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WCO-Lite version 1.1: an online nomenclatural catalogue of harvestmen of the world (Arachnida, Opiliones) curated in TaxonWorks

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The "World Catalogue of Opiliones" (WCO) is a collaborative effort to comprehensively index the Earth's species of harvestmen. This paper announces one component of the WCO, "WCO-Lite" a website available at https://wcolite.com/. WCO-Lite provides a graphic user interface for a second component of the WCO, "Opiliones of the World", a database on the taxonomy of the harvestmen curated in TaxonWorks (TW). WCO-Lite interfaces include: (1) a checklist of all valid taxa of the arachnid Opiliones, exhaustive up to December 2018; (2) a taxonomic tree; (3) a search engine comprising two modules; and (4) a counter of species diversity for each taxon. An e-Book companion was launched simultaneously with WCO-Lite version 1.1 on September 12, 2020 to account for the formal publication of mandatory nomenclatural changes and availability of taxonomic names. The collective components of the WCO are also being summarized in a forthcoming conventional paper-form catalogue, currently in manuscript stage.

Key words: Arachnida, electronic taxonomy, online catalogue

With almost 6,640 valid species, the Opiliones is the fourth most diverse order in arachnids after Acariformes, Parasitiformes and Araneae, although estimates of numbers, taxonomic rank and even the monophyly of the two major acarian groups varies wildly (Harvey 2007; van Dam *et al.* 2018; Kury *et al.* 2020a; World Spider Catalog 2020). There are already modern catalogues for spiders and for the minor arachnid orders, but hitherto none for harvestmen at world scale. The severe need for an accurate nomenclatural treatment of the order Opiliones is felt for several years, and in the last decades smaller steps have already been taken to this end, by dealing with specific subtaxa and specific geographic areas (e.g., Cokendolpher & Lee 1993; Crawford 1992; Giribet 2000; Kury 2003; Kury 2018; Kury *et al.* 2014; Kury *et al.* 2015; Kury & Pérez-González 2015; Schönhofer 2013; Sharma *et al.* 2011; Staręga 1992). Nevertheless, there are many areas of the world still without up-to-date checklists (Kury 2011; 2012; 2013).

To remedy this need, a World Catalogue of the arachnid order Opiliones (WCO) was initiated in the late 2000s (project described in Kury 2016~). The WCO will be ultimately released as a formal monographic paper possibly in the late 2020s or early 2030s and it will contain a detailed logonymy, meticulous and extensive nomenclatural comments and analyses. Previous efforts within the scope of the project were OmniPaper, a catalogue of the New World Laniatores (Kury 2003) and sundry nomenclatural papers published by Kury (e.g., Kury 2017; 2018; 2019; Kury & Mendes 2020).

In 2018, AB Kury initiated the project "Opiliones of the World", which is a database on the taxonomy of the harvestmen by using taxonomic information compiled in the manuscript of WCO which is being transferred to the TaxonWorks platform (TW; http://taxonworks.org/), an integrated web-based workbench for taxonomists, created by The Species File Group and many other contributors (Dmitriev 2018; Yoder *et al.* 2019). The web-based nature of TaxonWorks facilitated

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adding new collaborating curators over time. These presently include A. Mendes, L. Cardoso, M. Kury, and A. Granado. After the closure of this version, another collaborator joined the team: Gonzalo Giribet (Museum of Comparative Zoology).

As the initial scope of data curation was realized, we decided to create a graphic user interface (GUI), for use by the general public. The intent is an authoritative reference for taxonomy of all subtaxa of harvestmen worldwide. This online version is called WCO-Lite, with "Lite" being a restyling of "light" to emphasize its smaller dimensions (not including exhaustive subsequent geographic records and additional descriptive data) and depth (not including historical backgrounds of taxa nor chresonyms). Ian Kury was then recruited to code the GUI. Version 1.0 of WCO-Lite was ephemeral, and was online only in the week prior to the official release. Upon criticism by our peers, we improved WCO-Lite by changing some navigational features, adding a species counter and a versioning system, this becoming version 1.1.

The GUI includes: (1) a checklist of all valid taxa of the arachnid Opiliones, exhaustive up to December 2018; (2) a taxonomic hierarchical D3 tree; (3) a search engine comprising two data display modules (card and table); and (4) a counter of species diversity for each taxon.

On September 12, 2020 a fully functional online version of WCO-Lite was formally presented to the public (Kury *et al.* 2020a). Simultaneously an e-Book was published (Kury *et al.* 2020b) containing explanations of conventions used in the WCO project regarding names of authors, bibliographic citations, as well as several nomenclatural acts aimed to stabilize and standardize the taxonomy of the order Opiliones.

How the site works

The WCO-Lite website (in version 1.1 when this was written) adventurously marauds across data exported from TW. TaxonWorks facilitates exports in a range of fixed and evolving formats, in part projects like WCO-Lite symbiotically guide this evolution. Here, specifically, early versions of the emerging Catalog of Life DP format (https://github.com/CatalogueOfLife/coldp) were exported from TW (in comma separated values, or "CSV" format). The CSV files, raw plunder, are sliced and diced by alacritous cutlery forged in C++ (a programming language) to prepare the feast. The banquet is served by a JavaScript/Node (another language, and system to manage packages in that language) butler. The butler can flexibly summon arbitrary dishes (data) and send them out to honored guests back in the dining room (web-page front end). Guests can request dishes (look for data) via their ingredients (authors, authors + year, taxon name) or ingredient parts (substring of previous). The butler is quite knowledgeable, and when you provide an errant order, will ask you "did you mean?", to ensure the diner gets the proper dish. Dishes (data) are presentable in three ways (modes) with paths that instantly transition between them: 1) al-la-carte (tabular, en-masse); 2) spiced up (as cards, with extra details per row, with navigation options between cards), or 3) gourmet-style, with many flowery artistic details (as a tree-based layout, with visual cues and guides for navigation). The restaurant, styled in the mild color palette of guava yogurt, comes with a time-counter, so the diner (user) can appreciate the lightning fast performance of the butler, and tip appropriately.

Contents of WCO-Lite version 1.1

The version 1.1 already contains all current valid taxon names in the Opiliones (numeric summary in Table 1).

TABLE 1. Numeric synopsis of the contents of version 1.1 of WCO-Lite. Numbers generated from "Nomenclature stats" task in TW.

Main taxon (suborder)	Included valid families	Included valid genera	**Included valid species**
Cyphophthalmi Simon, 1879	6	40	229
Dyspnoi Hansen & Sørensen, 1904	11	49	409
Eupnoi Hansen & Sørensen, 1904	7	244	1806
Laniatores Thorell, 1876	39	1308	4189
Tetrophthalmi Garwood *et al*, 2014	1	2	2
Total	**65**	**1645**	**6637**

Planned improvements in future versions of WCO-Lite

This is the first project to expose, publically, data curated in TaxonWorks via mechanisms not developed within TaxonWorks (i.e. a website built by the authors, not TaxonWorks developers). While in many ways a simple proof of concept, the WCO-Lite adheres to the TW philosophy: providing a workbench focused on curation coupled with means to export the data in ways that others are empowered to use and develop on as they need. TaxonWorks has various ways to expose and wrap the data curated therein with more formal semantics (e.g. global identifiers, data standpoints, JSON endpoints, etc.) not presently used in WCO-Lite. The WCO-Lite project, developed quickly, illustrates that this level of semantics is not a prerequisite for producing meaningful by-product resources. This is not to say that richer semantics won't improve WCO-Lite, but rather to acknowledge that comprehensive knowledge-bases like the WCO have extensive lifespans (perhaps decades in this case) during which potentially useful entry points may emerge, and in some cases disappear. Ultimately some of these entry-points must be instantaneous (e.g. serving WCO via TaxonWorks' API endpoints—https://api.taxonworks.org), others "slower" (e.g. producing a paper catalog for "slow" human consumption).

Content-wise, the authors are taking advantage of the wide variety of concepts managed by TaxonWorks to enrich the WCO. The following goals for WCO-Lite reflect the richness of TaxonWorks current semantics, and the depth at which the authors are curating the WCO:

(a) Indication of complete bibliographic sources (with pointers to PDFs for those sources) and page numbers for all nomenclatural acts;
(b) Indication of type-species for all genera as well as designation mode; indication of type-specimens for all species with repositories (museum holdings);
(c) Cross-referenced invalid nomina (junior synonyms and homonyms);
(d) Cross-referenced ID for people, works, taxa, such as ORCID, Wikidata, Life Science Identifiers (LSID) of ZooBank for authors of works;
(e) Etymology and gender for all generic nomina; etymology and grammatical classification (if they are adjectives, participles, nouns) for all species epithets;
(f) Asserted geographic distribution of species;
(g) Indication of alternative published classifications and varied relationships among taxa;
(h) Alternative spellings and combinations;
(i) Periodic updates regarding the literature analyzed;
(j) Indication of homonyms in other phyla;
(k) Pointers from the website to corresponding datasets within the Catalog of Life.

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