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Are fieldwork studies being relegated to second place in conservation science?

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ABSTRACT

The collection of biological information, including data gathered in the field, is fundamental to improve our understanding of how human impacts on biological systems can be recognized, mitigated or averted. However, the role of empirical field research has faded appreciably in the past decades with sobering implications. Indeed, important instruments to help set national and global priorities in biodiversity conservation (i.e. synthetic analyses and big data approaches) can be severely handicapped by a lack of sound observational data, collected through fieldwork. We analyzed publication trends in the conservation literature from 1980 to 2014 to ascertain whether there is reason for concern about a potential decrease in fieldwork-based investigations compared to other types of studies. Here, we show that the proportion of fieldwork-based investigations in the conservation literature dropped significantly from the 1980s until today; indeed, fieldwork-based publications decreased by 20% in comparison to a rise of 600% and 800% in modelling and data analysis studies, respectively. In parallel, we found that the most highly cited academic journals in conservation science published fieldwork studies less frequently than the lower rank journals. We contend that an apparent decrease in fieldwork-based investigations is the result of bottom-up pressures, including those associated with the publishing and the academic reward systems, while a second set acts top-down, driven by current societal needs and/or priorities. We urge researchers, funders and journals to commit, respectively, to conducting, funding and divulging relevant fieldwork research, and make some recommendations on specific steps that can be adopted in that direction.

1. Introduction

Conservation science increasingly strives to understand how human impacts on biological systems can be recognized, mitigated or averted (Cardinale et al., 2012). These efforts rely on collating the most up-to-date and robust body of knowledge that can support evidence-based decision-making as to what strategies will effectively ameliorate the current relationship

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between humans and the environment. Several authors have suggested that the role of empirical field research has faded appreciably in the past decades (Noss, 1996; Tewksbury et al., 2014). This is worrisome, because potential repercussions percolate through the scientific sphere, where these data help describe and better understand the functioning of biological systems, into the policy-making arena, where they are used to inform decisions on which human interventions will delay biodiversity loss (Dijkstra, 2016; Mihoub et al., 2017). Indeed, synthetic analyses and big data approaches are instrumental to help set national and global priorities in biodiversity conservation (e.g., Brum et al., 2017; Knox et al., 2016), but they can be severely handicapped by a lack of sound observational data, including those collected through fieldwork. The latter is echoed by the modelling community who has made systematic calls for an increased collection of new biodiversity data to advance the real-world application of modelling tools (Table 1). Here, we analyzed publication trends in the conservation literature from 1980 to 2014 to ascertain whether there is reason for concern about a potential decrease in fieldwork-based investigations compared to other types of studies (primarily modelling and large data analyses). Additionally, we hypothesized that, if such decline was as evident as previously suggested (Ferreira et al., 2016), it could be associated with a lower popularity (i.e., lower importance) of field-based studies among conservation scientists in comparison to synthetic analyses. To test the latter, we compared: 1) the number of citations of field-based papers versus papers that did not provide new field data; and 2) the publication rate of fieldwork studies in top-tier versus low-tier journals. These metrics are appropriate because the importance of scholarly journals is highly correlated to their impact factor which, in turn, reflects the yearly average number of citations to recent articles published in that journal (Garfield, 1955). Most academics, as well as funding agencies, universities and alike, measure researcher performance and reputation based on the number of publications in top-tier journals and paper citation rates (Reich, 2013), and therefore, to some extent, these metrics can act as a surrogate for the popularity of a particular study.

2. Methods

From 1980 to 2014, a total of 59,575 papers was published in 43 different journals within the conservation literature (those listed under the “Biodiversity and Conservation” subject heading line in Thomson Scientific's Web of Knowledge database). Of these, we randomly selected 386 scientific papers (i.e., 57 papers per five-year period from 1980 to 2014; Dataset 1) to characterize the publication patterns of fieldwork investigations. Using this information, we estimated the frequency of publication of field-based studies in each period of time and calculated how it varied over the past 3.5 decades. In addition, we calculated the relative change of publication of three study types: fieldwork (papers that reported new observational and/or field investigations), modelling (papers which major endeavor was to construct a model, both those describing a new model and those using modelling to analyze existing data), and data analysis (papers that did not present new data, but analyzed information collected in previous studies, for example, meta-analysis) (Carmel et al., 2013). Articles that did not include any of the above types of research were excluded from the survey (reviews, short communications and editorials). The relative change of publication was calculated for each study type, as follows:

$$D\% = \frac{x2 - x1}{x1} \times 100$$

wherein $x1$ is the basal time period, 1980–1984, and $x2$ is the subsequent five-year period until 2014. To assess if fieldwork studies were published less frequently in more popular journals, we reviewed an additional 168 papers published during 2010–2014 in top-tier and low-tier journals, respectively, Q1 and Q4 journals ($n = 84$ papers on each quartile as defined by Journal Citation Reports, totaling 168 papers, selected from seven Q1 and six Q4 journals; Dataset 2). In addition, we used the first dataset ($n = 386$ papers; Dataset 1) to evaluate if fieldwork studies had been cited less frequently than those based on modelling or data analyses. All sample sizes were determined by power analysis assuming 90% confidence and a coefficient of variation of 25%. A list of journals used in both sets of analyses is presented in Table S1.

3. Results

Our results confirm that the proportion of fieldwork-based investigations in the conservation literature dropped significantly from the 1980s until today ($\chi^2 = 18.2$, 6 df, $p < 0.01$; Fig. 1a). Fieldwork-based publications decreased by 20% in comparison to a rise of 600% and 800% in modelling and data analysis studies, respectively, for the same period (Fig. 1b). The greatest differences were found between the 1980s and the 2010–2014 timeframe ($p < 0.05$), which suggests that in the last five years this change has been particularly dramatic. In parallel, we found that the most highly cited academic journals in conservation science published fieldwork studies less frequently than lower ranked journals over the time period considered ($\chi^2 = 29.591$, 1 df, $p < 0.001$). Thus, from 2010 to 2014 only 55% of papers published in top-tier journals, as opposed to 93% published in lower rank journals, included fieldwork. Moreover, our analyses confirmed that fieldwork studies significantly received fewer citations than modelling and data analyses (medians for studies with and without fieldwork, respectively: 1.5 and 4.4 citations per article per year; $W = 12{,}536$; $p < 0.001$; Cohen's $d = 0.464$), suggesting that the former may be less popular among conservation scientists.

Table 1
Ten examples of conservation studies calling for more biodiversity data (including fieldwork-based research).

Conservation issue	Goal of the study	Excerpt from discussion section
1. Biodiversity assessments	1.1 To assess if models with imperfect biodiversity information can be used to estimate patterns of reptile biodiversity in remote regions [1].	*"Limited knowledge of species distribution was the major cause of richness underestimation, as many species are recorded for only one or very few localities"*
	1.2 To review the role of natural history collections in exploring the global species diversity [2]	*"It is quite clear that we need large joint international efforts to speed up species discoveries and descriptions … Additionally, we need reference collections to continuously document species distributions, which are a prerequisite to describe and analyze the impact of human-induced climate change and socio-economic effects …"*
	1.3 To evaluate information requirements for biodiversity reporting, to identify information gaps and where data could be mobilized to bridge these gaps [3]	*"Although the options of data integration, modelling and the identification of relevant proxies are important options to bridge the information gap … Additional data collection efforts are still needed"*
	1.4 To evaluate quantitatively the temporal baselines that could be drawn from biodiversity monitoring schemes in Europe and to compare those with the rise of important anthropogenic pressures [4]	*"… irregular temporal coverage and biases in taxonomic groups, types of data collected, and Essential Biodiversity Variables classes targeted offer a very truncated picture of biodiversity"; "Our analysis shows that structured biodiversity monitoring data in Europe do not date back far enough in time to document and assess the full impact of anthropogenic pressures on biodiversity, even for popular taxonomic groups such as birds and mammals".*
	1.5 To review the current gaps in knowledge on avian breeding biology and to highlight the priorities for future research [5]	*"(there is a) deficiency in knowledge on avian breeding biology … young researchers' interest in doing field work is diminishing as modern lifestyles arise … How can we … fill the great knowledge gaps?... persuading governments and private agencies about the importance of natural history … promote appropriate ways of evaluating fundamental research among academia … undertake natural history research, especially in a time when more and more species are going extinct"*
2. Habitat loss and fragmentation	2.1 To review the development of habitat loss and fragmentation research spanning over 20 years to identify where and how research has been undertaken and in what way it has changed over time [6]	*"Almost 85% of studies were conducted in America and Europe, with temperate forests and birds the most studied groups … However, most natural ecosystems and biodiversity hotspots are located in developing parts of Asia, Africa and South America …"*
	2.2 To quantify and map global patterns of habitat fragmentation for the world's terrestrial mammals using high-resolution habitat-suitability models [7]	*"Additional efforts to apply these models to local scales, and validating them with empirical data on fine-scale distribution and habitat use, such as that derived from GPS telemetry or remote camera surveys, will help to more thoroughly assess their utility for real-world conservation application."*
3. Climate change	3.1 To review and to highlight the severe geographic and taxonomic biases that many 'global' reviews suffer and discusses how this preclude a comprehensive understanding of how climate change is impacting Earth's natural systems [8]	*"… the information currently available for most ecosystems and species remains woefully sparse, leading to geographic and taxonomic biases in any subsequent reviews … if we fail to recognize taxonomic and geographic biases, then there will be little motivation to initiate or fund new studies to gain information on understudied species and systems"*
	3.2 To identify mammals and birds for which there is evidence that they have already been impacted by climate change and to model the relationships between observed responses and intrinsic and spatial traits [9].	*"… the majority of threatened species live in tropical areas which are generally poorly studied and monitored … Improved monitoring of the abundance and distribution … and targeting such monitoring in areas where the effects of climate change are likely to occur soonest … are crucial to increase empirical knowledge about climate change impacts on species, and to validate and improve projections of future impacts."*
4. Overexploitation	4.1 To report historical changes of the Mediterranean Sea ecosystem by modelling the role and impact of changes in primary productivity and fisheries over time [10]	*"Modelling … is a challenging task … because of the difficulties of gathering and integrating regional data."*

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4. Discussion

Our findings generally support a decline of fieldwork studies in the conservation literature, a trend that is also becoming apparent in other fields (e.g., ecology, Carmel et al., 2013). This suggests that the abatement and lower popularity of these studies may be a more systemic problem, not exclusive to one academic discipline. We contend that two main sets of forces may be responsible for this. The first set alludes to bottom-up pressures, including those associated with the way the publishing and the academic reward systems work, while the second acts top-down, driven by current societal needs and/or priorities (Fig. 1c).

Scientists are under pressure to publish, ideally in high-rank journals because this can bring them better job opportunities, funding and career advancement (Gök et al., 2016; Reich, 2013). Thus, if fieldwork-based investigations are perceived as having a lower publication value (Bini et al., 2005; Fitzsimmons and Skevington, 2010), then this could become a disincentive for researchers to engage in such studies and instead move to approaches that offer greater professional rewards. Our findings that fieldwork-based studies receive fewer citations than other types of research and that they seem to be published more often in lower-impact journals would corroborate this. In contrast, "big data" approaches are usually wider in scope and scale and are construed to have a greater impact in the conservation and ecological literature (Hampton and Parker, 2011), which ultimately enhances their potential to attract citations, as our study demonstrates. In this context, a vicious circle is created: top-tier journals call for manuscripts that are expected to be highly impactful and to generate high citation rates (for example, modelling and meta-analyses studies), potentially detracting researchers from conducting studies based on non-synthetic approaches (like fieldwork), which are in turn less cited, thereby contributing to perpetuate the low impact factor of the journals where they are published. The chances for fieldwork studies to get into this system of popularity are dim, as long as academics, scholarly journals and funding agencies continue to positively reinforce paper citation rates and journal impact factors as gold standards of scientific excellence (Paulus et al., 2015).

On the other hand, scientists are ever more required to provide decision-makers with research that reports on biodiversity trends and ecosystem functioning at different scales (Cardinale et al., 2012; Pimm et al., 2014). This pressure is a key driver to produce fast research that is also more data-hungry, complex and global in scope; features that challenge the typically slow-paced, isolated and local nature of most fieldwork studies. Conversely, an increasing disconnect of society with nature might be indirectly discouraging scientists to perform empirical field studies, since a decline in pro-environmental attitudes and behavior (Soga and Gaston, 2016) may likely challenge the understanding of the relevance of these studies by a general audience (Hughes et al., 2017).

The contribution of fieldwork studies to our improved understanding of the natural world is unquestionable, but important challenges may hinder their long-term persistence. Admittedly, there may be cases where scientific knowledge is likely enough to make conservation decisions, as suggested by the mounting body of knowledge on the value of information for environmental decision-making (e.g., Moore and Runge, 2012; Williams and Johnson, 2015). However, this is not widespread and efforts to collect new biodiversity information have genuinely been weakening as underpinned by several authors who have also detected major taxonomic and regional biases in biodiversity data collection (Table 1). Observations and experiments remain essential today and provide data for modelling and meta-analyses. The broad spatial scales, and long-time scales of global ecological change need to be continuously documented even when current knowledge might seem sufficient.

In light of our findings, we urge the scientific community to find ways to raise the profile of fieldwork-based investigations. For example, top-tier journals could dedicate special sections to the publication of purely empirical studies (Tewksbury et al., 2014), which would enhance the popularity of fieldwork investigations. Such sections could publish, for example, novel field data collected in those places or for those species we know little about. Concomitantly, it is imperative that funding agencies 'ring-fence' funding for this type of empirical work, acknowledging that the only way forward to overcome transitional periods of immense environmental change is evidence-based decision-making which relies on data also collected through fieldwork. Finally, researchers, funders and journals need to commit, respectively, to conducting, funding and divulging locally relevant research, and be less constrained by publication metrics (Monjeau, 2013).

Despite globally increasing efforts in research aimed at tackling the current biodiversity crisis, our knowledge of the ecology, distribution and status of many species is still limited (Dijkstra, 2016, Table 1). Under such a scenario, field-based investigations are powerful allies of synthetic studies, providing the data that enable us to better identify global

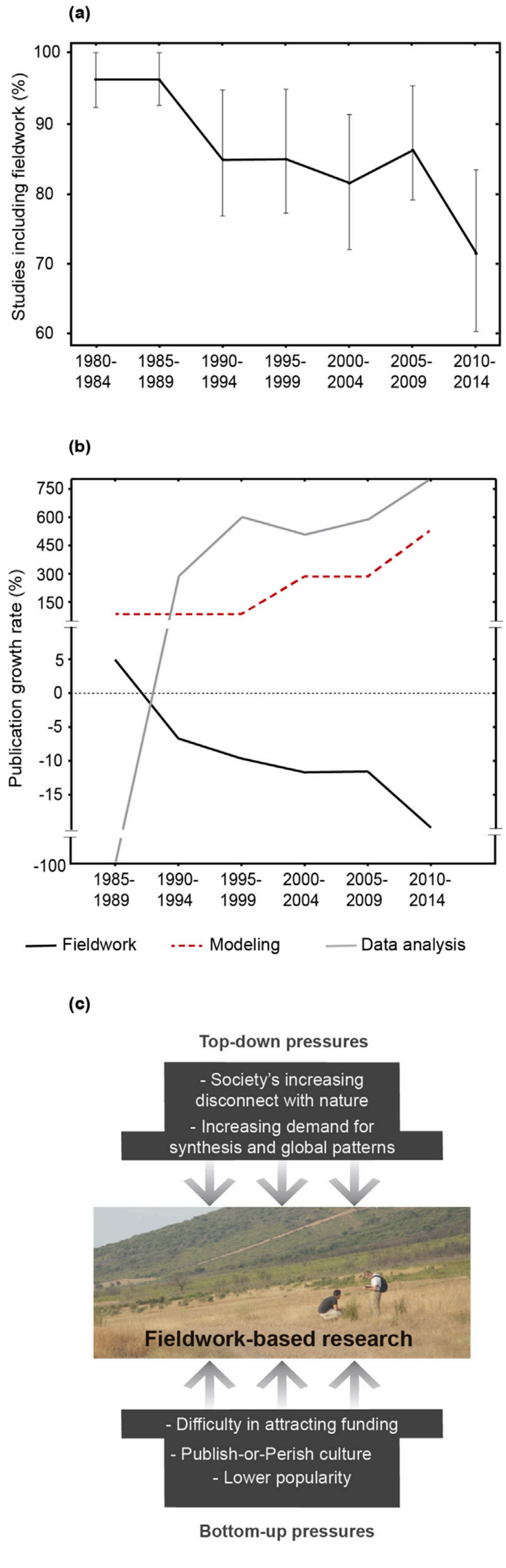

Fig. 1. Publication patterns of fieldwork-based studies in the conservation literature from 1980 to 2014 (n = 386 papers). (a) Percentage of studies that included fieldwork in each five-year period; 95% confidence interval estimates (Sison and Glaz, 1995) are shown; (b) Publications growth rate by type of research per five-year period (please note the breaks in the vertical axis); a null value in the y axis reflects no change in the proportion of publications within the category in relation to the basal period (i.e., 1980–1984); (c) Potential pressures causing the decrease in the number of fieldwork-based studies published in the last 3.5 decades (image courtesy of N. Romero).

biodiversity threats, and address them by informing decision-making across scales. Only a higher appreciation within the scientific community for empirical research may increase society's sense of awe and respect for nature, ultimately leading to additional paths to ecosystem restoration.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.gecco.2018.e00389.

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