



# HOKKAIDO UNIVERSITY

|                  |                                                                                                     |
|------------------|-----------------------------------------------------------------------------------------------------|
| Title            | Chromosome Numbers of Selected Vascular Plant Species from Sakhalin, Moneron and the Kurile Islands |
| Author(s)        | Probatova, Nina S.; Barkalov, Vyacheslav Yu.; Rudyka, Elvira G.                                     |
| Description      | Biodiversity and Biogeography of the Kuril Islands and Sakhalin vol.1                               |
| Citation         | 北海道大学総合博物館研究報告, 2, 15-23                                                                            |
| Issue Date       | 2004-03                                                                                             |
| Doc URL          | <a href="https://hdl.handle.net/2115/47769">https://hdl.handle.net/2115/47769</a>                   |
| Type             | departmental bulletin paper                                                                         |
| File Information | v. 1-3.pdf                                                                                          |



## Chromosome Numbers of Selected Vascular Plant Species from Sakhalin, Moneron and the Kurile Islands

Nina S. Probatova, Vyacheslav Yu. Barkalov and Elvira G. Rudyka

Laboratory of Vascular Plants, Institute of Biology and Soil Science, Far Eastern Branch of Russian Academy of Sciences, Vladivostok 690022, Russia

**Abstract** Chromosome numbers for 33 vascular plant species of 29 genera and 16 families, from Sakhalin, Moneron and the Kurile Islands, are given. The chromosome numbers were reported here for the first time for following 11 taxa: *Acelidanthus anticleoides*, *Artemisia unalaskensis*, *Carex microtricha*, *Gaultheria miqueliana*, *Hypericum yezoense*, *Macropodium pterospermum*, *Pinguicula macroceras*, *Poa sugawarae*, *Rumex regelii*, *Taraxacum vestitum*, *Tephrosia kawakamii*. In addition, for 12 species new cytotypes were revealed. At present, in Sakhalin, Moneron and the Kurile Islands chromosome numbers have been counted for 505 species, it means for about 18% of the total number of vascular plants in the Kuriles, and 24.5% in Sakhalin. Chromosome numbers are counted now also for 20 species from Moneron.

**Key words:** chromosome numbers, vascular plants, Sakhalin, Moneron, Kurile Islands, taxonomy, phytogeography

### Introduction

This is our further contribution, concerning new chromosome counts on the vascular plants from the Kurile Islands, now also from Sakhalin and Moneron Islands, as the results of IKIP and ISIP expeditions. The first paper has been published in Japan earlier (Probatova *et al.* 2000). In the present paper chromosome counts for 33 species are given, they were selected as new or noteworthy for some reasons. For 11 species there was no published information on the chromosome numbers before. In addition, for *Arabis glauca*, *A. stelleri*, *Crepis hokkaidoensis*, *Draba kurilensis*, *Hedysarum austrokurilense*, *Honckenya oblongifolia*, *Gentiana jamesii*, *Juncus leschenaultii*, *Nesodraba grandis*, *Noccaea cochleariformis*, *Oenanthe javanica* and *Taraxacum macilentum*, new chromosome numbers (new cytotypes) are reported here.

Chromosome studies on vascular flora of Sakhalin started in 1957 (first publication: Sokolovskaya 1960), first publication on the flora of the Kuriles (Gurzenkov and Gorovoy 1971), from Moneron Island (Gurzenkov and Pavlova 1984).

### Materials and Methods

Counts were made by E.G. Rudyka, on squashed preparations of root tips fixed with Carnoy's solution, in a greenhouse in Vladivostok, where alive plants collected by V.Yu. Barkalov in the field, were growing. Some plants were obtained from seeds taken from herbarium

specimens. Preparations were stained with iron hematoxylin or acetocarmin. First counts are indicated with an asterisk (\*). Voucher specimens are preserved in the Herbarium of the Institute of Biology and Soil Science, Far East Branch of the Russian Academy of Sciences, Vladivostok (VLA). The plants were identified by V.Yu. Barkalov and N.S. Probatova. The plant names and geographical distribution of the species studied are given mainly according to Vascular Plants of the Soviet Far East, Vols. 1–8 (Kharkevich 1985–1996), and to Cherepanov (1995). For some species new data on species distribution on the islands are included by V.Yu. Barkalov. The manuscript was prepared by N.S. Probatova, as well as translation.

### Annotated List of Plants with Chromosome Numbers Studied

#### Family Apiaceae

1. *Oenanthe javanica* (Blume) DC.  
(*Oe. decumbens* Koso-Pol. p.p., excl. basionym)  
Chromosome number.  $2n=22$ .

Voucher specimens. VLA 8588, Moneron Island, in vicinity of Staritsky settlement (south-east part of the island), on wet stony maritime slope, near the waterfall, 23.VIII.2001, coll. V. Barkalov; VLA 8041, Kuriles, Kunashir Island, Alyokhina Bay, on the slope, in the tall herbs community, near hot spring, 19.VIII.1999, coll. V. Barkalov.

Distribution. Southern Sakhalin, Moneron, South

Kuriles. East and South Asia. Riverside and wet meadows.

*Note.* From Sakhalin Sokolovskaya (1960) and later, Gurzenkov and Gorovoy (1971) reported the tetraploid chromosome number  $2n=44$  (as "*Oe. decumbens*"), and the same chromosome number has been reported from the Primorsky Territory (Sokolovskaya 1966). In the Russian Far East this plant was known for a long time under the name "*Oe. decumbens*", later it was referred to *Oe. javanica*. Nevertheless, for *Oe. javanica* from Japan (Hokkaido)  $2n=42$  was known (Nishikawa 1980), some other authors also give  $2n=42$  for this species, but most reports give  $2n=20$  (see Bolkhovskikh *et al.* 1969; Goldblatt 1981, 1984, 1988; Goldblatt and Johnson 1990). However, for various *Oenanthe* species  $2n=22$  is very common. Probably, this situation results from nomenclatural confusion, or not all the populations from the Russian Far East should be referred to *Oe. javanica* (this species is known to be described from Indonesia).

## Family Asteraceae

### 2. *Artemisia arctica* Less.

*Chromosome number.*  $2n=18$ .

*Voucher specimen.* VLA 8190, Kuriles, Shumshu Island, near Baykovo, meadow on marine terrace, 24.VII.2000, coll. V. Barkalov.

*Distribution.* Northern Sakhalin, Kuriles. Eastern Siberia, Far East; North America. Mountain tundras.

*Note.* Very polymorphic species. From Kamchatka Peninsula the tetraploid chromosome number  $2n=36$  have been reported (Sokolovskaya 1963), but from Japan (Hokkaido) and from North America,  $2n=18$  (Nishikawa 1988; Dawe and Murray 1979, respectively). The monographer of the genus *Artemisia* of North-East Asia Korobkov (1981) recognizes some subspecies within *A. arctica*. The most widely distributed (and well studied) is subsp. *ehrendorferi* Korobkov,  $2n=36$  (many references, see Agapova *et al.* 1990). Another one is subsp. *psilosantha* Hult., distributed in Kamchatka and on the Kuriles,  $2n=18$  (Korobkov 1981, from Kamchatka), we also refer the plant studied by us to this subspecies (perhaps it is also the case of plants studied in Japan). The subsp. *arctica* is also diploid (to this subspecies plants from North America should be referred). Diploid cytotypes could indicate the ancient parts of the area of species distribution. In Kamchatka and Chukotka they are displaced by more recent, tetraploid cytotype.

### 3. *Artemisia unalaskensis* Rydb.

*Chromosome number.*  $2n=36^*$ .

*Voucher specimen.* VLA 8300, Kuriles, Shishikotan Island, near the Cape Obvaljny, at the bottom of maritime slope, 2.VIII.1999, coll. V. Barkalov.

*Distribution.* Northern Sakhalin, Kuriles. North Pacific. Coastal meadows.

### 4. *Cirsium pectinellum* A. Gray

*Chromosome number.*  $2n=34$ .

*Voucher specimens.* VLA 9067, Moneron Island, in

vicinity of Staritsky settlement (south-east part of the island), Asakhi Mt., meadow on the slope (Calamagrostidetum varioso-herbosa), 23.VIII.2001, coll. V. Barkalov; VLA 8042, Kuriles, Kunashir Island, nature reserve "Kurilsky", tall herbs along the river running out of Peschanoye Lake, 17.VIII.1999, coll. V. Barkalov.

*Distribution.* Southern Sakhalin, Moneron, South Kuriles; Japan. Wet meadows and boggy places.

*Note.* Chromosome number  $2n=34$  was reported for *C. pectinellum* from Japan (Hokkaido), by T. Nishikawa (1984), and he reports at the same time the tetraploid cytotype  $2n=68$  for this species. *C. pectinellum* was poorly known in the Russian Far East until now. It has been found that the previously reported chromosome number  $2n=c.70$  for "*C. kamtschaticum* Ledeb." from Sakhalin (Sokolovskaya 1960) must be referred to *C. pectinellum*, as resulted from reexamination of the voucher (herbarium) specimen (in LEU), made by Barkalov. And we suppose that chromosome number of this (Kamchatkan) plant was  $2n=68$ , too.

### 5. *Crepis hokkaidoensis* Bab.

*Chromosome number.*  $2n=14-16$ .

*Voucher specimen.* VLA 8940, Sakhalin, Nabiljsky Mountain Range, Chamginsky Pass, the upper part of the rivulet (the right affluent of Khrebtovy Spring), the spot elevation "1511 m", break-stone deposits on the top of the mountain, 8.VIII.2002, coll. V. Barkalov.

*Distribution.* Sakhalin, Moneron, South Kuriles; Japan. Rocky places.

*Note.* *C. hokkaidoensis* was not hitherto studied caryologically on the Russian Far East. There were few counts from Japan, but all of them,  $2n=8$  (see Bolkhovskikh *et al.* 1969; Ikeda 1988). Our chromosome number, most probably, is  $2n=16$ , and the tetraploid cytotype is new for this species.

### 6. *Erigeron peregrinus* (Pursh) Greene

*Chromosome number.*  $2n=18$ .

*Voucher specimen.* VLA 8306, Kuriles, Paramushir Island, nearby the Pernatoye Lake, wet meadow, 25.VIII.2000, coll. V. Barkalov.

*Distribution.* North Kuriles. North Pacific. Meadows.

*Note.* It is the first chromosome count for *E. peregrinus* from Asia. Before it has been studied in North America,  $2n=18$  (for references: Bolkhovskikh *et al.* 1969; Goldblatt and Johnson 1990). This is a rare species in the Russian Far East, known only from the Commander Islands and Paramushir Island on the Kuriles.

### 7. *Ptarmica macrocephala* (Rupr.) Kom. (*P. speciosa* Herd.)

*Chromosome number.*  $2n=18$ .

*Voucher specimen.* VLA 8213, Kuriles, Chirpoi Island, Peschanaya Bay, on the slope of marine terrace, 3.VIII.2000, coll. V. Barkalov.

*Distribution.* Sakhalin, Moneron, Kuriles; North Pacific. Meadows.

*Note.* The chromosome counts for this species were known from Sakhalin (Sokolovskaya 1960, as "*Achillea*

*ptarmica* var. *speciosa*"; Probatova and Sokolovskaya, 1990, as "*P. speciosa*") as well as from Kamchatka Peninsula (Sokolovskaya 1963), all of them,  $2n=18$ . The present result confirmed the previous counts.

8. *Taraxacum macilentum* Dahlst.

Chromosome number.  $2n=16$ .

Voucher specimen. VLA 8884, Sakhalin, Nabiljsky Mountain Range, Chamginsky Pass, the upper part of the rivulet (the right affluent of Khrebtovy Spring), the spot elevation "1511 m", stony places in the valley of rivulet, 8.VIII.2002, coll. V. Barkalov.

Distribution. Northern Sakhalin (mountains); Eastern Europe, Siberia, North America. Arcto-montane. Rocky habitats.

Note. The diploid chromosome number  $2n=16$  in *T. macilentum* was revealed for the first time. Previously for this species only polyploid chromosome numbers were known:  $2n=24$  and  $32$ , from Chukotka and Wrangel Island (Tzvelyov and Zhukova 1986),  $2n=24$  and  $40$ , from Tajmyr Peninsula, Siberia (Krogulevich and Rostovtseva 1984).

9. *Taraxacum vestitum* Worosch.

Chromosome number.  $2n=16^*$ .

Voucher specimen. VLA 8910, Sakhalin, Schmidt Peninsula, Taliki River, maritime slope, on the silt, 14.VIII.2001, coll. V. Barkalov.

Distribution. North Sakhalin. Endemic. Coastal rocky habitats. The species was described from Schmidt Peninsula (Boljshaya Longri River).

Note. The diploid chromosome number  $2n=16$  in *Taraxacum* species is rare, especially among the numerous Far Eastern representatives of the genus: it was known until now only for West Chukotka endemic species, *T. leucocarpum* Jurtz. et Tzvel., coastal psammophyte (Tzvelyov and Zhukova 1986). It is noteworthy on this subject, that in Japan at least 7 species of *Taraxacum* are known to be diploids,  $2n=16$  (see Bolkhovskikh *et al.* 1969; Goldblatt and Johnson 1990), so we could suppose one of the ancient centers of differentiation (insular Pacific) for this huge apomictic genus. It is also noticeable that most counts in this genus reveal the triploid level:  $2n=24$  (see Bolkhovskikh *et al.* 1969 etc.).

10. *Tephroseris kawakamii* (Makino) Holub (*Senecio kawakamii* Makino)

Chromosome number.  $2n=48^*$ .

Voucher specimen. VLA 8782, Sakhalin, Schmidt Peninsula, Taliki River, mountain slope with scarce vegetation, near the sea coast, on the break-stone and silt deposits, 14.VIII.2001, coll. V. Barkalov.

Distribution. Sakhalin, South Kuriles (Shikotan Island). West Pacific. Meadows and rocky habitats.

Note. The early report  $2n=c.40$  for "*Senecio kawakamii*" from the Primorsky Territory (Probatova & Sokolovskaya 1990) was incorrect, and, moreover, we actually refer the plant, studied before, not to *T. kawakamii*, but to *T. subscaposa* (Kom.) Czer.

Family Brassicaceae

11. *Arabis glauca* Boissieu

(*A. serrata* var. *glauca* (Boissieu) Ohwi)

Chromosome number.  $2n=16$ .

Voucher specimen. VLA 8810, Moneron Island, in vicinity of Staritsky settlement (south-east part of the island), on silt slope, near the rocks, 23.VIII.2001, coll. V. Barkalov.

Distribution. Moneron, Kuriles; Japan. Scree and rocky habitats.

Note. Only one chromosome number was known for *A. glauca*, from Japan (Hokkaido):  $2n=32$  (Nishikawa, 1985, as "*A. serrata* var. *glauca*"). So we revealed the diploid cytotype for this species, which is found to be polymorphic cytologically.

12. *Arabis stelleri* DC.

Chromosome number.  $2n=16$ .

Voucher specimens. VLA 8711, Sakhalin, Tonino-Anivsky Peninsula, in vicinity of Lebyazhje Lake, near Cape Menaputzy, 21.VIII.2001, coll. V. Barkalov; VLA 8102, Kuriles, Zeljony Island, the bay northwards from Cape Glushnevsky, sandy-gravelly bar between sea coast and the lake Utinoye, 20.VIII.1998, coll. M. Iljushko.

Distribution. Sakhalin, Moneron, Kuriles; Eastern Siberia, Far East (also Kamchatka, Commander Islands); Japan. Scree and rocky habitats.

Note. *A. stelleri* was studied before in Kamchatka, but the chromosome number obtained there, was tetraploid,  $2n=32$  (Zhukova and Petrovsky 1984). The species is polymorphic (as to pubescence of plants, density of inflorescences when fruiting). The southern Sakhalin-South Kurilean part of the area of species distribution (where the species is revealed to be diploid) could obviously be more ancient (in comparison to Kamchatka).

13. *Draba kurilensis* (Turcz.) Fr. Schmidt

(*Draba borealis* auct., p.p.)

Chromosome number.  $2n=32$ .

Voucher specimens. VLA 8107, Kuriles, Matua Island, Dvoynaja Bay, on volcanic scoria, 3.VIII.1999, coll. V. Barkalov; VLA 8113, Kuriles, Shiashkotan Island, near the Cape Obvaljny, stony slope of marine terrace, 2.VIII.1999, coll. V. Barkalov.

Distribution. Sakhalin, Moneron, Kuriles; Japan. Coastal rocky habitats.

Note. We revealed a new cytotype in *D. kurilensis*, because for this species the only one chromosome number report existed:  $2n=16$ , from Sakhalin (Gurzenkov 1973). *D. kurilensis* belongs to the North Pacific complex *D. borealis* DC. aggr., and it is not unanimously recognized as a species. But for *D. borealis* s. str. only high polyploid levels are known:  $2n=8x=64$ , from East Chukotka (Zhukova and Petrovsky 1984),  $2n=10x=80$  (Heilborn 1927, see Bolkhovskikh *et al.* 1969). We suppose that chromosome numbers could provide some additional reasons to consider *D. kurilensis* as a separate species, more ancient entity in comparison to high polyploid northern cytotypes of *D. borealis* DC. aggr.

14. *Macropodium pterospermum* Fr. Schmidt

Chromosome number.  $2n=30^*$ .

Voucher specimen. VLA 9061, Sakhalin, Makarovsky District, in vicinity of Tikhaya railway station, at the mouth of Tikhaya River, on the slope in the water gap, tall herbs community, 20.VIII.2003, coll. V. Barkalov.

Distribution. Sakhalin; Japan. Also reported from Sikhote-Alinj Mountain Range (Khor R. basin). Mainly, rocky habitats in forests.

Note. The genus *Macropodium* Fr. Schmidt is considered to be one of the most ancient within Brassicaceae (Berkutenko 1988), it comprises 2 species: the chromosome number of the second species, Southern Siberian montane *M. nivale* (Pall.) R. Br. has been counted several times in Siberia:  $2n=30$  (see Agapova *et al.* 1990; Goldblatt 1981, 1988; Goldblatt and Johnson 1994). The basic chromosome number ( $x$ ) in this relict genus is still unclear:  $x=5$  or  $15$ ?

15. *Nesodraba grandis* (Langsd.) Greene

(*Draba grandis* Langsd., *D. hyperborea* auct.)

Chromosome number.  $2n=32$ .

Voucher specimen. VLA 8204, Kuriles, Raikoke Island, on the slope of marine terrace, 30.VII.2000, coll. V. Barkalov.

Distribution. Kuriles (North, Middle: Onkotan Island, South: Iturup Island). North Pacific. Coastal rocky habitats. Halophyte.

Note. This chromosome number is new for this species, which is better known under the name of "*Draba grandis*". Earlier chromosome report (from Iturup Island) was  $2n=14-16$  (Probatova *et al.* 2000), and there were two other previous reports from North America:  $2n=36, 38$  (Mulligan 1966, as "*Draba hyperborea* (L.) Desv."; see Bolkhovskikh *et al.* 1969). The existence of several cytotypes within this species needs further reassurances. Recent data on distribution and habitat of "*Draba grandis*" on the Kuriles were published in a special paper of Takahashi *et al.* (2000). As we suppose, this very peculiar species, slightly succulent coastal halophyte, belongs to the anciently proposed genus *Nesodraba* Greene, rather than to *Draba*.

16. *Noccaea cochleariformis* (DC.) A. et D. Löve

(*Thlaspi cochleariforme* DC.)

Chromosome number.  $2n=14$ .

Voucher specimen. VLA 8942, Sakhalin, Nabiljsky Mountain Range, Chamginsky Pass, the upper part of the rivulet (the right affluent of Khrebtovy Spring), the spot elevation "1511 m", break-stone screes, by the rocks, 8.VIII.2002, coll. V. Barkalov.

Distribution. Sakhalin; Eastern Europe, Siberia, Far East (relatively rare). Rocky places.

Note. The diploid chromosome number in this species, usually known under the name *Thlaspi cochleariforme* DC., is revealed for the first time. Until now only polyploid cytotypes were reported for it: from Siberia,  $2n=28$ , Putorana Plateau (Krogulevich 1976) and  $2n=56$ , Tajmyr Peninsula (Zhukova *et al.* 1973), and from the Russian Far East (Chukotka, Anyujskoye Upland),

$2n=84, 12x$  (Zhukova and Petrovsky 1980). There is little doubt, that the diploid cytotype might indicate the most ancient part of the area of species distribution. For another species, the North Pacific *N. kamtschatica* (Karav.) Czer. (*Thlaspi camtschaticum* Karav.), which is not present on Sakhalin and the Kuriles, the diploid chromosome number  $2n=14$  was reported from South Chukotka (Zhukova 1980).

Family Caryophyllaceae

17. *Honckenya oblongifolia* Torr. et Gray

(*H. frigida* Pobed.; *H. peploides* subsp. *major* (Hook.) Hult.; *Ammodenia peploides* auct.)

Chromosome number.  $2n=34$ .

Voucher specimen. VLA 8715, Moneron, Ussova Rivulet (south part of the island), on maritime sands, 24.VIII.2001, coll. V. Barkalov.

Distribution. Sakhalin, Moneron, Kuriles. North Pacific. Coastal halophyte.

Note. The diploid chromosome number in this species was revealed for the first time (it was obtained on seedlings). Previous reports were:  $2n=68-70$  from Sakhalin (Sokolovskaya 1960, as "*Ammodenia peploides*"),  $2n=66, 68, 68-70, 70$  from Wrangel Island, East Chukotka, as well as from the islands of Peter the Great Bay (the Primorsky Territory), under various names (see Agapova *et al.* 1990; Goldblatt 1985). Very close to *H. oblongifolia* is the Arctic species *H. diffusa* (Hornem.) A. et D. Löve, with the same chromosome numbers (and with  $2n=c.40$ ). For European *H. peploides* (L.) Ehrh. chromosome numbers  $2n=c.48, 48, 64, 66, 68$  are known (see Bolkhovskikh *et al.* 1969), among them  $2n=68$  is the most common (Goldblatt and Johnson 1998, 2000 etc.), the same is for *H. oblongifolia*, so this chromosome number seems to be tetraploid. The small genus (2–3 species), appears to be very peculiar as supralittoral halophytic succulent plants. This genus seems to occupy a very separate position within *Caryophyllaceae*.

18. *Minuartia verna* (L.) Hiern

Chromosome number.  $2n=24$ .

Voucher specimen. VLA 9113, Sakhalin, Schmidt Peninsula, the mountain "223 m", northwards from the confluence of Malaya Longri and Boljshaya Longri Rivers, break-stone and silt slope with poor vegetation, 16.VIII.2001, coll. V. Barkalov.

Distribution. Sakhalin. Holarctic. Rocks and stony slopes.

Note. This is the most common, diploid cytotype ( $x=12$ ) and the first count for *M. verna* in Russia. There is a series of chromosome numbers within this species, reported in the world literature:  $2n=24, 26, 48, 78, 120$  (see Bolkhovskikh *et al.* 1969; Goldblatt 1981, 1984, 1985; Goldblatt and Johnson 1990, 1996, 1998, 2000).

Family Cyperaceae

19. *Carex microtricha* Franch.

(*C. nervata* auct.)

Chromosome number.  $2n=30-32^*$ .

*Voucher specimen.* VLA 8220, Kuriles, Chirpoi Island, Peschanaya Bay, on the slope of marine terrace, 3.VIII.2000, coll. V. Barkalov.

*Distribution.* Sakhalin, Moneron, Kuriles. West Pacific. Woodside habitats.

*Note.* We have not found any chromosome report in the literature for this species. For its closely relative species, *C. nervata* Franch. et Savat.,  $2n=76$  is known; for another relative *C. caryophyllea* Latourr. (which is absent on the Russian Far East),  $2n=62, 64, 66, 68$  were reported (see Bolkhovskikh *et al.* 1969). *C. nervata* might be more ancient than two other species in his group.

#### Family Ericaceae

##### 20. *Gaultheria miqueliana* Takeda

*Chromosome number.*  $2n=22^*$ .

*Voucher specimen.* VLA 8290, Kuriles, Shiashtkotan Island, Zakatnaya Bay, on the climb to Pikovaya Mt., the glades in the thickets of *Pinus pumila*, 29.VII.2000, coll. V. Barkalov.

*Distribution.* Northern Sakhalin, Kuriles; Japan. Montane forests.

*Note.* This diploid chromosome number  $2n=22$  is common to many of *Gaultheria* species (Middleton and Wilcock 1990).

#### Family Fabaceae

##### 21. *Hedysarum austrokurilense* (N. S. Pavlova) N.S. Pavlova

(*H. sachalinense* subsp. *austrokurilense* N.S. Pavlova)

*Chromosome number.*  $2n=16$ .

*Voucher specimen.* VLA 9088, Sakhalin, Makarovskiy District, Maguntan mud volcano, boggy places around volcanic field, 12.IX.2003, coll. V. Barkalov.

*Distribution.* Southern Sakhalin, Moneron, South Kuriles. Endemic (?). Meadows.

*Note.* Our earlier chromosome study of this species was made on the root tips of the seedlings, and it showed  $2n=14, 16, 20, 21$  (Sokolovskaya *et al.* 1989). Now the chromosome number, obtained on adult plants (newly collected) is correct.

#### Family Gentianaceae

##### 22. *Gentiana jamesii* Hemsl.

*Chromosome number.*  $2n=26$ .

*Voucher specimen.* VLA 8879, Sakhalin, Nabiljisky Mountain Range, Chamginsky Pass, the upper part of the rivulet (the right affluent of Khrebtovy Spring), the spot elevation "1511 m", low shrub-mossy tundra on the slope, 8.VIII.2002, coll. V. Barkalov.

*Distribution.* Sakhalin, South Kuriles (Iturup Island); Japan. Also occurs in Sikhote-Alinj Range and China. Montane meadows.

*Note.* We found in the literature for *G. jamesii* only  $2n=36$  (Shigenobu 1982, 1984), the same chromosome number is reported by this author for two close relative species, *G. nipponica* Maxim. and *G. squarrosa* Ledeb.

(they are also presented in the Russian Far East). However, other sources give for *G. squarrosa*  $2n=c.28, 38$  and  $76$  (for references, Goldblatt and Johnson 2000). At the same time, for one more species, relative to *G. jamesii*, *G. uniflora* Georgi from Siberia,  $2n=26$  is reported (Krasnoborov *et al.* 1980). As we see, within this aggregate the chromosome numbers are variable. Further studies are needed.

#### Family Hypericaceae

##### 23. *Hypericum yezoense* Maxim.

*Chromosome number.*  $2n=16^*$ .

*Voucher specimen.* VLA 8773, Moneron Island, in vicinity of Staritsky settlement, Asakhi Mt., stony slope, on the rocks, 23.VIII.2001, coll. V. Barkalov.

*Distribution.* Southern Sakhalin, Moneron, South Kuriles; Japan. Rocky places and meadows.

#### Family Juncaceae

##### 24. *Juncus ensifolius* Wikstr.

*Chromosome number.*  $2n=40$ .

*Voucher specimen.* VLA 8285, Kuriles, Urup Island, Aleutka Bay, sedge-mossy bog in the valley of rivulet, 7.VIII.2000, coll. V. Barkalov.

*Distribution.* South Kuriles. North Pacific. Boggy places.

*Note.* The chromosome number  $2n=40$  was reported by Snogerup (1963) and by Harriman and Redmond (1976) from North America. Our count is consistent with these previous reports.

##### 25. *Juncus leschenaultii* J. Gay ex Laharpe

(*J. wallichianus* Laharpe)

*Chromosome number.*  $2n=30$ .

*Voucher specimen.* VLA 7875, Kuriles, Simushir Island, Browton Bay, boggy place near the rivulet, 8.VIII.1999, coll. V. Barkalov.

*Distribution.* Kuriles (Middle and South). East and South Asia. Riverside banks.

*Note.* The chromosome number was studied previously in *J. leschenaultii* on the Amur River basin (near Khabarovsk),  $2n=c.80$  (Probatova and Sokolovskaya 1981). It was the only one count for this species made before.

#### Family Lentibulariaceae

##### 26. *Pinguicula macroceras* Pall. ex Link

(*P. vulgaris* auct., p. p.)

*Chromosome number.*  $2n=16^*$ .

*Voucher specimen.* VLA 8467, Kuriles, Urup Island, Tetyajeva Bay, by the road covered with vegetation, 8.VIII.2000, coll. V. Barkalov.

*Distribution.* Kuriles. North Pacific (mainly insular, but also present in Kamchatka Peninsula). Boggy places in tundras.

*Note.* For a very close related species *P. vulgaris* L. we found in the literature various polyploid, chromosome numbers, among them  $2n=64$  prevail (for references, see

Bolkhovskikh *et al.* 1969 etc.). It is obvious that besides some floral characters distinguishing *P. macroceras* from *P. vulgaris* (Tzvelyov, 1996), the diploid chromosome number  $2n=16$  of *P. macroceras* also distinguishes these species. In the Russian Far East another species with  $2n=16$  exist, *P. villosa* L., Holarctic by distribution (Zhukova 1967; Sokolovskaya 1968).

#### Family Melanthiaceae

##### 27. *Acelidanthus anticleoides* Trautv. et C.A. Mey.

*Chromosome number.*  $2n=16^*$ .

*Voucher specimen.* VLA 8876, Sakhalin, Nabiljsky Mountain Range, Chamginsky Pass, the upper part of the rivulet (the right affluent of Khrebtovy Spring), the spot elevation "1511 m", low shrub-mossy tundra on the slope, 8.VIII.2002, coll. V. Barkalov.

*Distribution.* Northern Sakhalin. The Sea of Okhotsk basin. Montane tundras.

*Note.* The genus *Acelidanthus* is monotypic genus, closely related to *Veratrum* L. In *Veratrum*, the tetraploid chromosome number  $2n=32$  is generally common (see Bolkhovskikh *et al.* 1969), but in *V. maackii* Regel, which is the most close to the genus *Acelidanthus*, the chromosome number  $2n=16$  was reported, based on plants collected in the Primorsky Territory (Sokolovskaya 1966). For another related taxon, *Zigadenus sibiricus* (L.) A. Gray, the chromosome number  $2n=32$  is known, from the Primorsky Territory (Probatova and Sokolovskaya 1986), as well as from Siberia (see Agapova *et al.* 1990).

##### 28. *Veratrum grandiflorum* (Maxim. ex Baker) Loes. fil.

*Chromosome number.*  $2n=32$ .

*Voucher specimen.* VLA 8758, Moneron Island, in vicinity of Staritsky settlement (southeast part of the island), wet meadow in the upper part of a rivulet, 23.VIII.2001, coll. V. Barkalov.

*Distribution.* Sakhalin, Moneron, South Kuriles. West Pacific. Meadows (tall herbs communities).

*Note.* This species have been studied in Sakhalin:  $2n=32$  (Sokolovskaya 1960).

#### Family Poaceae

##### 29. *Deschampsia tzvelevii* Probat.

*Chromosome number.*  $2n=26$ .

*Voucher specimen.* VLA 8530, Sakhalin, Makarovsky District, Maguntan mud volcano, on the mud around volcanic field, 4.VIII.2001, coll. A. Smirnov.

*Distribution.* Sakhalin (Maguntan mud volcano). Endemic.

*Note.* This very peculiar species was described 20 years ago, nevertheless it is still known only from one locality (*locus classicus*), where it is abundant. Its chromosome number was published at the time of species describing (Probatova 1984). *D. tzvelevii* can be distinguished perfectly well by its very rigid erect folded leaf blades, bright yellow sheaths of numerous sterile shoots, broad smooth obtuse glumes, by awn emergent from the middle third of lemma back (not near the bottom), as well as by its ecology. A plant with

pseudoviviparous spikelets was found once.

##### 30. *Poa sugawarae* Ohwi

*Chromosome number.*  $2n=28^*$ .

*Voucher specimen.* VLA 8617 (10928), Sakhalin, Schmidt Peninsula, Longri Cape, near the mouth of Boljshaya Longri River, break-stone and silt screes on the mountain slope, 16. VIII. 2001, coll. V. Barkalov.

*Distribution.* Sakhalin (rare). Endemic.

*Note.* This is another very peculiar species of Sakhalin flora. Its chromosome number  $2n=28$  is of great interest, because it seems to be unusually low for representatives of subsection *Malacanthae* (Roshev.) Probat. (section *Poa*), where high polyploids are presented (*Poa malacantha* Kom., *P. platyantha* Kom., *P. macrocalyx* Trautv. et C.A. Mey., *P. neosachalinensis* Probat. etc.) (Probatova 2003). Besides, the analysis of the plants studied has shown that low internodes of *P. sugawarae* are very abbreviated (so blades of leaves on the numerous vegetative shoots are closely crowded), leaf blades shortened, rigid, loosely convolute (prickly when dry), the tufts are dense but connected by rather long rhizomes, the number of lemma veins is augmented, callus with a very small scanty flexuous hairs, but the anthers are unusually long (3.1–3.5 mm). All that could testify to some separate position of *P. sugawarae* within *Malacanthae* group and perhaps - to significant age of this species (paleo-endemic?).

#### Family Polygonaceae

##### 31. *Rumex regelii* Fr. Schmidt

*Chromosome number.*  $2n=40^*$ .

*Voucher specimen.* VLA 8460, Kuriles, Kunashir Island, Alyokhina Bay, the mouth of Alyokhina River, on the gravel, 19.VIII.1999, coll. V. Barkalov.

*Distribution.* Southern Sakhalin, South Kuriles; Japan (?). Riverside and bank habitats.

*Note.* This species has been described from Sakhalin (Tunai). In the estimation of Tzvelyov (1989), *R. regelii* is close to *R. japonicus* Houtt., and also to *R. stenophyllus* Ledeb., the herbarium specimens being not numerous, further studies are needed to approve the validness of *R. regelii* as a species. From caryological point of view, these species are different in chromosome number: in *R. stenophyllus* (which is absent in Sakhalin and the Kuriles) we revealed a hexaploid number  $2n=60$ , from the Primorsky Territory (Probatova & Sokolovskaya, 1989), which is typical for *R. stenophyllus* (see in: Bolkhovskikh *et al.* 1969) and for *R. japonicus* the decaploid chromosome number  $2n=100$  have been reported (Kihara and Ono 1926), while *R. regelii* is shown to be tetraploid.

#### Family Ranunculaceae

##### 32. *Miyakea integrifolia* Miyabe et Tatew.

(*Pulsatilla integrifolia* (Miyabe et Tatew.) Worosch.)

*Chromosome number.*  $2n=16$ .

*Voucher specimen.* VLA 8949, Sakhalin, Nabiljsky Mountain Range, Chamginsky Pass, the upper part of the rivulet (the right affluent of Khrebtovy Spring), the

spot elevation "1511 m", stony slope, 8.VIII.2002, coll. V. Barkalov.

*Distribution.* Northern Sakhalin. Endemic. Rare species. Rocky places.

*Note.* The chromosome number in *M. integrifolia* has been reported by Volkova and Ulanova (1986), Zakharjeva, in Agapova *et al.* (1993), Starodubtsev (1997, as *Pulsatilla integrifolia*).

## Family Scrophulariaceae

### 33. *Pedicularis schistostegia* Vved.

(*P. venusta* var. *schmidtii* Nakai; *P. venusta* auct., p.p.)

*Chromosome number.*  $2n=16^*$ .

*Voucher specimen.* VLA 8464, Kuriles, Urup Island, Tetyajeva Bay, on the slope of marine terrace, meadow, 8.VIII.2000, coll. V. Barkalov.

*Distribution.* Southern Sakhalin, South Kuriles; Japan. Rocks and meadows.

*Note.* *P. schistostegia* (described from Sakhalin: Manue) is close to continental southern Siberian-Far East species *P. venusta* Schang. ex Bunge, for the latter the chromosome number  $2n=16$  was known from Siberia (see Agapova *et al.* 1993).

## General remarks

Now chromosome numbers are known for 340 species of vascular plants of Sakhalin, accounting for about 24 % of the total number of vascular plant species, in the Kuriles, 251 species (nearly 18% of the total flora), and in Moneron, 20 species are studied. In total, for 505 species from these islands chromosome counts now exist. The compiling of the book on caryology of the flora of Sakhalin and the Kurile Islands is in progress, with complete data and a brief analysis.

## Acknowledgements

This study was supported in part by a Grant-in-Aid for Scientific Research (B) from the Japan Society for the Promotion of Science, n. 13575008 (to H. Takahashi), in 2001–2003.

Also this work was partly supported by Grants NN 98-04-49455, 98-04-49444, 01-04-49430 and 04-04-49750 from the Russian Fund for Basic Research (RFBR).

## References

- AGAPOVA, N.D., ARKHAROVA, K.B., VAKHTINA, L.I., ZEMSKOVA, E.A. AND TARVIS, L.V., 1990. Chromosome numbers in flowering plants of the flora of the U.S.S.R. *Aceraceae-Menyanthaceae*. In: A.L. TAKHTAJAN, ed. 509 pp. Nauka, Leningrad. (In Russian.)
- AGAPOVA, N.D., ARKHAROVA, K.B., VAKHTINA, L.I., ZEMSKOVA, E.A. AND TARVIS, L.V., 1993. Chromosome numbers in flowering plants of the flora of the U.S.S.R. *Moraceae-Zygophyllaceae*. In: A.L. TAKHTAJAN, ed. 430 pp. Nauka, St.-Petersbourg. (In Russian.)
- BERKUTENKO, A.N., 1988. *Brassicaceae*. In: S.S. KHARKEVICH, ed. Vascular plants of the Soviet Far East, Vol. 3, pp. 38–115. Nauka, Leningrad. (In Russian.)
- BOLKHOVSKIKH, Z., GRIF, V., MATVEJEVA, T. AND ZAKHARYEVA, O., 1969. Chromosome numbers of the flowering plants. In: AN.A. FEDOROV, ed. 926 pp. Nauka, Leningrad. (In Russian.)
- CHEREPANOV, S.K., 1995. Vascular plants of Russia and of neighbouring territories (within the limits of the former U.S.S.R.). 992 pp. *Miry Semyja* 95, St.-Petersbourg. (In Russian.)
- DAWE, J.C. AND MURRAY, D.F., 1979. In: IOPB chromosome number reports LXIII. *Taxon* 28, 265–268.
- GOLDBLATT, P. ed., 1981. Index to plant chromosome numbers 1975–1978. *Monogr. Syst. Bot.* 5, 553 pp. Missouri Botanical Garden, USA.
- GOLDBLATT, P. ed., 1984. Index to plant chromosome numbers 1979–1981. *Monogr. Syst. Bot.* 8, 427 pp. Missouri Botanical Garden, USA.
- GOLDBLATT, P. ed., 1985. Index to plant chromosome numbers 1982–1983. *Monogr. Syst. Bot.* 13, 224 pp. Missouri Botanical Garden, USA.
- GOLDBLATT, P. ed., 1988. Index to plant chromosome numbers 1984–1985. *Monogr. Syst. Bot.* 23, 264 pp. Missouri Botanical Garden, USA.
- GOLDBLATT, P. AND JOHNSON, D.E. eds., 1990. Index to plant chromosome numbers 1986–1987. *Monogr. Syst. Bot.* 30, 243 pp. Missouri Botanical Garden, USA.
- GOLDBLATT, P. AND JOHNSON, D.E. eds., 1991. Index to plant chromosome numbers 1988–1989. *Monogr. Syst. Bot.* 40, 238 pp. Missouri Botanical Garden, USA.
- GOLDBLATT, P. AND JOHNSON, D.E. eds., 1994. Index to plant chromosome numbers 1990–1991. *Monogr. Syst. Bot.* 51, 267 pp. Missouri Botanical Garden, USA.
- GOLDBLATT, P. AND JOHNSON, D.E. eds., 1998. Index to plant chromosome numbers 1994–1995. *Monogr. Syst. Bot.* 69, 208 pp. Missouri Botanical Garden, USA.
- GOLDBLATT, P. AND JOHNSON, D.E. eds., 2000. Index to plant chromosome numbers 1996–1997. *Monogr. Syst. Bot.* 81, 188 pp. Missouri Botanical Garden, USA.
- GURZENKOV, N.N., 1973. Chromosome numbers study on the plants from the south of the Far East. In: V.L. KOMAROV Memorial Lectures. Vladivostok 20, 47–62. (In Russian.)
- GURZENKOV, N.N. AND GOROVY, P.G., 1971. Chromosome numbers of the *Umbelliferae* in the Far East. *Bot. Zh.* 56(12), 1805–1815. (In Russian.)
- GURZENKOV, N.N. AND PAVLOVA, N.S., 1984. Chromosome numbers in the representatives of *Astragalus* and *Oxytropis* (*Fabaceae*) from the Far East of the USSR. *Bot. Zh.* 69 (11), 1569–1570. (In Russian.)

- HARRIMAN N.A. AND REDMOND, D., 1976. Somatic chromosome numbers for some North American species of *Juncus* L. // *Rhodora*. 78, 727–738.
- HEILBORN, O., 1927. Chromosome numbers in *Draba*. *Hereditas* 9 (1), 59–68.
- IKEDA, H., 1988. Karyomorphological studies on the genus *Crepis* with special reference to C-banding pattern. *J. Sci. Hiroshima Univ. Ser. B, Div. 2, Bot.* 22, 65–117.
- KHARKEVICH, S.S. ed., 1985–1996. Vascular plants of the Soviet Far East. Vol. 1, 1985, 398 pp.; vol. 2, 1987, 446 pp.; vol. 3, 1988, 421 pp.; vol. 4, 1989, 380 pp.; vol. 5, 1991, 390 pp.; vol. 6, 1992, 428 pp.; vol. 7, 1995, 395 pp.; vol. 8, 1996, 383 pp. Nauka, Leningrad-St.-Petersbourg. (In Russian.)
- KIHARA, H. AND ONO, T., 1926. Chromosomenzahlen und systematische Gruppierung der *Rumex*-Arten. *Zeitschr. Zellforsch. u. mikrosk. Anat.* 4 (3), 475–481.
- KOROBKOV, A. A., 1981. The genus *Artemisia* L. in the North-East of the U.S.S.R. 120 pp. Leningrad, Nauka. (In Russian.)
- KRASNOBOROV, I.M., ROSTOVTSEVA, T.S. AND LIGUS, S.A., 1980. Chromosome numbers in some plant species from South Siberia and Far East. *Bot. Zh.* 65 (5), 659–668. (In Russian.)
- KROGULEVICH, R. E., 1976. The role of polyploidy in genesis of the flora of Putorana. In: *Flora of Putorana*. Nauka: Novossibirsk. P. 217–235. (In Russian.)
- KROGULEVICH, R.E. AND ROSTOVTSEVA, T.S., 1984. Chromosome numbers in flowering plants of Siberia and Far East. Nauka, Novossibirsk. 286 pp. (In Russian.)
- MIDDLETON, D.J. AND WILCOCK, C.C., 1990. Chromosome counts in *Gaultheria* and related genera. *Edinburgh J. Bot.* 47, 303–313.
- MULLIGAN, G.A., 1966. Chromosome numbers of the family *Cruciferae*. III. *Canad. J. Bot.* 44 (3), 309–319.
- NISHIKAWA, T., 1980. Chromosome counts of flowering plants of Hokkaido (3). *J. Hokkaido Univ. Educ., Sect. 2B*, 31, 19–23.
- NISHIKAWA, T., 1984. Chromosome counts of flowering plants of Hokkaido (7). *J. Hokkaido Univ. Educ., Sect. 2B*, 35, 31–42.
- NISHIKAWA, T., 1985. Chromosome counts of flowering plants of Hokkaido (9). *J. Hokkaido Univ. Educ., Sect. 2B*, 36, 25–40.
- NISHIKAWA, T., 1988. Chromosome counts of flowering plants of Hokkaido (11). *J. Hokkaido Univ. Educ., Sect. 2B*, 38, 33–40.
- PROBATOVA, N.S., 1984. New taxa of *Poaceae* from the Far East of the U.S.S.R. *Bot. Zh.* 69 (2), 251–259.
- PROBATOVA, N.S., 2003. *Poaceae*. In: S.S. KHARKEVICH AND N.N. TZVELEV, eds. *Vascular plants of the Russian Far East*, Vol. 1, pp. 87–488. Science Publishers, Enfield (NH), USA.
- PROBATOVA, N.S., BARKALOV, V. YU., RUDYKA, E.G. AND SHATALOVA, S.A., 2000. Chromosome study on vascular plants of the Kurile islands. *Nat. Hist. Res.* [Chiba, Japan]. Special Issue 7, 21–38.
- PROBATOVA, N.S. AND SOKOLOVSKAYA, A.P., 1981. Chromosome numbers in some aquatic and riverside species of the flora of the Amur River basin, in connection with peculiarities of its formation. *Bot. Zh.* 66 (11), 1584–1594. (In Russian.)
- PROBATOVA, N.S. AND SOKOLOVSKAYA, A. P., 1986. Chromosome numbers in vascular plants from the Far East of the U.S.S.R. *Bot. Zh.* 71 (11), 1572–1575. (In Russian.)
- PROBATOVA, N.S. AND SOKOLOVSKAYA, A.P., 1989. Chromosome numbers in vascular plants from the Primorsky Territory, Amur River basin, Sakhalin, Kamchatka and Kurile Islands. *Bot. Zh.* 74 (1), 120–123. (In Russian.)
- PROBATOVA, N.S. AND SOKOLOVSKAYA, A.P., 1990. Chromosome numbers in some representatives of the families *Asclepiadaceae*, *Asteraceae*, *Boraginaceae*, *Chenopodiaceae*, *Lamiaceae*, *Oleaceae*, *Onagraceae*, *Scrophulariaceae*, *Solanaceae*, *Urticaceae* from the soviet Far East. *Bot. Zh.* 75 (11), 1619–1622. (In Russian.)
- SHIGENOBU, Y., 1982. Karyomorphological studies on *Gentiana jamesii*, *G. nipponica* and *G. nipponica* var. *robusta*. *J. Jap. Bot.* 57, 337–342.
- SHIGENOBU, Y., 1984. Karyomorphological studies in some genera of *Gentianaceae*. II. *Gentiana* and its allied four genera. *Bull. Coll. Child Develop., Kochi Womens Univ.* 8, 55–104.
- SNOGERUP, S., 1963. Studies in the genus *Juncus*. III. Observation on the diversity of chromosome numbers. *Bot. Notiser.* 116 (2), 142–156.
- SOKOLOVSKAYA, A.P., 1960. Geographical distribution of polyploid plant species. Study on the flora of Sakhalin. *Proc. Leningrad Univ., Biol.* 21 (4), 42–58. (In Russian.)
- SOKOLOVSKAYA, A.P., 1963. Geographical distribution of polyploid plant species. Study on the flora of Kamchatka Peninsula. *Proc. Leningrad Univ., Biol.* 3 (15), 38–52. (In Russian.)
- SOKOLOVSKAYA, A.P., 1966. Geographical distribution of polyploid plant species. Study on the flora of Primorsky Territory. *Proc. Leningrad Univ., Biol.* 1 (3), 92–106. (In Russian.)
- SOKOLOVSKAYA, A.P., 1968. Caryological study on the flora of Koryakskaya Land. *Bot. Zh.* 53 (1), 99–105. (In Russian.)
- SOKOLOVSKAYA, A.P., PROBATOVA, N.S. AND RUDYKA, E.G., 1989. Chromosome numbers in some species of the flora of the soviet Far East from the families *Actinidiaceae*, *Aristolochiaceae*, *Fabaceae*, *Ranunculaceae*, *Saxifragaceae*. *Bot. Zh.* 74 (2), 268–271. (In Russian.)
- STARODUBTSEV, V.N. 1997. Chromosome numbers in some rare species of vascular plants from the Russian Far East. *Bot. Zh.* 82 (5), 121–122.
- TAKAHASHI, H., KUWAHARA, Y., GAGE, S., SEMSROTT, B. AND BARKALOV, V. Y., 2000. Distribution and habitat of *Draba grandis* Langsd. (*Brassicaceae*) in the Kurils. *J. Phytogeogr. Taxon.* 48, 59–62.
- TZVELEV, N.N., 1989. *Polygonaceae*. In: S.S.

- KHARKEVICH, ed. Vascular plants of the Soviet Far East, Vol. 4, 25–122. Nauka, Leningrad. (In Russian.)
- TZVELYOV, N.N., 1996. *Lentibulariaceae*. In: S.S. KHARKEVICH, ed. Vascular plants of the Soviet Far East, Vol. 8, 260–267. Nauka, St.-Petersbourg. (In Russian.)
- TZVELYOV, N.N. AND ZHUKOVA, P.G., 1986. Caryotaxonomic study on *Taraxacum* (*Asteraceae*) of North-East Asia. *Bot. Zh.* 71 (12), 1621–1628. (In Russian.)
- VOLKOVA, S.A. AND ULANOVA, K.P., 1986. Chromosome numbers in some species of *Nelumbonaceae* and *Ranunculaceae* from the Far East of the U.S.S.R. *Bot. Zh.* 71 (12), 1692. (In Russian.)
- ZHUKOVA, P.G., 1967. Chromosome numbers in some plant species from the Extreme North-East of the U.S.S.R. *Bot. Zh.* 52 (7), 983–987. (In Russian.)
- ZHUKOVA, P.G., 1980. Chromosome numbers in some plant species of South Chukotka. *Bot. Zh.* 65 (1), 51–59. (In Russian.)
- ZHUKOVA, P.G. AND PETROVSKY, V.V., 1980. Chromosome numbers and taxonomy in some plant species from Anyujskoe Upland. *Bot. Zh.* 65 (5), 651–659. (In Russian.)
- ZHUKOVA, P.G. AND PETROVSKY, V.V., 1984. Cytotaxonomic study on some *Brassicaceae* species from North Asia. *Bot. Zh.* 69 (2), 236–240. (In Russian.)
- ZHUKOVA, P.G., PETROVSKY, V.V. AND PLIEVA, T.V., 1973. Chromosome numbers and taxonomy in some plant species of Siberia and the Far East. *Bot. Zh.* 58 (9), 1331–1342. (In Russian.)