

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

K.G. Mikhailov

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

ORCID 0000-0002-3304-5470

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

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 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 “Zoologicheskyy 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%) |
| Byelorussia(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 (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. 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).

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