

Progress in the study of the spider fauna (Aranei) of Russia and neighbouring regions: a 2020 update

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ABSTRACT: Recent (2020) calculations of spider species richness in the boundaries of Russia and the former Soviet Union republics, as well as between physiographical regions of these territories, are provided in comparison with earlier data. By December 31st, 2020, 3,529 and 2,497 spider species were reported from the FSU republics and Russia, respectively. A prediction for spider richness of the FSU and Russia is given. Additionally, 39 spider species lists of both the post-Soviet republics and physiographical regions are provided as electronic supplementary data.

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

Итоги изучения фауны пауков (Aranei) России и прилежащих стран: обновление 2020 года

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РЕЗЮМЕ: Приведены подсчеты разнообразия пауков России и других стран бывшего СССР, а также их физико-географических регионов по состоянию на 2020 год, в сравнении с ранними данными. На 31 декабря 2020 года отмечено 3529 и 2497 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.

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

Introduction

This paper is resulted from a long-term research and contributes to global biodiversity studies. The spider fauna of the former USSR territory (in the pre-1939 borders) was reviewed in detail by D.E. Kharitonov (Charitonov, 1932; Kharitonov, 1936) in his annotated spider catalogue accounting for 1,068 species, including 38 subspecies and varieties, in 29 families, based on the 1932 version. Kharitonov's work on cataloguing the USSR spider fauna was revived only in 1981, as part 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 was to compile and critically assess all the available literature, both taxonomic and faunistic, on spiders of Russia and all other republics of the former Soviet Union (= FSU) since the 18th century. Compared to the modern World Spider Catalog (WSC, 2020) and its earlier versions (Roewer, 1942, 1954a,b; Platnick, 2014, etc.), faunistic papers on spiders have never been reviewed worldwide since 1939 (Bonnet, 1955–1959). Separate annotated spider catalogues had been compiled for most European and some Asian countries, but not for the FSU countries, despite the availability of a significant amount of literature, mostly in Russian. Only regional catalogues and checklists, largely outdated, are available for Estonia (Vilbaste, 1987), Turkmenistan (Mikhailov, Fet, 1994), the Urals (Esyunin, Efimik, 1996), Georgia (Mkheidze, 1997), Tuva (Marusik *et al.*, 2000), Middle Povolzhye (Krasnobaev, 2004), left-bank Ukraine (Polchaninova, Prokopenko, 2013, 2017), the Crimea (Kovblyuk, Kastrygina, 2015), Latvia (Cera, 2018), etc. A project on an internet spider catalogue of Ukraine is under way (N.Yu. Polchaninova, E.V. Prokopenko). Separate catalogues are devoted to the linyphiids (Eskov, 1994) and the salticids (Logunov, Marusik, 2000) of Siberia and neighbouring regions, including Mongolia. At present, it is impossible to publish all the available data due to the sheer volume of information, which could take several volumes of 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 by sever-

al additions in 1998–2000 and the second, advanced edition of checklist without a bibliographical index (Mikhailov, 2013b), as well species lists as Excel-tables for republics and physiographical areas (Mikhailov, 2021).

Methods

This paper aims at providing the latest calculations (as of December 31st, 2020) of spider species diversity of the FSU territories to demonstrate progress in the existing knowledge. Earlier calculations were published in a number of papers (Mikhailov, 1992a, 1997, 2002, 2012b, 2013a, 2016, 2021, etc). An updated and the most complete bibliographical list appeared separately (Mikhailov, 2012a, 2019), with more than 4,220 references included. 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 5,030 sources were entered to the basic card catalogue. A great deal of data is scattered in books and publications of local universities, collective volumes, as well as conference proceedings, of which many are not available online yet; 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”, “ZooKeys”, and “Arachnology”.

The scope of spider families follows WSC (2022), with several exceptions (see below and in supplementary materials).

Results and Discussion

A new, updated version of the checklist is compiled. Until the end of 2020, 3,529 spider species (663 genera) in 53 of the 132 extant families worldwide had been reported from the FSU territories (Table 1). Slight differences in family names and scope as compared to WSC (2022) are kept in the current checklist. The

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
Linyphiidae	654 (29.95%)	850 (31.55%)	873 (30.88%)	979 (30.13%)	979 (29.70%)
Gnaphosidae	206 (9.43%)	286 (10.62%)	294 (10.40%)	357 (10.99%)	367 (11.13%)
Lycosidae	210 (9.62%)	247 (9.17%)	263 (9.30%)	319 (9.82%)	333 (10.10%)
Salticidae	211 (9.66%)	266 (9.87%)	307 (13.19%)	338 (10.40%)	340 (10.32%)
Thomisidae	146 (6.68%)	164 (6.09%)	168 (5.94%)	177 (5.45%)	179 (5.44%)
Theridiidae	116 (5.31%)	125 (4.64%)	132 (4.67%)	167 (5.14%)	168 (5.10%)
Araneidae	114 (5.22%)	108 (4.01%)	113 (4.00%)	128 (3.94%)	128 (3.88%)
Philodromidae	61 (2.79%)	73 (2.71%)	74 (2.62%)	92 (2.83%)	94 (2.85%)
Dysderidae	51 (2.34%)	90 (3.34%)	91 (3.22%)	90 (2.77%)	90 (2.73%)
Agelenidae	44 (2.01%)	45 (1.67%)	54 (1.91%)	80 (2.46%)	81 (2.46%)
Dictynidae	49 (2.24%)	53 (1.97%)	59 (2.09%)	71 (2.19%)	73 (2.21%)
others	322	387	399	451	464
TOTAL	2,184	2,694	2,827	3,249	3,296
Family	Species number (percentage)				
	2013	2015	2017	2020	
Linyphiidae	986 (29.52%)	997 (29.55%)	1019 (29.65%)	1033 (29.27%)	
Gnaphosidae	375 (11.23%)	378 (11.20%)	388 (11.29%)	401 (11.36%)	
Lycosidae	351 (10.51%)	357 (10.58%)	359 (10.45%)	369 (10.46%)	
Salticidae	340 (10.18%)	345 (10.23%)	346 (10.07%)	355 (10.06%)	
Thomisidae	181 (5.42%)	183 (5.42%)	184 (5.35%)	187 (5.30%)	
Theridiidae	172 (5.15%)	173 (5.13%)	175 (5.09%)	177 (5.02%)	
Araneidae	128 (3.83%)	127 (3.76%)	130 (3.78%)	133 (3.77%)	
Philodromidae	93 (2.78%)	93 (2.76%)	93 (2.71%)	94 (2.66%)	
Dysderidae	90 (2.69%)	91 (2.70%)	91 (2.65%)	93 (2.64%)	
Agelenidae	82 (2.46%)	81 (2.40%)	86 (2.50%)	87 (2.47%)	
Dictynidae	73 (2.19%)	76 (2.25%)	80 (2.33%)	81 (2.30%)	
others	469	473	486	519	
TOTAL	3,340	3,374	3,437	3,529	

Clubionidae is not included in the count because there is change to its species composition in in the surveyed period.

Cheracanthiidae is listed separately from Eutichuridae, and the Zoridae is considered separately from the Miturgidae, retaining its earlier scope that follows 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, 2022). The family Linyphiidae is most diverse in boreal and temperate zones, whereas Salticidae in (sub)tropical areas; the tropics are totally absent from the FSU, while the subtropics are represented only marginally.

In the FSU, Linyphiidae show the highest diversity (Table 1), with over 1,000 species recorded/described. Gnaphosidae, Lycosidae and Salticidae are the next three families to follow, the order of which was changed between

1989 and 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 (+379 species), followed by Gnaphosidae (+195), Lycosidae (+159), Salticidae (+144) and Theridiidae (+61) (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 2013–2020, 189 and 23.6.

An analysis of the spider fauna of the post-Soviet countries (Table 2, Supplements 1.01–1.15) reveals almost the same proportions as

Table 2. Spider species composition in the FSU and post-Soviet republics, data for 1989, 1996, 2000, 2008, 2009, 2011, 2013, 2015 2017 and 2020.
 Таблица 2. Видовой состав пауков бывшего СССР и постсоветских республик, данные за 1989, 1996, 2000, 2008, 2009, 2011, 2013, 2015, 2017 и 2020 годы.

Regions/ Years	Area, sq.km x 10 ³	1989	1996	2000	2008	2009	2011	2013	2015	2017	2020	2020, in comparison with 1996
Ex-USSR	22400	2184	2694	2827	3213	3249	3296	3340	3374	3437	3529	+835 (30.99%)
Russia	17075.4		1874	1974	2260	2297	2339	2366	2397	2445	2497	+623 (33.24%)
Estonia	45.1		506	509	505	507	511	511	511	511	512	+6 (1.19%)
Latvia	64.5		401	402	414	415	419	419	465	464	495	+94 (23.44%)
Lithuania	65.2		241	271	385	392	445	445	443	443	443	+202 (83.82%)
Byelorus(sia)	207.6		383	412	418	421	424	431	447	487	487	+104 (27.15%)
Ukraine	603.7		808	830	936	958	996	1008	1016	1056	1076	+268 (33.17%)
Moldova	33.7		291	292	292	292	292	292	292	293	294	+3 (1.03%)
Georgia	69.7		326	456	463	467	518	520	581	583	623	+297 (91.10%)
Azerbaijan	86.6		500	559	642	644	657	663	669	688	700	+200 (40.00%)
Armenia	29.8		118	127	134	135	136	136	141	155	169	+51 (43.22%)
Kazakhstan	2717.3		679	719	819	847	879	966	996	1010	1022	+343 (50.52%)
Uzbekistan	447.7		290	309	320	321	330	331	334	337	343	+53 (18.27%)
Turkmenistan	488.1		353	377	387	387	391	394	394	399	416	+63 (17.85%)
Kyrgyzstan	198.5		358	464	474	476	477	479	479	485	486	+128 (35.75%)
Tajikistan	143.1		293	310	316	317	318	318	322	331	352	+59 (20.14%)

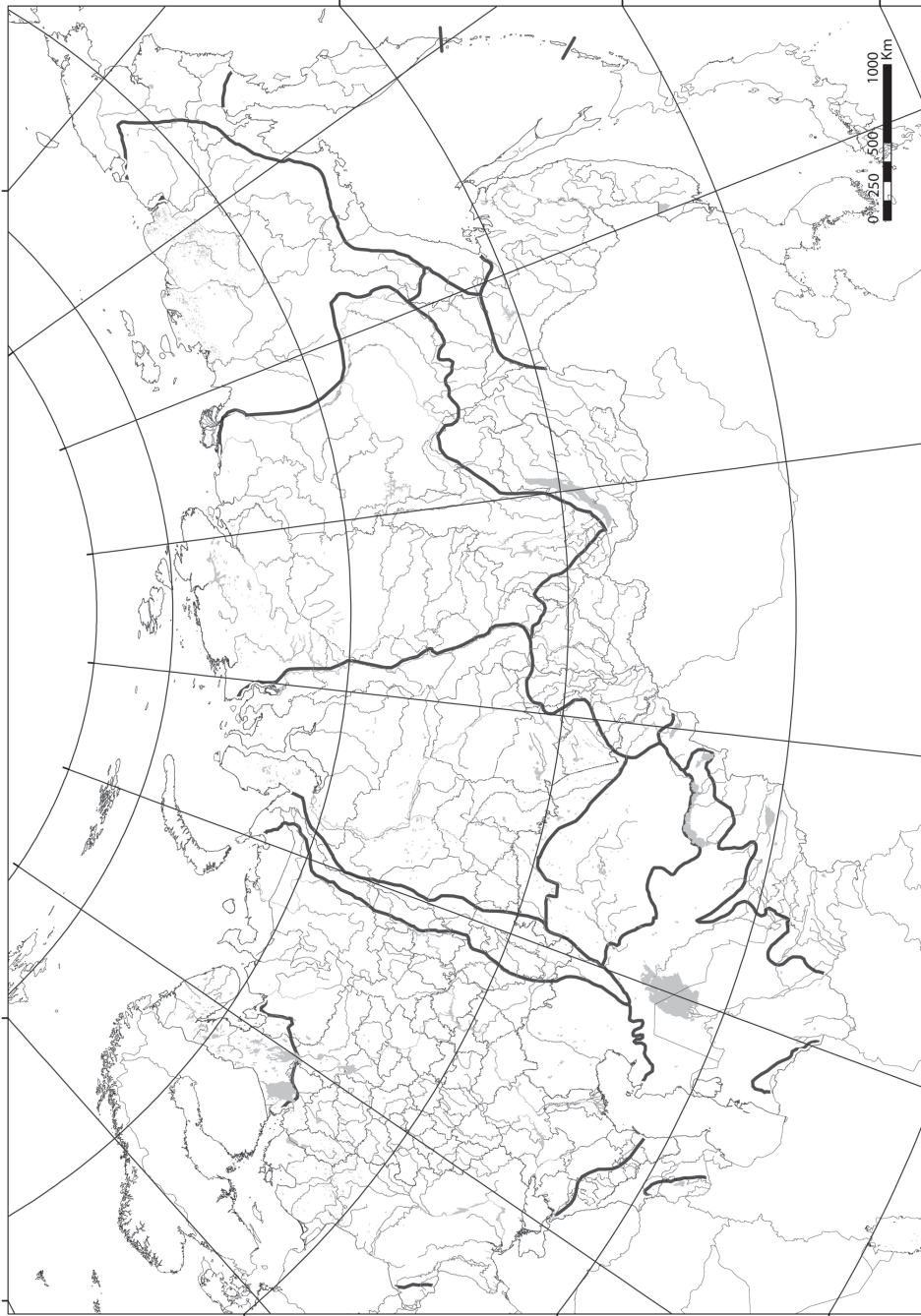


Fig. 1. See caption at the next page.
Рис. 1. Подпись см. на следующей странице.

earlier: Russia, as the largest FSU territory, supports the highest diversity (2,497 species), followed by Ukraine (1,076), Kazakhstan (1,022) and Azerbaijan (700). The spider fauna of Moldova shows no large increase in species number, 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, and 14 more in 2017–2020. A different situation is observed in Estonia (+6 species only), which is one of the best-studied republics in terms of arachnology thanks 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 (in that time) both in a species number and composition; in Latvia, such an increase was made especially in 2018 when local check-list was provided (Cera, 2018). In 1996–2020, the main increase in species richness was notable in Russia (+623 species), Kazakhstan (+343), Georgia (+297), Ukraine (+268), Lithuania (+202) and Azerbaijan (+200). A significant contribution to the spider knowledge of Kazakhstan had been made by overseas arachnologists (A.A. Fomichev, D.V. Logunov, Yu.M. Marusik).

No correlation was found between the spider species diversity and the size of the area from which they were recorded (Table 2). Overall, larger areas, like Russia and Kazakhstan, support lesser spider species diversities. A moderate level of species richness is also observed in Uzbekistan and Turkmenistan, where desert

landscapes predominate. Mountain areas, like Georgia and Azerbaijan, are richer in spider species per an area unit, yet being comparable in this index with poorly-studied Moldova.

The FSU physiographical regions accepted follow Gvozdetsky (1968) (Fig. 1). The main increase during 1996–2020 was observed in Russian Plain (V, +440 species), the continental southern Russian Far East (T1, +393 species), the Caucasus (E2, +319 species), West Siberia (M, +319 species), the Crimea (E1, +258 species), the mountains of South Siberia (P, +245 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 by both K.Yu. Eskov and Yu.M. Marusik. It is noteworthy that in the continental southern Russian Far East, crucial taxonomic/faunistic studies were largely performed by visiting arachnologists (before 2000ies, at least), while in the Crimea by local specialists.

The data provided herein are difficult to compare with such adjacent regions as West and Central Europe, China or Japan. Recent country calculations are available for Europe (Helsdingen, 2021), also with data on European Russia and Ukraine. For example, Poland, which is $312.7 \cdot 10^3 \text{ km}^2$ in area, supports 846 spider species, Germany ($357 \cdot 10^3 \text{ km}^2$) — 1,016 species. This is comparable with 1,076 species in Ukraine ($603.7 \cdot 10^3 \text{ km}^2$). A total of 2,361 spider species was registered in the entire territory of China earlier (Song et al., 1999); 3,714 species in 2013 (Shuqiang Li, pers. comm.), 4,282 spe-

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+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. 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+I — горы Средней (Центральной) Азии, K — пустыни Средней (Центральной) Азии, L — Казахстанский мелкосопочник, M — 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, 2017 and 2020.
 Таблица 3. Видовой состав пауков физико-географических регионов бывшего СССР, данные за 1989, 1996, 2000, 2008, 2009, 2011, 2013, 2015, 2017 и 2020 годы.

Regions/ Years	1989	1996	2000	2008	2009	2011	2013	2015	2017	2020	2020, in comparison with 1996
A	1	1	2	2	2	2	2	2	2	2	+1
B	385	429	516	532	534	554	557	568	589	589	+160 (+37.30%)
V	936	1001	1026	1294	1314	1347	1362	1381	1414	1441	+440 (43.96%)
G1+G2	600										
G1		21	21	20	24	24	24	25	33	35	+14 (66.67%)
G2		683	750	786	790	795	799	799	815	827	+144 (21.08%)
D	435	421	428	459	485	536	537	543	576	594	+173 (41.09%)
E1	308	311	342	478	500	508	520	538	561	569	+258 (82.96%)
E2+Zh1	671										
E2		752	834	927	940	974	987	1026	1039	1071	+319 (42.42%)
Zh1		127	135	228	231	233	233	241	259	273	+146 (114.96%)
Zh2+Z+I	650										
Zh2		221	240	243	244	245	247	247	247	255	+34 (15.38%)
Z+I		773	833	878	880	901	915	920	935	976	+203 (26.26%)
K	291	318	338	352	360	368	401	419	423	439	+121 (38.05%)
L	103	129	143	160	160	171	172	209	254	256	+127 (98.45%)
M	243	440	554	602	652	655	664	715	723	759	+319 (72.50%)
N+O	532	624	634	667	666	669	669	674	674	676	+52 (8.33%)
P	436	813	912	1002	1015	1017	1022	1045	1050	1058	+245 (30.14%)
R	277	395	397	408	408	410	410	410	421	425	+30 (7.59%)
S1+S2+S3+S4	278										
S1		411	415	446	451	449	449	454	454	462	+51 (12.41%)
S2		184	182	204	205	240	240	248	248	275	+91 (49.46%)
S3		54	60	81	81	82	82	82	82	85	+31 (57.41%)
S4		19	20	20	20	20	20	20	20	21	+2 (10.53%)

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

Regions/ Years	1989	1996	2000	2008	2009	2011	2013	2015	2017	2020	2020, in comparison with 1996
T1+T2+T3	375										
T1		507	566	797	843	861	864	870	888	900	+393 (77.51%)
T2		343	338	361	361	362	363	362	363	366	+23 (6.71%)
T3		144	149	165	166	170	170	172	174	177	+33 (22.92%)

Regions: 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+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.

cies (Li, Lin, 2016) and currently 5,084 species (Li, 2020). To date, 1,647 species and subspecies are known from Japan (calculated after Shinkai *et al.*, 2020) compared to 1,574 species in 2013 (A. Tanikawa, pers. comm., 2013).

Earlier estimates of the total FSU spider fauna accounted for 2,700–3,000 species (Mikhailov, 1992), later to 3,400–3,500 species (Mikhailov, 1997). The latest prediction, with a total spider diversity of the FSU being was likely to be 3,700–3,800 species, and that of Russia 2,500–2,600 species (Mikhailov, 2013a), seems to be worth updating to 4,000 and 2,700–2,800 species correspondingly. Faunistic studies of the spiders of Russia and the FSU are yet far from complete.

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. Tadjikistan.

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).

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