



<http://dx.doi.org/10.11646/zootaxa.3683.3.8>

<http://zoobank.org/urn:lsid:zoobank.org:pub:08BC877C-4BB0-4F61-B486-19197035EBF1>

## Automating the "Material examined" section of taxonomic papers to speed up species descriptions

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There has been much discussion of the “taxonomic impediment” and of speeding up descriptive taxonomy (e.g., Hoagland 1996; Wheeler *et al.* 2004; Godfray 2007; Ebach *et al.* 2011). It is claimed that the rate of species description is being impeded by the lack of cyber infrastructure resources (Wheeler 2008, for example). Other factors, such as lack of funding, lack of recognition for taxonomic work, the small number of researchers, and distractions from research (committee work, teaching, administration) are also likely sources of slow rates of species description, but some aspects of traditional species description could be improved upon.

Some of the suggested cyber infrastructure resources, although excellent in quality, are expensive to purchase or have a fairly steep learning curve, or both (e.g., LUCID—[www.lucidcentral.org](http://www.lucidcentral.org)). Their many advantages are exploited by relatively few workers. These tools are unlikely to help beleaguered taxonomists, many of whom pursue their studies in their spare time, or who are already underfunded and lacking in time and energy. What can more easily be done is to examine the existing species description process and determine where taxonomists can get bogged down.

In researching a group (at least a group of insects, my focal taxon), a taxonomist sorts the material, does necessary dissections and comparisons, eventually ending up in a series of specimens of each putative species. He or she then prepares descriptions, including a list of characteristics of the specimens, a definition or diagnosis of its differences from other species, a summary of its natural history, its distribution, and an all-important list of primary specimen data called “material examined”. All must be formatted in an appropriate manner for both the discipline and the publication outlet.

Species descriptions in large papers can be more efficiently produced using a program like MANTIS (Naskrecki 2008), DELTA (Dallwitz *et al.* 2000), or LUCID, if one wishes to climb the learning curve or pay for the program (in the case of LUCID). On the other hand, the “material examined” section of revisions and monographs can require a large amount of time in formatting species records. Especially for large papers where species are represented by many specimens, hours of time are necessary merely to prepare this part of the manuscript. Two issues are at stake: 1) getting species records into a material examined section, and 2) getting them into the particular format of the journal at hand.

**Formatting records.** Most taxonomists today record specimen label data digitally, or have the capability of doing so. Usually, researchers come to collections with a laptop computer and enter data into a spreadsheet or database program. Often the program is Microsoft Excel, whose simple format is a *lingua franca* for many other programs. If not Microsoft Excel, then most programs can produce comma- or tab-delimited records that can be read by Excel.

To translate these records into a material examined section, the records must be organized by country, then state, collecting locality, date, etc. If done manually, especially in large revisions with hundreds or thousands of specimens, this can consume a significant part of the time invested in the paper. In order to circumvent this suboptimal use of time, I wrote a macro that translates Excel records into material examined sections. It is available without charge from the website [www.phorid.net/software](http://www.phorid.net/software). Input can be cut and pasted from other Excel spreadsheets, imported from comma delimited files, or typed in directly. The fields are common ones, found in or easily extracted from most taxonomic databases (Appendix 1). Once in the spreadsheet, a single click of a button provides completely formatted output that can be cut and pasted directly into a manuscript for Zootaxa. An example prepared by the spreadsheet is given below:

**Material examined. ARGENTINA: La Rioja:** Santa Cruz, 28.57°S, 67.6°W, 1♂, 15.ix–4.x.2002, P.Fildago, Malaise trap (LACM); **Mendoza:** La Consulta, 33.73°S, 69.12°W, 2♂, 15–19.i.2007, S.Lanati, Malaise trap (LACM), 1♂, 19–22.ii.2007, S.Lanati, Malaise trap (LACM). **COLOMBIA: Cauca:** Isla Gorgona, 2.97°N, 78.18°W, 1♂, 1–5.iii.2000, B.Brown,G.Kung,M.Sharkey, Malaise trap #10 (LACM). **COSTA RICA: Alajuela:** Estación San Ramón Oeste, 620m, 1♂, 11–15.iv.1994, C.Moraga (INBC); **Guanacaste:** 3km SE Rio Naranjo, Finca Montezuma, 10.67°N, 85.06°W, 600m, 1♀, 21.ii.2002, Brown,Walker,Gonzalez, Malaise trap (LACM).

**Specific journal formats.** A further question is whether different formats should be provided for other journals. The material examined section for various journals can vary markedly. For instance, a record for the journal Zootaxa might read: