
EDITORIAL

Correct procedure for citing taxonomic works in non-taxonomic scientific papers

The purpose of this editorial is to motivate for the citation of taxonomic works in all scientific articles that require the identification of species as part of the methodology and provide guidelines for the type of additional information required.

Motivation

Many studies require or rely on identification of taxa as part of the methodology (Bortolus 2008; Franz and Peet 2009; Meier 2017; Packer et al. 2018). Such studies cover a wide range of fields that include many taxa, from assessing biodiversity of local and alien species, estimating the impact of global change on biodiversity loss, and ecological studies, whereas others might consider single model organisms that frequently come from longstanding laboratory cultures or single species used in behavioural or physiological studies (e.g. Bortolus 2008; Meier 2017; Packer et al. 2018). However, very often the names applied to species reflect regional, temporal and individual bias that is reflected in the source of the names (Franz and Peet 2009). Such bias is usually not immediately evident, because taxonomic research is seldom cited by the broader scientific community. For example, Bortolus (2008) found that 62.5% of the ecological papers that he examined did not provide any information as to how the authors identified the taxa named in their studies. Similarly, Packer et al. (2018) found that 29% of the entomological publications they examined did not cite identification methods, such as identification keys and monographs.

Such poor citation of taxonomic works has had several consequences. The first relates to citation metrics (e.g. Krell 2002; Wägele et al. 2011; Steiner et al. 2015) and will not be considered further here. However, more serious consequences relate to the violation of the scientific method; not providing identification methodology essentially renders the study irreproducible (Packer et al. 2018), because species identification cannot be validated. To overcome this, the Latin binomial names should always be accompanied by the authority when first mentioned in an article, and the literature used for identification, be it identification keys, monographs or taxonomic revisions should be cited (Meier 2017). The original description might be cited (e.g. Wägele et al. 2011), but only if it is informative and aids identification (Meier 2017).

Consider the hypothetical *Species* α Author A, 1880 with a distribution range along the coast of South Africa. Two simple scenarios illustrate the importance of citing taxonomic revisions in addition to (or instead of) original species descriptions, when reporting a species in any scientific article (more complicated, but equally realistic scenarios exist, Franz and Peet (2009)). In Scenario 1, Author B revises *Species* α in 2000 and finds that the species, as originally described, actually comprises two species, *Species* α Author A, 1880 and *Species* β Author B, 2000. Consequently, if only Author A is acknowledged as the authority of *Species* α by Author C in 2010, it disregards the fact that the original definition of *Species* α refers to two separate species. This implies that Author C identified *Species* α as defined only by Author A, and therefore also includes *Species* β . In Scenario 2, Author D records *Species* α in Australia in 1910. Author D provides a description that highlights a consistent, albeit minor, difference from *Species* α , as described from South Africa, which is ascribed to intraspecific variation. Subsequent to this, many other authors record *Species* α in Australia, but without acknowledging the publications of either Author A or D as the source of identification. Consequently, when Author E determines, in 2012, that *Species* α *sensu* Author D is in fact NOT equivalent to *Species* α *sensu* Author A or Author B, and describes it as *Species* γ Author E, 2012, it will be almost impossible to determine, retrospectively, whether records of *Species* α in Australia actually refer to *Species* α , *Species* β or *Species* γ , without examining deposited material (if such material exists, see 3 below). Acknowledging the method of identification better enables later researchers to validate these identifications.

Some might argue that this is not necessary if the species is “well-established”, a model organism or sourced from a laboratory culture (Wägele et al. 2011; Packer et al. 2018). However, some species, such as the malaria vector *Anopheles gambiae* (Giles 1902), are members of species complexes that can only be distinguished using molecular data (Coetsee et al. 2013), whereas others, such as the widely used ecotoxicology model species *Eisenia fetida* (Savigny 1826), had been misidentified in some laboratory cultures in South Africa (Voua Otomo et al. 2013).

Procedure for citing taxonomic works

Towards preventing these problems for future researchers, the editors of African Zoology have adopted recommendations of Meier (2017) and Packer et al. (2018), and require that in papers where the identification of species form part of the methodology, data on all species collected should include the following:

- 1. A clear statement of identification methods used, names of researchers who identified the species, citations of the literature upon which the identifications were based and the dates when identifications were performed. These should be included in the Methods section.** This information must also be included if the organism has