

The Future for a Prominent Taxonomy

Chris A. Hamilton,^{1,7} Floyd W. Shockley,² Rebecca Simmons,³ Aaron Smith,⁴ Jessica Ware,⁵ and Jennifer M. Zaspel⁶

¹Department of Entomology, Plant Pathology & Nematology, University of Idaho, Moscow, ID, USA, ²Department of Entomology, National Museum of Natural History, Smithsonian Institution, Washington, DC, USA, ³Department of Biology, University of North Dakota, Grand Forks, ND, USA, ⁴Department of Entomology, Purdue University, West Lafayette, IN, USA, ⁵Division of Invertebrate Zoology, American Museum of Natural History, New York, NY, USA, ⁶Department of Zoology, Milwaukee Public Museum, Milwaukee, WI, USA, and ⁷Corresponding author, e-mail: hamiltonlab@uidaho.edu

After the first author, all authors are in alphabetical order by surname.

The year 2020 was one of tremendous upheaval, both socially and culturally. Perhaps most importantly, this year has been known for an awakening to the concept of implicit (unconscious) bias in our society that changed the understanding of ethics and equality for many people. This spotlight has illuminated biased views across all strata of society, even in science—which has long regarded itself as neutral to these biases. Implicit bias has determined which disciplines are considered ‘cutting-edge’ and which are deemed ‘second tier’. For example, taxonomy, a thriving science for two centuries, has declined in significance over the last several decades—although it is central to understanding the global biodiversity crisis. Fortunately, this perception is not shared by the public, as newly discovered species, the cornerstone of taxonomic research, hold great engagement value. In other words, an assessment of the importance of taxonomy by scientists outside the field does not match its inherent contributions and importance to society. We seek to correct this mismatch by addressing the undervalued contributions of taxonomists and suggest solutions to improve the perception of this essential science.

This year, the taxonomic research community was faced with an immediate and serious threat when Clarivate Analytics made a decision that excluded the journal *Zootaxa* from the 2020 *Journal Citation Reports* (JCR) for deemed self-citation infractions, a decision that would have stripped *Zootaxa* of an Impact Factor (IF). As *Zootaxa* represents one of the few peer-reviewed, alpha-taxonomy journals globally available to researchers describing animal diversity, this decision would have had a severe and negative impact on the field of taxonomy. Strong objection from the scientific community to Clarivate’s assertion of excessive self-citation resulted in a reversal of their decision to omit *Zootaxa* from JCR. Nonetheless, due to the arguably misinterpreted and widespread use of the IF by the research community to assess the quality of a scientific journal, Clarivate’s original decision came dangerously close to jeopardizing not only the discipline but the future careers of taxonomists worldwide.

The Science of Taxonomy

Taxonomy is one of the oldest spheres of biological investigation, formally dating back to the mid-18th century. By discovering, identifying, and describing new species, taxonomy is the foundation

upon which all biological research rests. It is one of the three disciplines within the broader field of systematics, which also includes the study of classification and phylogenetics. The combination of these areas aids in the development of hypotheses about how the biological diversity on the planet has evolved. If we are to understand evolution, ecology, behavior, genomics, diseases, and more, it is critical for us to understand the basic units of biological diversity that constitute the Tree of Life.

Historically, the formalized version of taxonomy was an amateur pursuit (as was all science in the 18th century), practiced by privileged individuals, including Carl Linnaeus and Charles Darwin, who were able to dedicate their lives to characterizing the natural world without the necessity of a paying job. These biologists principally used morphological traits that could be discerned with a dissecting microscope to decipher and describe new species. However, the practice of taxonomy began to change during the 20th century as society developed a larger middle class of practicing scientists. Additionally, natural history museums required permanent staff to curate their growing collections, resulting in the creation of professional taxonomy jobs. The Modern Synthesis of the 1940–1950s helped bring synthetic aspects of population biology into taxonomy, and vice versa. In recent times, taxonomic research methods have broadened to include not only morphological traits to distinguish species, but molecular, ecological, and behavioral characters as well. By creating standardized tools to distinguish and classify taxa, taxonomy has provided a universal language for studying and sharing information about millions of species across geopolitical boundaries.

Taxonomy’s Vulnerability in the Current Publishing Environment

Given taxonomy’s central role in describing biodiversity over the centuries, what caused the field to dwindle in significance by the 21st century? The answer is in part a direct consequence of the nature of the discipline. Few experts work on a particular taxonomic group at any given time within a generation, and their expertise requires large amounts of time and training. The integrative nature of taxonomic work also results in long lag times between completing research and publications. Further, because the number of experts on a taxon is

limited, it is necessary to cite one's own work or collaborative work with a few specialist taxonomists. Additionally, due to the highly-focused expertise required to practice taxonomy, a significant period of apprenticeship training with an expert on a given taxon is required, limiting the participation of younger researchers who often enter other biological fields that require less training time.

A decrease in journals solely dedicated to taxonomy exacerbates self-citation issues. This decline is due in part to decreased funding and a devaluation of the discipline (Leather 2009). In particular, the availability of high-throughput, internationally visible taxonomic journals, such as *Zootaxa* and *ZooKeys*, has led to a plethora of taxonomic papers principally targeting these journals. Although a limited number of high-visibility journals would seem to be good for the field by increasing the efficiency of finding taxonomic names and information, the paucity of journals is, in reality, a detriment due to the way IF is calculated and erroneously applied.

The IF of an academic journal was originally designed to aid libraries and other institutions in choosing journal subscriptions with limited resources; IF was not meant as a metric to evaluate the research impact of papers or scientists. The IF score attempts to quantify the weight of a journal in its particular field by calculating the average number of times its articles, from a 2-yr period, are cited over the following third year. This value is often portrayed as a measure of the importance or status of a journal; the higher the value, the more important the research papers found within its pages. This inappropriate extrapolation of IF has not just created issues for western scientists, who may be encouraged to publish in high IF journals to raise their profile, but also those countries and research institutions that use this as a measure of success (Gruber 2014). For example, in a number of countries, careers of colleagues are often judged by the IF of the journals in which they publish, with salary, promotion, tenure, grant funding, and even governmental perks such as cars and apartments influenced by this value (Gruber 2014).

Taxonomists have been especially penalized by this stretched interpretation of IF, suffering a double whammy as a result of the long tradition requiring meticulous documentation of the history of a taxonomic name (thus citing themselves and other publications often in the same journal), while not being cited outside of taxonomy for its critical contributions to the names, descriptions and taxonomic keys used by all (Agnarsson and Kuntner 2007). The former has the potential to result in what Clarivate considered to be excessive self-citation, while the latter leads to relatively low impact factors. The misapplication of a publishing metric can have significant impacts on the lives and careers of taxonomic researchers.

How Can We Make Taxonomy Equitable for Our Colleagues?

There are many ways we can make this situation more equitable, but one genuinely beneficial and simple solution is to promote more citations for taxonomic names and works. This is not a new proposal (Agnarsson and Kuntner 2007). In an ever competitive job market that relies to a significant degree on publication IFs, we must recognize the adverse effects these metrics can have on students, postdocs, and other colleagues applying for jobs, tenure, and other

promotional milestones. Currently, the academic system does not recognize their contributions realistically. The Impact Factor makes no adjustment to account for the relatively long relevance timelines for taxonomic papers. While papers in fields such as physics, chemistry, and medicine may be relevant for only a few months or years, taxonomic research may remain relevant for decades, even centuries. If change is to come, however, it must originate from within the scientific community itself rather than from entities like Clarivate.

We, the Governing Council of the Systematics, Evolution, and Biodiversity section of the Entomological Society of America, think that action is required to set an example for taxonomic journals and publications that use the products of taxonomic research. We propose that any journal using taxon names, other than those of familiar or model organisms, should require authors to cite the paper proposing the taxon name, as well as any recent and relevant revisionary work. Furthermore, when it is clear that the author of a manuscript has used a taxonomic resource (e.g., identification key, distributional checklist or catalog), that resource should also be credited (Monckton et al. 2020). Historically, this has not been a requirement of journals; the lack of citations for taxonomic works fails to acknowledge that the published research would not have been possible without previous foundational work. Citing taxonomic literature in appropriate ways should be enforced by the editor and reviewers, and all journals should include a clear statement to this effect in *Instructions to the Authors*. Such enforcement is scientifically nondiscriminatory and acknowledges the value of taxonomic work to all downstream publications. Implementing these basic changes could potentially encourage more young scientists to engage in the fundamental work of taxonomy.

As the vast majority of modern taxonomic work describes tropical biodiversity, it is often our colleagues in these countries who are working tirelessly to discover, document, and understand the biodiversity of our planet. Their efforts provide data and tools to understand the ecological impacts caused by the loss of that biodiversity and the implications for the overall biosphere. Their research should be recognized for its basic value in revealing otherwise hidden diversity. If taxonomy is important, if our colleagues are important (past and present), then we must cite their work. In this way, we can change the culture. This change is not about eliminating the IF, though we agree that it alone is an artificial and arbitrary metric for assessing productivity and relevance of research. Instead, we propose to work within the current scientific culture, with the goal of fostering change that recognizes the value of taxonomic works to all biological sciences.

References Cited

- Agnarsson, I., and M. Kuntner. 2007. Taxonomy in a changing world: seeking solutions for a science in crisis. *Syst Biol.* 56: 531–539.
- Gruber, T. 2014. Academic sell-out: how an obsession with metrics and rankings is damaging academia. *J. Mark. High. Edu.* 24: 165–177.
- Leather, S. 2009. Taxonomic chauvinism threatens the future of entomology. *Biologist.* 56: 10–13.
- Monckton, S. K., S. Johal, and L. Packer. 2020. Inadequate treatment of taxonomic information prevents replicability of most zoological research. *Can. J. Zool.* 98: 633–642.