

Chromosome numbers in some vascular plant species from Siberia and the Russian Far East

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ABSTRACT

Chromosome numbers (CN) for 22 species of vascular plants from 17 genera (11 families): *Crepis*, *Adenophora*, *Weigela*, *Arenaria*, *Psammophiliella*, *Hylotelephium*, *Phyllodoce*, *Phlomooides*, *Luzula*, *Agrostis*, *Elymus*, *Elytrigia*, *Eragrostis*, *Festuca* (*Schedonorus*), *Poa*, *Physaliastrum*, *Viola* from Siberia and the Russian Far East are presented. For 9 species: *Crepis coreana* (Nakai) H.S. Pak (Asteraceae), *Weigela suavis* L.H. Bailey (Caprifoliaceae), *Arenaria redowskii* Cham. et Schldl. (Caryophyllaceae), *Hylotelephium pseudospectabile* (Praeger) S.H. Fu (Crassulaceae), *Phlomooides pacifica* Kamelin et Schlotg. (Lamiaceae), *Elytrigia amgunensis* (Nevski) Nevski, *Festuca gudoshnikovii* Stepanov (Poaceae), *Physaliastrum japonicum* (Franch. et Sav.) Honda (Solanaceae) and *Viola kusnezowiana* W. Becker (Violaceae) the CN are revealed for the first time. The new CN were obtained for *Adenophora curvidens* Nakai, *Luzula beringensis* Tolm. and *Eragrostis imberbis* (Franch.) Prob. In the RFE *Phyllodoce caerulea* (L.) Bab. was studied first caryologically. Besides, the CNs were studied for the first time: in Khabarovskii krai – for *Agrostis clavata* Trin., *A. stolonifera* L., *Elymus sibiricus* L. and *Poa angustifolia* L.; in Primorskii Krai – for *Elymus gmelinii* (Trin.) Tzvelev and *Psammophiliella muralis* (L.) Ikon.; in Kamchatka Peninsula – for *Echinochloa crus-galli* (L.) P. Beauv.; in Buryatia Republic – for *Poa palustris* L.

Key words: chromosome numbers, vascular plants, flora, Siberia, Russian Far East

РЕЗЮМЕ

Пробатова Н.С., Баркалов В.Ю., Степанов Н.В. Числа хромосом некоторых видов сосудистых растений из Сибири и Дальнего Востока России. Сообщаются числа хромосом (2n) для 22 видов сосудистых растений из 17 родов (11 семейств): *Crepis*, *Adenophora*, *Weigela*, *Arenaria*, *Psammophiliella*, *Hylotelephium*, *Phyllodoce*, *Phlomooides*, *Luzula*, *Agrostis*, *Elymus*, *Elytrigia*, *Eragrostis*, *Festuca* (*Schedonorus*), *Poa*, *Physaliastrum*, *Viola* во флоре Сибири и Дальнего Востока России. Впервые исследованы в кариологическом отношении *Crepis coreana* (Nakai) H.S. Pak (Asteraceae), *Weigela suavis* L.H. Bailey (Caprifoliaceae), *Arenaria redowskii* Cham. et Schldl. (Caryophyllaceae), *Hylotelephium pseudospectabile* (Praeger) S.H. Fu (Crassulaceae), *Phlomooides pacifica* Kamelin et Schlotg. (Lamiaceae), *Elytrigia amgunensis* (Nevski) Nevski, *Festuca gudoshnikovii* Stepanov (Poaceae), *Physaliastrum japonicum* (Franch. et Sav.) Honda (Solanaceae) и *Viola kusnezowiana* W. Becker (Violaceae). Для *Adenophora curvidens* Nakai, *Luzula beringensis* Tolm. и *Eragrostis imberbis* (Franch.) Prob. выявлены новые (не известные ранее) значения чисел хромосом. На РДВ *Phyllodoce caerulea* (L.) Bab. впервые исследован в кариологическом отношении. Кроме того, впервые исследованы: в Хабаровском крае – *Agrostis clavata* Trin., *A. stolonifera* L., *Elymus sibiricus* L. и *Poa angustifolia* L.; в Приморском крае – *Elymus gmelinii* (Trin.) Tzvelev и *Psammophiliella muralis* (L.) Ikon.; на п-ове Камчатка – *Echinochloa crus-galli* (L.) P. Beauv.; в Республике Бурятия – *Poa palustris* L.

Ключевые слова: числа хромосом, сосудистые растения, флора, Сибирь, Дальний Восток России

We announce new results on chromosome number (CN) study of 22 species of vascular plants from Siberia and the Russian Far East (RFE). (Fig. 1). This contribution continues previous publications as to Poaceae of Russia (Probatova et al. 2015, 2016, 2017), and these data on Poaceae will be added to the book “Grasses of Russia” by Tzvelev & Probatova (in press). Chromosome countings in most species were made by E.G. Rudyka, in 2 species – by N.V. Stepanov, on squashed preparations of root tips. The root tips were taken and fixed with Carnoy’s solution by N.S. Probatova from living plants, or from seedlings obtained through herbarium specimens, which

were collected in the field. Preparations were stained with iron hematoxylin. Voucher specimens are mainly preserved in VLA, 2 vouchers – in KRSU. First CN data for the species are indicated by asterisk (*). The number of the dot on the map follows the number of voucher specimen. Brief information about affinity and distribution of the species studied is given.

ASTERACEAE

Crepis coreana* (Nakai) H.S. Pak (*Hieracium coreanum* Nakai), **2n = 16

Russia, Far East, Khabarovskii Krai, Nanayskii Raion, Sikhote-Alin’ mountain range, Tardoki-Yangi Mt., 1900 m

alt., meadow in the *Betula ermanii* belt, 29 Aug 2012, coll. V.Yu. Barkalov 12193: **1** (VLA). Distribution: North-East China, Korean Peninsula. Mountain meadow species. In Russia it is found in Sikhote-Alin' mountain range, in the subalpine zone and in the *Betula ermanii* zone. Described from Korean Peninsula. The CN is studied for the first time. *C. coreana* was excluded, through misunderstanding, from earlier publication (Probatova et al. 2013), but it was not excluded there from Annotation with erroneous CN, which is clarified now. $2n = 4x$. The CN $2n = 16$ is typical for the genus *Crepis*, but not for *Hieracium*.

CAMPANULACEAE

Adenophora curvidens Nakai (*A. subblata* Kom.), * $2n = 34$

Russia, Far East, Khabarovskii Krai, Verkhnebureinskii Raion, Badzhal'skii mountain range, at the mouth of Bugar River – right tributary of the Yarap River in its middle course, riverside rocks, among shrubs, 14 Aug 2016, coll. V.Yu. Barkalov 13106: **2** (VLA). East Siberia, Far East. Deciduous (*Betula*, *Quercus*), mixed and coniferous forests, up to subalpine zone. Described from North Korea. Very polymorphous species. We revealed a new, diploid CN for this species: before the tetraploid CN $2n = 68$ was known, from Amurskaya Oblast' (Probatova & Sokolovskaya 1989 – as *A. subblata*). $2n = 2x$, $4x$.

CAPRIFOLIACEAE

**Weigela suavis* L.H. Bailey, $2n = 36$

Russia, Far East, Khabarovskii Krai, Verkhnebureinskii Raion, Badzhal'skii mountain range, at the mouth of Bugar River – right tributary of the Yarap River in its middle course, valley forest, 14 Aug 2016, coll. V.Yu. Barkalov 13107: **2** (VLA). Area of distribution: north of the Amur River basin. Endemic. Described from Khabarovskii Krai (near Bolon'-Odzhal Lake). Rare, poorly studied species. Mountain forests (*Picea ajanensis*), in the zone of *Pinus pumila*, along streams and small rivers. The CN of the species is revealed for the first time. Two other species of *Weigela* in the RFE also have $2n = 36$ (see Agapova et al. 1990). $2n = 4x$.

CARYOPHYLLACEAE

**Arenaria redowskii* Cham. et Schldl., $2n = 22$

Russia, Far East, Khabarovskii Krai, Verkhnebureinskii Raion, Badzhal'skii mountain range, the middle course of the Yarap River, sandy-pebble sediments, 31 Jul 2016, coll. V.Yu. Barkalov 13037: **2** (VLA). Transbaikalia and the south part of the RFE. In subalpine zone, on mossy bogs, carbonate rocks, on pebbles along streams. Described from Khabarovskii Krai. Very polymorphous species. The CN of this species is studied for the first time. $2n = 2x$.

Psammodiella muralis (L.) Ikonn., $2n = 34$

Russia, Far East, Primorskii Krai, Muravëv-Amurskii Peninsula, Vladivostok city, Akademgorodok, as a weed on the flower-bed, 15 Oct 2016, coll. N.S. Probatova and V.P. Seledets 13030: **3** (VLA). Euro-Mediterranean species, adventive in Siberia and in continental part in the south of the RFE. As a ruderal weed in settlements, along roadsides, in the fields. The first CN count in the Primorskii Krai. Be-

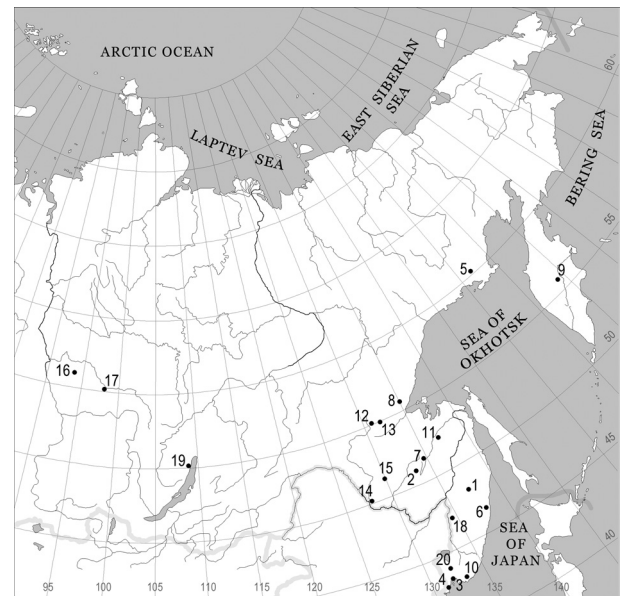


Figure 1 Study area. Dots with numbers from 1 to 20 are the sampling plot locations (according to numbering in the text)

fore the CN was studied from Amurskaya Oblast' (Probatova et al. 2005). $2n = 2x$.

CRASSULACEAE

**Hylotelephium pseudospectabile* (Praeger) S.H. Fu, $2n = 24$

Russia, Far East, Primorskii Krai, Khassanskii Raion, Priozernaya Mt., on the rocks, among shrubs, 17 Jun 2014, coll. V.Yu. Barkalov 12667: **4** (VLA). Chinese-Korean rocky species; in Russia it occurs only in the south of Primorye (Goncharova 2006a, b). For the time being the Priozernaya Mt. is a unique locality of this species in Russia. The CN of *H. pseudospectabile* is studied for the first time. $2n = 4x$.

ERICACEAE

Phyllodoce caerulea (L.) Bab., $2n = 24$

Russia, Far East, Khabarovskii Krai, Verkhnebureinskii Raion, Badzhal'skii mountain range, the middle course of Yarap River, the slope of the mountain 1500 m, *Betula ermanii* forest, 30 Jul 2016, coll. V.Yu. Barkalov 13053: **2** (VLA). Holarctic. In almost all the RFE, except south part. Mountain tundras with low shrubs, mossy-lichen tundras, in alpine zone near snowfields. The CN is studied first in the RFE. $2n = 4x$.

JUNCACEAE

Luzula beringensis Tolm., * $2n = 24$

Russia, Far East, Magadanskaya Oblast', Khassinskii Raion, Ol'skoe Plateau, Skif Mt. (1662 m), the watershed of the Ola and Maltan rivers, along the temporary reservoir, the big stones' slide-rocks on the slope, 8 Aug 2011, coll. V.Yu. Barkalov 12117: **5** (VLA). Chukotka, North Koryakia, Okhotia. Mountain tundras. The species was poorly studied. Its CN was known from Chukotka and North Koryakia: $2n = 36$ (Zhukova 1967, Probatova & Sokolovskaya 1983). This was, as we see, the hexaploid CN ($6x$), and now we revealed the tetraploid CN $2n = 24$ ($x = 6$). This species is studied in Magadanskaya Oblast' at the southern limit of

its geographical distribution. $2n = 4x, 6x$. Variable ploidy.

LAMIACEAE

**Phlomis pacifica* Kamelin et Schlotg., $2n = 24$

Russia, Far East, Khabarovskii Krai, Sovgavanskii Raion, the Botchinskii nature reserve, the upper course of Mul'pa River (the tributary of Botchi River), the valley of Solontsovyi spring, *Picea* forest, 10 Aug 1999, coll. S.D. Shlotgauer & M.V. Kriukova 8188: **6** (VLA). Earlier, this specimen was referred to *P. alpina* (Pall.) Adylov, Kamelin et Makhm. (Probatova et al. 2006). Almost at the same time *P. pacifica* was described from the Botchinskii nature reserve, by R.V. Kamelin and S.D. Schlotgauer (2006): these authors consider *P. pacifica* as more close to the other Far East species – *P. woroschilovii* (Makarov) Czerep., the endemic of Badzhal'skii mountain range, while *P. alpina* is mainly the Altai species. $2n = 4x$; $x = 6$.

POACEAE

Agrostis clavata Trin., $2n = 42$

Russia, Far East, Khabarovskii Krai, Verkhnebureinskii Raion, Badzhal'skii mountain range, the valley of Yarap River, 12 km downstream from the confluence of Left Yarap and Right Yarap, along the old stony overgrown river-bed, 31 Jul 2016, coll. V.Yu. Barkalov 13050: **7** (VLA). Area of distribution: Europe (except south), Asia, North America (Alaska). Coniferous and mixed forests, among shrubs, forest glades, meadows, riverside sands and gravels; up to the middle mountain belt. Described from Kamchatka. The species was perfectly studied cytologically. Many CN counts from the Baikal Siberia and the RFE (for Poaceae the references will be done in the book "Grasses of Russia", mentioned above). This is the first CN count from Khabarovskii Krai. $2n = 4x$.

Agrostis stolonifera L., $2n = 28$

Russia, Far East, Khabarovskii Krai, Ayano-Mayskii Raion, Nel'kan settlement, Jul 2016, coll. M.I. Vernoslova 13105: **8** (VLA). Very polymorphous species. Eurasian, but as alien or introduced species – in many temperate regions. Described from Europe. Widely distributed in the RFE, but often as adventive plant. Meadows, swamps, riversides and lakesides, on sands and gravels, and as a weed, on roadsides, in settlements; up to the upper mountain belt. The CN was studied from Siberia, Primorskii Krai and the Kuriles. $2n = 4x$ (also aneuploids occur). In Khabarovskii Krai the CN in *A. stolonifera* is revealed for the first time.

Echinochloa crus-galli (L.) P. Beauv., $2n = 54$

Russia, Far East, Kamchatskii Krai, Kamchatka Peninsula, Bystrinskii Raion, Anavgai village, 2015, coll. V.V. Buryi 13079: **9** (VLA). Almost cosmopolitan. In all the RFE, but in the north – near the thermal springs. Riversides, edges of swamps, often as a weed on plantations and roadsides. Described from "Europe and USA". In Kamchatka the CN for *E. crus-galli* is revealed for the first time. $2n = 4x$ (rare), $6x$ (common); $x = 9$. Variable ploidy.

Elymus gmelinii Trin.) Tzvelev, $2n = 28$

Russia, Far East, Primorskii Krai, Shkotovskii Raion, Petrovka settlement, coll. S.V. Prokopenko 13076: **10**.

(VLA). Described from Altai. Distributed in Siberia, Far East, Central Asia. Widely distributed in the RFE, except Arctic, Commander Islands and the Kurils. Meadows, forest clearings, among shrubs; up to the middle mountain belt. Several CN counts from Siberia and RFE. In Primorskii Krai the CN of *E. gmelinii* is studied for the first time. $2n = 4x$.

Elymus sibiricus L., $2n = 28$

Russia, Far East, Khabarovskii Krai, Poliny Ossipenko Raion, Amghun' settlement, 2003, coll. L.A. Antonova 13111: **11**. (VLA). Almost Holarctic. Described from Siberia. In all the RFE, except Arctic and the Kurile Islands. Clearings, forest edges, sands and gravels in the river valleys, on the slopes and scree, on roadsides; up to the middle mountain belt. From Khabarovskii Krai the CN for *E. sibiricus* is revealed for the first time. Multiple CN counts from Siberia and the RFE. $2n = 4x$.

**Elytrigia amgunensis* (Nevski) Nevski, $2n = 14$

Russia, Far East, Khabarovskii Krai, Ayano-Mayskii Raion, left riverside of Maya River, opposite the mouth of Tommunzha River, on the scree, 29 Jul 2016, coll. M.I. Vernoslova 13102: **12** (VLA); Russia, Far East, Khabarovskii Krai, Ayano-Mayskii Raion, the Maya River basin, right riverside of Yakundzha River, pine forest, 28 Jul 2016, coll. M.I. Vernoslova 13104: **13** (VLA). Okhotia, Amgun', lower side of the Amur River basin. Endemic. Described from the Amgun' River basin (Chukchagirskoe Lake). Stony slopes, rocks, in lower and middle mountain belts. *E. amgunensis* belongs to *E. aggr. strigosa* (M. Bieb.) Nevski. Its closely related species in the RFE *E. jacutorum* (Nevski) Nevski is also endemic, with $2n = 14$ (Zhukova & Petrovsky 1977), but its area of distribution extends from Yakutia and Chukotka up to Sikhote-Alin' mountain range. First CN count for the species. $2n = 2x$.

Eragrostis imberbis (Franch.) Prob., * $2n = 20$

Russia, Far East, Amurskaya Oblast', Blagoveshchensk city, roadside, 12 Sep 2001, coll. E. Aistova 11802: **14** (VLA); Russia, Far East, Amurskaya Oblast', 6 km NW of Belogorsk town, the Tom' River, sandy sediments near the mouth of the former river-bed, SW of Tomskoe settlement, silty plots of sandbank along the riverside, 23-25 Aug 2006, coll. V.P. Verkholat 12087: **15** (VLA); Russia, Far East, Primorskii Krai, Vladivostok city, Postysheva Str., as a ruderal weed near the building, 22 Sep 2006, coll. N.S. Probatova & V.P. Seledets 11912: **3** (VLA). Earlier the specimen № 11802 was erroneously referred to *E. pilosa* (L.) P. Beauv. (Probatova et al. 2016), but after the plants were revised by A.P. Seregin. Distribution of the species: East Siberia, Far East, Central Asia. Saline meadows, riverside sands and pebbles, roadsides. Described from the North-East of China. This is the new CN for *E. imberbis*: before only $2n = 40$ was known, from Amurskaya Oblast' (Probatova et al. 2009). $2n = 2x, 4x$. Variable ploidy.

Festuca gigantea (L.) Vill., $2n = 28$ (N.V. Stepanov)

Russia, East Siberia, Krasnoyarskii Krai, Yermakovskii Raion, 5 km NE of Ossinovka village, the slope of a hill near the mouth of Bezym'annyi spring, (tributary of the Ossi-

novka River), 4 Oct 2015, coll. N.V. Stepanov: **16** (KRSU). Actually, this species, as well as the next one, are considered to belong to a small genus *Schedonorus* P. Beauv. (*Festuca* sect. *Schedonorus* (P. Beauv.) W.D.J. Koch), with 5 species in Russia. However *Schedonorus* is not accepted unanimously up to now as a separate genus. The CN $2n = 28$ is unusual in *F. gigantea* (its common CN is $2n = 42$; see Agapova et al. 1993), but $2n = 28$ has been revealed already 3 times: from Novosibirskaya Oblast' (Salajirskii Kryazh), Krasnodarskii Krai (Abin River, the Kuban' River basin), Krasnoyarskii Krai (near Tanzybei). The polymorphism of this species deserves careful study. $2n = 4x, 6x$. Variable ploidy.

****Festuca gudoschnikovii*** Stepanov (*F. gigantea* var. *arcana* Stepanov), **$2n = 28$** (N.V. Stepanov)

Russia, East Siberia, Krasnoyarskii Krai, Yermakovskii Raion, in vicinity of Tanzybey settlement, the locality Vtoroe Kol'tso, the riverside of Maliy Kebezh River, *Saxilix* forest, 20 Aug 2016, coll. N. V. Stepanov: **17** (KRSU). Endemic of the Upper-Yenisey region. Rare species. In the valley mixed forests, at the edges of swamps. Described from Krasnoyarskii Krai. From closely related *Festuca* (*Schedonorus*) *gigantea* the species under discussion differs by panicles with erect branches adpressed to the axis, by spikelets larger 1.5–2 times, awns of lemmas shorter – up to 8 mm (aequal or subaequal to lemma); when maturing the spikelets become brownish irregularly and they look variegated. *F. gudoschnikovii* was discovered near the east limit of *Schedonorus giganteus*' area of distribution. First CN data for this species. $2n = 4x$.

***Poa angustifolia* L., $2n = 56$**

Russia, Far East, Khabarovskii Krai, Bikinskii Raion, outskirts of Bikin settlement, riverside of the Bikin River, Jul 2015, coll. M.V. Kriukova 12812: **18** (VLA). Eurasia, introduced to North America and elsewhere in the temperate regions. Dry meadows, steppes, riverside and coastal sands and pebbles, roadsides. In all the RFE (but alien in the north, in Sakhalin and in the Kurils). Described from Europe. In Russia the CN was studied from European part, the Baikal Siberia and RFE ($2n = 56, 63–64, c. 70, 70–72$), and this is the first CN report from Khabarovskii Krai. Variable ploidy. $2n = 8x, 9x, 10x$ and aneuploids.

***Poa palustris* L., $2n = 28$**

Russia, East Siberia, Republic of Buryatia, Severo-Baikalskii Raion, Cape Kotel'nikovskii, 457 m alt., lakeside of the Baikal Lake, stony beach, 24 Sep 2016, coll. I.V. Yenuschenko 13057: **19** (VLA). Holarctic. In almost all the RFE. Wet and moist meadows, swampy places, clearings, among shrubs, riverside sands and gravels, roadsides; up to the middle mountain belt. Described from Europe. Very polymorphous species, one of the most common in Russia. Multiple CN counts in Russia, mainly from the RFE. This is the first CN report for *P. palustris* from Buryatia Republic. $2n = 4x$.

SOLANACEAE

****Physaliastrum japonicum*** (Franch. et Sav.) Honda, **$2n = 24$**

Russia, Far East, Primorskii Krai, Nadezhdinskii Raion, 10 km W from Razdol'noe settlement, clearing in the mixed

forest, 21 Jun 2014, coll. V.A. Nechaev 12671: **20** (VLA). China, Japan. In Russia the representative of the small East Asian genus *Physaliastrum* occurs only in the south of the Primorskii Krai. Valley forests, clearings, among shrubs. Described from Japan. This is the first CN report for *P. japonicum*. The same CN $2n = 24$ was revealed in the only one wild species of the closely related genus *Physalis* L. – *P. franchetii* Mast., from Primorskii Krai (see Probatova 2014). $2n = 2x$.

VIOLACEAE

****Viola kusnezowiana*** W. Beck., **$2n = 20$**

Russia, Far East, Khabarovskii Krai, Verkhnebureinskii Raion, Badzhal'skii mountain range, the middle course of the Yarp River, riverside rocky outcrop, under forest canopy, 13 Aug 2016, coll. V.Yu. Barkalov 13006: **2** (VLA). The South Okhotia – North Sikhote-Alin' endemic species, which belongs to the monotypic section *Memorabiles* W. Becker. Described from the left side of the Amur River basin. In coniferous forests, on riverside rocks, in subalpine zone along the streams. The species was studied caryologically for the first time. $2n = 4x; x = 5$.

CONCLUSION

The 22 species from 17 genera (11 families) presented here show the diversity of CNs: different ploidy levels, a series of basic CN numbers ($x = 4, 5, 6, 7, 9, 10, 11, 12, 17$). The tetraploids ($4x$) prevail (11 species). There are species with variable ploidy in *Adenophora*, *Echinocloa*, *Eragrostis*, *Festuca* (*Schedonorus*), *Luzula*, *Poa*, and this phenomenon may indicate progressive species. The tetraploid CNs ($2n = 4x$) reveal the optimal ploidy level for species. 9 species were studied caryologically for the first time. For 3 species the new CN were obtained.

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