

Fame, glory and neglect in meta-analyses

Christoph Kueffer¹, Ülo Niinemets², Rebecca E. Drenovsky³, Jens Kattge⁴, Per Milberg⁵, Hendrik Poorter⁶, Peter B. Reich^{7,8}, Christiane Werner⁹, Mark Westoby¹⁰ and Ian J. Wright¹⁰

¹Institute of Integrative Biology – Plant Ecology, ETH Zurich, CH-8092 Zurich, Switzerland

²Institute of Agricultural and Environmental Sciences, Estonian University of Life Sciences, Kreutzwaldi 1, Tartu 51014, Estonia

³Biology Department, John Carroll University, University Heights, OH 44118, USA

⁴Max Planck Institute for Biogeochemistry, 07745 Jena, Germany

⁵IFM Biology, Division of Ecology, Linköping University, 581 83 Linköping, Sweden

⁶IBG-2, Plant Sciences, Forschungszentrum Jülich, D-52425 Jülich, Germany

⁷Department of Forest Resources and Institute on the Environment, University of Minnesota, St Paul, MN 55108, USA

⁸Hawkesbury Institute for the Environment, University of Western Sydney, Richmond, NSW 2753, Australia

⁹Experimental and Systems Ecology, University of Bielefeld, D-33615 Bielefeld, Germany

¹⁰Department of Biological Sciences, Macquarie University, NSW 2109, Australia

Ecology increasingly relies on data synthesis and integration [1,2]. We fear, however, that the academic culture and merit system in ecology has not evolved in pace with the emergent need for increased collaboration. In particular, meta-analyses, which are often based on a large number of independent data sets (e.g. [3]), are reliant on the collection of primary data, and the willingness of field and experimental researchers to share these data. Therefore, it is vital that this empirical work and expertise should be adequately valued. Foremost, all contributed data and expertise must be properly acknowledged by at least a citation of the original work in a form that is indexed by ISI Web of Science and, where appropriate, by offering data collectors the option to contribute to the work as coauthors.

Currently, however, empirical studies that are integrated into meta-analyses are often not cited in the main article owing to restrictive journal policies limiting the space available for references, and are often listed instead in an electronic appendix. These online supplements are not indexed by scientific performance databases, such as ISI Web of Science, and do not count as academic credits for the producer of the primary data. A solution to this problem is that journals should be more generous about the length of reference lists in meta-analysis-type publications. Papers based on meta-analyses are commonly downloaded and cited more often than are other papers. For instance, the 27 meta-analyses published in *Ecology Letters* between 2005 and 2009 were cited, on average, 53 times, whereas the 441 empirical articles were cited, on average, 30 times (Web of Science, 15 April, 2011). Therefore, even with some additional pages, the publication cost per download or citation will be less than that for primary research papers. Another solution could be that journals ensure that electronic appendices are also indexed by Web of Science and other databases, and there are indeed successful examples of this approach (e.g. [4]). Increasingly, data repositories are becoming widely established for all relevant ecological data [5–7]. The number of data points shared in recognized data repositories and the number of times that data sets are

further used and cited should become a measurable research output that data providers can list in their CVs.

We also recommend a policy of being inclusive rather than exclusive with sharing co-authorship. Ecological meta-analysis and other data syntheses often require primary data that are in a very different form than in their original publication and, because of the context dependence of ecological data, the expertise of the data collector is needed in many cases for the proper use and interpretation of the data. Hence, rather than simply a secondary analysis of already published data, an ecological meta-analysis becomes a primary analysis of data (whether published, unpublished or a mixture), leading to insights and conclusions in addition to those previously published.

Ultimately, we need to work consciously towards a new research culture that values collaborative efforts. Traditionally, individual creativity and the novelty of empirical and theoretical insights are particularly valued in ecology. This discourages repeated studies and results in a situation of only a few data sets on each ecological topic. In particular, because data will be collected first for species and ecosystems, where data gathering is less costly and time to publication is fast, biases in the available information for rare species or remote ecosystems could be introduced. Indeed, even in the most comprehensive databases (e.g. the TRY database of plant traits [7]), there is a large geographical bias of data coverage, with some areas having much better coverage than others, such as parts of Africa or Asia. In an increasingly collaborative and integrative ecology, more papers will be required whose reason for existence is to nail down a generality for a broad range of ecosystems and functionally diverse species, so that the pattern and its dependencies on taxonomical and ecological context can then be taken as being firmly established. Ecology will advance faster if conceptual ideas are based on solid empirical grounds. This requires a research culture that appropriately values collaborative efforts and acknowledges the often-challenging empirical field and experimental work.

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Corresponding author: Kueffer, C. (kueffer@env.ethz.ch).

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Letters

Endosymbionts and honey bee colony losses?

Alexandre Aebi¹ and Peter Neumann^{2,3}

¹Agroscope Reckenholz-Tänikon, Research Station ART, Reckenholzstrasse 191, CH-8046 Zürich, Switzerland

²Swiss Bee Research Centre, Agroscope Liebefeld-Posieux, Research Station ALP, Schwarzenburgstrasse 161, CH-3003 Bern, Switzerland

³Department of Zoology and Entomology, Rhodes University, Grahamstown 6140, South Africa

Honey bees, *Apis mellifera*, are essential pollinators for the maintenance of natural biodiversity and agriculture [1]. Colony losses witnessed throughout the Northern hemisphere are therefore worrying [2], especially because no single driver has yet emerged as the definitive cause [3]. Interactions between viruses, ectoparasitic mites and microsporidian endoparasites are most likely key factors [3–5], but the underlying mechanisms are not well understood. Although it is known that maternally-inherited, facultative bacterial endosymbionts such as *Wolbachia* or *Rickettsia* can significantly interfere with viral and fungal infections of arthropods [6], they have so far been neglected in this regard. Here we propose to evaluate the potential role of such endosymbionts for colony losses.

Endosymbionts are widespread [7] in arthropods and transmitted vertically [8], but can only spread in host populations when infected females have a higher fitness, e.g. via providing protection against viruses or fungi [6]. For example, *Wolbachia* can protect the host against several vectored RNA viruses [9] and can be regarded as part of host immunity [6]. However, endosymbionts such as *Spiroplasma* and *Hamiltonella* can also be beneficial for their host's vectorial capacity, e.g. in the whitefly *Bemisia tabaci*-Tomato yellow leaf curl virus system, *Hamiltonella* protects viral particles in the vector [6,10].

To shed light on the potential influence of endosymbionts on losses, we here suggest an investigation of symbiont-mediated host protection against viruses transmitted by parasitic mites and/or associated with microsporidians (e.g. *Nosema ceranae*) [5], which could contribute to the tolerance of honey bee populations, e.g. against the mite *Varroa destructor* [11]. Moreover, endosymbionts carried by parasitic mites might favour virus transmission to and virulence in honeybees, which could explain regional differences in the impact of mites [11]. A combination of metagenomics and laboratory experiments appears suitable to compare the bacterial and viral communities associated with honey bees and their parasites in host populations

with or without elevated losses [2]. In conclusion, it seems as if endosymbionts play a role in honey bee pathology [12] and should therefore be investigated as a potential key to our understanding of major colony losses.

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Corresponding author: Neumann, P. (peter.neumann@alp.admin.ch).