2022. Journal of Arachnology 50:113–117

SHORT COMMUNICATION

Introducing the World Arachnida Catalog: the new research environment for (almost all) arachnid orders

Danilo Harms[1], **Wolfgang Nentwig**[2], **Daniel Gloor**[3] and **Mark S. Harvey**[4,5]: [1]Zoological Museum Hamburg, Leibniz Institute for the Analysis of Biodiversity Change (LIB), Center for Morphology and Taxonomy, Martin-Luther-King-Platz 3, 20146 Hamburg, Germany. E-mail: danilo.harms@uni-hamburg.de; [2]Institute of Ecology and Evolution, University of Bern, Baltzerstraße 6, 3012 Bern, Switzerland; [3]Natural History Museum Bern, Bernastrasse 15, 3005 Bern, Switzerland; [4]Collections & Research, Western Australian Museum, 49 Kew Street, Welshpool, WA 6106, Australia; [5]University of Western Australia, School of Biological Sciences, Crawley WA 6009, Australia

Abstract. The World Arachnida Catalog (WAC, online at https://wac.nmbe.ch) is introduced as an amalgamation of the highly successful World Spider Catalog (WSC), the Pseudoscorpions of the World Catalog, and the Smaller Arachnid Order Catalogs. The new catalogs present all available taxonomic information on eight arachnid orders (Amblypygi, Araneae, Pseudoscorpiones, Ricinulei, Palpigradi, Schizomida, Solifugae and Uropygi) in a single location and a standardized format, continuously updated by specialists, to members of the World Spider Catalog Association (WSCA). For the first time, the majority of taxonomic literature for Pseudoscorpiones and the smaller arachnid orders will be available in downloadable PDF format for members according to the Swiss copyright laws. Up-to-date counts of families, genera and species are given alongside the current taxonomy for each taxon. Now in a common place and presented in an almost unified format, the new catalog aims to become the primary repository of taxonomic information for the Arachnida and will hopefully stimulate arachnological research across all arachnid orders by removing boundaries imposed by literature accessibility, incompatibility of formats, or taxonomic jargon.

Keywords: Arachnida, nomenclature, systematics, taxonomy.

https://doi.org/10.1636/JoA-S-21-063

The World Spider Catalog (WSC, online at https://wac.nmbe.ch) is undoubtedly the most important repository for taxonomic data pertaining to spiders and provides the foundation not only for taxonomic research, but also other fields of research such as spider ecology, faunistics and conservation science. Deeply founded in arachnological tradition, this ever-evolving database has roots stemming back to Pierre Bonnet's famous *Bibliographia Araneorum* (three volumes: 1945–1961), Eduard Reimoser's *Katalog der echten Spinnen des paläarktischen Gebietes* (1919) and Carl-Friedrich Roewer's *Katalog der Araneae* (two volumes: 1942, 1955) with supplements provided by Brignoli (1983) and Norman Platnick, who continued to update the catalogs in book format (1989, 1993, 1998). Platnick also realized the vast potential of the then-emerging internet and moved the entire catalog online in 2000 (Platnick 2000) where he presented the data as simple but editable lists. The new format pioneered the use of the internet for data distribution, and stimulated research on spiders by removing barriers and providing free access to bibliographic information for the entire arachnological community, not just those who could afford expensive books or had access to scientific libraries. In half-year intervals between 2000 and 2014, Platnick managed and edited a total of 27 updates before the WSC was moved to the Natural History Museum in Bern, Switzerland. The World Spider Catalog Association was formed under the Swiss Civil Code to support future development of this online source and provide members free access to all taxonomic literature in downloadable PDF-format. The catalog is now updated and enhanced regularly, and new taxa are being added at an unprecedented rate along with the relevant taxonomic literature and important details not available in previous catalogs, such as type repositories, number of type specimens, editorial histories, Life Science Identifiers (LSIDs), and a complete record of fossil taxa omitted in previous catalogs. Presently, the World Spider Catalog lists all available taxonomic information for roughly 50,000 Recent species, which is an increase of 33% from the first online catalog in 2000.

Meanwhile, all available scientific information pertaining to pseudoscorpions between 1758 and 1988 was published as the first ever *Catalogue of the Pseudoscorpionida* (Harvey 1991) and a second catalog, the *Catalogue of the Smaller Arachnid Orders of the World*, followed more than a decade later (Harvey 2003). A concerted effort was made to document the type localities for each species and accumulate all literature sources. In 2008, the pseudoscorpion catalog was moved online by the Western Australian Museum, again in the form of simple lists and some introduction pages. This catalog saw three versions (Harvey 2008, 2011, 2013) but has not been updated since 2013. The smaller arachnid order catalogs also went online in 2013 (Harvey 2013a–f) but have not since been updated or augmented. The online versions of the pseudoscorpion and small order catalogs differed from the WSC format by a (now defunct) map function for type localities, listing all relevant literature pertaining to these orders, not just taxonomic papers, a distribution browser with checklists for each country, and the inclusion of fossil taxa alongside the Recent fauna. Conversely, these catalogs lacked a literature repository found in the WSC, and the original literature remains unavailable to many taxonomists—particularly those from developing nations—where arachnological collections are rare and taxonomic literature has not been archived by museum curators or librarians.

In 2017, the first and the second author of this paper met after a presentation in Hamburg and the idea of unified catalogs for these orders for the entire arachnological community was born over a beer. A string of emails followed, and consensus was reached between all authors to develop unified catalogs, with funding organized from the Western Australian Museum in Perth, the Zoological Museum (Hamburg) of the Leibniz Institute for the Analysis of Biodiversity Change, and the Natural History Museum in Bern. The project proved a little more difficult than initially thought because new

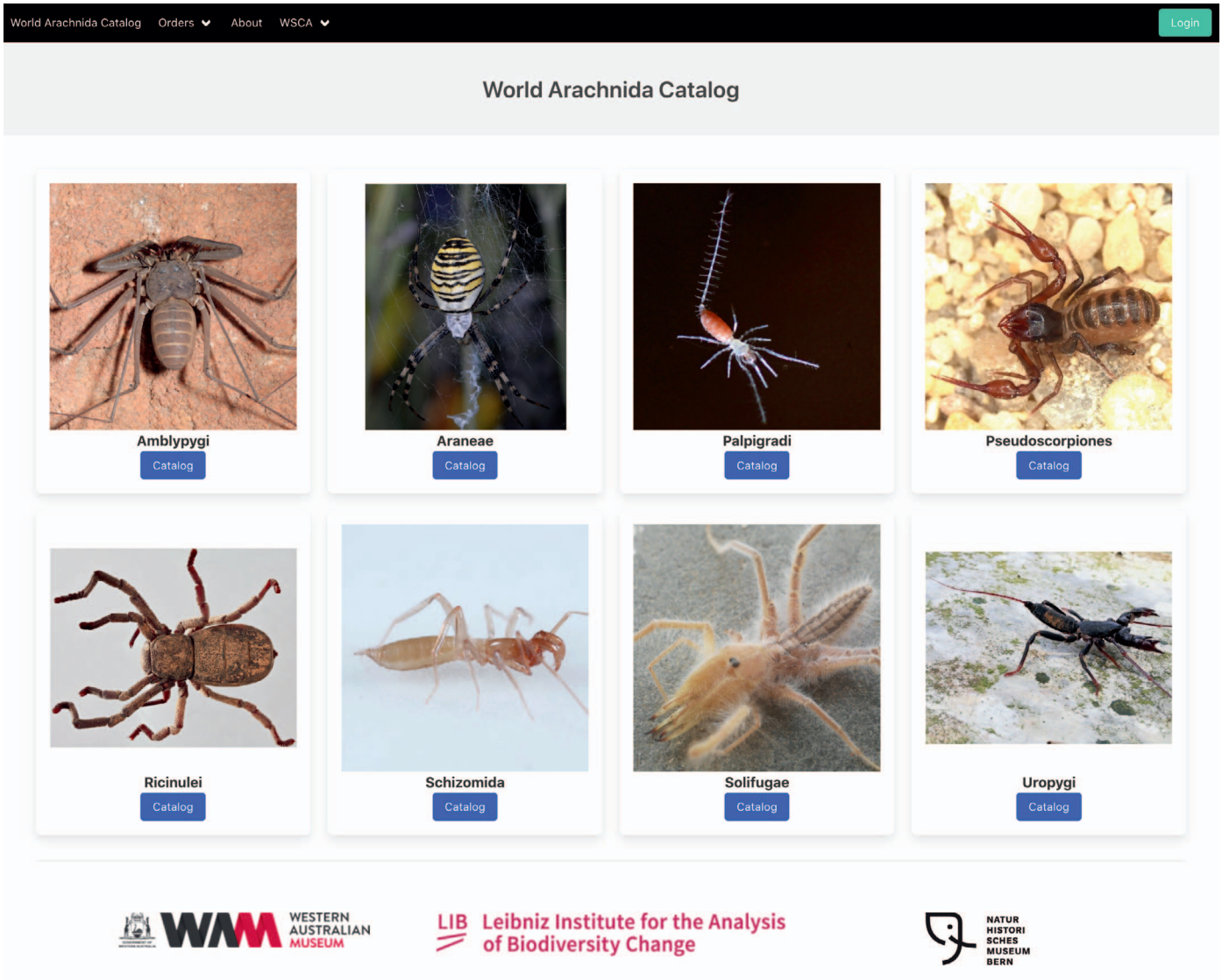

Figure 1.—Current landing page of the World Arachnida Catalog.

computer code had to be written, literature libraries organized, new functions and features implemented or modified, responsibilities clarified, and the taxonomy of many taxa updated.

The new WAC functions and layout.—The user arrives on a common landing page which is modified from the World Spider Catalog format and provides a header with a dropdown for the orders and an explanation of the World Spider Catalog Association, with details of membership and activities. The user may decide to create an account with the WSCA at this stage, which allows access to data restricted to members, such as the scientific literature. Eight buttons feature the arachnid orders treated here (Fig. 1) and the user may navigate to the World Spider Catalog, which retains its old format, or the newly designed and edited catalogs for the other orders. Title pages for each of the orders include a count of taxa according to rank (families, genera or species), and counts for fossil taxa (Fig. 2). Altogether, the catalogs for the seven smaller orders provide the complete taxonomic history, ecological and faunistic entries, distribution maps, type repositories, and literature for Recent taxa, including 7 orders, 29 families, 707 genera, and 5918 valid species, plus an additional 12 families, 40 genera, and more than 100 species in the fossil fauna (Table 1). Currently, some catalogs (e.g., Amblypygi and Ricinulei) still use the species counts from 2013, but they are being updated, and species described in the last decade will be added soon. With spiders included a total of 55,540 Recent species and some 1,500 fossil taxa are now classified and treated with their accompanying information (Table 1).

As with the World Spider Catalog, the websites are curated and all registered users are invited to contribute and correct the data as presented, to generate an interactive work medium for the community. Quality management is achieved through a scientific advisory board that checks the data and aims to assure a high academic standard. Board decisions are communicated as FAQs and discussions invited for problem cases (i.e., nomenclature and priority rules) within the scientific community.

Where to from here?—Like all scientific endeavours, catalogs improve over time and incorporate new technology We highlight four avenues for improvement for the WAC.

(1) **Improving the World Spider Catalog:** Updating the smaller arachnid orders and pseudoscorpion catalogs and moving them to their new hosting location required extensive recoding of many sections and the design of a new layout. Since new computer code

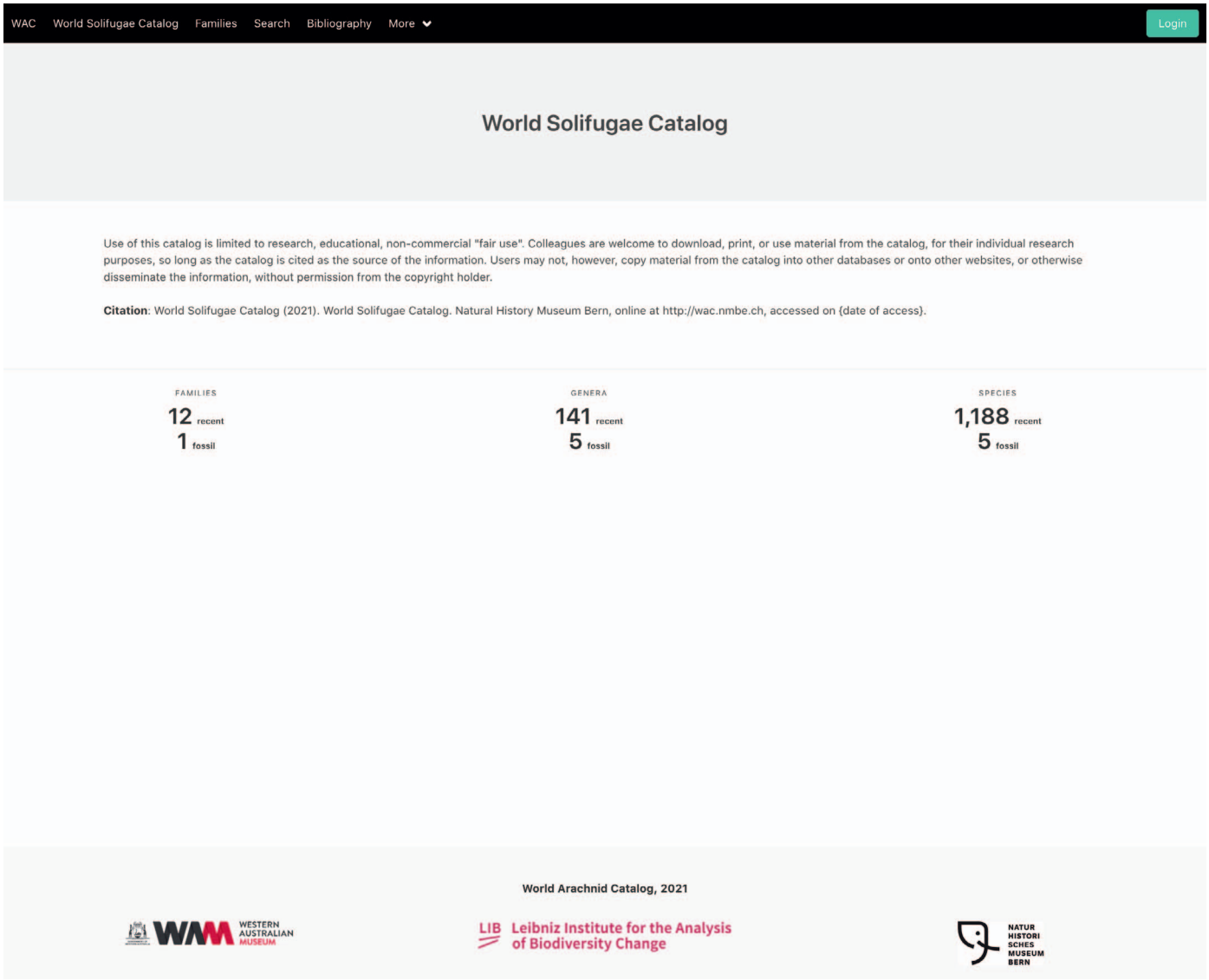

Figure 2.—Landing page for the World Solifugae Catalog highlighting layout and functionality.

was used, some features are now available for the smaller orders that are not yet included in the somewhat older code for the World Spider Catalog, such as a mapping function, the integration of fossil taxa, and new browser functions.

(2) **The other arachnid orders**: A second future aspect is the other non-acarine arachnid orders, most notably the scorpions (Scorpiones) and the harvestmen (Opiliones). The Scorpion Files website (https://www.ntnu.no/ub/scorpion-files/) offers a species list and taxon count but no additional taxonomic information. A printed catalog for the scorpions exists (Fet et al. 2000) but this catalog would have to be updated, digitized and integrated into the WSC by the scorpionologists.

A recent exciting development was the publication of the *World Catalogue of Opiliones* (WCO) which started off as an annotated catalog of the Laniatores (Kury 2003) and complemented catalogs for the other suborders (e.g., Cyphophthalmi, Giribet 2020; Dyspnoi, Schönhofer 2013). The first online version of the catalog was essentially an amended checklist of taxa (Kury et al. 2021a,b; also see wcolite.com) but the WCO is updated continuously and currently presents not only a checklist of species, species counts and a search engine, but also a full hierarchical taxonomic structure with citations for all supraspecific taxa, together with synonymies and homonymies. A printed version of this catalog is currently being prepared (Kury et al. 2021a) and a comprehensive checklist is available online (Kury et al. 2020). In the future, the WAC and the WCO could be reconciled and presented together online if the community seeks such a unified format, a consensus is reached on common functions and layout, and sustainable funding is provided by our community.

(3) **Integrating ecological and faunistic data:** The WAC is designed to be a dynamic tool, open to feedback and future developments. A discussion topic for the spider community could be the integration of ecological and faunistic data, as has been done for the other orders. Platnick explicitly excluded faunistic studies from the first online catalog (Platnick 2000) and they were not included in the earlier printed catalogs. However, recent developments such as the World Spider Trait Database (Lowe et al 2020; Pekár et al. 2021) for ecological and evolutionary analysis may be stimulated by faunistic data available in the smaller orders. However, inclusion of ecological and faunistic references in the WSC needs

Table 1.—Counts for the WAC orders according to valid family, genera, and species as of 1 October 2021. Fossil taxa belonging to both extinct and extant genera and families are denoted by a dagger.

WAC	No. of Families	No. of Genera	No. of Species
Amblypygi	5	17	205
	†6	†7	†13
Araneae	129	4221	49,622
	†123	†668	†1400
Palpigradi	2	6	115
	†0	†2	†2
Pseudoscorpiones	26	464	3892
	†1	†12	†46
Ricinulei	1	3	81
	†3	†5	†17
Schizomida	2	61	317
	†1	†3	†6
Solifugae	12	141	1188
	†1	†5	†5
Uropygi	1	15	120
	†0	†6	†11
Total Recent	178	4928	55,540
Total Fossil	135	708	†1500

strong quality control of faunistic data and a much broader scientific board with responsibility for such entries.

(4) **What about the mites?** A fourth discussion topic is the daunting task of including the mites. The desire to bridge the gap between acarologists and other arachnologists is frequently expressed in the community but no action has yet been taken. Some paper catalogs for at least some of the mite groups do exist (e.g., Beron 2008, 2011, 2014, 2015a,b) as well as bibliographies that are continuously being updated (e.g., the *Bibliographia Oribatologica* and the *Bibliographia Mesostigmatologica* of the Senckenberg Museum for Natural History in Görlitz, Germany) and in the future, common catalogs might lead to a closer collaboration between acarologists and arachnologists. A general problem for mites (and also scorpions) is that experts still struggle to agree on a common nomenclature system for at least families (Fet et al. 2000; Beron 2011) but with the advancement of molecular phylogenies this issue might be overcome.

Funding is perhaps the greatest impediment to developing the catalogs in the future; hosting, updating, and developing the catalogs is not only time-consuming but also requires a small permanent group of core staff that need ongoing funding. This problem has not yet been solved for the WAC/WSC.

CONCLUSION

Future developments aside, for now the new WAC provides a modern and up-to-date reservoir for taxonomic information for the entire global arachnological community, free of charge, easy to access, continuously checked and updated by experts, and open to feedback and suggestions from the community that it is meant to serve. We hope that the new catalogs will facilitate trans-ordinal research in our community, provide access to data for every arachnologist in all parts of the world, foster research on the neglected orders of arachnids (Harvey 2002, 2007), stimulate future development of the World Spider Catalog that now has an 80-year-old tradition, and provide a path to the continuous growth of our community by removing barriers to taxonomic data accessibility and scientific knowledge.

ACKNOWLEDGMENTS

We thank all those catalog lovers – past and present – who made this work possible: Max Beier for pseudoscorpions (1903–1979), Bruno Condé (Palpigradi), Pierre Bonnet (1897–1990), Paolo Brignoli (1942–1986), Norman I. Platnick (1951–2020), Eduard Reimoser (1864–1940) and Carl-Friedrich Roewer (1881–1963) (all spiders). We thank the editorial board of the World Spider Catalog (Theo Blick, Maria Chatzaki, Peter Jäger, Christian Kropf, Hirotsugo Ono, Cristina Rheims), the expert board and the country coordinators for their tremendous work in the past years. Theo Blick and Christian Kropf are acknowledged for their longstanding support of the project and the countless hours they have put into the catalog. Jason Dunlop added some critical counts for fossil spider groups and Adriano Kury provided some critical data on the WCO. Finally, we thank the financial support of the following organizations for keeping this project free to the scientific community: Leibniz Institute for the Analysis of Biodiversity Change, Hamburg and Bonn; Naturhistorisches Museum, Bern; and Western Australian Museum, Perth.

LITERATURE CITED

Beron P. 2008. Acarorum Catalogus I. Acariformes: Calyptostomatoidea (Calyptostomatidae), Erythraeoidea (Smaridiidae, Erythraeidae). Pensoft, Moscow.

Beron P. 2011. Acarorum Catalogus II. Acariformes: Acaridida, Listrophoroidea, Listrophoridae, Dromiciocoptidae, Myocoptidae, Chirodiscidae, Atopomelidae. Pensoft, Sofia, Moscow.

Beron P. 2014. Acarorum Catalogus III. Parasitiformes: Opilioacarida, Holothyrida, Mesostigmata. Pensoft, Sofia, Moscow.

Beron P. 2015a. Acarorum Catalogus IV. Acariformes: Trombidiformes, Prostigmata. Pensoft, Sofia,

Beron P. 2015b. Acarorum Catalogus V. Acariformes, Sarcoptiformes. Pensoft, Sofia.

Bonnet P. 1945–1961. Bibliographia Araneorum (3 volumes). Les Frères Douladoure, Toulouse.

Brignoli PM. 1983. A Catalogue of the Araneae described between 1940 and 1981. Manchester University Press, Manchester.

Fet V, Sissom WD, Lowe G, Braunwalder ME. 2000. Catalog of the Scorpions of the World (1758–1998). New York Entomological Society, New York.

Giribet G. 2020. An updated catalogue of the Opiliones suborder Cyphophthalmi (Arthropoda, Arachnida). *Revista Ibérica de Aracnología* 37:61–100.

Harvey MS. 1991. Catalogue of the Pseudoscorpionida. Manchester University Press, Manchester, UK & New York.

Harvey MS. 2002. The neglected cousins: what do we know about the smaller arachnid orders? *Journal of Arachnology* 30:357–372.

Harvey MS. 2003. Catalogue of the Smaller Arachnid Orders of the World: Amblypygi, Uropygi, Schizomida, Palpigradi, Ricinulei and Solifugae. CSIRO Publishing, Collingwood, Victoria, Australia.

Harvey MS. 2007. The smaller arachnid orders: diversity, descriptions and distributions from Linnaeus to the present (1758 to 2007). *Zootaxa* 1668:363–380.

Harvey MS. 2008. Pseudoscorpions of the World, version 1.1. Western Australian Museum, Perth. http://www.museum.wa.gov.au/arachnids/pseudoscorpions/.

Harvey MS. 2011. Pseudoscorpions of the World, version 1.2. Western Australian Museum, Perth. http://www.museum.wa.gov.au/arachnids/pseudoscorpions/.

Harvey MS. 2013. Pseudoscorpions of the World, version 2.0. Western Australian Museum, Perth. http://www.museum.wa.gov.au/arachnids/pseudoscorpions/.

Harvey MS. 2013a. Palpigradi of the World, version 1.0. Western

Australian Musuem, Online at: http://www.museum.wa.gov.au/catalogues/palpigrades
Harvey MS. 2013b. Ricinuleids of the World, version 1.0. Western Australian Musuem, Online at: http://www.museum.wa.gov.au/catalogues/ricinuleids
Harvey MS. 2013c. Schizomids of the World, version 1.0. Western Australian Musuem, Online at: http://www.museum.wa.gov.au/catalogues/schizomids
Harvey MS. 2013d. Solifuges of the World, version 1.0. Western Australian Museum, Online at: http://www.museum.wa.gov.au/catalogues/solifuges
Harvey MS. 2013e. Whip Spiders of the World, version 1.0. Western Australian Museum. Online at: http://www.museum.wa.gov.au/catalogues/whip-spiders
Harvey MS. 2013f. Whip Scorpions of the World, version 10. Western Australian Museum, Online at: http://museum.wa.gov.au/catalogues-beta/whip-scorpions
Kury AB. 2003. Annotated catalogue of the Laniatores of the New World (Arachnida, Opiliones). *Revista Iberica de Aracnología, Vol. especial monográfico*1:1–337.
Kury AB, Mendes AC, Cardoso L, Kury MS, Granado AA. 2020. WCO-Lite: online word catalogue of harvestmen (Arachnida, Opiliones). Version 1.0. Checklist of all valid nomina in Opiliones with authors and dates of publication up to 2018. Ed. Do autor. Rio de Janeiro, Brazil.
Kury AB, Mendes, AC, Cardoso L, Kury MS, Granado AA, et al. 2021a. WCO-Lite version 1.1: an online nomenclatural catalog of harvestmen of the World (Arachnida, Opiliones) curated in TaxonWorks. *Zootaxa* 4908:447–450.
Kury AB, Mendes AC, Cardoso L, Kury MS, Granado AdA, Giribet G, et al. 2021b. World Catalogue of Opiliones. In *Catalogue of Life Checklist* (Version 2021-03-23). Digital resource at www.catalogueoflife.org. Species 2000: Naturalis, Leiden, the Netherlands. ISSN 2405-8858.
Lowe EC, Wolff JO, Aceves-Aparicio A, Birkhofer K, Branco VV, Cardoso P, et al. 2020. Towards establishment of a centralized spider traits database. *Journal of Arachnology* 48:103–109.
Pekár S, Wolff J, Cernecka L, Birkhofer K, Mammola S, Lowe C, et al. 2021. The world spider trait database: a centralized global open repository for curated data on spider traits. *Database* 2021 (0):1–10.
Platnick NI. 1989. Advances in Spider Taxonomy 1981–1987: Manchester University Press, Manchester.
Platnick NI. 1993. Advances in Spider Taxonomy 1988–1991, with synonymies and transfers 1940–1980. New York Entomological Society, New York.
Platnick NI. 1998. Advances in Spider Taxonomy 1992–1995, with Redescriptions 1940–1980. New York Entomological Society, New York.
Platnick NI. 2000. The World Spider Catalog. Version 1.0. Online at: https://wsc.nmbe.ch/resources/archive/catalog_1.0/INTRO1.html
Reimoser E. 1919. Katalog der echten Spinnen (Araneae) des paläartischen Gebietes. *Abhandlungen der Zoologisch-Botanischen Gesellschaft in Wien* 10:1–280.
Roewer CF. 1942. Katalog der Araneae von 1759–1949 (Vol. 1). Buchhandlung für Naturkunde und exakte Wissenschaften Paul Budy, Bremen, Germany.
Roewer CF. 1955. Katalog der Araneae von 1758 bis 1940, bzw. 1954. 2. Band. L'Institut Royal des Sciences Naturelles de Belgique, Bruxelles, Belgium.
Schönhofer A. 2013. A taxonomic catalogue of the Dyspnoi Hansen and Sørensen, 1904 (Arachnida: Opiliones). *Zootaxa* 3679:1–68.

Manuscript received 8 October 2021, revised 16 December 2021, accepted 20 December 2021.