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## Chromosome numbers of adventive species in the flora of the Republic of Altai. Post VI

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**Summary.** Chromosome numbers ( $2n$ ) of 14 adventive plant species from the families Apiaceae, Campanulaceae, Caryophyllaceae, Convolvulaceae, Geraniaceae, Lamiaceae, Malvaceae, Onagraceae, Poaceae, Polygonaceae, and Rosaceae are reported based on the material collected in the Republic of Altai. To determine chromosome number (ploidy level), the method of direct counting was used. Among species studied, chromosome numbers for *Anethum graveolens* ( $2n = 22$ ), *Myosoton aquaticum* ( $2n = 28$ ), *Epilobium hirsutum* ( $2n = 36$ ), and *Fagopyrum esculentum* ( $2n = 16$ ) were first examined for Russia; for *Silene dichotoma* ( $2n = 24$ ), *Ipomoea purpurea* ( $2n = 30$ ), and *Sorbaria sorbifolia* ( $2n = 36$ ) – first for Siberia; for *Erodium cicutarium* ( $2n = 40$ ) – for West Siberia; *Campanula rapunculoides* ( $2n = 68, 102$ ), *Nepeta cataria* ( $2n = 34$ ), *Malva pusilla* ( $2n = 42$ ), *Dianthus deltoides* ( $2n = 30$ ), and *Echinochloa crus-galli* ( $2n = 54$ ) were first studied for the Republic of Altai. General distribution and the history of floristic findings of these species in the Republic of Altai are given. Previously published data on chromosome numbers from Russia are cited.

## Числа хромосом адвентивных видов во флоре Республики Алтай: сообщение 6

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**Ключевые слова:** Республика Алтай, расселение видов, числа хромосом, Apiaceae, Campanulaceae, Caryophyllaceae, Convolvulaceae, Geraniaceae, Lamiaceae, Malvaceae, Onagraceae, Poaceae, Polygonaceae, Rosaceae.

**Аннотация.** Приводятся данные о числах хромосом ( $2n$ ) для 14 адвентивных видов из семейств Apiaceae, Campanulaceae, Caryophyllaceae, Convolvulaceae, Geraniaceae, Lamiaceae, Malvaceae, Onagraceae, Poaceae, Polygonaceae, Rosaceae, полученные на материале из Республики Алтай. Для определения чисел хромосом (уровня пloidности) использован метод прямого подсчета. Впервые для России определено число хромосом у *Anethum graveolens* ( $2n = 22$ ), *Myosoton aquaticum* ( $2n = 28$ ), *Epilobium hirsutum* ( $2n = 36$ ), *Fagopyrum esculentum* ( $2n = 16$ ); впервые для Сибири – у *Silene dichotoma* ( $2n = 24$ ), *Ipomoea purpurea* ( $2n = 30$ ), *Sorbaria sorbifolia* ( $2n = 36$ ); впервые для Западной Сибири – у *Erodium cicutarium* ( $2n = 40$ ); впервые для Республики Алтай – у *Campanula rapunculoides* ( $2n = 68, 102$ ), *Nepeta cataria* ( $2n = 34$ ), *Malva pusilla* ( $2n = 42$ ), *Dianthus deltoides* ( $2n = 30$ ), *Echinochloa crus-galli* ( $2n = 54$ ). Для всех исследованных видов приводятся сведения по общему распространению, истории флористических находок и расселению на территории Республики Алтай, а также литературные данные по числам хромосом с территории России.

We continue the karyological study of adventive, including invasive and potentially invasive species in the flora of southern Siberia on the material from the Republic of Altai (Lomonosova et al., 2018; Zykova et al., 2018, 2020, 2021a, b). This research provides data on the chromosome numbers for 14 species. *Epilobium hirsutum*, *Malva pusilla*, and *Echinochloa crus-galli* are invasive on the territory of the Republic of Altai (Zykova, Ebel, 2022). The information on the history of floristic studies of examined species in the territory of the Republic of Altai is provided here. For each species, published data on the chromosome numbers determined from the territory of Russia are given. Latin names of plants are given according to the “Catalogue of Life” (Hassler, 2022). The chromosome numbers were determined by direct counting in metaphase on root meristem squash preparations. The method was described in our previous article (Lomonosova et al., 2018). Metaphase plates were observed under 100× magnification by the Axioscope 40 (Karl Zeiss, Axio Lab) and photographed by the AxiCam MRC 5 digital camera (AxioVision 4.8 software). The herbarium specimens (vouchers) are deposited in the Herbarium of the Central Siberian Botanical Garden SB RAS (NS).

#### APIACEAE

##### *Anethum graveolens* L.

**2n = 22:** “Russian Federation, the Republic of Altai, Gorno-Altaysk city, Choros-Gurkina street near the Mebelny stop, pebbled bank of the Mayma River, 21 VIII 2017. E. Zykova”, Z567-6617 (NS0046838).

Annual. Mediterranean species. Widely cultivated, often runs wild. In the Republic of Altai, it has been checked outside of culture since the end of 20th century (Zolotukhin, 1983). By now, it is occasionally found in landfills, deposits, along roads in the northern and central regions of the Republic of Altai (Zykova, 2015).

This is the first record of the chromosome number in this species for Russia on the material collected outside the cultivation area. The same chromosome number was reported for Europe, South and East Asia (Rice et al., 2015).

Diploid (2x), x = 11.

#### CAMPANULACEAE

##### *Campanula rapunculoides* L.

**2n = 68:** “Russian Federation, the Republic of Altai, Gorno-Altaysk city, Ulalushinskaya street, the bank of the Ulalushka River, 51°58'N, 85°55'E. 25 VIII 2017. E. Zykova”, Z612-6917 (NS0045602).

**2n = 102:** “Russian Federation, the Republic of Altai, Gorno-Altaysk city, bus stop «Mebelnaya», the bank of the Mayma River, 51°58'N, 85°55'E. 21 VIII 2020. E. Zykova”, Z843-1220 (NS0041423).

Perennial. The species is native in Europe and North Africa. In Siberia, it is cultivated as ornamental plant, runs wild. In the Republic of Altai, it was first discovered in the vicinity of the village of Dubrovka, Mayma district (Olonova, 1996). Later it was recorded in the village of Mayma (Zykova, 2014b), at the cordons of the Altai State Reserve (Zolotukhin, 2012), and in the city of Gorno-Altaysk (Zykova et al., 2019). In Mayma district and in the city of Gorno-Altaysk, it actively settles on disturbed habitats, and is found along the banks of water bodies.

The chromosome number is given for the first time for the Republic of Altai. Tetraploid (2n = 68) was revealed in collections from the Irkutsk Region (Chepinoga, 2014, and references therein). Hexaploid (2n = 102) was known in collections from the Tomsk (Malakhova, 1990) and Novosibirsk Regions (Zykova, Pankova, 2021).

Tetraploid (4x), hexaploid (6x), x = 17.

#### CARYOPHYLLACEAE

##### *Dianthus deltoides* L.

**2n = 30:** “Russian Federation, the Republic of Altai, Choya district, Choya village, 52°02'N, 86°33'E, by the road, 30 VI 2017. E. Zykova”, Z332-3517 (NS0041427).

Perennial. Euro-Siberian species. It occurs in many regions of Siberia, in most of them in single localities (Baykov, 1993). In the Republic of Altai, it was discovered in 2016 in the vicinity of Choya village, Choya district (Ebel et al., 2016).

The chromosome number is given for the first time for the Republic of Altai. The same chromosome number was reported from the Tomsk Region (Malakhova, 1990).

Diploid (2x), x = 15.

##### *Myosoton aquaticum* (L.) Moench

**2n = 28:** “Russian Federation, the Republic of Altai, Gorno-Altaysk city, pebble bank of the Mayma River. 15 VIII 2018. E. Zykova”, Z672-2318 (NS0041422).

Perennial. Eurasian. Native to the steppe and forest-steppe zones of the West Siberia (Vlasova, 1993). In the Republic of Altai, it was found for the first time in the village of Mayma, Mayma district (Zykova, An'kova, 2017), later – in the city of Gorno-Altaysk (Zykova et al., 2019).

This is the first record of the chromosome number for this species in the Russian part of its

area. The same chromosome number was reported from Europe and East Asia (Rice et al., 2015).

Diploid ( $2x$ ),  $x = 14$ .

***Silene dichotoma*** Ehrh.

**$2n = 24$ :** “Russian Federation, the Republic of Altai, Gorno-Altaysk city, bus stop «Rodnik», the bank of the Mayma River, 15 VII 2019. E. Zykova”, Z761–0419 (NS0041419).

Annual or biennial. Native to East and South Europe and West Asia, as alien – cosmopolitan. Rare species in Siberia. In the Republic of Altai, it was collected in 2019 in the city of Gorno-Altaysk (Ebel, Zykova, 2020), where it forms monodominant thickets which increase from year to year.

This is the first report of the chromosome number from Siberia. The same chromosome number was known in collections from the Sakhalin Region (Probatova et al., 2012a).

Diploid ( $2x$ ),  $x = 12$ .

CONVOLVULACEAE

***Ipomoea purpurea*** (L.) Roth.

**$2n = 30$ :** “Russian Federation, the Republic of Altai, Gorno-Altaysk city, bus stop «Park Pobedy», wasteland. 29 IX 2021. E. Zykova”, Z965–1021 (NS0045604).

Annual. A North American ornamental plant, cultivated and occasionally running wild. It occurs in disturbed habitats near horticultural associations and in settlements. In the Republic of Altai, it was recorded for the first time in the village of Kyzyl-Ozek, Mayma district (Ebel et al., 2016), and later in the city of Gorno-Altaysk (Zykova et al., 2019).

This is the first report of the chromosome number for Siberia. The same chromosome number was established in collections for the Primorye Territory (Probatova, 2014, and references therein).

Diploid ( $2x$ ),  $x = 15$ .

GERANIACEAE

***Erodium cicutarium*** (L.) L'Her.

**$2n = 40$ :** “Russian Federation, the Republic of Altai, Gorno-Altaysk city, the central embankment of the Mayma River, pebbled river bank, 51°58'N, 85°55'E. 18 VIII 2017. E. Zykova”, Z357–6117 (NS0041418).

Annual. Eurasian, as alien – cosmopolitan. In the Republic of Altai, it was found first in the Ust-Kan district in the vicinity of the village of Cherny Anuy (Krylov, 1935). Invasive species in the Republic of Altai (Zykova, Ebel, 2022). Currently, it is found in

fields, fallow lands, wastelands, along roads in all districts, with the exception of Kosh-Agach (Zykova, 2015).

This is the first report of the chromosome number for western Siberia. The same chromosome number was revealed in collections from the Primorye Territory (Probatova, 2014, and references therein) and the Irkutsk Region (Probatova et al., 2018a).  $2n = 18$  was indicated in the Irkutsk Region (Chepinoga, 2014, and references therein).

Tetraploid ( $4x$ ),  $x = 10$ .

LAMIACEAE

***Nepeta cataria*** L.

**$2n = 34$ :** “Russian Federation, the Republic of Altai, Gorno-Altaysk city, Partizanskiy log, on the streets and along the roads. 12 VIII 2021. E. Zykova”, Z957–1421 (NS0041415).

Perennial. Native to Europe, Caucasus, West and Central Asia, introduced to the Far East and North America. It is found in most regions of the West Siberia. In the Republic of Altai, it was discovered first at the end of the 20th century in the city of Gorno-Altaysk and the village of Mayma, Mayma district (Nikiforov, 1989). Later, it was found in the Choya and Chemal districts (Zykova, 2014a), in the Turochak district (Zykova, 2015), and in the Mayma district (Zykova, 2017). A rare species, not abundant in these localities.

The chromosome number is given for the first time from the Republic of Altai. The same chromosome number was revealed in collections from the Primorye Territory (Probatova, 2014, and references therein), Amur (Probatova et al., 2009) and Novosibirsk (Zykova, Pankova, 2021) Regions. The number  $2n = 36$  was reported for Primorye Territory (Probatova, 2014, and references therein).

Diploid ( $2x$ ),  $x = 17$ .

***Nepeta sibirica*** L.

**$2n = 18$ :** “Russian Federation, the Republic of Altai, Gorno-Altaysk city, the central embankment of the Mayma River, pebble on the river bank, 51°58'N, 85°55'E. 18 VIII 2017. E. Zykova”, Z413–6117 (NS0041425).

Perennial. The range of the species covers the regions of southern Siberia, Central Asia, and Mongolia. In the Republic of Altai, it is native steppe species. Until the middle of the 20th century, it was found only in the southeast of the Republic of Altai (Krylov, 1937). At the end of the 20th century, it appeared in the northern regions of the republic,

where the species currently forms extensive, abundantly flowering thickets in ditches and along roads (Zykova, 2014b).

The same chromosome number was revealed in collections from the Krasnoyarsk Territory (Stepanov, 1992) and also from the Republic of Altai (Probatova et al., 2013b).

Diploid ( $2x$ ),  $x = 9$ .

#### MALVACEAE

##### *Malva pusilla* Sm.

$2n = 42$ : “Russian Federation, the Republic of Altai, Choya district, Choya village, wasteland, 52°02'N, 86°33'E. 7 VIII 2015. E. Zykova”, Z788–3715 (NS0041420); “Russian Federation, the Republic of Altai, Mayma district, Podgornoye village, wasteland, 52°01'N, 85°53'E. 24 VI 2017. E. Zykova”, Z363–1417 (NS0041426); “Russian Federation, the Republic of Altai, Gorno-Altaysk city, Protochnaya street, wasteland, 51°58'N, 85°55'E. 18 VIII 2017. E. Zykova”, Z364–6017 (NS0041417).

Annual or biennial. Holarctic. In Siberia, the species is one of the most common ruderal plants. The first locations in the Republic of Altai were discovered in the beginning of the 20th century, single locations were found in the Ust-Kan, Mayma, Chermal, Ust-Koksa districts, and in the city of Gorno-Altaysk (Krylov, 1935). At present, it has widely settled in the northern and central regions of the republic (Zykova, 2015). Invasive species in the Republic of Altai (Zykova, Ebel, 2022).

The chromosome number is given for the first time for the Republic of Altai. The same number was identified for Amur (Probatova et al., 2012b), Irkutsk (Probatova et al., 2018b), and Novosibirsk (Zykova, Pankova, 2021) Regions and the Primorye Territory (Probatova, 2014, and references therein).

Hexaploid ( $6x$ ),  $x = 7$ .

#### ONAGRACEAE

##### *Epilobium hirsutum* L.

$2n = 36$ : “Russian Federation, the Republic of Altai, Gorno-Altaysk city, Shosseynaya street, wasteland, 51°58' N, 85°55'E. 22 VIII 2017. E. Zykova”, Z462–6717 (NS0041424).

Perennial. Eurasian. In the Republic of Altai, the first locality was recorded in the Shebalino district (Krylov, 1935). By the end of the 20th century it was noted for the territory of the Altai State Reserve (Zolotukhin, 1983), and for the Choya and Mayma districts (Vlasova, 1996). At present, it is common in these areas. Since the beginning of the 21st century, it

actively settled in the city of Gorno-Altaysk (Zykova, 2015). The species is invasive in the Republic of Altai (Zykova, Ebel, 2022).

This is the first record of the chromosome number for this species for the Russian part of its area. The same chromosome number was reported for Europe, Kazakhstan, America, India (Rice et al., 2015).

Diploid ( $2x$ ),  $x = 18$ .

#### POACEAE

##### *Echinochloa crus-galli* (L.) P. Beauv.

$2n = 54$ : “Russian Federation, the Republic of Altai, Turochak district, Iogach village, stadium, 51°46'N, 87°15'E. 15 VIII 2017. E. Zykova”, Z782–5517 (NS0041421).

Annual. South Asian species with cosmopolitan secondary range. It is included in the list of invasive and potentially invasive species of Siberia (Ebel et al., 2014) and the “Black Book of Siberian Flora” (Sheremetova, 2016). The first locality in the Republic of Altai is the village of Kibezhen, Turochak district (Krylov, 1914), the second one is the village of Uznezya, Chermal district (Krylov, 1928). By now, it is invasive in the Republic of Altai (Zykova, Ebel, 2022), occurring throughout the republic, with the exception of the Kosh-Agach district (Zykova, 2015).

The chromosome number is given for the first time in the Republic of Altai. The same one was counted from the Amur (Chisla khromosom ..., 1993), Irkutsk (Chepinoga, 2014, and references therein), and Novosibirsk (Zykova, Pankova, 2021) Regions, from the Krasnodar (Probatova et al., 2013a), Primorye (Probatova, 2014, and references therein), and Kamchatka (Probatova et al., 2017) Territories.  $2n = 36$  was determined for the Krasnoyarsk (Stepanov, Muratova, 1992), Khabarovsk (Probatova et al., 2006), and Primorye (Probatova, 2014, and references therein) Territories, from the Sakhalin Region (Probatova et al., 2007, and references therein).

Hexaploid ( $6x$ ),  $x = 9$ .

#### POLYGONACEAE

##### *Fagopyrum esculentum* Moench

$2n = 16$ : “Russian Federation, the Republic of Altai, Mayma district, in vicinity of Mayma village, along country roads, 52°02'N, 85°54'E. 12 VIII 2017. E. Zykova”, Z952–5017 (NS0045601).

Annual. Asian species widely cultivated in Europe, Asia, and North America as a food plant, found as a weed along roadsides, wastelands, and fallows.

In the Republic of Altai, it was noted in the northern districts, single localities were found in the central districts of the republic (Zykova, 2015).

Outside of the culture, this is the first record of the chromosome number for this species from Russian part of its distribution area. The same chromosome number was reported for cultivated material in China and India (Rice et al., 2015).

Diploid ( $2x$ ),  $x = 8$ .

#### ROSACEAE

##### *Sorbaria sorbifolia* (L.) A. Braun

**$2n = 36$ :** “Russian Federation, the Republic of Altai, Turochak district, the Altai State Reserve, Yaylyu village, by the roads along the streets, 51°46'N, 87°36'E. 14 VIII 2017. E. Zykova”, Z613–5317 (NS0045603).

Perennial. Asian species, widely used in landscaping, runs wild easily. It is included in the list of invasive and potentially invasive species of Siberia (Ebel et al., 2014). In the Republic of Altai, outside of culture, it was noted at the end of the 20th century in the Altai State Reserve (Zolotukhin, 1990). It is widely distributed in the city of Gorno-Altaysk and Mayma district (Zykova, 2015).

This is the first report of species chromosome number for Siberia. The same chromosome number was revealed in collections from the Khabarovsk (Probatova et al., 2008) and Primorye (Probatova, 2014, and references therein) Territories.

Tetraploid ( $4x$ ),  $x = 9$ .

#### Conclusion

The study provides the first records of chromosome numbers for 14 adventive species based on the material from the Republic of Altai, three of them are invasive species on the territory of the republic. Five of the species studied are polyploids, namely *Sorbaria sorbifolia*, *Erodium cicutarium*, *Echinochloa crus-galli*, *Malva pusilla*, *Campanula rapunculoides*. Among the 14 investigated species, the most active in the Republic of Altai, are: tetraploids – *Sorbaria sorbifolia*, *Erodium cicutarium*, hexaploids – *Echinochloa crus-galli*, and *Malva pusilla*.

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#### REFERENCES / ЛИТЕРАТУРА

- Baykov K. S. 1993. *Dianthus* L. In: *Flora Sibiri [Flora of Siberia]*. Vol. 6. Novosibirsk: Nauka. Pp. 88–94. [In Russian] (Байков К. С. *Dianthus* L. // Флора Сибири. Т. 6. Новосибирск: Наука, 1993. С. 88–94).
- Chepinoga V. V. 2014. *Chromosome numbers of plant species from Baikal Siberia*. Novosibirsk: Nauka. 419 pp. [In Russian] (Чепинога В. В. Хромосомные числа растений флоры Байкальской Сибири. Новосибирск: Наука, 2014. 419 с.).
- Chisla khromosom tsvetkovykh rasteniy flory SSSR: Moraceae – Zygophyllaceae [Chromosome numbers of flowering plants of the USSR flora: Moraceae – Zygophyllaceae]*. 1993. A. L. Takhtadzhyan (ed.). Vol. 2. St. Petersburg: Nauka. 480 pp. [In Russian] (Числа хромосом цветковых растений флоры СССР: Морасеае – Зигофиллацеае. Под ред. акад. А. Л. Тахтаджяна. Т. 2. СПб.: Наука, 1993. 480 с.).
- Ebel A. L., Strelnikova T. O., Kupriyanov A. N., Anenkhonov O. A., Ankipovich E. C., Antipova E. M., Verkhozina A. V., Efremov A. N., Zykova E. Yu., Mikhailova S. I., Plikina N. V., Ryabovol S. V., Silantjeva M. M., Stepanov N. V., Terekhina T. A., Chernova O. D., Shaulo D. N. 2014. Invasive and potential invasive species of Siberia. *Byull. Glavn. bot. sada (Moscow) [Bulletin of the Main Botanical Garden]* 1(200): 52–61. [In Russian] (Эбель А. Л., Стрельникова Т. О., Куприянов А. Н., Аненхонов О. А., Анкипович Е. С., Антипова Е. М., Верхозина А. В., Ефремов А. Н., Зыкова Е. Ю., Михайлова С. И., Пликина Н. В., Рябовол С. В., Силантьева М. М., Степанов Н. В., Терехина Т. А., Чернова О. Д., Шауло Д. Н. Инвазионные и потенциально инвазионные виды Сибири // Бюл. Глав. ботан. сада, 2014. № 1 (вып. 200). С. 52–61). URL: [http://www.gbsad.ru/science/doc/biulleten\\_gbs\\_2014\\_200\\_1.pdf](http://www.gbsad.ru/science/doc/biulleten_gbs_2014_200_1.pdf)
- Ebel A. L., Zykova E. Yu. 2020. *Silene dichotoma* Ehrh. (Caryophyllaceae). In: Findings to the flora of Russia and adjacent countries: New national and regional vascular plant records, 2 (A.V. Verkhozina (ed.)). *Botanica Pacifica* 9(1): 144–145. DOI: 10.17581/bp.2020.09115

- Ebel A. L., Zykova E. Yu., Verkhovina A. V., Mikhaylova S. I., Prokopyev A. S., Strelnikova T. O., Sheremetova S. A., Khrustaleva I. A.** 2016. New data on distribution of alien and synanthropic plant species in Siberia. *Sist. Zametki Mater. Gerb. Krylova Tomsk. Gosud. Univ.* [Systematic notes on the materials of P. N. Krylov Herbarium of Tomsk state University] 114: 16–37. [In Russian] (**Эбель А. Л., Зыкова Е. Ю., Верховина А. В., Михайлова С. И., Проконьев А. С., Стрельникова Т. О., Шереметова С. А., Хрусталева И. А.** Новые сведения о распространении в Сибири чужеродных и синантропных видов растений // Сист. зам. Герб. Томск. ун-та, 2016. № 114. С. 16–37). DOI: 10.17223/20764103.114.4
- Hassler M.** 2022. World Plants: Synonymic Checklists of the Vascular Plants of the World (version Nov 2018). In: Y. Roskov, G. Ower, T. Orrell, D. Nicolson, N. Bailly, P. M. Kirk, T. Bourgoin, R. E. DeWalt, W. Decock, E. van Nieukerken, L. Penev (eds.). Species 2000 & ITIS Catalogue of Life, 2020-08-01 Beta. Species 2000: Naturalis, Leiden, the Netherlands. URL: [www.catalogueoflife.org/col](http://www.catalogueoflife.org/col) (Accessed 04 April 2022).
- Krylov P. N.** 1914. *Panicum* L. *Flora Altaya i Tomskoy gubernii* [Flora of Altai and Tomsk province]. Vol. 7. Tomsk. Pp. 1544–1546. [In Russian] (**Крылов П. Н.** *Panicum* L. // Флора Алтая и Томской губернии. Т. 7. Томск, 1914. С. 1544–1546).
- Krylov P. N.** 1928. *Panicum* L. In: *Flora Zapadnoy Sibiri* [Flora of Western Siberia]. Vol. 2. Tomsk. Pp. 149–151. [In Russian] (**Крылов П. Н.** *Panicum* L. // Флора Западной Сибири. Т. 2. Томск, 1928. С. 149–151).
- Krylov P. N.** 1935. *Erodium* L' Herit., *Malva* L., *Epilobium* L. In: *Flora Zapadnoy Sibiri* [Flora of Western Siberia]. Vol. 8. Tomsk: Tomsk University Press. Pp. 1835–1838, 1898–1901, 1961–1973. [In Russian] (**Крылов П. Н.** *Erodium* L' Herit., *Malva* L., *Epilobium* L. // Флора Западной Сибири. Т. 8. Томск, 1935. С. 1835–1838, 1898–1901, 1961–1973).
- Krylov P. N.** 1937. *Nepeta* L. In: *Flora Zapadnoy Sibiri* [Flora of Western Siberia]. Vol. 9. Tomsk. Pp. 2306–2314. [In Russian] (**Крылов П. Н.** *Nepeta* L. // Флора Западной Сибири. Т. 9. Томск, 1937. С. 2306–2314).
- Lomonosova M. N., Zykova E. Yu., An'kova T. V.** 2018. Chromosome numbers of invasive species of the Republic of Altai flora. II. *Turczaninowia* 21, 4: 63–72. DOI: 10.14258/turczaninowia.21.4.7
- Malakhova L. A.** 1990. Karyological analysis of natural populations of rare and endangered plants in the south of the Tomsk Region. *Byull. Glavn. bot. sada (Moscow)* [Bulletin of Main Botanical Garden] 155: 60–66. [In Russian] (**Малахова Л. А.** Кариологический анализ природных популяций редких и исчезающих растений на юге Томской области // Бюл. Глав. ботан. сада, 1990. Вып. 155. С. 60–66). URL: [http://www.gbsad.ru/science/doc/biulleten\\_gbs\\_1990\\_155.pdf](http://www.gbsad.ru/science/doc/biulleten_gbs_1990_155.pdf)
- Nikiforov Yu. V.** 1989. *Zavetnyye travy Altaya* [Treasured herbs of Altai]. Barnaul. 208 pp. [In Russian] (**Никифоров Ю. В.** Заветные травы Алтая. Барнаул, 1989. 208 с.).
- Olonova M. V.** 1996. *Campanula* L. In: *Flora Sibiri* [Flora of Siberia]. Vol. 12. Novosibirsk: Nauka. Pp. 148–156. [In Russian] (**Олонова М. В.** *Campanula* L. // Флора Сибири. Т. 12. Новосибирск: Наука, 1996. С. 148–156).
- Probatova N. S.** 2014. *Chromosome numbers in vascular plants of the Primorskii Territory (Russian Far East)*. Vladivostok: Dalnauka. 343 pp. [In Russian] (**Пробатова Н. С.** Хромосомные числа сосудистых растений Приморского края. Владивосток: Дальнаука, 2014. 343 с.).
- Probatova N. S., Barkalov V. Yu., Rudyka E. G.** 2007. *Karyology of the flora of Sakhalin and the Kurile Islands. Chromosome numbers, taxonomic and phytogeographical comments*. Vladivostok: Dalnauka. 392 pp. [In Russian] (**Пробатова Н. С., Баркалов В. Ю., Рудыка Э. Г.** Кариология флоры Сахалина и Курильских островов. Числа хромосом, таксономические и фитогеографические комментарии. Владивосток: Дальнаука, 2007. 392 с.).
- Probatova N. S., Barkalov V. Yu., Rudyka E. G.** 2012a. Chromosome numbers for vascular plant from Sakhalin, Moneron and the Kuril Islands (North-East Asia). *Botanica Pacifica* (1)1: 121–126. DOI: 10.17581/bp.2012.01107
- Probatova N. S., Barkalov V. Yu., Stepanov N. V.** 2017. Chromosome numbers in some vascular plant species from Siberia and the Russian Far East. *Botanica Pacifica* 6(1): 51–55. DOI: 10.17581/bp.2017.06103
- Probatova N. S., Kazanovsky S. G., Chernyagina O. A.** 2018a. Chromosome numbers in some vascular plant species from Russia: Komi Republic, Volga Region, Siberia and the Far East. *Botanica Pacifica* 7(2): 157–161. DOI: 10.17581/bp.2018.072010
- Probatova N. S., Kazanovsky S. G., Chernyagina O. A.** 2018b. IAPT/IOPB chromosome data 27. Ed. K. Marhold. *Taxon* 67(5): 1045–1046; E14–E16.
- Probatova N. S., Kazanovsky S. G., Rudyka E. G., Gnutikov A. A., Verkhovina A. V.** 2013a. IAPT/IOPB chromosome data 15. Ed. K. Marhold. *Taxon* 62(5): 1080–1081; E23–E26.
- Probatova N. S., Kazanovsky S. G., Rudyka E. G., Seledets V. P., Nechaev V. A.** 2012b. IAPT/IOPB chromosome data 13. Ed. K. Marhold. *Taxon* 61(4): 899–902; E34–E42.
- Probatova N. S., Kazanovsky S. G., Rudyka E. G., Seledets V. P., Ovchinnikova S. V.** 2013b. IAPT/IOPB chromosome data 16. Ed. K. Marhold. *Taxon* 62(6): 1359–1360; E10–E13.
- Probatova N. S., Kozhevnikova Z. V., Rudyka E. G., Shatokhina A. V., Kozhevnikov A. E., Barkalov V. Yu., Seledets V. P.** 2009. Chromosome numbers for the flora of the Russian Far East and the East Siberia. *Bot. Zhurn.* 94(5): 764–780. [In Russian] (**Пробатова Н. С., Кожевникова З. В., Рудыка Э. Г., Шатохина А. В., Кожевников А. Е.,**

**Баркалов В. Ю., Селедец В. П.** Числа хромосом видов флоры Дальнего Востока и Восточной Сибири // Бот. журн., 2009. Т. 94, № 5. С. 764–780).

**Probatova N. S., Rudyka E. G., Barkalov V. Yu., Nesterova I. A., Kudrin S. G., Chubar E. A.** 2006. Chromosome numbers of vascular plants from nature reserves of the Primorye Territory and the Amur River basin. *Bot. Zhurn.* 91(7): 1117–1134. [In Russian] (**Пробатова Н. С., Рудыка Э. Г., Баркалов В. Ю., Нестерова И. А., Кудрин С. Г., Чубарь Е. А.** Числа хромосом сосудистых растений из заповедников Приморского края и Приамурья // Бот. журн., 2006. Т. 97, № 7. С. 1117–1134).

**Probatova N. S., Seledets V. P.** 2008. IAPT/IOPB chromosome data 5. Ed. K. Marhold. *Taxon* 57(2): 555–558; E7–E16.

**Sheremetova S. A.** 2016. *Echinochloa crusgalli* (L.) Beauv. In: *Chyernaya kniga flory Sibiri [Black book of the flora of Siberia]*. Novosibirsk: “Geo” Publ. Pp. 302–308. [In Russian] (**Шереметова С. А.** *Echinochloa crusgalli* (L.) Beauv. // Черная книга флоры Сибири. Новосибирск: Академическое изд-во «Гео», 2016. С. 302–308).

**Stepanov N. V.** 1992. Chromosome numbers in representatives of some families of higher plants. *Bot. Zhurn.* 77(2): 113–114. [In Russian] (**Степанов Н. В.** Числа хромосом представителей некоторых семейств высших растений // Бот. журн., 1992. Т. 77, № 2. С. 113–114).

**Stepanov N. V., Muratova E. N.** 1992. Chromosome numbers of some species of higher plants of flora of the Krasnoyarsk Region. *Bot. Zhurn.* 77(7): 125–126. [In Russian] (**Степанов Н. В., Муратова Е. Н.** Числа хромосом некоторых видов высших растений флоры Красноярского края // Бот. журн., 1992. Т. 77, № 7. С. 125–126).

**Vlasova N. V.** 1993. *Myosoton* Moench. In: *Flora Sibiri [Flora of Siberia]*. Vol. 6. Novosibirsk: Nauka. P. 29. [In Russian] (**Власова Н. В.** *Myosoton* Moench // Флора Сибири. Т. 6. Новосибирск: Наука, 1993. С. 29).

**Vlasova N. V.** 1996. *Epilobium* L. In: *Flora Sibiri [Flora of Siberia]*. Vol. 10. Novosibirsk: Nauka. Pp. 107–115. [In Russian] (**Власова С. Н.** *Epilobium* L. // Флора Сибири. Т. 10. Новосибирск: Наука, 1996. С. 107–115).

**Zolotukhin N. I.** 1983. Adventive plants in the Altai State Reserve. *Bot. Zhurn.* 68(11): 1528–1533. [In Russian] (**Золотухин Н. И.** Адвентивные растения на территории Алтайского заповедника // Бот. журн., 1983. Т. 68, № 11. С. 1528–1533).

**Zolotukhin N. I.** 1990. Perennial dynamics of adventive flora in the village of Yaylu and on the cordons of the Altai State Reserve. In: *Antropogennyye vozdeystviya na prirodu zapovednikov: Sb. nauch. tr. [Anthropogenic impacts on the nature of nature reserves: Sat. scientific tr.]* Moscow: Central Laboratory Glavokhoty RSFSR. Pp. 107–118. [In Russian] (**Золотухин Н. И.** Многолетняя динамика адвентивной флоры в поселке Яйлу и на кордонах Алтайского заповедника // Антропогенные воздействия на природу заповедников: Сб. науч. тр. ЦНИЛ Главохоты РСФСР. М., 1990. С. 107–118).

**Zolotukhin N. I.** 2012. Floristic records in the Republic of Altai. *Byull. Moskovsk. Obshch. Isp. Prir., Otd. Biol. [Bull. Moscow Soc. Natur. Biol. Ser.]* 117, 3: 77–80. [In Russian] (**Золотухин Н. И.** Флористические находки в Республике Алтай // Бюл. МОИП. Отд. биол., 2012. Т. 117, вып. 3. С. 77–80).

**Zykova E. Yu.** 2014a. New records of alien species in the Republic of Altai flora. *Byull. Moskovsk. Obshch. Isp. Prir., Otd. Biol. [Bull. Moscow Soc. Natur. Biol. Ser.]* 119, 1: 80–81. [In Russian] (**Зыкова Е. Ю.** Новые находки адвентивных видов во флоре Республики Алтай // Бюл. МОИП. Отд. биол., 2014а. Т. 119, вып. 1. С. 80–81).

**Zykova E. Yu.** 2014b. New data on the distribution of alien species in the the Republic of Altai. *Byull. Moskovsk. Obshch. Isp. Prir., Otd. Biol. [Bull. Moscow Soc. Natur. Biol. Ser.]* 119, 6: 74–76. [In Russian] (**Зыкова Е. Ю.** Новые данные о распространении адвентивных видов во флоре Республики Алтай // Бюл. МОИП. Отд. биол., 2014б. Т. 119, вып. 6. С. 74–76).

**Zykova E. Yu.** 2015. Alien flora of the Republic of Altai. *Rastitelnyy mir Aziatskoy Rossii [Plant Life of Asian Russia]* 3(19): 72–87. [In Russian] (**Зыкова Е. Ю.** Адвентивная флора Республики Алтай // Растительный мир Азиатской России, 2015. № 3(19). С. 72–87). URL: <http://www.izdatgeo.ru/pdf/rast/2015-3/72.pdf>

**Zykova E. Yu.** 2017. New data on distribution of alien species in Altai. *Byull. Moskovsk. Obshch. Isp. Prir., Otd. Biol. [Bull. Moscow Soc. Natur. Biol. Ser.]* 122, 6: 64–66. [In Russian] (**Зыкова Е. Ю.** Новые данные о распространении адвентивных видов на Алтае // Бюл. МОИП. Отд. биол., 2017. Т. 122, вып. 6. С. 64–66).

**Zykova E. Yu., An'kova T. V.** 2017. Additions to the alien flora of the Republic of Altai. *Byull. Moskovsk. Obshch. Isp. Prir., Otd. Biol. [Bull. Moscow Soc. Natur. Biol. Ser.]* 122, 3: 77–78. [In Russian] (**Зыкова Е. Ю., Анькова Т. В.** Дополнения к адвентивной флоре Республики Алтай // Бюл. МОИП. Отд. биол., 2017. Т. 122, вып. 3. С. 77–78).

**Zykova E. Yu., An'kova T. V., Lomonosova M. N.** 2020. Chromosome numbers of invasive and potentially invasive species in the flora of the Republic of Altai. III. *Turczaninowia* 23, 1: 133–139. DOI: 10.14258/turczaninowia.23.1.15

**Zykova E. Yu., An'kova T. V., Lomonosova M. N.** 2021a. Chromosome numbers of invasive and potentially invasive species in the flora of the Republic of Altai. IV. *Turczaninowia* 24, 1: 89–97. DOI: 10.14258/turczaninowia.24.1.11

**Zykova E. Yu., Ebel A. L.** 2022. “Black-list” of flora of the Republic of Altai. In: *Phytoinvasions: can we stop them or need to give up? Proceedings of the All-Russian Scientific and Practical conference (Moscow, Botanical Garden of Lomonosov Moscow State University, February 10–11, 2022)*. Moscow: Moscow University Press. Pp. 162–166. [In Russian] (**Зыкова Е. Ю., Эбель А. Л.** «Black-list» флоры Республики Алтай // Фитоинвазии: остановить нельзя сдавать-

ся: материалы Всеросс. науч.-практ. конф. с междунар. участием (г. Москва, 10–11 февраля 2022 г.). М.: Изд-во МГУ, 2022. С. 162–166).

**Zykova E. Yu., Ebel A. L., Ebel T. V., Sheremetova S. A.** 2019. New findings of alien plants in the Republic of Altai. *Turczaninowia* 22, 1: 143–153. [In Russian] (**Зыкова Е. Ю., Эбель А. Л., Эбель Т. В., Шереметова С. А.** Новые находки адвентивных видов растений в Республике Алтай // *Turczaninowia*, 2012. Т. 15, № 4. С. 34–40). DOI: 10.14258/turczaninowia.22.1.11

**Zykova E. Yu., Lomonosova M. N., An'kova T. V.** 2018. Chromosome numbers of invasive species of the Republic of Altai flora: post I. *Turczaninowia* 21, 1: 41–51. [In Russian] (**Зыкова Е. Ю., Ломоносова М. Н., Анькова Т. В.** Числа хромосом инвазионных видов во флоре Республики Алтай: сообщение 1 // *Turczaninowia*, 2018. Т. 21, № 1. С. 41–51). DOI: 10.14258/turczaninowia.21.1.

**Zykova E. Yu., Pankova (An'kova) T. V.** 2021. Chromosome numbers in some alien plant species of Novosibirsk Region: post II. *Turczaninowia* 24, 2: 12–18. DOI: 10.14258/turczaninowia.24.2.2

**Zykova E. Yu., Pankova T. V., Lomonosova M. N.** 2021b. Chromosome numbers of invasive and potentially invasive species in the flora of the Republic of Altai. Post V. *Turczaninowia* 24, 4: 95–103. DOI: 10.14258/turczaninowia.24.3.9