

Advances in the study of the spider fauna (Aranei) of Russia and adjacent regions: a 2017 update

K.G. Mikhailov

Zoological Museum, Moscow Lomonosov State University, Bolshaya Nikitskaya str., 2, Moscow, 125009 Russia. E-mail: mikhailov2000@gmail.com

ABSTRACT: Recent (2017) calculations of spider species richness in the boundaries of Russia and other former Soviet Union republics, as well as between physiographical regions of these territories, are provided in comparison with earlier data. By December 31st, 2017, 3437 and 2445 spider species were reported from the FSU territories and Russia, respectively. A prediction for a spider species richness of the FSU and Russia is given. 39 spider species lists of both the post-Soviet republics and physiographical regions are provided as electronic supplementary data.

How to cite this paper: Mikhailov K.G. 2021. Advances in the study of the spider fauna (Aranei) of Russia and adjacent regions: a 2017 update // *Invert. Zool.* Vol.18. No.1. P.25–35, Supplements 1.01–1.15, 2.01–2.24. doi: 10.15298/invertzool.18.1.03

KEY WORDS: Araneae, diversity, spiders, post-Soviet republics, physiographical regions, fauna, catalogue.

Итоги изучения фауны пауков (Aranei) России и прилежащих стран: обновление 2017 года

К.Г. Михайлов

Зоологический музей, Московский государственный университет им. М.В. Ломоносова, ул. Большая Никитская, д.2, Москва, 125009 Россия. E-mail: mikhailov2000@gmail.com

РЕЗЮМЕ: Приведены подсчеты разнообразия пауков России и других стран бывшего СССР, а также их физико-географических регионов по состоянию на 2017 год, в сравнении с ранними данными. На 31 декабря 2017 года отмечено 3437 и 2445 видов пауков для территории бывшего СССР и России, соответственно. Дан прогноз видового богатства пауков бывшего СССР и России. В качестве дополнительных электронных приложений дано 39 списков видов пауков пост-советских республик и их физико-географических регионов.

Как цитировать эту статью: Mikhailov K.G. 2021. Advances in the study of the spider fauna (Aranei) of Russia and adjacent regions: a 2017 update // *Invert. Zool.* Vol.18. No.1. P.25–35, Supplements 1.01–1.15, 2.01–2.24. doi: 10.15298/invertzool.18.1.03

КЛЮЧЕВЫЕ СЛОВА: Araneae, разнообразие, пауки, пост-советские республики, физико-географические регионы, фауна, каталог.

Introduction

This paper, being the result of long-term research, contributes to global biodiversity studies. The spider fauna of the USSR territory (in the borders before 1939) was reviewed in detail by D.E. Kharitonov (Charitonov, 1932; Kharitonov, 1936) in his annotated catalogue of spiders covering 1,068 species with 38 subspecies and varieties from 29 families in the basic 1932 version. The work on cataloguing the USSR spider fauna was revived only in 1981 in the framework of a comprehensive study of animal and plant diversity undertaken by the Academy of Sciences of the former USSR. The aim of the entire project is to compile and critically assess all available literature, both taxonomic and faunistic, sources on spiders of Russia and other republics of the former Soviet Union (= FSU) since the 18th century. Compared to World Spider Catalog (WSC, 2020) and its earlier versions (Roewer, 1942, 1954a,b; Platnick, 2014, etc.), faunistic papers on spiders have not been reviewed worldwide since 1939 (Bonnet, 1955–1959). Separate annotated spider catalogues are compiled for most European and some Asian countries, but not for the FSU countries, the latter despite a considerable number of sources, mostly in Russian, being available. Only local catalogues and checklists, mostly outdated, are available for Estonia (Vilbaste, 1987), Turkmenistan (Mikhailov, Fet, 1994), the Urals (Esyunin, Efimik, 1996), Georgia (Mkheidze, 1997), Tuva Republic (Marusik *et al.*, 2000), Middle Povolzhye (Krasnobaev, 2004), Left-Bank Ukraine (Polchaninova, Prokopenko, 2013, 2017), the Crimea (Kovblyuk, Kastygina, 2015), etc. Separate works are devoted to the linyphiids (Eskov, 1994) and the salticids (Logunov, Marusik, 2000) of the FSU Asian part, including Mongolia, as well as to the gnaphosid genus *Micaria* Westring, 1851 (Mikhailov, 1987) and the sac spider genus *Clubiona* Latreille, 1804 (Mikhailov, 1992b, 2003) of the FSU territory and the salticid genus *Yllenus* Simon, 1868 of whole Eurasia (Logunov, Marusik, 2003). At present, publication of all available data is impossible because of a too large amount of information that is likely to

run to several volumes of a printed text. To date, only a checklist of the spiders of the former USSR together with a bibliographical index covering all literature sources has been published by Mikhailov (1997), followed in 1998–2000 by several addenda and the second, advanced edition of the checklist without a bibliographical index (Mikhailov, 2013b).

Methods

This paper aims at providing the latest calculations (as of December 31st, 2017) of spider species diversity of the FSU territories in order to demonstrate changes in the current knowledge. Earlier calculations were published in a number of papers (Mikhailov, 1992a, 1997, 2002, 2012b, 2013a, 2016, etc). An updated and the most complete bibliographical list appeared separately (Mikhailov, 2012a, 2019), with more than 4,220 references. An unpublished list of 2016–2017 literature sources includes 230 references. To avoid re-counting the number of species with changing state borders, the boundaries of the post-Soviet countries are accepted here as of 1992.

Only the published literature data on spider records are used in this project. More than 4,450 sources were entered to the basic card catalogue. A lot of data are scattered in local university books and transactions, collective papers, as well as conference proceedings; such a search needs special efforts in visiting various libraries and contacting numerous colleagues. Among the well-known specialized scientific periodicals, most of the contributions to Russian/Soviet arachnology were published in “Zoologichesky Zhurnal” (before 1992), followed since 1992 by “Arthropoda Selecta”. Over the last decade, numerous data appeared also in “Zootaxa” and “ZooKeys”.

The scope of spider families follows WSC (2021), with several exceptions (see below and in supplementary materials).

Results and Discussion

A new, updated version of the checklist is compiled. Until 2017, 3,437 spider species (649

Table 1. Species diversity of the main spider families in the territory of the former USSR.
Таблица 1. Видовое разнообразие основных семейств пауков на территории бывшего СССР.

Family	Species number (percentage)									
	1989	1996	2000	2009	2011	2013	2015	2017		
Linyphiidae	654 (29.95%)	850 (31.55%)	873 (30.88%)	979 (30.13%)	979 (29.70%)	986 (29.52%)	997 (29.55%)	1019 (29.65%)		
Gnaphosidae	206 (9.43%)	286 (10.62%)	294 (10.40%)	357 (10.99%)	367 (11.13%)	375 (11.23%)	378 (11.20%)	388 (11.29%)		
Lycosidae	210 (9.62%)	247 (9.17%)	263 (9.30%)	319 (9.82%)	333 (10.10%)	351 (10.51%)	357 (10.58%)	359 (10.45%)		
Salticidae	211 (9.66%)	266 (9.87%)	307 (13.19%)	338 (10.40%)	340 (10.32%)	340 (10.18%)	345 (10.23%)	346 (10.07%)		
Thomisidae	146 (6.68%)	164 (6.09%)	168 (5.94%)	177 (5.45%)	179(5.44%)	181 (5.42%)	183 (5.42%)	184 (5.35%)		
Theridiidae	116 (5.31%)	125 (4.64%)	132 (4.67%)	167 (5.14%)	168(5.10%)	172 (5.15%)	173 (5.13%)	175 (5.09%)		
Araneidae	114 (5.22%)	108 (4.01%)	113 (4.00%)	128 (3.94%)	128(3.88%)	128 (3.83%)	127 (3.76%)	130 (3.78%)		
Philodromidae	61 (2.79%)	73 (2.71%)	74 (2.62%)	92 (2.83%)	94(2.85%)	93 (2.78%)	93 (2.76%)	93 (2.71%)		
Dysderidae	51 (2.34%)	90 (3.34%)	91 (3.22%)	90 (2.77%)	90(2.73%)	90 (2.69%)	91 (2.70%)	91 (2.65%)		
Agelenidae	44 (2.01%)	45 (1.67%)	54 (1.91%)	80 (2.46%)	81(2.46%)	82 (2.46%)	81 (2.40%)	86 (2.50%)		
Dictyidae	49 (2.24%)	53 (1.97%)	59 (2.09%)	71 (2.19%)	73(2.21%)	73 (2.19%)	76 (2.25%)	80 (2.33%)		
others	322	387	399	451	464	469	473	486		
TOTAL	2,184	2,694	2,827	3,249	3,296	3,340	3,374	3,437		

Clubionidae is not included into the count, due to change of the species composition in this family.

genera) from 53 of the 128 recent families in the world fauna had been reported from the FSU territories (Table 1). Compared to the 2013 checklist, the Clubionidae is split into Clubionidae and Cheiracanthiidae, while the Corinnidae into Corinnidae, Phrurolithidae and Trachelidae. Slight differences in family names and scope as compared to the WSC (2021) are kept in the current checklist. The Argyronetidae is used instead of Cybaeidae, while the Chera-canthiidae is listed separately from Eutichuridae, and the Zoridae is considered separately from the Miturgidae and retains its earlier scope, following Marusik & Kovblyuk (2011).

A comparison of the species diversity of the FSU (Table 1) shows that the first place in the FSU is taken by Linyphiidae, not Salticidae (as in WSC, 2021). The family Linyphiidae is most diverse in boreal and temporal zones, whereas Salticidae in tropical and subtropical areas; the tropics are totally absent from the FSU, while the subtropics are represented only marginally.

Linyphiidae show the highest diversity in the FSU (Table 1), with over 1,000 species recorded/described. Gnaphosidae, Lycosidae and Salticidae are the next three groups to follow, with their order having changed in 1989–2013. The second-rich Salticidae in 1989 and 2000 shifted to the third place in 1996, 2009 and 2011. Gnaphosidae were the fourth in 1989 and the third in 2000. Since the 1989 evaluation, the main increase in species numbers has been documented for Linyphiidae (+365 species), followed by Gnaphosidae (+182), Lycosidae (+149), Salticidae (+135) and Theridiidae (+59) (Table 1). Altogether, the increase in species richness was 510 during 1989–1995, or approximately 73 species annually. In 1996–2000, these figures were 130 and 33, respectively, in 2001–2011, 469 and 43, in 2012–2017, 141 and 23.5. In several families, a great increase in species diversity was reported for 1989–1996: +196 species in Linyphiidae (due to the research of K.Yu. Eskov, A.V. Tanasevitch and Yu.M. Marusik), +80 species in Gnaphosidae (due to Yu.M. Marusik, V.I. Ovtsharenko and D.V. Logunov), +49 species in Dysderidae (due

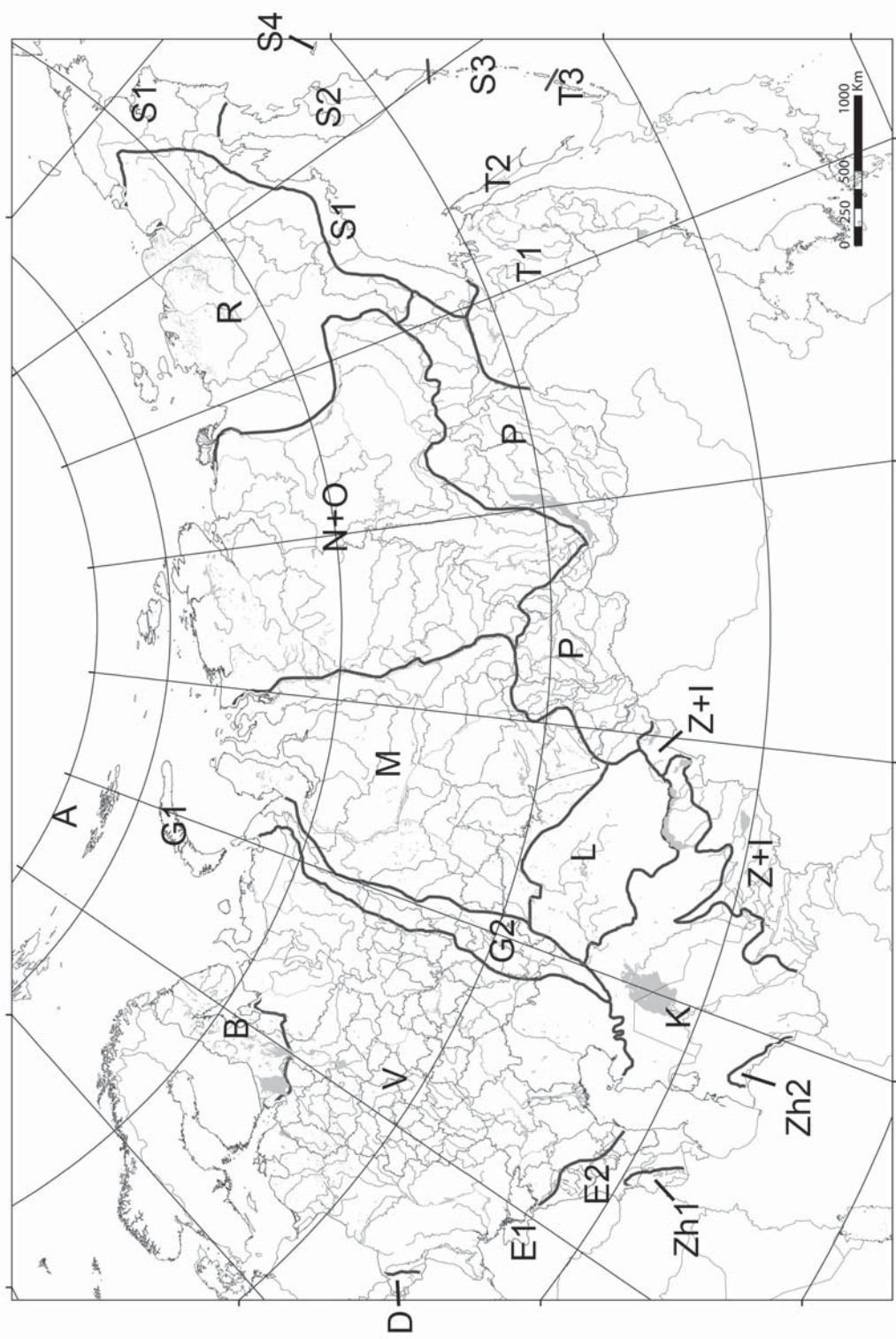
to the late P.M. Dunin). D.V. Logunov is also responsible for a large number of Salticidae records in 1989–2009, +127 species. A second increase in the Linyphiidae number is recorded in 2000–2009 (+106 species, due to A.V. Tanasevitch, Yu.M. Marusik and V.A. Gnelitsa).

An analysis of the spider fauna of the post-Soviet countries (Table 2, Supplements 1.01–1.15) reveals almost the same proportions as earlier: Russia supports the highest diversity (2445 species), followed by Ukraine (1056), Kazakhstan (1010) and Azerbaijan (688). The spider faunas of Moldova and Armenia show no large increase in species numbers, remaining not sufficiently studied yet, apparently due to the absence of local arachnologists. A project devoted to the spider fauna of Armenia started only recently, resolved in 14 additional species recorded between 2015 and 2017. A different situation is observed in Estonia (+5 species only), one of the best arachnologically studied republics due to the 1960–1980 research by A. Vilbaste. In Lithuania, a lot of species have been added between 2000 and 2011, revealing that its spider fauna is similar to that of Latvia both in a species number and composition; in Latvia, such an increase was found between 2013 and 2015. In 1996–2017, the main increase in species richness was notable in Russia (+571 species), Kazakhstan (+331), Georgia (+257), Ukraine (+248), Lithuania (+202) and Azerbaijan (+188). Most significant contributions to the knowledge of Kazakhstan and Georgian spiders were made by overseas arachnologists. Large increase in the spider fauna of Byelorussia (Belarus) during 2015–2017 (+40) is owed to Zhukovets (2017) book.

No correlation is found between a spider species diversity and an area size (Table 2). In general, larger areas like Russia and Kazakhstan support lesser spider species diversities. Moderate richness levels are reported also in Uzbekistan and Turkmenistan, both dominated by desert landscapes. Mountain areas like Georgia and Azerbaijan are richer in spider species per area unit, yet being comparable in this index with poorly-studied Moldova.

Table 2. Spider species composition in the FSU and post-Soviet republics, data for 1989, 1996, 2000, 2008, 2009, 2011, 2013, 2015 and 2017.
 Таблица 2. Видовой состав пауков бывшего СССР и постсоветских республик, данные за 1989, 1996, 2000, 2008, 2009, 2011, 2013, 2015 и 2017 годы.

Regions/ Years	Area, sq.km x 10 ³	1989	1996	2000	2008	2009	2011	2013	2015	2017	2017, in comparison with 1996
Ex-USSR	22400	2184	2694	2827	3213	3249	3296	3340	3374	3437	+743 (27.58%)
Russia	17075.4		1874	1974	2260	2297	2339	2366	2397	2445	+571 (30.47%)
Estonia	45.1		506	509	505	507	511	511	511	511	+5 (0.99%)
Latvia	64.5		401	402	414	415	419	419	465	464	+63 (15.71%)
Lithuania	65.2		241	271	385	392	445	445	443	443	+202 (83.82%)
Byelorus(sia)	207.6		383	412	418	421	424	431	447	487	+104 (27.15%)
Ukraine	603.7		808	830	936	958	996	1008	1016	1056	+248 (30.69%)
Moldova	33.7		291	292	292	292	292	292	292	293	+2 (0.69%)
Georgia	69.7		326	456	463	467	518	520	581	583	+257 (78.83%)
Azerbaijan	86.6		500	559	642	644	657	663	669	688	+188 (37.60%)
Armenia	29.8		118	127	134	135	136	136	141	155	+37 (31.36%)
Kazakhstan	2717.3		679	719	819	847	879	966	996	1010	+331 (48.75%)
Uzbekistan	447.7		290	309	320	321	330	331	334	337	+47 (16.21%)
Turkmenistan	488.1		353	377	387	387	391	394	394	399	+46 (13.03%)
Kyrgyzstan	198.5		358	464	474	476	477	479	479	485	+127 (35.47%)
Tajikistan	143.1		293	310	316	317	318	318	322	331	+38 (12.97%)



Physiographical regions of the FSU territory are here accepted after Gvozdetsky (1968) (Fig. 1). The main increase during 1996–2017 was observed in the Russian Plain (V, +413 species), the continental southern Far East (T1, +381 species), the Caucasus (E2, +287 species), West Siberia (M, +283 species), the Crimea (E1, +250 species), the mountains of South Siberia (P, +237 species) (Table 3, see also species lists in Supplements 2.01–2.24). Moderate increases in Middle Siberia (N+O), the continental Far North-East (S1) and Sakhalin Island (T2) are explained by earlier (the 1980's to early 1990's for T2) activities both of K. Yu. Eskov and of Yu. M. Marusik. It is noteworthy that in the continental southern Far East (Russia), crucial taxonomic/faunistic studies were largely performed by visiting arachnologists, while in the Crimea by local specialists. Earlier, during 1989–1996, the main progress was made in the mountains of South Siberia (P, +377 species, due to D. V. Logunov, Yu. M. Marusik and S. N. Danilov), West Siberia (M, +197 species, due to S. L. ESYUNIN and others) and north-eastern Siberia (R, +118 species, the activities of Yu. M. Marusik).

The data provided herein are difficult to compare with the adjacent regions such as West and Central Europe, China or Japan. The recent

country calculations are available for Europe (Helsdingen, 2020), also with data on European Russia and Ukraine. For example, Poland, which is $312.7 \cdot 10^3 \text{ km}^2$ in area, supports 844 spider species. This is comparable with 1056 species in Ukraine and 1016 in Germany ($357.4 \cdot 10^3 \text{ km}^2$). 642 species in Finland ($338 \cdot 10^3 \text{ km}^2$) correspond to 589 species in Fennoscandia. A total of 2361 spider species were registered in the whole territory of China earlier (Song et al., 1999); 3714 species in 2013 (Shuqiang Li, pers. comm.), 4282 species (Li, Lin, 2016) and currently 5084 species (Li, 2020). To date, 1647 species and subspecies are known from Japan (Shinkai *et al.*, 2020) in comparison with 1574 species in 2013 (A. Tanikawa, pers. comm., 2013).

Earlier estimates of the total FSU spider fauna first amounted to 2700–3000 species (Mikhailov, 1992), later to 3400–3500 species (Mikhailov, 1997). The latest prediction, with the total spider diversity of the FSU being likely to be 3700–3800 species, and that of Russia 2500–2600 species (Mikhailov, 2013a), seems to be worth updating to 4000 and 2700–2800 species correspondingly. Faunistic studies of the spiders of Russia and the FSU are yet far from complete.

Fig. 1. Physiographical regions of the FSU after Gvozdetsky (1968): A — Atlantic-Arctic area, B — Fennoscandia, V — Russian Plain, G1 — Novaya Zemlya, G2 — Urals, D — Carpathians, E1 — Crimea, E2 — Caucasus, Zh1 — Armenian Upland, Zh2 — Kopet Dagh Mts, Z+1 — mountains of Middle (= Central) Asia, K — deserts of Middle (= Central) Asia, L — Kazakhstan hills, M — West Siberia, N+O — Middle Siberia, P — mountains of South Siberia, R — Northeastern Siberia, S1 — continental Far North-East, S2 — Kamchatka, S3 — N-Kuriles, S4 — Commander Islands, T1 — continental southern Far East, T2 — Sakhalin, T3 — S-Kuriles. English capital letters correspond to the Russian ones given in Gvozdetsky's book.

Рис. 1. Физико-географические регионы бывшего СССР по Н.А. Гвоздецкому (Gvozdetsky, 1968): А — Атлантико-Арктическая область, В — Фенноскандия, V — Русская равнина, G1 — Новая Земля, G2 — Урал, D — Карпаты, E1 — Крым, E2 — Кавказ, Zh1 — Армянское нагорье, Zh2 — Копет-Даг, Z+1 — горы Средней (Центральной) Азии, К — пустыни Средней (Центральной) Азии, L — Казахский мелкосопочник, М — Западная Сибирь, N+O — Средняя Сибирь, P — горы Южной Сибири, R — Северо-восточная Сибирь, S1 — континентальный Дальний Северо-Восток, S2 — Камчатка, S3 — Северный Курилы, S4 — Командорские о-ва, T1 — континентальный южный Дальний Восток, T2 — Сахалин, T3 — Южные Курилы. В книге Н.А. Гвоздецкого приведены русские буквенные обозначения, которые здесь даны в транслитерации.

Table 3. Spider species composition in the FSU physiographical areas, data for 1989, 1996, 2000, 2008, 2009, 2011, 2013, 2015 and 2017. Таблица 3. Видовой состав пауков физико-географической регионов бывшего СССР, данные за 1989, 1996, 2000, 2008, 2009, 2011, 2013, 2015 и 2017 годы.

Regions/ Years	1989	1996	2000	2008	2009	2011	2013	2015	2017	2017, in comparison with 1996
A	1	1	2	2	2	2	2	2	2	+1
B	385	429	516	532	534	554	557	568	589	+160 (+37.30%)
V	936	1001	1026	1294	1314	1347	1362	1381	1414	+413 (41.26%)
G1 + G2	600									
G1		21	21	20	24	24	24	25	33	+12 (57.14%)
G2		683	750	786	790	795	799	799	815	+132 (19.33%)
D	435	421	428	459	485	536	537	543	576	+155 (36.82%)
E1	308	311	342	478	500	508	520	538	561	+250 (80.39%)
E2 + Zh1	671									
E2		752	834	927	940	974	987	1026	1039	+287 (38.16%)
Zh1		127	135	228	231	233	233	241	259	+132 (103.94%)
Zh2 + Z + I	650									
Zh2		221	240	243	244	245	247	247	247	+26 (11.76%)
Z+I		773	833	878	880	901	915	920	935	+162 (20.96%)
K	291	318	338	352	360	368	401	419	423	+105 (33.02%)
L	103	129	143	160	160	171	172	209	254	+125 (96.90%)
M	243	440	554	602	652	655	664	715	723	+283 (64.32%)
N+O	532	624	634	667	666	669	669	674	674	+50 (8.01%)
P	436	813	912	1002	1015	1017	1022	1045	1050	+237 (29.15%)
R	277	395	397	408	408	410	410	410	421	+26 (6.58%)
S1 + S2 + S3 + S4	278									
S1		411	415	446	451	449	449	454	454	+43 (10.46%)
S2		184	182	204	205	240	240	248	248	+64 (34.78%)

Table 3 (continued).
Таблица 3 (продолжение).

Regions/ Years	1989	1996	2000	2008	2009	2011	2013	2015	2017	2017, in comparison with 1996
S3		54	60	81	81	82	82	82	82	+28 (51.85%)
S4		19	20	20	20	20	20	20	20	+1 (5.26%)
T1 + T2 + T3	375									
T1		507	566	797	843	861	864	870	888	+381 (75.15%)
T2		343	338	361	361	362	363	362	363	+20 (5.83%)
T3		144	149	165	166	170	170	172	174	+30 (20.83%)

Regions: A — Atlantic-Arctic area, B — Fennoscandia, V — Novaya Zemlya, G2 — Urals, D — Carpathians, E1 — Crimea, E2 — Caucasus, Zh1 — Armenian Upland, Zh2 — Kopet Dagh Mts, Z+I — mountains of Middle (= Central) Asia, K — deserts of Middle (= Central) Asia, L — Kazakhstan hills, M — West Siberia, N+O — Middle Siberia, P — mountains of South Siberia, R — Northeastern Siberia, S1 — continental Far North-East, S2 — Kamchatka, S3 — N-Kuriles, S4 — Commander Islands, T1 — continental southern Far East, T2 — Sakhalin, T3 — S-Kuriles.

Supplementary data. The following Excel-tables are available online.

Supplement 1. Lists of spiders of Russia and FSU republics.

- 1.01. Russia.
- 1.02. Estonia.
- 1.03. Latvia.
- 1.04. Lithuania.
- 1.05. Byelorussia (Belarus).
- 1.06. Ukraine.
- 1.07. Moldavia (Moldova).
- 1.08. Georgia.
- 1.09. Azerbaijan.
- 1.10. Armenia.
- 1.11. Kazakhstan.
- 1.12. Uzbekistan.
- 1.13. Turkmenistan.
- 1.14. Kirghizia (Kyrgyzstan).
- 1.15. Tadzhikistan.

Supplement 2. Lists of spiders of FSU physiological regions.

- 2.01. Atlantic-Arctic area (A).
- 2.02. Fennoscandia (B).
- 2.03. Russian Plain (V).
- 2.04. Novaya Zemlya (G1).
- 2.05. Urals (G2).
- 2.06. Carpathians (D).
- 2.07. Crimea (E1).
- 2.08. Caucasus (E2).
- 2.09. Armenian Upland (Zh1).
- 2.10. Kopet Dagh Mts (Zh2).
- 2.11. Mountains of Middle (= Central) Asia (Z + I).
- 2.12. Deserts of Middle (= Central) Asia (K).
- 2.13. Kazakhstan hills (L).
- 2.14. West Siberia (M).
- 2.15. Middle Siberia (N + O).
- 2.16. Mountains of South Siberia (P).
- 2.17. Northeastern Siberia (R).
- 2.18. Continental Far North-East (S1).
- 2.19. Kamchatka (S2).
- 2.20. N-Kuriles (S3).
- 2.21. Commander Islands (S4).
- 2.22. Continental southern Far East (T1).
- 2.23. Sakhalin (T2).
- 2.24. S-Kuriles (T3).

Acknowledgements. I am most grateful to Dr Yuri M. Marusik (Magadan, Russia) for his comprehensive critiques and useful suggestions for previous version of this paper and Dr Dmitry V. Logunov (Manchester, Great Britain) for both linguistic and logistic help. The work is supported by MSU Zoological Museum State Program.

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Responsible editor E.N. Temereva