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Policy Forums

Negative results provide valuable evidence for conservation

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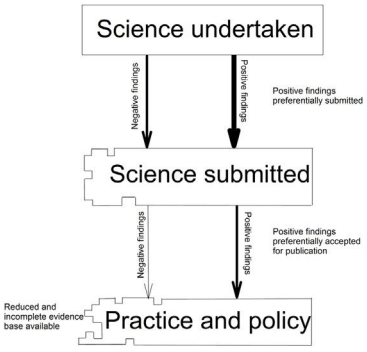
HIGHLIGHTS

- Conservation practice and policy draw on information from a range of disciplines.
- A publication bias limits the dissemination of negative findings.
- This bias restricts and distorts the evidence used to inform conservation.
- Both positive and negative findings can provide valuable evidence for conservation.
- Addressing such bias requires the efforts of scientists, practitioners, policy-makers, editors and reviewers.

GRAPHICAL ABSTRACT



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ABSTRACT

A pervasive publication bias, whereby studies that report positive results are prioritised over those that report negative findings, has been shown to exist in the disciplines that conservation practice and policy draw information from. The bias reflects the preferential submission of positive results by scientists and the preferential publication of positive results by journals. In this Reflective Practice essay, I consider the implications of this publication bias for the end-users of conservation evidence, and consider potential solutions. The documented publication bias limits and distorts the evidence available to inform conservation. Other disciplines have begun to take steps to redress publication biases, providing examples for conservation to learn from. Reducing the bias in the literature will help to increase the use of peer-reviewed scientific evidence in conservation by making the evidence more relevant to the needs of practitioners and policy-makers.

Introduction

Conservation research aims to provide the evidence needed to inform action and policy, for example to understand how wildlife responds to anthropogenic environmental change or the effectiveness of conservation interventions (Soulé, 1985; Kareiva and Marvier, 2012). Studies that report conservation evidence can present positive findings (i.e. evidence that an intervention is effective), negative or null findings (i.e. no evidence that an intervention is effective), or mixed findings (i.e. some evidence that an intervention is effective, for example under specific circumstances) (Salafsky et al., 2019). The publication of such studies in the scientific literature increases the information available for conservation practice and policy, and increasing the applied use of peer-reviewed scientific evidence remains a long-standing aim of the conservation community (Sutherland et al., 2004; Adams and Sandbrook, 2013). To inform practice and policy effectively, however, the conserva-

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tion literature should represent an unbiased collection of scientific knowledge.

Publication bias

A pervasive publication bias, whereby studies that report positive findings are prioritised over those that report negative or mixed findings, exists in the disciplines that conservation draws evidence from, including biology, ecology, behaviour, geosciences, and social sciences (Jennions and Møller, 2002; Fanelli, 2012; Martínez-Abraín, 2013; Franco et al., 2014; van Emmerik et al., 2018; Tincani and Travers, 2019). This well-documented bias is associated with the behaviours of both researchers and journals. Researchers face increasingly intense competition for funding and prestige, both of which are considered more likely to result from publishing positive results, and hence the publication of negative findings is likely to be a lower priority (Csada et al., 1996). Journals similarly compete for prestige, often judged through proxies such as impact factors (despite the widely-acknowledged limitations of such metrics), and so prioritise the publication of those findings deemed to be the most novel and exciting, and hence the most likely to be well-cited in future work (Leimu and Koricheva, 2005). The bias against the submission and publication of negative findings has been termed the 'file drawer problem', whereby scientists gradually accumulate negative results over the course of their careers which are not published and so are not added to the scientific literature (Csada et al., 1996; Franco et al., 2014).

Negative results in conservation

While earlier articles have identified and described this publication bias, to date there has been little consideration of the implications for the end-users of conservation evidence. Here, I argue that negative findings can provide practitioners and policy-makers with valuable evidence for conservation, and that the current bias of the literature towards positive findings hinders conservation efforts. Therefore, while I am not advocating for the publication of studies that provide negative findings due to poor design, insufficient sampling, or inadequate statistical power, the publication of high quality studies featuring negative results broadens the evidence-base available for conservation practitioners and policy-makers to draw upon. Recent advances in the assessment of conservation evidence, such as the framework proposed by Salafsky et al. (2019), will allow such high quality negative findings to be identified more easily.

For a conservation organisation such as the Wildfowl & Wetlands Trust, negative results that can inform our work might include findings of no effect of a perturbation on a species or ecosystem, no change in the conservation status of a population, or no effect of a conservation intervention on the target species or ecosystem. The value of negative findings in conservation can also be considered in terms of a Bayesian learning approach, such as that suggested by Salafsky et al. (2019). As such, negative findings can maintain an evidence base in a prior state, for example if a new land management approach is found to offer no improved conservation outcomes relative to the previous management approach. Alternatively, negative findings can moves the evidence base away from a prior state to an updated posterior state, for example if no support is found for a particular conservation intervention (Salafsky et al., 2019).

A less-biased conservation literature would help us to better prioritise conservation actions on critical threats, and direct us away from those actions shown to have little or no effect, so that limited resources are allocated effectively (Wilson et al., 2009). Where studies that report negative findings are not published, opportunities are lost to strengthen the work through peer-review and post-publication discussion, and hence increase the quality of the information available to the end-users of conservation evidence. Preferentially publishing positive results also biases the evidence-base available to inform actions and decision-making. For example, the publication bias against negative findings means that positive findings are overrepresented in meta-analyses, which will then inevitably overestimate the effectiveness of conservation interventions or the impacts of certain threats on biodiversity (Stewart, 2010). More frequent publication of negative results would also prevent the duplication of effort as scientists are less likely to repeat earlier work, and practitioners are less likely to repeat interventions that have been shown to be ineffective.

Numerous examples of valuable negative findings can be found in the research undertaken by the Wildfowl & Wetlands Trust and its collaborators: (i) evidence that high levels of lead poisoning continued among waterbirds despite regulations on the use of lead shot in recreational shooting (Newth et al., 2013); (ii) survival rates of Common Pochard *Aythya ferina* have not changed over time despite their declining population size (Folliot et al., 2020); (iii) the strength of autumn tailwinds in the Baltic Sea had no effect of the demographic rates of migratory swans (Nuijten et al., 2020); (iv) supplementary food resources would not alleviate the decline of the northwest European Bewick's Swan *Cygnus columbianus bewickii* population (Wood et al., 2019). This final example is illustrative, as without this information, conservation organisations may have undertaken actions to attempt to increase food availability for swans in the landscape, for example by working with farmers and land managers. As the negative findings were published, conservationists were instead able to pursue alternative explanations for the decline in swan numbers (Nuijten et al., 2020).

Moving towards solutions

Other disciplines have begun to take steps to redress publication biases, providing examples for conservation to draw on. Fundamentally, a shift in publication culture is required to better reflect the needs of those using conservation evidence. Institutions and funders of conservation scientists should better recognise the value of negative findings to conservation, to reduce any real or perceived pressure to prioritise positive findings. The pre-registration of studies may also help, as both authors and journals must evaluate the merits of a study before knowing the results (Nosek et al., 2018; Chalmers et al., 2013). Conservation practitioners could also do more to highlight the benefits of publishing negative or null findings for conservation action and decision-making. Journal editors and their reviewers should not penalise good studies for negative findings. In 2015 the editors of eight health economics journals issued an editorial statement calling on reviewers not to reject studies on the basis of negative findings, which has resulted in an increased proportion of papers published in those journals reporting negative findings (Blanco-Perez and Brodeur, 2019). Some medical journals have published commentary articles to highlight the usefulness of negative results (Chalmers et al., 2013; Taragin, 2019).

Disseminating negative findings could also benefit from other publication routes beyond traditional journals, for example the *Conservation Evidence* database which collates examples of conservation interventions regardless of whether the findings were positive or negative (Sutherland et al., 2019). The growth in the use of pre-print servers such as *bioRxiv*, *EcoEvoRxiv*, or *PeerJ* will also help to share negative findings (Abdill and Blekhman, 2019), although the lack of peer-review associated with pre-prints may reduce the perceived evidence value.

Future work

Research scientists can play a crucial role in quantifying the impacts of publication bias and testing proposed solutions. Whilst publication bias has been shown to exist across a wide range of scientific disciplines (Jennions and Møller, 2002; Fanelli, 2012; Martínez-Abraín, 2013; Franco et al., 2014; van Emmerik et al., 2018; Tincani and Travers, 2019), it is not known whether some areas of conservation are more affected than others. It is also unknown whether all areas of conservation decision-making are equally susceptible to the problems caused by a biased, incomplete evidence base in which negative findings are under-represented. Addressing these unknowns could help to prioritise areas where solutions to the publication bias are required most urgently. The previous section of this essay identified potential solutions to the issue of publication bias, and no doubt others will be suggested as the issue increases in prominence. Some potential solutions have begun to be enacted, and yet the impacts of many of these solutions on the rates of acceptance of manuscripts that report negative findings, remain largely untested (but see Blanco-Perez and Brodeur, 2019). Where attempts are made to reduce publication bias in the disciplines that conservation draws evidence from, the effectiveness of these should therefore be tested.

Conclusions

My aim in this Reflective Practice essay was to inspire and inform greater consideration of the impacts of publication bias on conservation practice and policy, whilst recognising that it is beyond the scope of a short essay to solve such a complex, multi-faceted issue. It is clear that a publication bias towards positive findings pervades the many research disciplines that conservation draws evidence from. Any such solutions to the current publication bias will require the concerted and collective efforts of conservation scientists, practitioners, policy-makers, editors, and reviewers. Reducing the bias in the current conservation literature to better reflect the needs of practitioners and policy-makers will help the long-standing aim of increasing the use of peer-reviewed scientific evidence in conservation (Sutherland et al., 2004; Adams and Sandbrook, 2013).

Conflict of interest

The authors declare no conflict of interest.

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