Floodplain meadows, banks of reservoirs, shallows, roadside ditches. Rare.

76. (9) *R. pseudonatronatus* (Borbás) Murb. – **Field Dock**. Herbaceous perennial taproot mesohygrophyte. Boreal Eurasian. Meadow. Meadows, banks of reservoirs, roadside ditches and puddles. Rare.

FAMILY 19. CARYOPHYLLACEAE Juss. – CARNATIONS

77. (1) *Arenaria uralensis* Pall. ex Spreng. – **Uralian Sandwort**. Herbaceous annual taproot mesophyte. Plurizentral Eurasian. Meadow. Open areas near housing, roadsides, field margins. Rare.

78. (2) *Cerastium holosteoides* Fries – **Mouse-ear chickweed**. Herbaceous perennial aboveground creeping mesophyte. Plurizentral Holarctic. Meadow. Meadows, slopes, near dwellings, along roads. Common.

79. (3) *Melandrium album* (Mill.) Garcke – **White campion**. Herbaceous biennial or annual monocarpic mesophyte. Boreal Eurasian. Erosiophilous. Vegetable gardens, near housing, along roads, fallow lands, fields. Frequent.

80. (4) *Psammophiliella muralis* (L.) Ikonn. – **Annual gypsophila**. Herbaceous annual taproot xerophyte. Boreal Eurasian. Erosiophilous. Fields, clearings, burnt areas, vegetable gardens, roadsides, disturbed habitats. Sporadic.

81. (5) ***Sagina procumbens*** L. – **Procumbent pearlwort**. Herbaceous perennial taproot aboveground creeping mesohygrophyte. Plurizontal Holarctic. Erosiophilous. Disturbed forests, vegetable gardens, river banks, lawns, roadsides. Rare.

82. (6) ***Spergularia rubra*** (L.) J. Presl & C. Presl – **Red sand-spurrey**. Herbaceous annual taproot mesophyte. Cosmopolitan. Coastal. Collected by B.S. Kharitontsev on silty deposits of the Irtysh River (TOB6808).

83. (7) ***Stellaria graminea*** L. – **Common starwort**. Herbaceous perennial aboveground creeping hygromesophyte. Plurizontal Eurasian. Meadow-forest. Meadows, glades, banks of reservoirs, roadsides, near housing. Common.

Order Boraginales Juss. ex Bercht. et J. Presl – Borage

FAMILY 20. BORAGINACEAE Juss. – BORAGE

84. (1) ***Myosotis sparsiflora*** Pohl – **Sparse forget-me-not**. Herbaceous annual taproot mesohygrophyte. Boreal European-West Asian. Marsh-forest. Damp shady places, banks of reservoirs, near housing. Rare.

85. (2) ***Nonea rossica*** Steven – **Russian Nonea**. Herbaceous perennial taproot xeromesophyte. Forest-steppe European-Siberian. Meadow-steppe. Steppe slopes, near roads. Rare.

Order Solanales Juss. ex Bercht. & J. Presl – Nightshades

FAMILY 21. CONVULVACEAE Juss. – BINDWEEDS

86. (1) ***Calystegia sepium*** (L.) R. Br. – **Hedge bindweed**. Herbaceous perennial liana-like short-rhizome mesophyte. Cosmopolitan. Erosiophilous. Road slopes, wastelands. Rare.

87. (2) ***Cuscuta europaea*** L. – **Greater dodder**. Herbaceous annual stem parasite, mesophyte. Plurizontal Eurasian. Parasitic. On shoots of dicotyledonous herbaceous plants; shrubs, banks of reservoirs, wastelands, vegetable gardens. Rare.

FAMILY 22. SOLANACEAE Juss. – NIGHTSHADES

88. (1) ***Solanum kitagawae*** Schonb.-Tem. – **Bittersweet nightshade**. Liana-like subshrub, mesophyte. Plurizontal East European-Asian. Erosiophilous. Wastelands, vegetable gardens, near housing. Rare.

Order Lamiales Bromhead – Mints

СЕМЕЙСТВО 23. PLANTAGINACEAE Juss. – PLANTAINS

89. (1) ***Callitriche palustris*** L. – **Vernal water-starwort**. Herbaceous annual rooting hydrophyte with floating rosettes of leaves. Boreal Holarctic. Aquatic. Shores and shallows of reservoirs, shoals. Sporadic.

90. (2) ***Plantago major*** L. – **Broadleaf plantain**. Herbaceous perennial racemose root mesophyte. Boreal Eurasian. Meadow. Vegetable gardens, roadsides, paths, pastures, near housing. Common.

91. (3) ***P. media*** L. – **Hoary plantain**. Herbaceous perennial taproot mesophyte. Boreal Eurasian. Meadow. Pastures, along roads, clearings, forest edges, near housing. Common.

СЕМЕЙСТВО 24. SCROPHULARIACEAE Juss. – FIGWORTS

92. (1) ***Linaria vulgaris*** Mill. – **Toadflax**. Herbaceous perennial taproot mesophyte. Boreal Eurasian. Meadow. Slopes and roadsides. Frequent.

93. (2) ***Odontites vulgaris*** Moench – **Red Bartsia**. Herbaceous annual root semiparasite, mesophyte. Boreal Eurasian. Forest. Lawns, roadsides. Rare.

94. (3) ***Verbascum thapsus*** L. – **Great mullein**. Herbaceous biennial taproot xerophyte. Forest-steppe Eurasian. Meadow-steppe. Coastal slopes, roadsides. Rare.

FAMILY 25. LAMIACEAE Martinov – SAGES

95. (1) ***Glechoma hederacea*** L. – **Ground ivy**. Herbaceous perennial aboveground creeping mesophyte. Boreal-nemoral Eurasian. Meadow. Lawns, squares, vegetable gardens, near housing, along roads. Common.

96. (2) ***Lamium album*** L. – **White dead-nettle**. Herbaceous perennial rhizome stoloniforming mesophyte. Boreal Eurasian. Forest. Squares, wastelands, lawns, near housing, along roads. Frequent.

97. (3) ***Mentha arvensis*** L. – **Wild mint**. Herbaceous perennial long-rhizome hygrophyte. Boreal Eurasian. Coastal-aquatic. Banks of reservoirs, damp weedy places, vegetable gardens, floodplain willows. Frequent.

98. (4) ***Scutellaria galericulata*** L. – **Common skullcap**. Herbaceous perennial long-rhizome mesophyte. Boreal Eurasian. Coastal-aquatic. Wet ruderal habitats, roadsides. Frequent.

99. (5) ***Stachys palustris*** L. – **Marsh woundwort**. Herbaceous perennial long-rhizome tuber-forming mesohygrophyte. Boreal Eurasian. Meadow-marsh. Vegetable gardens, roadsides, near housing. Sporadic.

Order Asterales Link – Asters

FAMILY 26. ASTERACEAE Bercht. et J. Presl – ASTERS

100. (1) ***Achillea millefolium*** L. – **Common yarrow**. Herbaceous perennial long-rhizome xeromesophyte. Boreal Eurasian. Meadow. Fallow lands, vegetable gardens, along roads. Common.

101. (2) ***Artemisia dracunculus*** L. – **Tarragon**. Herbaceous perennial short-rhizome mesophyte. Forest-steppe Eurasian. Meadow-steppe. Coastal slopes, railway embankments. Sporadic.

102. (3) ***Bidens cernua*** L. – **Nodding bur-marigold**. Herbaceous annual taproot hygrophyte. Boreal Holarctic. Coastal-aquatic. Banks of reservoirs, roadside ditches. Rare.

103. (4) ***B. radiata*** Thuill. – **Radiate bur-marigold**. Herbaceous annual taproot hygrophyte. Forest-steppe Holarctic. Coastal-aquatic. Banks of reservoirs and watercourses, shallows. Sporadic.

104. (5) ***B. tripartita*** L. – **Trifid bur-marigold**. Herbaceous annual taproot hygrophyte. Almost cosmopolitan. Coastal-aquatic. Silt deposits near the railway bridge (TOB8996), roadside puddles (TOB1771). Rare.

105. (6) ***Carduus crispus*** L. – **Wetted thistle**. Herbaceous biennial taproot hygromesophyte. Plurizentral Eurasian. Meadow. Meadows, roadsides, near housing. Common.

106. (7) ***Centaurea scabiosa*** L. – **Greater knapweed**. Herbaceous perennial taproot xeromesophyte. Forest-steppe Euro-Siberian. Meadow-forest. Meadows, fields, roadsides. Frequent.

107. (8) ***Cirsium incanum*** (S.G. Gmel.) Fisch. – **Creeping thistle**. Herbaceous perennial long-rhizome root-suckering hygromesophyte. Plurizentral Eurasian. Erosiophilous. Banks of reservoirs, pastures, fields, clearings, roadsides. Frequent.

108. (9) ***C. setosum*** (Willd.) Besser – **Prickly thistle**. Herbaceous perennial long-rhizome root-suckering mesophyte. Forest-steppe Euro-Siberian. Erosiophilous. Meadows, fields, pastures, clearings, roadsides. Common.

109. (10) ***Crepis tectorum*** L. – **Narrowleaf hawkbeard**. Herbaceous annual taproot mesophyte. Boreal Eurasian. Erosiophilous. Dry meadows, clearings, fields, roadsides. Common.

110. (11) ***Erigeron acris*** L. – **Bitter fleabane**. Herbaceous biennial taproot mesophyte. Boreal Eurasian. Meadows, forest edges, vegetable gardens, fallow lands, roadsides. Common.

111. (12) ***Hieracium umbellatum*** L. – **Northern hawkweed**. Herbaceous perennial short-rhizome mesophyte. Boreal Holarctic. Meadow. Meadows, wastelands, roadsides, near housing. Common.

112. (13) ***Inula britannica*** L. – **Meadow fleabane**. Herbaceous perennial short-rhizome mesophyte. Forest-steppe Eurasian. Coastal water-meadow. Floodplain meadows, banks of reservoirs, shallows, pastures, roadsides. Frequent.

113. (14) ***Leontodon autumnalis*** L. – **Fall hawkbit**. Herbaceous perennial short-rhizome mesophyte. Boreal European-West Asian. Meadow. Meadows, glades, lawns, roadsides. Common.

114. (15) ***Leucanthemum vulgare*** (Vaill.) Lam. – **Oxeye daisy**. Herbaceous perennial short-rhizome mesophyte. Boreal Eurasian. Meadow-forest. Meadows, forest park zones, clearings, river banks, lawns, roadsides. Frequent.

115. (16) ***Tanacetum vulgare*** L. – **Tansy**. Herbaceous perennial short-rhizome mesophyte. Boreal Eurasian. Meadow. Meadows, forest edges, glades, wastelands, river banks, roadsides. Common.

116. (17) ***Taraxacum officinale*** Wigg. – **Common dandelion**. Herbaceous perennial taproot mesophyte. Boreal Eurasian. Meadow. Fallow lands, vegetable gardens, lawns, slopes and roadsides, near housing. Common.

117. (18) ***Tussilago farfara*** L. – **Coltsfoot**. Herbaceous perennial long-rhizome hygromesophyte. Boreal Eurasian. Erosiophilous. Banks of streams, ditches, embankments, yards, vegetable gardens, slopes, embankments and roadsides. Frequent.

Order Dipsacales Juss. ex Bercht. & J. Presl – Honeysuckle

FAMILY 27. ADOXACEAE E. Mey. – MOSCHATELS

118. (1) ***Sambucus sibirica*** Nakai – **Siberian elderberry**. Shrub, hygrophYTE. Boreal-nemoral Eastern European-Siberian. Forest. River and stream banks, cultivated. Rare.

119. (2) ***Viburnum opulus*** L. – **Guellder-rose**. Shrub, hygrophYTE. Boreal-nemoral Eurasian. Forest. Widely used in landscaping, cultivated as an ornamental and food plant. Common.

Order Apiales Nakai – Umbellifers

FAMILY 28. APIACEAE Lindl. – UMBELLIFERS

120. (1) ***Aegopodium podagraria*** L. – **Ground elder**. Herbaceous perennial long-rhizome mesophyte. Boreal-nemoral European-West Asian. Forest. Wastelands, roadsides, vegetable gardens, near housing. Frequent.

121. (2) ***Anthriscus sylvestris*** (L.) Hoffm. – **Cow parsley**. Herbaceous perennial taproot mesophyte. Boreal-nemoral Eurasian. Meadow-forest. Meadows, glades, forest edges, clearings, wastelands, roadsides. Common.

122. (3) ***Carum carvi*** L. – **Cumin**. Herbaceous biennial or perennial taproot mesophyte. Boreal Eurasian. Meadow. Meadows, fields, roadsides. Sporadic.

123. (4) ***Chaerophyllum prescottii*** DC. – **Siberian Chervil**. Herbaceous perennial tuber-forming mesophyte. Boreal Eurasian. Meadow. Wastelands, near housing, roadsides. Rare.

124. (5) ***Pimpinella saxifraga*** L. – **Burnet-saxifrage**. Herbaceous perennial taproot mesophyte. Boreal Eurasian. Meadow-forest. Meadows, wastelands, lawns, roadsides. Common.

Discussion

The list of the flora of Tobolsk, compiled based on our own collections, herbarium materials and previous publications, includes 124 apophytic species belonging to 88 genera and 28 families. Of the identified families, the largest proportion were Asteraceae, Poaceae, Rosaceae, Fabaceae, Polygonaceae and Caryophyllaceae, together comprising 42% of the total number of identified species. The highest number of species are in the following genera: *Rumex*, *Poa* – five species each, *Salix*, *Potentilla* – four species each. The genera *Lemna*, *Typha*, *Agrostis*, *Trifolium*, *Vicia*, *Persicaria*, *Bidens* are represented by three species each. Most genera (56%) are represented by a single species.

Geographical analysis of zonal (latitudinal) groups revealed the predominance of boreal species – 65, or 53% (*Equisetum arvense*, *Epipactis helleborine*, *Dactylorhiza incarnata*, *Typha incana*, etc.), which agrees with the city's latitudinal position. The plurizonal group includes 45 species (36%) (*Juncus compressus*, *Dactylis glomerata*, *Carduus crispus*, *Cirsium incanum*, etc.). Forest-steppe (8 species, 6%) and boreal-nemoral (5 species, 4%) groups are represented approximately equally. Only 1% of the apophytic flora of the city comprises plants from the steppe group (*Astragalus contortuplicatus*).

Regional analysis of geographical elements showed the prevalence of species with a very wide distribution – Eurasian and Holarctic. The group of Eurasian species comprises 76 species (61%): *Trifolium medium*, *Agrimonia pilosa*, *Sanguisorba officinalis*, *Carum carvi*, etc. The Holarctic group is represented by 26 species (20%) (*Typha latifolia*, *Festuca rubra*, *Phalaris arundinacea*, *Poa palustris*, etc.). The proportions of Siberian (11 species, 9%) and pluriregional (10 species, 8%) groups are equal. The proportion of the European group among apophytes is insignificant – 1 species, or 1% (*Barbarea arcuata*).

Biomorphological analysis revealed a relatively wide range of plant life forms. The prevalence of herbaceous terrestrial and amphibious perennials was recorded – 82 species (66%). Among them, the life forms of vascular plants, characterized by high vegetative mobility and rapid territory capture, number 43 species (35%). This group includes long-rhizome (*Scutellaria galericulata*, *Achillea millefolium*, *Mentha arvensis*, etc.), aboveground creeping (*Cerastium holosteoides*, *Sagina procumbens*, *Stellaria graminea*, *Glechoma hederacea*) and stoloniferous (*Ranunculus repens*, *Lamium album*) plants. Another group consists of species incapable of active vegetative reproduction: taproot, short-rhizome, racemose-root and tuber-forming plants. This group contains 34 species (27% of the total number of species). Aquatic grasses include 5 species (4%).

The proportion of non-perennial (annual and biennial) plants is 24%. Herbaceous biennial plants are represented only by taproot species (5 species, 3%). Herbaceous annual or biennial plants include representatives of taproot monocarpic life forms – two species or 2% (*Melandrium album*, *Potentilla norvegica*). Among annual plants, taproot plants predominate – 16 species, or 13% (*Astragalus contortuplicatus*, *Crepis tectorum*, *Spergularia rubra*, *Bidens tripartita*, etc.). Racemose-root life forms include 4 species (3%) (*Juncus bufonius*, *Alopecurus aequalis*, *Poa annua*). Stem parasites (two species, 2%) and root parasites (one species, 1%) of other plants, are represented approximately equally.

The proportion of woody plants among apophytes is 10%. Among the trees (4 species, or 3%), we have identified the following groups: single-stemmed forest-type trees, which include *Betula pendula*, *Populus tremula*, and fruit-type trees – *Padus avium*, *Sorbus aucuparia*. Shrubs (6 species, or 5%) are represented only by the aeroxyl form (*Salix gmelinii*, *S. pentandra*, *S. triandra*, *S. viminalis*, *Sambucus sibirica*, *Viburnum opulus*). There are two species of semi-woody plants (2% of the total): erect form (*Rubus idaeus*); liana-like form (*Solanum kitagawae*).

In relation to moisture preferences, the apophytes in the synanthropic flora of Tobolsk are mostly represented by mesophytes – 50 species, or 40% (*Urtica dioica*, *Geranium pratense*, *G. sibiricum*, *Arabis pendula*, etc.). The proportion of hygrophytes is 21 species, or 17% (*Rorippa palustris*, *Persicaria lapathifolia*, *Bidens cernua*, *B. radiata*, *B. tripartita*, etc.). Helophytes (*Alisma plantago-aquatica*, *Typha incana*, *T. latifolia*, *T. linnaei*, *Phragmites australis*) and hydrophytes (*Lemna minor*, *L. trisulca*, *L. turionifera*, *Spirodela polyrrhiza*, *Callitriche palustris*) are equally represented (five species each, or 4%). Xerophytes are represented by only two species: *Psammophiliella muralis* and *Verbascum thapsus*. A significant proportion (33%) of apophytes represents intermediate groups: hygromesophytes – 13 species, or 10% (*Ranunculus polyanthemus*, *Astragalus danicus*, *Geum aleppicum*, etc.); mesohygrophytes – 23 species, or 19% (*Persicaria maculosa*, *P. scabra*, *Myosotis sparsiflora*, *Stachys palustris*, etc.); xeromesophytes – four species, or 3% (*Chamaenerion angustifolium*, *Nonea rossica*, *Achillea millefolium*, *Centaurea scabiosa*); hygrophelophyte (*Agrostis stolonifera*).

The ecocoenotic groups are dominated by meadow plant species (35%), widely represented in all types of anthropogenic habitats. Many of them are forest and meadow-forest species found in the development zone, on house lawns under the canopy of trees and shrubs, along railways and highways. They make up 20% of the total number of species. Aquatic, coastal, coastal-aquatic, coastal-aquatic-meadow, coastal-meadow plants are associated with water bodies of natural and anthropogenic origin, accounting for 20%. Erosiophilic apophyte species closely associated with ruderal habitats account for 12%. Marsh, meadow-marsh and coastal-marsh species make up 9%. The group of meadow-steppe species is small (4%).

Conclusions

The urban flora of Tobolsk includes 124 apophytic species from 88 genera and 28 families. Most species belong to the families Asteraceae, Poaceae, Rosaceae, Fabaceae, Polygonaceae, and Caryophyllaceae. The composition of the flora under study shows a predominance of species with a very wide distribution (81%). In zonal terms, the boreal group of species is in the lead (53%), which is due to the latitudinal position of the city. Biomorphological analysis revealed a predominance of herbaceous terrestrial and amphibious perennials (66%). The most numerous among the ecological groups by the moisture factor are mesophytes (40%). In the ecological structure of the flora under study, the predominance of the meadow component (35%) is noticeable. Such a high proportion of meadow flora is very typical of urban flora populated by mesophytes, which include most weeds.

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