
REVIEW ARTICLES

ОБЗОРНЫЕ СТАТЬИ

ORCHIDS OF RUSSIA: ANNOTATED CHECKLIST AND GEOGRAPHIC DISTRIBUTION

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A checklist of orchids is presented for Russia. Data from the project «Biodiversity Mapping of Orchidaceae of Russia» are supplemented by the literature data in order to analyse the geographical distribution of species. We consider that the orchid diversity of Russia comprises 135 species and 13 subspecies belonging to 38 genera, including several taxa with status «uncertain for Russia»: *Dactylorhiza majalis*, *D. sambucina*, *Epipactis purpurata*, *Cephalanthera caucasica*, *Anacamptis laxiflora* subsp. *palustris*, and *Platanthera komarovii* subsp. *maximovicziana*. Krasnodarsky Krai has the highest number of orchid species (56 species), followed by Sakhalin Region (50), Republic of Dagestan (49), Republic of Crimea (45), Primorsky Krai (42), and Khabarovsk Krai (41). Only in Astrakhan Region there are no orchids known. One species (*Anacamptis laxiflora*, from one locality) is known from the Republic of Kalmykia, three species from Chukotsky Autonomous Okrug, eight species from Nenetsky Autonomous Okrug. *Gymnadenia conopsea* is the most widely distributed species, being found in 74 regions (90%), followed by *Corallorhiza trifida* (73 regions), *Dactylorhiza incarnata* (72), and *D. viridis* (71). Twenty-five species are known from only one administrative region. Eleven of them have been found in Sakhalin Region, four of them in Republic of Dagestan. *Cephalanthera erecta*, *Epipactis euxina*, and *E. leptochila* subsp. *neglecta* are the rarest orchids in Russia (excluding the ones with «uncertain for Russia» status), considering the number of localities: each of these species is known from the unique locus. Two endemic species have been registered in Russia: *Epipactis euxina* and *E. krymmontana*. Both species have been described recently. So their distribution demands future studies: supposedly, they may be found in the Caucasus region outside Russia. *Liparis loeselii* subsp. *sachalinensis* is another endemic for Russia at the subspecies rank. However, this taxon is uncertain and may be a synonym of *L. loeselii* subsp. *loeselii*. *Neottia krasnojarsica* and *N. ussuriensis*, earlier reported as endemics of Russia, are treated here as synonyms of *N. nidus-avis* and *N. acuminata*, respectively. *Chamorchis alpina* and *Liparis loeselii* subsp. *sachalinensis* are the taxa with the highest probability of extinction in Russia.

Key words: biodiversity mapping, geographical analysis, nature conservation, Orchidaceae, rare species, regions of Russia, vascular plants

Introduction

Over the last few decades, there has been a substantial increase of new data about the systematics and taxonomy of Orchidaceae, largely based on molecular polymorphism studies. This is especially true for orchids in the temperate climatic zone. Particularly, their systematics at the genus level is currently developed in detail, and much effort is put in the infra-genera classification issues. Knowledge about the orchid species of Russia is integrating step-by-step into the worldwide dataset. The composition of many taxonomically problematic orchid genera, such as *Epipactis* Zinn, *Platanthera* Rich., *Liparis* Rich., and some others, received in-depth studies in Russia. New catalogues of orchids of many administrative regions of Russia were published or their publication is underway, examples are the Crimea (Fateryga, 2019) or the Asian part of Russia (Chepinoga et al., unpub-

lished). However, a new catalogue of orchids of the whole Russian territory has never been compiled up to now. The current contribution aims to fill this gap.

The taxonomical background for the current catalogue comprises numerous up-to-date data on the orchid systematics and taxonomy. In our study, the priority has been given to the research performed for the Russian territory. Recently, the revisions of several genera have been performed in Russia: *Cypripedium* L. (Averyanov, 2000), *Epipactis* (Fateryga & Fateryga, 2018), *Liparis* (Efimov, 2010), *Ophrys* L. (Fateryga et al., 2018), three genera, *Anacamptis* Rich., *Neotinea* Rchb.f., and *Orchis* L. s.str., earlier included in *Orchis* s.l. (Kuropatkin & Efimov, 2014), *Serapias* L. (Averyanova, 2019), *Spiranthes* Rich. (Averyanov, 1998), and *Traunsteinera* Rchb. (Kuropatkin, 2013). Extremely important data about the systematics of particular species belonging to the

genera *Cephalanthera* Rich. (Fateryga et al., 2020), *Neottia* Guett. (Efimov, 2019), *Gymnadenia* R.Br. (Kulikov & Filippov, 2011; Efimov, 2013), and *Dactylorhiza* Neck. ex Nevski (e.g. Shipunov et al., 2004; Pedersen, 2006; Shipunov & Efimov, 2015; Efimov et al., 2016) have been taken into account. Genus taxonomy and nomenclature mostly follow the «Genera Orchidacearum» project (Pridgeon et al., 1999, 2001, 2003, 2005, 2009, 2014).

The current catalogue is supplemented by a geographical analysis of distribution of orchid species in Russia in regard to the state administrative subdivision. Detailed data about distribution of particular species in certain regions of Russia were supplied by a database from a new project «Biodiversity Mapping of Orchidaceae of Russia». This project has been launched in 2017 at the Komarov Botanical Institute of the Russian Academy of Sciences (Efimov et al., 2018) and aims to analyse the orchid species dynamics and developing of a detailed «Atlas of Orchids of Russia», presenting the historical and current distribution of every orchid species as known to date.

Data collection for the project «Biodiversity Mapping of Orchidaceae of Russia» is a two-step process. First of all, the data from the 20–25 main herbarium collections of Russia have been pooled and analysed. Then the regional correspondents from particular administrative units of Russia will contribute the detailed data on a mutually beneficial basis. Currently, the first stage of the project is about to be accomplished. Orchids from the main herbarium collections of Russia have been examined either personally or after digital images, the label information has been put into the database, the data have been attributed in regard to present-day administrative units, and the geotagging is currently underway. At this stage, a special database, which includes entries of orchid localities of Russia, is developed rather in detail. It allows presenting first generalised data about the orchids of Russia in the form of a checklist and to provide the first overview on the geographic distribution of orchids of Russia in general.

Material and Methods

The main data source for this study is the ongoing database, which is a part of the project «Biodiversity Mapping of Orchidaceae of Russia». The database currently holds 73 338 entries, mainly herbarium data. The proportions of literature data and observations are still minimal (11% and 3%, respectively). The following herbarium collections were studied: LE, MW, MHA, LECB, VLA, TK, ALTB, NS, NSK, KFTA, SYKO, PKM, YALT,

LENUD, KPABG (partly), IRKU, VBGI, SVER, MOSP, UFA, IRK, SARAT, PERM, SAKH, NNSU, CSAU, UDU (partly), H (partly), KW (partly), KBHG, KUZ, SIMF, UUH, KBAI, CSR, PVB, and KHA. Small collections of less than 10 000 herbarium specimens in total are not mentioned here. Data from the two most important crowdsourcing online projects, www.inaturalist.org («iNat») and www.plantarium.ru («Plantarium»), were used as well. All images from both sources were checked and, if needed, re-determined according to the accepted methods. It should be noted that the determinations of particular entries from «iNat» and «Plantarium» accepted in the present study may have been changed by later redeterminations. However, the determinations accepted here could always be traced by the logs in «iNat» and «Plantarium». They have been published under the name of the author of this article.

The database uses much of original material, such as originally examined herbarium specimens, as well as crowdsourcing online datasets, original literature, personal communications, etc. The use of «secondary» data, such as published maps, generalised lists of localities, lists of herbarium specimens, etc. was avoided whenever possible. The «secondary» data tend to accumulate progressively incorrect data, such as incorrect determinations and inaccurately geotagged material.

One of the important issues for using this database for correct geographic analysis lies in the incomplete data delivery from numerous small regional herbaria and other local sources. So the extraction of full lists of orchid taxa for particular regions may be unavailable from the database. Therefore, information from a local Red Data Book list or recent floristic account has been used for the analysis as well, as a temporary measure. The full list of literature sources is provided in Appendix. In case of discrepancy between our dataset and literature data, priority was given to that providing more complete data. Exceptional priority to original dataset has been given for *Dactylorhiza* species (except *D. aristata* (Fisch. ex Lindl.) Soó, *D. iberica* (M.Bieb. ex Willd.) Soó, and *D. viridis* (L.) R.M.Bateman, Pridgeon & M.W.Chase), because the literature data are often unreliable due to many incorrect determinations of these species.

The diversity of the orchid species in Russia has been analysed in regard to the 1st-level administrative subdivision principle, meaning that Russia consists of 85 «federal subjects», further referred as «regions». Federal cities (Saint-Petersburg, Moscow, and Sevastopol) have formally been included

into their larger nearest regions, Leningrad Region, Moscow Region, and the Republic of Crimea, respectively. Thus, complete lists of orchid species have been compiled and analysed for each of these 82 regions. The dividing of the Russian territory into «large geographical units» («LGUs»), which are groups of adjacent regions analysed as a whole, is a simplified, but more convenient approach. There are fourteen LGUs: north-western European Russia (Leningrad Region, Novgorod Region, and Pskov Region), «Fennoscandian» Russia (Republic of Karelia, Murmansk Region), northeastern European Russia (Nenetsky Autonomous Okrug, Arkhangelsk Region, Vologda Region, Kostroma Region, and Republic of Komi), central European Russia (Belgorod Region, Bryansk Region, Ivanovo Region, Kaliningrad Region, Kaluga Region, Kursk Region, Lipetsk Region, Moscow Region, Orel Region, Rostov Region, Ryazan Region, Smolensk Region, Tambov Region, Tula Region, Tver Region, Vladimir Region, Voronezh Region, and Yaroslavl Region), Volga region (Astrakhan Region, Nizhniy Novgorod Region, Penza Region, Samara Region, Saratov Region, Ulyanovsk Region, Volgograd Region, Republics of Chuvashia, Kalmykia, Mari El, Mordovia, Tatarstan, and Udmurtia), Crimea (Republic of Crimea), Caucasus (Krasnodarsky Krai, Stavropolsky Krai, Republics of Adygeya, Chechnya, Dagestan, Ingushetia, Kabardino-Balkaria, Karachay-Cherkessia, North Ossetia-Alania), Urals (Permsky Krai, Chelyabinsk Region, Orenburg Region, Sverdlovsk Region, Republic of Bashkortostan), western Siberia (Khanty-Mansi Autonomous Okrug, Yamalo-Nenetsky Autonomous Okrug, Kurgan Region, Omsk Region, and Tyumen Region), southern Siberia (Altaisky Krai, Kemerovo Region, Novosibirsk Region, Tomsk Region, Republic of Altai), Yenisei Siberia (Krasnoyarsky Krai, Republic of Khakassiya, Tyva Republic), eastern Siberia (Trans-Baikalsky Krai, Irkutsk Region, Republic of Buryatia), southern Far East of Russia (Jewish Autonomous Region, Khabarovsk Krai, Primorsky Krai, Amur Region, and Sakhalin Region), northern Far East of Russia (Chukotsky Autonomous Okrug, Kamchatsky Krai, Magadan Region, and Republic of Yakutia).

Results

Checklist of orchids in Russia

The diversity of orchids in Russia comprises up-to-date 135 species (Table 1). Nine species, (*Anacamptis morio* (L.) R.M. Bateman, Pridgeon & M.W. Chase, *Dactylorhiza romana* (Sebast.) Soó,

Epipactis leptochila (Godfery) Godfery, *Ophrys mammosa* Desf., *Orchis militaris* L., *O. purpurea* Huds., *Platanthera chorisiana* (Cham.) Rehb.f., *P. densa* Freyn, and *P. komarovii* Schltr.), are divided into two subspecies, two species, (*Anacamptis laxiflora* (Lam.) R.M. Bateman, Pridgeon & M.W. Chase, *Liparis loeselii* (L.) Rich.), are divided into three subspecies. Three species, (*Anacamptis collina* subsp. *fedtschenkoi* (Czerniak.) Kuropatkin & Efimov, *A. papilionacea* subsp. *schirwanica* (Woronow) H. Kretzschmar, Eccarius & H. Dietr., and *Serapias orientalis* subsp. *feldwegiana* (H.Baumann & Künkele) Kreutz), are represented in Russia by non-nominative subspecies only.

The orchid species of Russia belong to 38 genera; 22 genera are monotypic in Russia. The highest species richness is noted in the genus *Dactylorhiza* (18 species), followed by *Epipactis* (16), *Platanthera* (15), *Neottia* (8), *Orchis* (8), *Cephalanthera* (7), *Anacamptis* (6), *Cypripedium* (5), and *Liparis* (5 species), but the number of *Liparis* species may be seriously underestimated.

Regard must be paid to some taxonomical issues in the checklist, which are still ambiguous and deserve further studies. Thus, large taxonomical controversy is performed by the taxa with large distribution areas, which show a geographically-correlated variability. Most often, this is a problem of taxonomic rank choice, which is usually based on a personal opinion rather than resolved on solid grounds. Absence of such taxa as *Dactylorhiza umbrosa* (Kar. et Kir.) Nevski and *Platanthera ditmariana* Kom., or presence of such species as *Epipactis papillosa* Franch. & Sav. and *Neottia papilligera* Schltr. in our list both represent such cases. Large-scale variation in species-level taxonomy concerns genus *Dactylorhiza*, which is characterised by numerous morphological forms of basic diploid species (mostly not accepted in the present study) and numerous allopolyploid taxa (accepted here as full species). Future study of orchids will inevitably shed new light on the taxonomy of such taxonomically problematic groups. In some cases, more taxa may be added to the orchid flora of Russia. Currently we may underestimate the diversity in the genera that include cryptic taxa, such as *Gymnadenia* or *Liparis*. More taxa may be also discovered in genus *Epipactis*, if one is going to accept autogamic species that are morphologically weakly delimited, but occur over large geographical areas. In the Caucasus region, *Dactylorhiza* may be underestimated in regard to allotetraploid taxa other than *D. urvilleana* (Steud.) H.Baumann & Künkele (Hedrén, 2001).

Table 1. Checklist of orchids in Russia and their distribution along Large Geographic Units

№	Species	Subspecies	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	<i>Anacamptis collina</i> (Banks & Sol. ex Russell) R.M.Bateman, Pridgeon & M.W.Chase	subsp. <i>fedtschenkoi</i> (Czerniak.) Kuropatkin & Efimov							+							
2	<i>A. coriophora</i> (L.) R.M. Bateman, Pridgeon & M.W. Chase					+	+	+	+							
3	<i>A. laxiflora</i> (Lam.) R.M. Bateman, Pridgeon & M.W. Chase	subsp. <i>dielsiana</i> (Soó) H. Kretzschmar, Eccarius & H. Dietr.				+	+		+							
		subsp. <i>elegans</i> (Heuff.) Kuropatkin & Efimov						+								
		(?) subsp. <i>palustris</i> (Jacq.) Kuropatkin & Efimov				+										
4	<i>A. morio</i> (L.) R.M. Bateman, Pridgeon & M.W. Chase	subsp. <i>caucasica</i> (K. Koch) H. Kretzschmar, Eccarius & H. Dietr.							+	+						
		subsp. <i>morio</i>				+										
5	<i>A. papilionacea</i> (L.) R.M. Bateman, Pridgeon & M.W. Chase	subsp. <i>schirwanica</i> (Woronow) H. Kretzschmar, Eccarius & H. Dietr.								+						
6	<i>A. pyramidalis</i> (L.) Rich.								+	+						
7	<i>Calypso bulbosa</i> (L.) Oakes		+	+	+	+	+				+	+	+	+	+	+
8	(?) <i>Cephalanthera caucasica</i> Kraenzl.								+							
9	<i>C. damasonium</i> (Mill.) Druce					+		+	+							
10	<i>C. epipactoides</i> Fisch. & C.A.Mey.								+							
11	<i>C. erecta</i> (Thunb.) Blume														+	
12	<i>C. longibracteata</i> Blume														+	
13	<i>C. longifolia</i> (L.) Fritsch					+	+	+	+	+						
14	<i>C. rubra</i> (L.) Rich.		+		+	+	+	+	+	+						
15	<i>Chamorchis alpina</i> (L.) Rich.			+												
16	<i>Corallorhiza trifida</i> Châtel.		+	+	+	+	+	+	+	+	+	+	+	+	+	+
17	<i>Cremastra appendiculata</i> (D.Don) Makino														+	
18	<i>Cypripedium calceolus</i> L.		+	+	+	+	+	+		+	+	+	+	+	+	+
19	<i>C. guttatum</i> Sw.				+	+	+			+	+	+	+	+	+	+
20	<i>C. macranthos</i> Sw.				+	+	+			+	+	+	+	+	+	+
21	<i>C. shanxiense</i> S.C.Chen														+	+
22	<i>C. yatabeanum</i> Makino														+	+
23	<i>Dactylorhiza amblyoloba</i> (Nevski) Aver.								+							
24	<i>D. aristata</i> (Fisch. ex Lindl.) Soó														+	+
25	<i>D. baltica</i> (Klinge) Nevski		+	+	+	+	+									
26	<i>D. euxina</i> (Nevski) Czerep.								+							
27	<i>D. fuchsii</i> (Druce) Soó		+	+	+	+	+			+	+	+	+	+	+	+
28	<i>D. iberica</i> (M.Bieb. ex Willd.) Soó								+	+						
29	<i>D. incarnata</i> (L.) Soó		+	+	+	+	+	+	+	+	+	+	+	+	+	+
30	<i>D. maculata</i> (L.) Soó		+	+	+	+	+			+	+	+	+			
31	(?) <i>D. majalis</i> (Rchb.) P.F.Hunt & Summerh.						+									
32	<i>D. ochroleuca</i> (Wüstnei ex Boll) Holub		+	+	+	+	+			+	+	+	+	+		
33	<i>D. psychrophila</i> (Schltr.) Aver.			+	+					+	+		+			
34	<i>D. romana</i> (Sebast.) Soó	subsp. <i>romana</i>							+							
		subsp. <i>georgica</i> (Klinge) Soó ex Renz & Taubenheim								+						
35	<i>D. salina</i> (Turcz. ex Lindl.) Soó								+			+	+	+		
36	(?) <i>D. sambucina</i> (L.) Soó					+										
37	<i>D. sibirica</i> Efimov									+	+	+	+	+	+	
38	<i>D. traunsteineri</i> (Saut. ex Rchb.) Soó		+	+	+	+	+			+	+	+				
39	<i>D. urvilleana</i> (Steud.) H.Baumann & Künkele								+							
40	<i>D. viridis</i> (L.) R.M.Bateman, Pridgeon & M.W.Chase		+	+	+	+	+	+	+	+	+	+	+	+	+	+
41	<i>Dactylostalix ringens</i> Rchb.f.														+	
42	<i>Eleorchis japonica</i> (A.Gray) Maek.														+	
43	<i>Epipactis atrorubens</i> (Hoffm.) Bess.		+	+	+	+	+			+	+	+				
44	<i>E. condensata</i> Boiss. ex D.P. Young								+							
45	<i>E. distans</i> Arv.-Touv.								+							
46	<i>E. euxina</i> Fateryga, Popovich & Kreutz								+							
47	<i>E. helleborine</i> (L.) Crantz		+	+	+	+	+	+	+	+	+	+	+	+	+	+
48	<i>E. krymmontana</i> Kreutz, Fateryga & Efimov								+	+						
49	<i>E. leptochila</i> (Godfery) Godfery	subsp. <i>leptochila</i>							+	+						
		subsp. <i>neglecta</i> Kämpel								+						

№	Species	Subspecies	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
50	<i>E. microphylla</i> (Ehrh.) Sw.							+	+								
51	<i>E. muelleri</i> Godfery							+	+								
52	<i>E. palustris</i> (Mill.) Crantz		+	+	+	+	+	+	+	+	+	+	+	+			
53	<i>E. papillosa</i> Franch. & Sav.														+	+	
54	<i>E. persica</i> (Soó) Hausskn. ex Nannf.							+	+								
55	<i>E. pontica</i> Taubenheim								+								
56	(?) <i>E. purpurata</i> Sm.					+											
57	<i>E. tangutica</i> Schltr.													+			
58	<i>E. thunbergii</i> A. Gray														+		
59	<i>Ehippianthus sachalinensis</i> Rchb.f.														+		
60	<i>Epipogium aphyllum</i> (F.W. Schmidt) Sw.		+	+	+	+	+	+	+	+	+	+	+	+	+	+	
61	<i>Galearis cyclochila</i> (Franch. & Sav.) Soó														+	+	
62	<i>Gastrodia elata</i> Blume														+		
63	<i>Goodyera henryi</i> Rolfe														+		
64	<i>G. repens</i> (L.) R.Br.		+	+	+	+	+	+	+	+	+	+	+	+	+	+	
65	<i>G. schlechtendaliana</i> Rchb.f.														+		
66	<i>Gymnadenia conopsea</i> (L.) R.Br.		+	+	+	+	+	+	+	+	+	+	+	+	+	+	
67	<i>G. densiflora</i> (Wahlenb.) A.Dietr.		+														
68	<i>G. odoratissima</i> (L.) Rich.					+				+							
69	<i>Habenaria linearifolia</i> Maxim.													+	+		
70	<i>H. yezoensis</i> H.Hara														+		
71	<i>Hammarbya paludosa</i> (L.) O. Kuntze		+	+	+	+	+			+	+	+		+	+	+	
72	<i>Herminium monorchis</i> (L.) R.Br.		+		+	+	+		+	+	+	+	+	+	+	+	
73	<i>Himantoglossum caprinum</i> (M.Bieb.) Spreng.							+	+								
74	<i>H. comperianum</i> (Steven) P.Delforge							+	+								
75	<i>H. formosum</i> (Steven) K.Koch								+								
76	<i>Limodorum abortivum</i> (L.) Sw.							+	+								
77	<i>Liparis japonica</i> (Miq.) Maxim.														+		
78	<i>L. krameri</i> Franch. & Sav.														+		
79	<i>L. kumokiri</i> F.Maek.								+				+		+	+	
80	<i>L. loeselii</i> (L.) Rich.	subsp. <i>loeselii</i>	+	+	+	+	+			+	+	+					
		subsp. <i>orientalis</i> Efimov											+	+	+		
		subsp. <i>sachalinensis</i> (Nakai) Efimov														+	
81	<i>L. makinoana</i> Schltr.														+		
82	<i>Malaxis monophyllos</i> (L.) Sw.	+	+	+	+	+				+	+	+	+	+	+	+	
83	<i>Myrmechis japonica</i> (Rchb.f.) Rolfe														+		
84	<i>Neolindleya camtschatica</i> (Cham.) Nevski														+	+	
85	<i>Neotinea tridentata</i> (Scop.) R.M. Bateman, Pridgeon & M.W. Chase							+	+								
86	<i>N. ustulata</i> (L.) R.M. Bateman, Pridgeon & M.W. Chase	+	+		+	+	+	+	+	+							
87	<i>Neottia acuminata</i> Schltr.														+	+	
88	<i>N. camtschatea</i> (L.) Rchb.f.											+	+	+	+	+	
89	<i>N. convallarioides</i> (Sw.) Rich.															+	
90	<i>N. cordata</i> (L.) Rich.	+	+	+	+	+			+	+	+	+	+	+	+	+	
91	<i>N. nidus-avis</i> (L.) Rich.	+	+	+	+	+	+	+	+	+	+	+	+	+			
92	<i>N. nipponica</i> (Makino) Szlach.														+		
93	<i>N. ovata</i> (L.) Bluff & Fingerh.	+	+	+	+	+	+	+	+	+	+	+	+	+			
94	<i>N. puberula</i> (Maxim.) Szlach.														+	+	
95	<i>N. papilligera</i> Schltr.														+		
96	<i>Ophrys apifera</i> Huds.							+	+								
97	<i>O. insectifera</i> L.	+	+	+	+	+				+							
98	<i>O. mammosa</i> Desf.	subsp. <i>caucasica</i> (Woronow ex Grossh.) Soó							+								
		subsp. <i>mammosa</i>						+	+								
									+	+							
99	<i>O. oestrifera</i> M.Bieb.							+	+								
100	<i>Orchis mascula</i> (L.) L.	+			+	+	+	+	+								
101	<i>O. militaris</i> L.	subsp. <i>militaris</i>	+	+	+	+				+	+	+	+	+		+	
		subsp. <i>stevenii</i> (Rchb.f.) B. Baumann, H. Baumann, Lorenz & Ruedi Peter							+	+							
102	<i>O. pallens</i> L.							+	+								
103	<i>O. provincialis</i> Balb. ex Lam. & DC.							+	+								
104	<i>O. punctulata</i> Steven ex Lindl.							+	+								

№	Species	Subspecies	1	2	3	4	5	6	7	8	9	10	11	12	13	14
105	<i>O. purpurea</i> Huds.	subsp. <i>caucasica</i> (Regel) B. Baumann, H. Baumann, Lorenz & Ruedi Peter subsp. <i>purpurea</i>							+							
106	<i>O. simia</i> Lam.							+	+							
107	<i>O. spitzelii</i> Saut. ex W.D.J. Koch								+							
108	<i>Oreorchis patens</i> (Lindl.) Lindl.														+	+
109	<i>Pecteilis radiata</i> (Thunb.) Raf.														+	
110	<i>Platanthera bifolia</i> (L.) Rich.		+	+	+	+	+	+	+	+	+	+	+	+	+	+
111	<i>P. chlorantha</i> (Cust.) Rchb.		+			+	+	+	+							
112	<i>P. chorisiana</i> (Cham.) Rchb.f.	subsp. <i>chorisiana</i> subsp. <i>elata</i> (Finet) Efimov ined.					+									+
113	<i>P. convallariifolia</i> (Fisch. ex Lindl.) Lindl.														+	+
114	<i>P. densa</i> Freyn														+	+
115	<i>P. dilatata</i> (Pursh) Lindl. ex L.C.Beck															+
116	<i>P. fuscescens</i> (L.) Kraenzl.											+	+	+	+	
117	<i>P. hologlottis</i> Maxim.													+	+	
118	<i>P. komarovii</i> Schltr.	subsp. <i>komarovii</i> (?) subsp. <i>maximowicziana</i> (Schltr.) Efimov														+
119	<i>P. metabifolia</i> F.Maek.															+
120	<i>P. oligantha</i> Turcz.											+	+	+	+	+
121	<i>P. ophrydioides</i> F.Schmidt															+
122	<i>P. sachalinensis</i> F.Schmidt															+
123	<i>P. tipuloides</i> (L.f.) Lindl.														+	+
124	<i>P. ussuriensis</i> (Regel) Maxim.															+
125	<i>Pogonia japonica</i> Rchb.f.															+
126	<i>Ponerorchis chusua</i> (D.Don) Soó															+
127	<i>P. cucullata</i> (L.) X.H.Jin, Schuit. & W.T.Jin				+	+	+			+	+	+	+	+	+	+
128	<i>P. kinoshitae</i> (Makino) X.H.Jin, Schuit. & W.T.Jin															+
129	<i>Pseudorchis albida</i> (L.) Á.Löve & D.Löve			+	+						+					
130	<i>Serapias orientalis</i> (Greuter) H.Baumann & Künkele	subsp. <i>feldwegiana</i> (H.Baumann & Künkele) Kreutz							+							
131	<i>Spiranthes sinensis</i> (Pers.) Ames								+	+	+	+	+	+	+	+
132	<i>S. spiralis</i> (L.) Chevall.								+							
133	<i>Steveniella satyrioides</i> (Spreng.) Schltr.								+	+						
134	<i>Traunsteinera globosa</i> (L.) Rchb.								+	+						
135	<i>T. sphaerica</i> (M.Bieb.) Schltr.								+							

Note: Large Geographic Units: 1 – north-western European Russia, 2 – «Fennoscandian» Russia, 3 – northeastern European Russia, 4 – central European Russia, 5 – Volga region, 6 – Crimea, 7 – Caucasus, 8 – Urals, 9 – western Siberia, 10 – southern Siberia, 11 – Yenissei Siberia, 12 – eastern Siberia, 13 – southern Far East of Russia, 14 – northern Far East Russia.

Hybrids are not included in the list, but those considered to be «species of hybrid origin» are included. Therefore, allotetraploid dactylorchids (*D. majalis* (Rchb.) P.F.Hunt & Summerh. aggregate) are listed as full taxa, whereas *Cypripedium* × *ventricosum* Sw. is not mentioned, although its localities may be locally important for conservation.

Orchids uncertain in Russia

Special attention should be paid to four species and two subspecies, which are included in the Flora of Russia on preliminary basis, as we do not know whether they are present here (or were historically present). These taxa are presented below.

1. *Dactylorhiza majalis*. It is an allotetraploid species. The eastern boundary of its distribution

range lies somewhere in between Central and Eastern Europe, i.e. approximately, coincides with the western border of Russia. Literature data about this species in Russia are numerous and confusing, because some other allotetraploid species, especially *D. baltica* (Klinge) Nevski, were often given this name. There are reports on *D. majalis* in Kaliningrad Region (Gubareva et al., 1999) and Bryansk Region (Fedotov, 2004). These are the areas of its most probable findings. The information from Kaluga Region, Kirov Region, and the Republic of Mari El (Bardunov & Novikov, 2008) is obviously mistaken. We have not seen any herbarium material of this taxon from Russia.

2. *Dactylorhiza sambucina* (L.) Soó. The eastern boundary of its distribution is similar

to *D. majalis*. It is also determined incorrectly quite often. However, *D. sambucina* is currently threatened with extinction, and old literature data cannot be checked when the herbarium specimens are absent. It is reported from Bryansk Region (Bossek, 1986; Fedotov, 2004). We have not seen any herbarium material of this taxon from Russia.

3. *Epipactis purpurata* Sm. The eastern boundary of its distribution is similar to *D. majalis*. It was reported from Kaliningrad Region (Gubareva et al., 1999). We have not seen any herbarium material of this taxon from Russia.

4. *Cephalanthera caucasica* Kraenzl. It is reported from Republic of Dagestan historically and nowadays (Grossheim, 1940; Murtazaliev, 2009). Three herbarium specimens have been found (LE!, DAG!, LENUD!). Therefore, four possible localities are known up-to-date. However, all the reports may refer to the hybrid *C. longifolia* (L.) Fritsch × *C. damasonium* (Mill.) Druce, which is similar to *C. caucasica*. Two of the three collections of *C. caucasica* were made together with *C. longifolia* or *C. damasonium* specimens. The main part of the geographic range of *C. caucasica* is situated around the south part of the Caspian Sea, including Talysh.

5. *Anacamptis laxiflora* subsp. *palustris*. Kalinin [= Tver] Region, Bologoye district, near Berezayka station, 20–22 June 1975, Matsenko (MHA!). A surprising collection from a locality isolated from the main range, the nearest localities are in the Baltic countries. A specimen may be mislabeled. The original determination was *Dactylorhiza baltica*, re-determined correctly by Pavel Kulikov in 1993.

6. *Platanthera komarovii* subsp. *maximovicziana* (Schltr.) Efimov. [Sakhalin Region] Kuril Islands, Chirpoi Island, Peschanaya Bay, grassland at the sea terrace, 3 August 2000, Barkalov 20546 – LE 1040765! This taxon belongs to the taxonomically ambiguous *P. mandarinorum* Rchb.f. aggregate. Its systematics was discussed in detail by Efimov (2016). Earlier, *P. komarovii* was referred to *P. maximoviczii* Schltr. or *P. cornu-bovis* Nevski in many literature sources. In fact, *P. komarovii* (= *P. cornu-bovis*) is represented by two subspecies, subsp. *komarovii* and subsp. *maximovicziana*, the latter usually inhabits higher altitudes and has been recorded only from Japan (Efimov, 2016). Transitional forms between the two subspecies are rare. At Kuril Islands, only subsp. *komarovii* is known. The

specimen cited above represents its northernmost locality. Vyacheslav Yu. Barkalov collected a similar specimen on the nearby Brat Chirpoyev Island (personal communication). It is not yet clear whether the plants from Chirpoi and Brat Chirvoyev Islands in fact represent subsp. *maximovicziana* or subsp. *komarovii*, which developed a *maximovicziana*-like morphology in the northern climate. In addition, it is possible that both subspecies may represent ecological forms rather than true taxa.

Discussion

Our estimates of 135 species of the orchid flora in Russia is quite close to earlier values of 126 species (Vakhrameeva et al., 2014), but the true difference obviously exceeds nine species. The list presented by these authors includes many species, which we consider to be synonymous to other species of orchids found in Russia (*Dactylorhiza cruenta* (O.F. Müll.) Soó, *D. russowii* (Klinge) Holub, *D. umbrosa*, *Liparis sachalinensis* Nakai, *Neottia ussuriensis* (Kom. & Nevski) Soó, *Ophrys taurica* Nevski, *Orchis cassidea* Biebl, *O. picta* Raf.) and a hybrid taxon *Cypripedium* × *ventricosum*. On the other hand, our list includes species not accepted by Vakhrameeva et al. (2014) (*Dactylorhiza amblyoloba* (Nevski) Aver., *D. ochroleuca* (Wüstnei ex Boll) Holub, *D. psychrophila* (Schltr.) Aver., *Gymnadenia densiflora* (Wahlenb.) A. Dietr.), discovered in Russia later (*Dactylorhiza sibirica* Efimov, *Epipactis euxina* Fateryga, Popovich & Kreutz, *E. krymmontana* Kreutz, Fateryga & Efimov, *E. leptochila*, *E. muelleri* Godfery, *E. persica* (Soó) Hausskn. ex Nannf., *E. pontica* Taubenheim, *E. tangutica* Schltr.), found only in Crimea (*Epipactis distans* Arv.-Touv.), or omitted by Vakhrameeva et al. (2014) for other reasons (*Anacamptis collina* (Banks & Sol. ex Russell) R.M. Bateman, Pridgeon & M.W. Chase, *A. papilionacea* (L.) R.M. Bateman, Pridgeon & M.W. Chase, *Cephalanthera caucasica*, *Epipactis condensata* Boiss. ex D. P. Young, *E. purpurata*). Many species are given under different binomial names, resulting in only 82 binomials in common for the two lists. If one compares our catalogue with earlier data, the difference would be even larger. For example, only 111–114 species are listed in the «Flora of USSR» (Nevski, 1935). The exact number is even unknown, because the distribution of taxa is given in this publication according to phytogeographic

regions, which do not correspond in many cases to the modern administrative border of Russia.

Orchid species richness in regard to Large Geographic Units

Orchid species are unevenly distributed over Russia. Arid and Arctic areas are characterised by a minimum number of orchid species, whereas afforested zones, especially humid subtropical regions, by a maximum number. A presence/absence matrix of species distribution over LGUs evidences that the most diverse orchid flora is found in the southern Far East of Russia and in the Caucasus region, with 64 and 63 species, respectively, followed by 45 species in Crimea and 43 species in central European Russia (Table 1). Other LGUs comprise from 28 up to 38 species. The minimal number of species (28) is characteristic for «Fennoscandian» Russia, which is a rather small area (two regions only) situated in the northern part of the country.

Orchid species richness in various administrative regions

Krasnodarsky Krai is characterised by the highest orchid species richness of 56 species (Fig. 1), followed by Sakhalin Region (50 species), Republic of Dagestan (49), Republic of Crimea (45), Primorsky Krai (42), Khabarovsk Krai (41), and Republic of Adygeya (38). The lowest orchid species richness is characteristic for arid areas and for the extreme North. Astrakhan Region is the only region with no orchid species. There is a very old sample of *Dactylorhiza incarnata* (L.) Soó labelled «Astrachan» (MW 296034!). But it was likely collected in the northern part of the former Astrakhan Province (= «Astrakhanskaya Guberniya») outside the modern Astrakhan Region. For a long time, no orchid species were known in the neighbouring Republic of Kalmykia, until 30 *Anacamptis laxiflora* plants were discovered in 2011 at Bezdonnoye bog in the Maloderbetovskiy district, near the village Plodovitoye (Baktasheva, 2014).

Three orchid species, *Corallorhiza trifida* Châtel., *Dactylorhiza viridis*, and *Platanthera oligantha* Turcz., are known in Chukotsky Autonomous Okrug, which is situated in the extreme North. Eight orchid species have been registered in another northern region, Nenetsky Autonomous Okrug, followed by Yamalo-Nenetsky Autonomous Okrug (10 species), Magadan Region (10), Rostov Region (12), and Volgograd Region

(14 species). The distribution of the number of administrative regions according to the number of orchid species is surprisingly very symmetrical, with maximum number of regions comprising 25–29 orchid species (Fig. 1).

Widely distributed orchid species in Russia

A diagram showing the Orchidaceae species richness per administrative region in Russia is presented in Fig. 2. The diagram is bimodal, indicating that orchid species characterised by narrow and wide distribution prevail, whereas those of intermediate values are rather few, found in 17–36 regions.

«Widely distributed» species are here arbitrarily considered to be present in more than half of the administrative regions. There are twenty-two «widely distributed» species in Russia (number of regions is shown in brackets): *Dactylorhiza maculata* (L.) Soó (43), *Liparis loeselii* (45), *Ponerorchis cucullata* (L.) X.H.Jin, Schuit. & W.T.Jin (47), *Cypripedium guttatum* (49), *Epipogium aphyllum* (F.W. Schmidt) Sw. (52), *Hammarbya paludosa* (L.) O. Kuntze (56), *Neottia cordata* (L.) Rich. (56), *Malaxis monophyllos* (L.) Sw. (57), *Dactylorhiza fuchsii* (Druce) Soó (59), *Cypripedium calceolus* L. (61), *Herminium monorchis* (L.) R.Br. (62), *Orchis militaris* (62), *Neottia nidus-avis* (L.) Rich. (63), *Epipactis palustris* (Mill.) Crantz (65), *Neottia ovata* (L.) Bluff & Fingerh. (67), *Epipactis helleborine* (L.) Crantz (68), *Goodyera repens* (L.) R.Br. (69), *Platanthera bifolia* (L.) Rich. (69), *Dactylorhiza viridis* (71), *D. incarnata* (72), *Corallorhiza trifida* (73), *Gymnadenia conopsea* (L.) R.Br. (74). All of them are taxa characterised by a wide distribution mostly in the boreal zone, either Holarctic or only in the Old World. *Gymnadenia conopsea* is the most widely distributed species, occurring in 90% of the Russian regions. This species is able to survive particularly both in arid and in cold climate. Therefore, it has probably the widest distribution in latitudinal direction. In addition, *G. conopsea* has a maximum number of entries (4787) in our database (6.5% of the total number of entries), significantly differing from the second most common species, *Dactylorhiza fuchsii*, with 4136 entries.

Rare orchid species in Russia

Twelve orchid species are found in three administrative regions, 15 species in two regions, and 25 species are registered in only one administrative region of Russia each (Fig. 2).

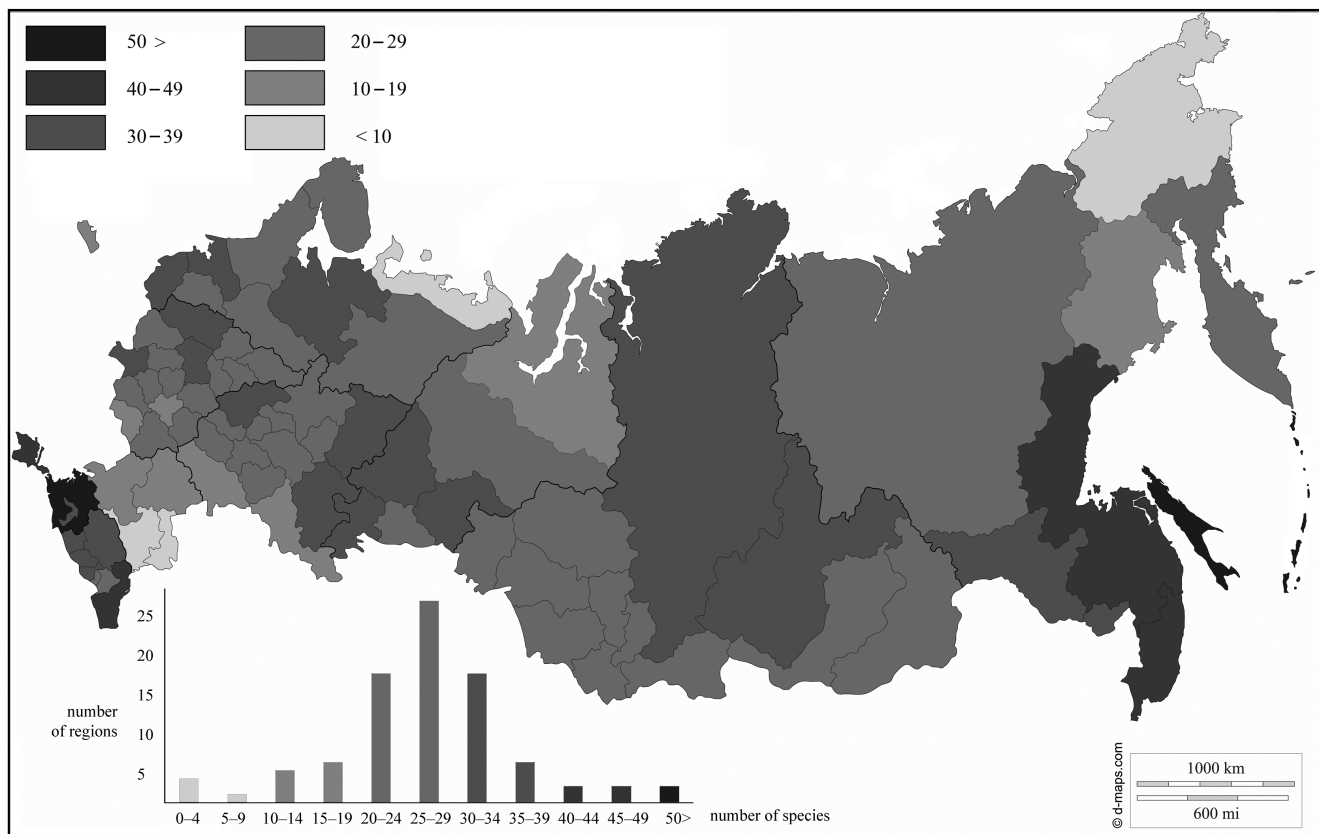


Fig. 1. Orchid species richness in the regions of Russia.

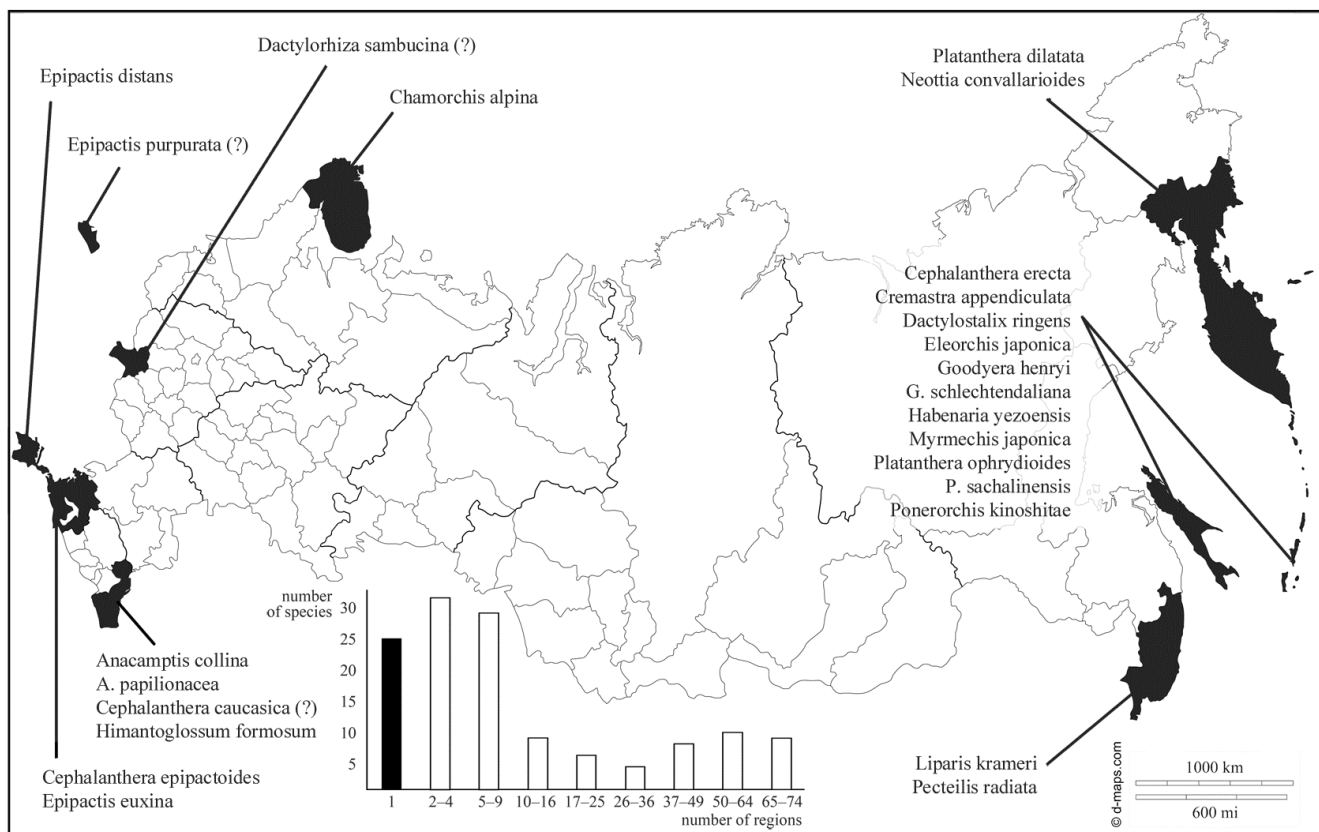


Fig. 2. Occurrence of orchid species in regard to the number of regions. Rare taxa found in one region only are shown on the map.

Only one species within the 25 mentioned above taxa, *Epipactis euxina*, is possibly a narrow endemic. The distribution areas of the other 24 species continuously extend beyond Russia. The highest number of rare species (11 taxa) is noted in Sakhalin Region. In particular, *Cephalanthera erecta* (Thunb.) Blume, *Daclylostalex ringens* Rchb.f., *Eleorchis japonica* (A.Gray) Maek., *Goodyera henryi* Rolfe, *G. schlechtendalians* Rchb.f., *Habenaria yezoensis* H.Hara, *Myrmechis japonica* (Rchb.f.) Rolfe, and *Ponerorchis kinoshitae* (Makino) X.H.Jin, Schuit. & W.T.Jin are all found only on the southern Kuril Islands. The others, i.e. *Cremastra appendiculata* (D.Don) Makino, *Platanthera ophrydioides* F.Schmidt, and *P. sachalinensis* F.Schmidt, are known both from the Kuril Islands and from Sakhalin Island. All these taxa are also registered in Japan. The Republic of Dagestan is another topical region for orchids, which do not occur anywhere else in Russia. There are four species, all of which extend southwards to the Caucasus. Among these four species, *Himantoglossum formosum* (Steven) K.Koch, *Anacamptis collina*, and *A. papilionacea* are known from a few localities, whereas the presence of *Cephalanthera caucasica* needs confirmation (see above). In five regions, Kamchatsky Krai, Krasnodarsky Krai, Primorsky Krai, Republic of Crimea, and Kaliningrad Region, two orchid species are found in each, which are not registered elsewhere. In Kamchatsky Krai, these are *Platanthera dilatata* (Pursh) Lindl. ex L.C.Beck and *Neottia convallarioides* (Sw.) Rich. Both of them are found only on the Commander Islands, representing the American flora with a wide distribution in the boreal zone of the New World. *Liparis krameri* Franch. & Sav. and *Pecteilis radiata* (Thunb.) Raf. are unique orchids of Primorsky Krai, both known from solitary localities in the southernmost part of the region. However, they are also known from China and the Korean Peninsula. In Russia, *Cephalanthera epipactoides* Fisch. & C.A.Mey. and *Epipactis euxina* occur only in Krasnodarsky Krai. The distribution of the latter species extends southwards beyond Russia. In Russia, *Epipactis distans* is currently known only from the Republic of Crimea. *Epipactis purpurata* s.str. has been reported in the Kaliningrad Region, but its occurrence needs confirmation. The same counts for *Dactylorhiza sambucina* in the Bryansk Region. If it really occurred there, it should be treated now as region-

ally extinct, similarly to *Chamorchis alpina* (L.) Rich., collected long ago from a small area only, which now belongs to the Murmansk Region.

What orchid is the rarest in Russia, considering the number of localities? If one takes into account the total number of localities and omits possible extinction rates (see below about regionally extinct species) and «uncertain» species (discussed above), then *Cephalanthera erecta*, *Epipactis euxina*, and *E. leptochila* subsp. *neglecta* Kumpel are the rarest orchid taxa in Russia according to our current knowledge. Of each of these taxa only the single record is known (Table 2). However, it is possible that the distribution of the two *Epipactis* taxa is underestimated, because they are hardly distinguishable in a herbarium from *E. persica* or *E. helleborine*, respectively, and further reports from the Caucasus are greatly expected. As for *Cephalanthera erecta*, its distribution also may be underestimated due to a superficial similarity to *Epipactis papillosa* (Vyshin, 1996). But since *Cephalanthera erecta* is found in Russia at the limit of its distribution area, substantial underestimation is hardly possible here. In the literature, one more species, *Habenaria yezoensis*, was reported from a single locality in Russia, dating back to the contribution by Tatewaki (1954). In Russian herbaria, no specimens were considered to exist (Vyshin, 1996; Vakhrameeva et al., 2014). But, fortunately, we discovered a nice collection of correctly determined specimens of this species dating back from the year 1975 and stored in VBG herbarium, providing the second locality for this taxon in Russia.

A small number of localities is not the only factor which may promote the taxon extinction. Some orchid species, known from more than two localities, may be even more threatened if their abundance decreases or if the number of the plants in the local populations is too low. Such species as *Anacamptis collina* subsp. *fedtschenkoi*, *A. papilionacea* subsp. *schirwanica*, *Gymnadenia odoratissima* (L.) Rich., *Himantoglossum formosum*, *Orchis spitzelii* Saut. ex W.D.J. Koch, *Ponerorchis chusua* (D.Don) Soó, *Eleorchis japonica* or *Goodyera schlechtendalians* may face the brink of extinction in a short time. However, a detailed analysis of this issue is out of the scope of the present study.

A species has a single locality in a region in 266 cases, two localities in 162 cases, and there are more than two localities per region in 1753 cases.

Table 2. Localities of the rarest orchids, which are known from 1–2 localities only (taxa «uncertain for Russia» excluded)

Taxon name	Number of localities	Data sources
<i>Cephalanthera erecta</i>	1	Kuril Islands, Iturup Isl., near Kurilsk, oak forest, 07.08.1988, Barkalov, Vyshin, Yakubov, Bezdeleva (VLA!)
<i>Epipactis euxina</i>	1	Krasnodar Region, Gelendzhik District, near Dzhankhot, Svyataya Nina Mt, burnt pine forest, 10.06.2017, Fateryga, Fateryga, Popovich (holotype, LE!)
<i>Epipactis leptochila</i> subsp. <i>neglecta</i>	1	Krasnodar Region, left bank of Khosta River, 123 m a.s.l., Fagus – Carpinus forest with <i>Taxus baccata</i> , 01.07.2017, Averyanova – LE!, PHEO!. Photographs from the same locality were published on «Plantarium» by A. Fateryga: near Khleborob, 12.06.2017, entry no. 516125 (Fateryga, 2017).
<i>Chamorchis alpina</i>	2	1) Lps, ad peninsulam Karelsгамmen districtu Kolaensi, 1829, Fellman (H 1746362); «Karelsгамmen» (Fellman, 1831 – cited after Blinova & Uotila, 2011) – according to Blinova & Uotila (2011), actual place is Murmansk Region, Rybachiy Peninsula, Vajda-Guba. 2) Lps, ad alpis Peisen, districtu Kolaensi (Pechenga, in alpes Petchenga), 09.1829, Fellman (H 1746361) – according to Blinova & Uotila (2011), collected in Murmansk Region, near Pechenga.
<i>Habenaria yezoensis</i>	2	1) «Kunashiri, Tomari» [Golovnino] (Tatewaki, 1954). Reference herbarium possibly deposited at herbarium SAP. 2) Kunashir Isl., near Yuzhno-Kurilsk, bog, 11.08.1975, Verkholat, Krivenko 5309 (VBGI!).

Climatic limits of the orchid distribution in the northern areas and in the arid zone

Corallorhiza trifida is a species characterised by the northernmost localities in Russia. However, its northernmost locality is doubtful (ad fl. Taimyr pr. Petrowkrest [?], 27.07.1843, Middendorf – LE 1030927!). There is no correct locality name on the label of the herbarium specimen. According to the collection date, our colleague Igor Pospelov has found that it should be collected at the mouth of the River Verkhnyaya Taimyra (Kupffer Island or Sablera Cape) at 74.50° N. However, the herbarium specimens seem to be too large for the harsh climate of this location, showing evidence that it may be mislabeled. In this case, another sample of the same species from Taimyr, at 73.25° N refers to the northernmost point of Orchidaceae distribution in Russia: «West Taimyr, terrace of the left bank of the River Pyasina in its middle reach in front of the village Tareya, 27.07.1965, Boch» (LE 1030933!). It is followed by the sample obtained from the River Zakharova Rassokha (MW 156299!). In addition to *Corallorhiza trifida*, *Dactylorhiza viridis*, and *Platanthera oligantha* also stand the harsh conditions of tundra zone successfully. At last, some localities of *Neottia cordata*, *Pseudorchis albida* (L.) Á.Löve & D.Löve, *Dactylorhiza psychrophila*, *Goodyera repens*, *Gymnadenia conopsea*, and *Chamorchis alpina* also refer formally to the tundra zone.

In the arid zone, no orchids cope with true arid environment. But they grow here locally in damp places which represent a kind of extra-zonal distribution. *Anacamptis morio* or *A. laxiflora* are possibly the most drought-resistant species, since their localities in Krasnodarsky Krai, Stavropolsky Krai, Republic of Crimea, Republic

of Dagestan, Republic of Kalmykia, and Rostov Region protrude the most far into the arid zone compared to other species. Another species of the same genus, *A. pyramidalis* (L.) Rich., is notable for its isolated locality in the central Crimea, if not resulted of mislabeling. Possibly, *Neotinea tridentata* (Scop.) R.M. Bateman, Pridgeon & M.W. Chase, *Dactylorhiza incarnata*, and *Ophrys mammosa* also stand arid environment more successfully than the other taxa.

Endemism

There are only a few Orchidaceae endemics in Russia. If they do not exist in fact, this is not a surprise in regard to the biogeography. Currently, only two taxa at the rank of species, *Epipactis euxina* and *E. krymmontana*, should be considered as endemics. Both were described only recently. Given that *Epipactis* species of the *helleborine*-complex are often hardly distinguishable in a herbarium, the true distribution area of *E. euxina* and *E. krymmontana* cannot be outlined by herbarium material and, therefore, may be seriously underestimated. It is highly possible that in future, both species will be discovered in the Caucasian countries adjacent to Russia, and the accumulation of online crowd-source data confirmed by photographs may strongly contribute to this.

Liparis loeselii subsp. *sachalinensis* (Nakai) Efimov may be another possible endemic taxon. In most of the literature sources, it is treated at species level (*L. sachalinensis*). However, its taxonomy is poorly understood now. So this taxon is either identical or very closely related to *L. loeselii* subsp. *loeselii* (Efimov, 2010), just representing an isolated locality of *L. loeselii* outside its main distribution range. All *Liparis* specimens

from Sakhalin were earlier determined as «*L. sachalinensis*» (Barkalov & Taran, 2004). However, except for the type specimen of *L. sachalinensis* (TI!) and one other collection, all the other *Liparis* specimens from Sakhalin belong to the group of *L. japonica* (Miq.) Maxim. – *L. kumokiri* F.Maek. – *L. makinoana* Schltr., which is very different morphologically. Only one, poorly collected specimen in fruit (Nevelsk district, Southern Sakhalin State Nature Reserve, Kuznetsovo, River Kuznetsovka, 07.08.1950, Kravchenko – LE 1034591!) may belong to subsp. *sachalinensis*, along with its holotype. The scarce material does not allow judging on the degree of difference between subsp. *sachalinensis* and subsp. *loeselii*.

Local endemism may be typical for *Dactylorhiza*, if one accepts stabilised allotetraploids at species rank. The recently described *D. sibirica* may serve as an example, if it has been not found in adjacent Kazakhstan. Therefore, it may be classified only as sub-endemic of Russia. It should be noted that the size of the distribution area of *D. sibirica* in Russia is incomparably larger (more than 200 loci), whereas only a few localities are currently known in Kazakhstan (vouchers in herbaria TK! and SVER!, data from the website www.plantarium.ru).

Liparis loeselii subsp. *orientalis* Efimov is another sub-endemic of Russia. It has also been described recently. Similarly to *D. sibirica*, it is a Siberian flora element with a single locus in Kazakhstan (voucher in herbarium MOSP!). Its final taxonomical position is not established yet. It may be a variant of geographic polymorphism of *L. loeselii*, or it may represent the consequence of introgression of *L. loeselii* with Far East species of the genus, with the predominance of the traits of the former.

Epipactis euxina, *E. krymmontana*, *Dactylorhiza sibirica*, and *Liparis loeselii* subsp. *orientalis* have been described recently (in 2018, 2014, 2016, and 2010, respectively) and they deserve further studies, which, in turn, may alter their endemic or subendemic status.

In the literature, two other endemic species are mentioned from time to time: *Neottia ussuriensis* (Vakhrameeva et al., 2014) and *N. krasnojaraica* E.M. Antipova (Varlygina, 2011; Vakhrameeva et al., 2014). These species are not accepted here for several reasons.

Neottia ussuriensis was described in 1935 as a member of a new genus, *Holopogon* Kom. & Nevski, which was characterised by such impressive features as semi-actinomorphic flowers and a specific column structure with some traits in pre-

sumable ancestral state (Chen & Tsi, 1987). *Holopogon* was not accepted by most of the authors. It was assumed that all species of this genus represented the transitional stages to peloric forms of the genus *Neottia* (Wu et al., 2009). This was later confirmed by molecular methods for Chinese *Holopogon smithianus* (Schltr.) S.C.Chen (Zhou & Jin, 2018). Here, we support the reduction of *Holopogon* to *Neottia* and suggest to bring *Neottia ussuriensis* into synonymy of *N. acuminata*. The latter was also proposed earlier by Skvortsov (2004) on the basis of morphological studies. This synonymisation may explain the unusual rarity of *N. ussuriensis*, because it was found only twice after its discovery in 1935: in 1984, at a new place, and in 2003, at the type locality again (Vyshin, 1996; see Skvortsov, 2004 for a detailed description of the species morphology and localities).

Neottia krasnojaraica was described in 2003 as a third component of a vicarious pair *N. nidus-avis* – *N. papilligera*. It was reported to occur very locally within the gap between the distribution ranges of *N. nidus-avis* and *N. papilligera*. However, in fact *N. krasnojaraica* is neither geographically, nor morphologically isolated from *N. nidus-avis*. In particular, its papillose pubescence in the inflorescence is not a discriminative feature of *N. krasnojaraica*, because it may occur in all three species. Moreover, *N. papilligera* itself is a dubious species, possibly, better referred as a subspecies of *N. nidus-avis*.

By summarising, only two endemic species of orchids, *Epipactis euxina* and *E. krymmontana*, are currently accepted in Russia. However, new localities outside Russia are highly expected. The subspecies *Liparis loeselii* subsp. *sachalinensis* may also be endemic, if not taxonomically identical with subsp. *loeselii*.

Orchids «regionally extinct» in Russia

A problem of species' dynamics is one of the main objectives of the project «Biodiversity Mapping of Orchidaceae of Russia». A detailed study of their dynamics will be possible after all the geotagging data will be put into the database. However, the conclusions about the possible extinct orchids of Russia may be drawn right now. The list of taxa with the highest extinction probability in Russia or that may become extinct in the nearest future (taxa «uncertain for Russia» excluded) is presented below.

1. *Chamorchis alpina*. In 1829, it was recorded from two localities of the current area of Murmansk Region (Blinova & Uotila, 2011). And it has

never been seen again over there, despite visiting its localities by botanists several times, including a small expedition in 2014 designed by the author especially for a *Chamorchis* search. In Russia, the localities represented the easternmost point of the species' distribution area. By comparing with the other orchids of Russia, the extinction of *Chamorchis* is certainly of the highest probability.

2. *Liparis loeselii* subsp. *sachalinensis*. If this taxon is not taxonomically identical with subsp. *loeselii* (see above), it may be extinct because its habitat has been destroyed after it was collected in 1906; nowadays, the former site is possibly located within the Yuzhno-Sakhalinsk town. The second locality is doubtful (determination unsure). On the other hand, new findings are still possible in other localities of Sakhalin Island.

3. *Habenaria yezeensis* was recorded in Russia twice. The most recent record is dated back to 1975. Nothing is known about this species since that time. But the presence of this species in some place(s) on Kunashir Island is very possible.

4. *Ponerorchis chusua*. This species was recorded in Amur Region (most of the localities), Jewish Autonomous Okrug, Khabarovsk Krai, Primorsky Krai, and Trans-Baikalsky Krai (in total, ca. 30 databased localities). But it has possibly undergone the most severe decline if compared with all other orchid species of Russia. The most recent finding dated back to 1987, although there are some data on its survival at least in the Khingansky State Nature Reserve in the Red Data Book of Amur Region (Senchik, 2019). In the meantime, there are some doubts whether this species survived in Russia generally (Kozhevnikov, 2008). In Bardunov & Novikov (2008), there is an estimation of the total number of plants («500–1000»), but any factual data are absent. So any estimation like this cannot be taken seriously. Most possibly, it survived up to the present days, but the number of the localities is obviously minimal.

Conclusions

A checklist and some short statistical data about the orchids of Russia represent the first results of the project «Biodiversity Mapping of Orchidaceae of Russia». The taxonomical treatment of orchid species in Russia proposed here may be recommended for various local floristic accounts and checklists, as well as for developing of the lists of protected taxa. To date, there is a substantial inconsistency for certain groups of orchids between their taxonomical treatments and revisions presented in

local Russian publications. Especially out-of-date taxonomic concepts may often be encountered in Red Data Books and Red Lists, and as a result they are confusing nature protection actions.

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Appendix. Literature sources for Russian regions.

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ОРХИДНЫЕ РОССИИ: ЧЕК-ЛИСТ И КРАТКИЙ АНАЛИЗ ГЕОГРАФИЧЕСКОГО РАСПРОСТРАНЕНИЯ

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В статье представлен чек-лист орхидных России. При помощи данных проекта «Картирование орхидных России», а также сведений из литературы осуществлен географический анализ распространения орхидных России. Общее разнообразие орхидных России оценено в 38 родов, 135 видов и 13 подвидов, включая виды, предположительно встречающиеся в России – *Dactylorhiza majalis*, *D. sambucina*, *Epipactis purpurata*, *Cephalanthera caucasica*, *Anacamptis laxiflora* subsp. *palustris*, *Platanthera komarovii* subsp. *maximovicziana*. Наиболее богатым административным регионом страны по числу видов орхидных оказался Краснодарский край, в котором встречается 56 видов, за ним следуют Сахалинская область (50), Республика Дагестан (49), Республика Крым (45), Приморский край (42), Хабаровский край (41). Ни одного вида орхидных неизвестно только из Астраханской области; один вид (*Anacamptis laxiflora*, всего одно местонахождение) известен из Республики Калмыкия, три вида встречаются в Чукотском автономном округе, восемь – в Ненецком автономном округе. Наиболее широко распространенным видом оказался *Gymnadenia conopsea*, встречающийся в 74 регионах (90% от общего количества), за ним следуют *Corallorhiza trifida* (73), *Dactylorhiza incarnata* (72) и *D. viridis* (71 регион). 25 видов встречаются в России всего в одном административном регионе, из них 11 – в Сахалинской области и четыре – в Республике Дагестан. Наиболее редкими орхидными России, если судить только по числу местонахождений (исключая виды, предположительно встречающиеся в России), оказываются *Cephalanthera erecta*, *Epipactis euxina* и *E. leptochila* subsp. *neglecta*, каждый из которых известен из единственного местонахождения. В России отмечаются и два эндемика в ранге вида – *Epipactis euxina* и *E. krymmontana*, но оба были описаны лишь недавно, их распространение требует дальнейшего изучения, оба впоследствии могут быть обнаружены на Кавказе за пределами России. В России имеется также один эндемик в ранге подвида, *Liparis loeselii* subsp. *sachalinensis*. Но самостоятельность этого таксона подвергается сомнению и возможно, что он является синонимом *L. loeselii* subsp. *loeselii*. *Neottia krasnojarsica* и *N. ussuriensis*, ранее указывавшиеся в качестве эндемиков для территории России, рассматриваются нами как синонимы *N. nidus-avis* и *N. acuminata*, соответственно. Таксоны, с наибольшей вероятностью исчезнувшие в России – это *Chamorchis alpina* и *Liparis loeselii* subsp. *sachalinensis*.

Ключевые слова: Orchidaceae, географический анализ, картографирование биоразнообразия, охрана природы, регионы России, редкие виды, сосудистые растения