Ensuring tests of conservation interventions build on existing literature

William Sutherland, Sergio Ticul Alvarez-castañeda, Tatsuya Amano, Roberto Ambrosini, Philip Atkinson, John Baxter, Alexander Bond, Philip Boon, Katherine Buchanan, Jos Barlow, et al.

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Article Impact Statement: Authors of conservation articles asked to include citations of existing evidence and to place studies in context of that evidence.

That scientific knowledge grows by building on previous understanding is familiarly expressed in English by Isaac Newton's phrasing of a much older idea, "If I have seen further it is by standing on the shoulders of giants." However, in science, we often do not always clamber as high as we could because we fail to consider previous work. Multiple factors beyond quality and relevance affect the likelihood of a scientific article being cited, including the author's status, country, and affiliation (Leimu & Koricheva 2005), number of authors (Neiminen et al. 2007, Sala and Brooks 2008), journal prestige (Tahamtan et al. 2016), length (Neiminen et al. 2007, Stanek 2008), language (van Leeuwen et al. 2001), geographical location of authors and readers (Nunez et al. 2019), direction and strength of the results (Neiminen et al. 2007), accessibility, and whether the article is a self-citation (Schreiber 2009). Furthermore, cited articles are not always used correctly. In ecology (Todd et al. 2007) and marine biology (Todd et al. 2010), 16-18% of citations offer either ambiguous or no support for an associated assertion. Even when articles are debunked, the original papers continue to be cited 17 times more than the rebuttal (Banobi et al. 2011).

We suggest that such failings distort knowledge. Few conservation practitioners cite original studies (Pullin et al. 2004, Sutherland 2004), although there is some evidence this is starting to change (Wainwright et al. 2018). Furthermore, most conservation scientists use previous literature selectively, leading to bias (Gossa et al. 2015). We checked the most recent issue of 5 major conservation journals and found 23 papers testing conservation interventions. Together, authors of these papers failed to cite

This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1111/cobi.13555.

at least 51 other studies, collected on www.conservationevidence.com, that tested the same interventions in similar environments. Such underutilisation exaggerates the originality of new findings and distorts impressions of existing knowledge and may result in actions being biased toward the single latest study.

Poor citation practices have distorted ideas (Smith and Banks 2017), such as that Darwin developed his theory of evolution by looking at Galapagos finches, despite not mentioning them in *The Origin of Species* (Sulloway 1983); that exotic ants in Madeira were responsible for the extinction of native ants, which never actually went extinct (Wetterer 2006); and that black rats were important predators of Australian mammals, based on a study that found no significant effect of rats on native mammal numbers (Smith & Banks 2017). The failure to assess the existing evidence base fully can lead to an overemphasis on outlying, well publicized, or even discredited studies or those published in prestigious outlets. Effective policy and management rarely emerge from single, definitive experiments. Rather, reliable knowledge accumulates from diverse sources of evaluated evidence that persuade communities of professionals (Collins and Pinch 2012; Roche et al. 2019).

We can best understand how to employ interventions by evaluating how they have worked in a range of circumstances. For example, an article on the efficacy of streamer lines in reducing bycatch of seabirds should incorporate previous studies of streamer lines in different locations, with different species, and with different numbers of lines or types of line so as to provide a comprehensive picture of whether the action is generally effective or more effective in some situations than others. In this way, the giant is assembled, and future researchers can avoid pitfalls and target knowledge gaps. Reliability is important and conservation science should encourage studies that replicate interventions (Baker 2016).

One solution is the Conservation Evidence website (www.conservationevidence.com) (Sutherland et al 2019), which was developed to collect, curate, and summarize tests of conservation interventions. It provides a means of checking the literature. Authors may summarise the existing literature by referring to the individual papers or, if the literature is extensive, make use of the review provided.

We envisage a simple, routine check of Conservation Evidence and then addition of other relevant literature. Researchers can use it to check they have not missed key references and may reference the webpage to avoid adding references to their manuscript. Conservation Evidence focuses exclusively on conservation solutions, and does not, for example, collect papers describing threats or compile or summarize conceptual and theoretical papers for hypothesis generation and inference. It does not yet cover interventions for all habitats and taxa, and there may be relevant papers published since a literature was synthesized by Conservation Evidence.

Other options for extracting the relevant literature include systematic reviews (especially those collated by the Collaboration for Environmental Evidence [www.environmentalevidence.org]); other specialist websites, such as the Resource database of the Society for Ecological Restoration (https://www.ser-rrc.org/resource-database) or the CABI Invasive species compendium (https://www.cabi.org/isc); standard literature searches (ideally with the search process specified); and the forthcoming Applied Ecology Resources (https://www.britishecologicalsociety.org/publications/applied-ecology-resources/), which will host a searchable and citable repository of gray literature.

Forty conservation-focused journals, whose lead editors are authors on this editorial (journal names are italicized in the list of author affiliations), are requesting that authors outline how they have placed the literature in context (e.g., by searching Conservation Evidence) by incorporating this in the submission process or in instructions to authors.

Asking authors who have tested interventions to explain how they have placed their paper in context will help ensure conservation science reduces the perils of cherry picking scientific evidence and will improve the design of future work. It will not provide a complete remedy to bias in conservation articles. Ideally, the impact of this measure will grow as the evidence base grows, so that we can have the extended vision that comes from standing on the shoulders of giants rather than the limited vision from standing on their toes.

Acknowledgments

We thank Arcadia for funding and the referees for improving this piece.

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Title:
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Date:
2020-08

Citation:
Sutherland, W. J., Alvarez-Castañeda, S. T., Amano, T., Ambrosini, R., Atkinson, P., Baxter, J. M., Bond, A. L., Boon, P. J., Buchanan, K. L., Barlow, J., Bogliani, G., Bragg, O. M., Burgman, M., Cadotte, M. W., Calver, M., Cooke, S. J., Corlett, R. T., Devictor, V., Ewen, J. G. ,... Wordley, C. (2020). Ensuring tests of conservation interventions build on existing literature.. Conserv Biol, 34 (4), pp.781-783. https://doi.org/10.1111/cobi.13555.