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Progress in the study of the spider fauna (Aranei) of Russia and neighbouring regions: a 2022 update

Итоги изучения фауны пауков (Aranei) России и прилежащих стран: обновление 2022 года

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

ABSTRACT: Calculations of the spider diversity of Russia and other countries of the former USSR (FSU), as well as of their physiographic regions, as of 2022 are given compared to earlier data. By December 31st, 2022, 3,586 and 2,531 spider species had been reported from the FSU republics and Russia, respectively. As additional electronic appendices, 43 spider species lists are provided for the post-Soviet republics and their physiographic regions, as well as European and Asian parts of FSU and Russia.

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РЕЗЮМЕ: Приведены подсчеты разнообразия пауков России и других стран бывшего СССР, а также их физико-географических регионов по состоянию на 2022 год, в сравнении с ранними данными. На 31 декабря 2022 г. отмечено 3586 и 2531 вид пауков для территории бывшего СССР и России, соответственно. Дан прогноз видового богатства пауков бывшего СССР и России. В качестве дополнительных электронных приложений даны 43 списка видов пауков пост-советских республик, их физико-географических регионов, а также европейской и азиатской частей бывшего СССР и России.

Introduction

This paper is the result of a long-term study contributing to the understanding of global biodiversity. 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 (hereafter FSU). The aim of the entire project was to compile and critically assess all the available literature, both taxonomic and faunistic, on the spiders of Russia and other FSU republics since the 18th century. Compared to the modern World Spider Catalog [WSC, 2024] and its earlier versions [Roewer, 1942, 1954a,b; Brignoli 1983; 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 FSU countries, despite the availability a considerable literature, mainly 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], SE part of European Russia together with neighbouring territories of Kazakhstan [Ponomarev, 2022], Lvov Area [Hirna, Zhukovets, 2022], etc. A project was recently launched to create an internet catalogue of the spiders of Ukraine, which is currently frozen (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 and Kazakhstan. 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 several 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 FSU republics and physiographical areas [Mikhailov, 2021, 2022].

Methods

This paper aims at providing the latest calculations (as of 31 December 2022) of spider species diversity of the FSU territories to demonstrate progress in the existing knowledge. Earlier calculations have been published in a series of papers [Mikhailov, 1992, 1997, 2002, 2012b, 2013a, 2016, 2021, 2022, etc.]. An updated and the most complete bibliographical list has appeared separately [Mikhailov, 2012a, 2024], with 5,268 references included. In order not to recalculate the number of species to account for changes in state borders, the 1992 borders of the FSU countries have been adopted herein.

Only the published literature data on spider records are used in this project. Numerous 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 [2024], 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 2022, 3,586 spider species (670 genera) in 54 (+Synotaxidae, cf. Mikhailov [2022]) of the 134 extant families worldwide had been reported from the FSU territories (Table 1). Slight differences in family names and scope as compared to WSC [2024] are kept in the current checklist. The Cheracanthiidae is listed instead of Eutichuridae, same for Zoridae – Miturgidae.

A comparison of FSU species diversity (Table 1) shows that Linyphiidae, rather than Salticidae (as in WSC [2024]), now hold the first place. 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.

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**	**2022**
Linyphiidae	986 (29.52%)	997 (29.55%)	1,019 (29.65%)	1,033 (29.27%)	1,040 (29.00%)
Gnaphosidae	375 (11.23%)	378 (11.20%)	388 (11.29%)	401 (11.36%)	405 (11.29%)
Lycosidae	351 (10.51%)	357 (10.58%)	359 (10.45%)	369 (10.46%)	378 (10.54%)
Salticidae	340 (10.18%)	345 (10.23%)	346 (10.07%)	355 (10.06%)	355 (9.90%)
Thomisidae	181 (5.42%)	183 (5.42%)	184 (5.35%)	187 (5.30%)	189 (5.27%)
Theridiidae	172 (5.15%)	173 (5.13%)	175 (5.09%)	177 (5.02%)	178 (4.96%)
Araneidae	128 (3.83%)	127 (3.76%)	130 (3.78%)	133 (3.77%)	136 (3.79%)
Philodromidae	93 (2.78%)	93 (2.76%)	93 (2.71%)	94 (2.66%)	93 (2.59%)
Dysderidae	90 (2.69%)	91 (2.70%)	91 (2.65%)	93 (2.64%)	98 (2.73%)
Agelenidae	82 (2.46%)	81 (2.40%)	86 (2.50%)	87 (2.47%)	93 (2.59%)
Dictynidae	73 (2.19%)	76 (2.25%)	80 (2.33%)	81 (2.30%)	79 (2.20%)
others	469	473	486	519	542
TOTAL	3,340	3,374	3,437	3,529	3,586

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

Table 2. Spider species composition in the FSU and post-Soviet republics, data for 1989–2022.
Таблица 2. Видовой состав пауков бывшего СССР и постсоветских республик, данные за 1989–2022 гг.

Regions/ Years	Area, sq.km • 10^3	1989	1996	2000	2008	2009	2011	2013	2015	2017	2020	2022	2022, in comparison with 1996
Ex-USSR	22400	2,184	2,694	2,827	3,213	3,249	3,296	3,340	3,374	3,437	3,529	3,586	+892 (33.11%)
Russia	17075.4		1,874	1,974	2,260	2,297	2,339	2,366	2,397	2,445	2,497	2,531	+657 (35.05%)
Estonia	45.1		506	509	505	507	511	511	511	511	512	512	+6 (1.19%)
Latvia	64.5		401	402	414	415	419	419	465	464	495	496	+95 (23.69%)
Lithuania	65.2		241	271	385	392	445	445	443	443	443	443	+202 (83.82%)
Byelorus(sia)	207.6		383	412	418	421	424	431	447	487	487	490	+107 (27.94%)
Ukraine	603.7		808	830	936	958	996	1,008	1,016	1,056	1,076	1,096	+288 (35.64%)
Moldova	33.7		291	292	292	292	292	292	292	293	294	295	+4 (1.37%)
Georgia	69.7		326	456	463	467	518	520	581	583	623	624	+298 (91.41%)
Azerbaijan	86.6		500	559	642	644	657	663	669	688	700	706	+206 (41.20%)
Armenia	29.8		118	127	134	135	136	136	141	155	169	227	+109 (92.37%)
Kazakhstan	2717.3		679	719	819	847	879	966	996	1,010	1,022	1,035	+356 (52.43%)
Uzbekistan	447.7		290	309	320	321	330	331	334	337	343	345	+55 (18.97%)
Turkmenistan	488.1		353	377	387	387	391	394	394	399	416	421	+68 (19.26%)
Kyrgyzstan	198.5		358	464	474	476	477	479	479	485	486	488	+130 (36.31%)
Tajikistan	143.1		293	310	316	317	318	318	322	331	352	363	+70 (23.89%)

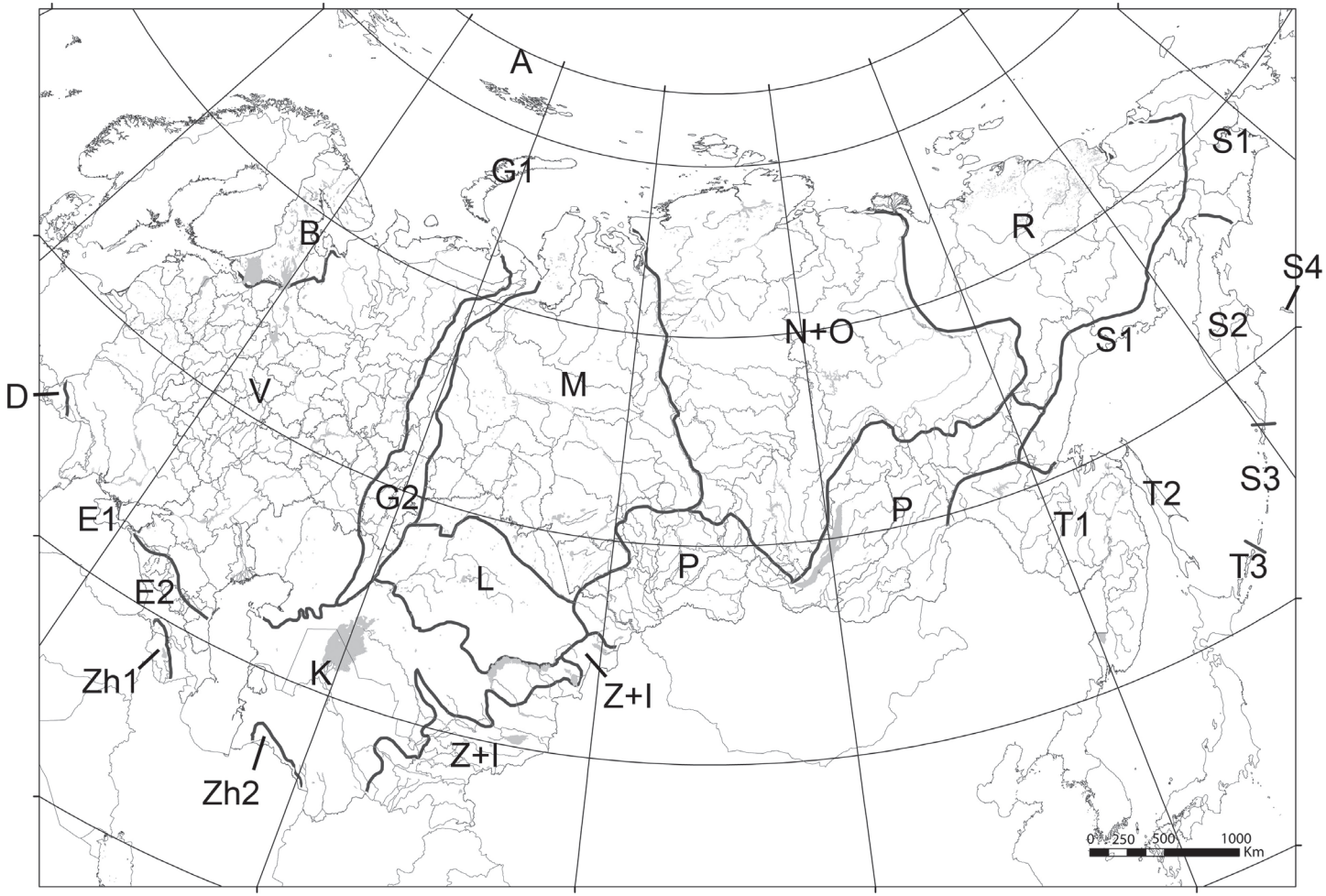

Fig. 1. Physiographical regions of the FSU after Gvozdetsky [1968]: A — Atlantic-Arctic area, B — Fennoscandia, V — Russian Plain, G1 — Novaya Zemlya, G2 — Urals, D — Carpathians, E1 — Crimea, E2 — Caucasus, Zh1 — Armenian Upland, Zh2 — Kopet Dagh Mts, Z+I — Mountains of Middle (= Central) Asia, K — 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]: A — Атлантико-Арктическая область, B — 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 1989–2022.
Таблица 3. Видовой состав пауков физико-географический регионов бывшего СССР, данные за 1989–2022 гг.

Regions/ Years	1989	1996	2000	2008	2009	2011	2013	2015	2017	2020	2022	2022, in comparison with 1996
A	1	1	2	2	2	2	2	2	2	2	2	+1
B	385	429	516	532	534	554	557	568	589	589	591	+162 (37.76%)
V	936	1,001	1,026	1,294	1,314	1,347	1,362	1,381	1,414	1,441	1,452	+451 (45.05%)
G1+G2	600											
G1		21	21	20	24	24	24	25	33	35	35	+14 (66.67%)
G2		683	750	786	790	795	799	799	815	827	834	+151 (22.11%)
D	435	421	428	459	485	536	537	543	576	594	604	+183 (43.47%)
E1	308	311	342	478	500	508	520	538	561	569	576	+265 (85.21%)
E2+Zh1	671											
E2		752	834	927	940	974	987	1,026	1,039	1,071	1,088	+336 (44.68%)
Zh1		127	135	228	231	233	233	241	259	273	322	+195 (153.54%)
Zh2+Z+I	650											
Zh2		221	240	243	244	245	247	247	247	255	256	+35 (15.84%)
Z+I		773	833	878	880	901	915	920	935	976	991	+218 (28.20%)
K	291	318	338	352	360	368	401	419	423	439	446	+128 (40.25%)
L	103	129	143	160	160	171	172	209	254	256	295	+166 (128.68%)
M	243	440	554	602	652	655	664	715	723	759	770	+330 (75.00%)
N+O	532	624	634	667	666	669	669	674	674	676	676	+52 (8.33%)
P	436	813	912	1,002	1,015	1,017	1,022	1,045	1,050	1,058	1,071	+258 (31.73%)
R	277	395	397	408	408	410	410	410	421	425	425	+30 (7.59%)
S1+S2+S3+S4	278											
S1		411	415	446	451	449	449	454	454	462	464	+53 (12.90%)
S2		184	182	204	205	240	240	248	248	275	276	+92 (50.00%)
S3		54	60	81	81	82	82	82	82	85	85	+31 (57.41%)
S4		19	20	20	20	20	20	20	20	21	26	+7 (36.84%)
T1+T2+T3	375											
T1		507	566	797	843	861	864	870	888	900	913	+406 (80.08%)
T2		343	338	361	361	362	363	362	363	366	372	+29 (8.45%)
T3		144	149	165	166	170	170	172	174	177	177	+33 (22.92%)

See abbreviations overleaf.

Abbreviations for Table 3: 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.

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 (+386 species), followed by Gnaphosidae (+199), Lycosidae (+168), Salticidae (+144) and Theridiidae (+62) (Table 1). Overall, the increase in species richness between 1989 and 1995 was 510 species, or about 73 species per year. In 1996–2000, these figures were 130 and 33, respectively, in 2001–2011, 469 and 43, in 2013–2022, 246 and 24.6.

An analysis of the FSU spider faunas (Table 2, Supplements 1.01–1.15) reveals almost the same proportions as earlier: Russia, as the largest FSU territory, supports the highest diversity (2,531 species), followed by Ukraine (1,096), Kazakhstan (1,035) and Azerbaijan (706). The spider fauna of Moldova shows no large increase in species number, yet remaining not sufficiently studied due to the absence of local arachnologists. A project devoted to the spider fauna of Armenia started only recently and resulted in 14 additional species recorded between 2015 and 2017, 14 more in 2017–2020, and 58 more in 2020–2022! The situation is different in Estonia (+6 species in total), which is one of the best studied republics in terms of arachnology due to the studies of A. Vilbaste in the 1960s–1980s. In Lithuania, a lot of species have been added between 2000 and 2011, revealing that its spider fauna is similar to that of Latvia (at the time) in both species number and composition; in Latvia, such an increase was made especially in 2018 when a local checklist was published [Cera, 2018]. In 1996–2022, the main increase in species richness was recorded in Russia (+657 species), Kazakhstan (+356), Georgia (+298), Ukraine (+288), Azerbaijan (+206) and Lithuania (+202). A significant contribution to the spider knowledge of Kazakhstan was made by Russian arachnologists (A.A. Fomichev, D.V. Logunov, Yu.M. Marusik, A.V. Ponomarev). Besides Armeinia, the largest increase in the spider fauna recorded in 2020–2022 was in Russia (+30 species), Ukraine (+20), Kazakhstan (+13), and Tajikistan (+11). When comparing the territory size, the arachno-champions are Armenia and Ukraine.

The present data that have been collected over 40 years for the Middle Asian republics and Kazakhstan do not agree with the obviously incorrect calculations by Li & Lin [2023, with a missing electronic appendix], supposedly based on WSC; yet, the WSC does not contain any calculations of the kind (T. Blick, pers. comm.).

No correlation has been found between the spider species diversity and the size of the territory where they were recorded (Table 2). Overall, larger areas, like Russia and Kazakhstan, support comparatively lesser spider species diversities. A moderate level of species richness has been 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 1996–2022 has been observed in Russian Plain (V, +451 species), the continental southern part of the Russian Far East (T1, +406 species), the Caucasus (E2, +336 species), West Siberia (M, +330 species), the Crimea (E1, +265 species), the mountains of South Siberia (P, +258 species) (Table 3, see also species lists in Supplements 2.01–2.24). Moderate increases in Middle Siberia (N+O), the continental part of the Far North-East (S1) and Sakhalin (T2) could be explained by the earlier (the 1980s to the early 1990s for T2) activities by K.Yu. Eskov and Yu.M. Marusik. Compared to the corresponding species lists, increases between 1996 and 2022 have been shown for Armenian Upland (Zh1, +153.54%), Kazakhstan Hills (L, +128.68%), the Crimea (+85.21%), the continental southern part of the Russian Far East (+80.08%), West Siberia (+75.00%), and Novaya Zemlya (G1, +66.67%). It is noteworthy that in the continental southern part of the Russian Far East, crucial taxonomic/faunistic studies were largely conducted by visiting arachnologists (before the 2000s, at least), while in the Crimea by local specialists.

The European part of FSU (including the Urals) accounts for 1,811 species in 44 families, whereas the Asian part (without the cis-Caucasian Russia) — 3,087 species in 53 families (Supplements 3.01–3.02). Yet, 1,572 species have been found in European Russia (the cis-Caucasia and Urals included) and 1,861 — in Asian Russia (Supplements 3.03–3.04).

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, no new versions], including European Russia and Ukraine. For example, Poland, which is $312.7 \cdot 10^3$ km^2 in area, supports 846 spider species, Germany ($357 \cdot 10^3$ km^2) — 1,016 species. These figures are comparable with 1,096 species in Ukraine ($603.7 \cdot 10^3$ km^2). A total of 2,361 spider species were registered in the entire territory of China earlier [Song *et al*., 1999]; 3,714 species in 2013 (Shuqiang Li, pers. comm., 2013), 4,282 species [Li, Lin, 2016], 5,084 species [Li, 2020], and 6,344 species [Li, Lin, 2023]. Recently, 1,708 species have been listed from Japan [Tanikawa, 2024, and pers. comm.], compared to 1,647 (sub)species calculated after Shinkai *et al*. [2020] and 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 calculation, according to which the total spider

diversity in the FSU could be 3,700–3,800 species and in Russia 2,500–2,600 species [Mikhailov, 2013a], seems reasonable to update to 4,000 and 2,700–2,800 species, respectively. Faunistic studies of spiders of Russia and FSU countries are still far from being completed.

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 (Kyrghyzstan).
1.15. Tadjikistan.

Supplement 2. Lists of spiders of FSU physiographical 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).

Supplement 3. Lists of spiders of European and Asian parts.

3.01. European part of ex-USSR including Urals and Caucasian Russia.

3.02. Asian part of ex-USSR excluding Urals and Caucasian Russia.

3.03. European part of Russia including Urals and Caucasian Russia.

3.04. Asian part of Russia excluding Urals and Caucasian Russia.

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