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Insights from two decades of the Student Conference on Conservation Science

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Insights from two decades of the Student Conference on Conservation Science

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Abstract

Conservation science is a crisis-oriented discipline focused on reducing human impacts on nature. To explore how the field has changed over the past two decades, we analyzed 3,245 applications for oral presentations submitted to the Student Conference on Conservation Science (SCCS) in Cambridge, UK. SCCS has been running every year since 2000, aims for global representation by providing bursaries to early-career conservationists from lower-income countries, and has never had a thematic focus, beyond conservation in the broadest sense. We found that the majority of projects submitted to SCCS were based on primary biological data collected from local scale field studies in the tropics, contrary to established literature which highlights gaps in tropical research. Our results showed a small increase over time in submissions framed around how nature benefits people as well as a small increase in submissions integrating social science. Our findings suggest that students and early-career conservationists could provide pathways to increase availability of data from the tropics and address well-known biases in the published literature towards wealthier countries. We hope this research will motivate efforts to support student projects, ensuring data and results are published and data made publicly available.

Keywords: Bias; Capacity building; Cross-disciplinarity; Early career; Field study; New conservation; Student

1. Introduction

Conservation science focuses on understanding and reducing the negative impacts of human activities on nature, and has, from its inception, been framed as a "mission-oriented discipline" (Soulé 1985). It has its origins in biology and, as a result, its initial emphasis was on describing and explaining the distribution of biodiversity as well as the ecological and evolutionary processes shaping the diversity of life under human pressure. However, over the last few decades it has become increasingly clear that understanding biological processes alone is insufficient in identifying robust solutions to reduce pressures on nature and the environment (Balmford and Cowling 2006; Bennett et al. 2017; Kareiva and Marvier 2012; Meine et al. 2006). This has led to the integration of the social sciences, economics, and psychology to understand the role of people when addressing conservation problems (Mace 2014; Martin et al. 2012b; Teel et al. 2018) and an interest in the motivations for conserving nature (Greenwald et al. 2013; Kareiva 2014; Kareiva and Marvier 2012; Noss et al. 2013; Soule 2013).

Even though primary data are the foundation for conservation science and management (Tewksbury et al. 2014; Wilson 2017), the proportion of published studies based on primary data collection has decreased over the past two decades, though they still represent 70% of ecological studies (Ríos-Saldaña et al. 2018). In addition, the conservation literature continues to exhibit considerable geographical bias toward wealthier, often English-speaking countries (Amano and Sutherland 2013; Martin et al. 2012a) and certain taxonomic groups (Clark and May 2002) and away from the tropics (Collen et al. 2008; Mammides et al. 2016; Meijaard et al. 2015). These biases limit our ability to assess what conservation actions work and where.

Analysis of trends in peer-reviewed articles can give an unrepresentative picture of the work being done on the ground (Godet and Devictor 2018). Understanding the extent to which the peer-reviewed literature is missing specific types of studies or research from certain parts of the world can help to highlight publications gaps and improve the uptake of data and experiences outside the Western dominated academic environment. One possible pathway to address the evidence gap and entrenched biases is to analyze conference submissions. Conferences are an important part of academic culture and student conferences especially provide early-career scientists with an opportunity to showcase and discuss their ideas, projects, and fieldwork at a stage prior to publication. While not immune or without possible biases of their own, conference submissions may be less vulnerable to some of the issues in the peer-reviewed literature (e.g. positive-results publication bias, English language skills) and could identify the disconnect between on-the-ground research and the published literature. This information could help to utilize the full potential of the conservation research community.

In this study, we assessed the scope, data and methods of studies submitted for presentation at the Student Conference on Conservation Science (SCCS) in Cambridge, UK using a database of >3000 applications. To our knowledge, SCCS is the oldest dedicated student conservation conference. Over the 20 years it has been running, it has welcomed applications from bachelor, masters and PhD students. It has never had a thematic focus but instead encourages submissions from across the diverse disciplines of conservation science. It has consistently received applicants from around the world, in part thanks to its provision of bursaries to those from lower income countries.

We classified these applications to explore patterns and trends over time in what conservation students study, focusing on potential changes in framing, the types of studies conducted, the methods used, and the integration of data and ideas from the social sciences. We were particularly interested in understanding if the transition from conservation as a predominantly biological science to a more multi-disciplinary one had changed the framing around the value of nature to people or the integration of the social sciences.

2. Material and methods

We included 3,487 submissions for oral presentations (i.e. poster submissions were excluded) at SCCS-Cambridge covering 15 individual years spanning the 18 years between 2002-2019. These are the years for which we had access to all the original conference submissions, not only accepted submissions, to ensure we captured the full scale of work undertaken and to avoid any selection bias by the conference organisers. The years 2000, 2001, 2004, 2005, and 2006 were excluded due to missing data. Ethics approval was obtained through the Human Biology Research Ethics Committee, School of Biological Sciences, University of Cambridge (ref no.: PRE.2018.068). Conference submissions were anonymized before being used to generate a database of submissions containing: 1) Row ID, 2) Nationality, 3) Country of residence, 4) Stage in career, 5) Talk title, and 6) Talk abstract. E-mails were sent to all applicants asking them to reply if they did not want to be included in the study. This led to the removal of seven submissions.

The data extraction protocol and guidelines outlining the information extracted from each submission were developed prior to reviewing the submissions (Table S1). The protocol was pilot tested on a subset of submissions (n = 20) by a sub-group of reviewers and subsequently revised based on these experiences. Two workshops were conducted prior to the data extraction to explain and discuss the final protocol. In total, 25 of the paper's authors participated in the data extraction based on the information in the submissions database. The conference-submissions were assigned randomly among all 25 reviewers, with each reviewer extracting data from approximately 140 abstracts. The year of submission was removed to avoid biasing the data extraction.

2.1 Data extraction

For each submission (title and abstract), the reviewers extracted information on the applicant (nationality, country of residence, career stage) as well as on 25 elements pertaining to the research carried out by the student. The abstracts for 2002 and 2003 consisted of a title and an abstract with no formatting requirements. For subsequent years the abstract was divided into four parts: 1) What conservation problem or question does your talk address?, 2) What were the main research methods you used?, 3) What are your most important results?, and 4) What is the relevance of your results to conservation?. The 25 elements covered research locations (e.g. country, region); study type (i.e. field, laboratory, modelling, remote sensing); and scale of study (e.g. local, national, multi-country) (see Table S1 for the full list and definitions). Where possible, answers were assigned to predefined categories (e.g. realm of study: terrestrial, marine, freshwater, coastal, or multiple). In addition, reviewers used 'not sure' where the abstract did not allow a clear interpretation or 'not applicable' where a particular question was not relevant.

Where one or multiple species were studied, we recorded the broad taxon using 16 categories: algae, lichens, plants, fungi, arthropods, marine invertebrates, other invertebrates, fish, amphibians, reptiles, birds, mammals, other, multiple, not applicable, and not sure.

For each conference submission each reviewer assessed whether the study primarily addressed 'Pressure', 'State', or 'Response' following the PSR-framework of the Organisation for Economic Co-operation and Development (1993). For example, a study could examine the effect of protected areas (response) in reducing hunting (pressure) on numbers of lions (state). This was done based on an interpretation of the entire abstract. Where more than one category could apply, we used a hierarchical approach to assign a single category to each submission, where 'response' superseded 'pressure' which superseded 'state' - so the example above would be classed as a response study. The hierarchical approach was used to reflect the conceptual thinking behind the PSR-framework, that conservation is the human response to human pressures affecting the natural state of the world.

We extracted information on the extent to which human dimensions were included in the studies through two questions. The first addressed whether the submission mentioned conservation benefiting people and/or the importance of involving people in conservation decisions. It was not necessary for the study to be primarily framed around the value of nature to people, only that the role of, or relevance to, people was articulated. The second addressed whether the primary focus of the study was the value nature provides to people.

We assessed whether submissions recorded biological data (e.g. species, habitats, genetics or any other data derived from a biological system) and/or socio-economic data (e.g. livelihood issues, economy/finances, attitudes, human behavior, or human behavior change). Additionally, we recorded if the data was collected by the students themselves, or if the study included secondary data sources.

Finally, we recorded the methods for both biological (e.g. transects, camera-traps, remote sensing, interviews) and socio-economic data collection (e.g. interviews, questionnaires). For biological methods the original 20 categories (Table S1) were reduced to six: 1) field data, 2) genetic data, 3) internet/literature search, 4) audio and camera recordings, 5) remote sensing, and 6) other.

Following data extraction, 359 (11.1%) submissions were selected for kappa analysis to test the inter-reviewer variability in data extraction. This was done by randomly selecting 10% of the conference-submissions of each reviewer to be re-reviewed by a different randomly selected reviewer. For the years 2002 and 2003 we assessed 20% of each year following the same procedure. Kappa analysis was conducted on all questions individually and on overall agreement. Based on this, questions with a Cohen's kappa score below 0.6 (weak agreement) were not included in the analysis (McHugh 2012). The average Cohen's kappa for all included questions was 0.78 (S.E. = 0.07, min = 0.64, max = 0.87, Table S2). Only the identification of main threat (Cohen's kappa = 0.21) did not meet this criterion, potentially because the perception of threats in the field does not always align with the five main categories used here and adopted from The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. The years 2002 and 2003 were assessed separately leading to the exclusion of the Pressure-State-Response questions for those years (Cohen's kappa = 0.40).

2.2 Analysis

Prior to calculations of proportions, all empty fields, 'not applicable', and 'not sure' were removed. Thus, the number of responses for each year varies across analyses. For questions where we assessed proportional changes over time, we used beta-regression to model the proportion as the dependent variable and year as a continuous independent variable. All analyses were carried out in R 3.5.1 (R Development Core Team 2019).

3. Results

3.1 Geographical and taxonomic focus

We assessed 3,245 submissions after removing 235 that had been submitted but did not contain an abstract and/or title. Over the 18-year period, the conference received applications from 128 countries;

with the highest number of applicants, by nationality, from India (n = 454), United Kingdom (n = 312), Kenya (n = 125), Nigeria (n = 121), or Nepal (n = 100). By region, Asia was the largest source of applicants (n = 992), followed by Africa (n = 961), Europe (n = 598) and Latin America (n = 213) (Table 1).

Table 1. Proportion of abstracts across the six regions

Region	Nationality	Residence	Fieldwork	% studies based on own fieldwork	% people focused
Africa	961 (34%)	958 (33%)	1,016 (41%)	82%	36%
Asia	992 (33%)	921 (34%)	949 (39%)	83%	26%
Europe	598 (21%)	846 (21%)	216 (9%)	73%	27%
Latin America	213 (7%)	166 (7%)	222 (9%)	70%	32%
North America	86 (3%)	115 (3%)	16 (<1%)	66%	49%
Oceania	41 (1%)	55 (1%)	38 (2%)	51%	17%

Nationality, residence and fieldwork shows the percentage of submissions (after removing those that noted not applicable and not sure) from each region. % fieldwork and % people-focused shows the percentage of submissions, within each region that included fieldwork and a focus on people related values respectively. For the last two columns, submissions were assigned a region based on the nationality of the applicant. Because of different degrees of missing data in individual questions, the sums across columns are not the same.

Noticeably there were very few submissions from North America (n = 86) and Oceania (n = 41). No changes were observed over time in the proportion of applicants from different regions (Fig. S1) and only a few, and minor changes, at the country level (Fig. S2). India was the country where the most studies took place (n = 435), followed by South Africa (n = 114), Kenya (n = 110), Nepal (n = 101), and Madagascar (n = 97). Many applicants from Europe (64%) and North America (81%) worked outside their own region, which was much less the case with students from other regions (Fig. 1).

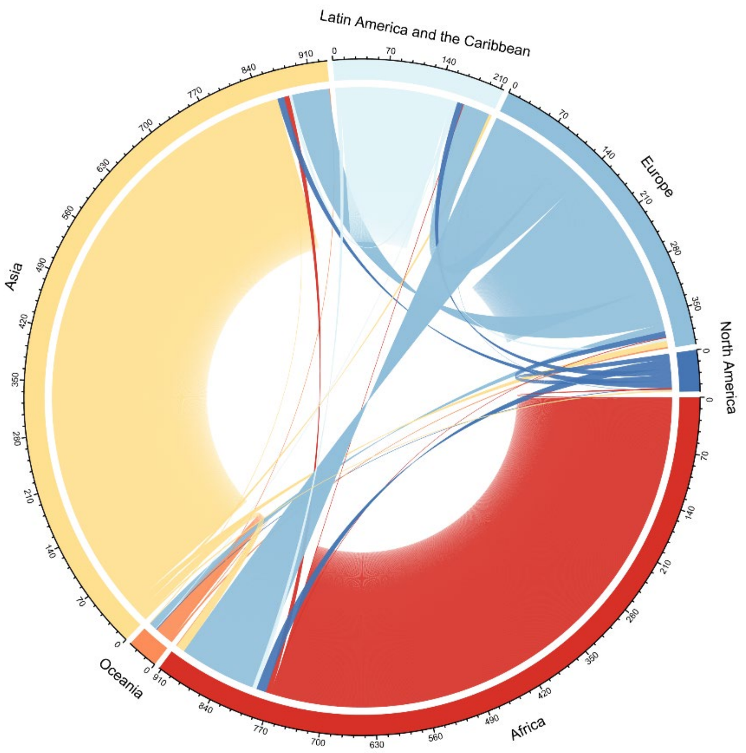

Figure 1. Diagram showing the number of SCCS applicants conducting fieldwork in different regions (the outer ring). The color of the inner (thicker) ring indicates the nationality, grouped by region, of the person conducting the research. The figure shows that there are more Europeans working in Africa, Asia, and Latin America and the Caribbean than there are people from those regions working in Europe.

The vast majority of studies were terrestrial (n = 2,393) followed by freshwater (n = 225), marine (n = 177), multiple (n = 119) and coastal (n = 102). Across taxonomic groups, mammals were the most studied (n = 875), followed by plants (n = 470), birds (n = 432), fish (n = 121) and arthropods (n = 89), while potentially-important indicator groups, such as amphibians (n = 58), fungi (n = 10), and lichens (n = 2), were far less represented (Fig. 2).

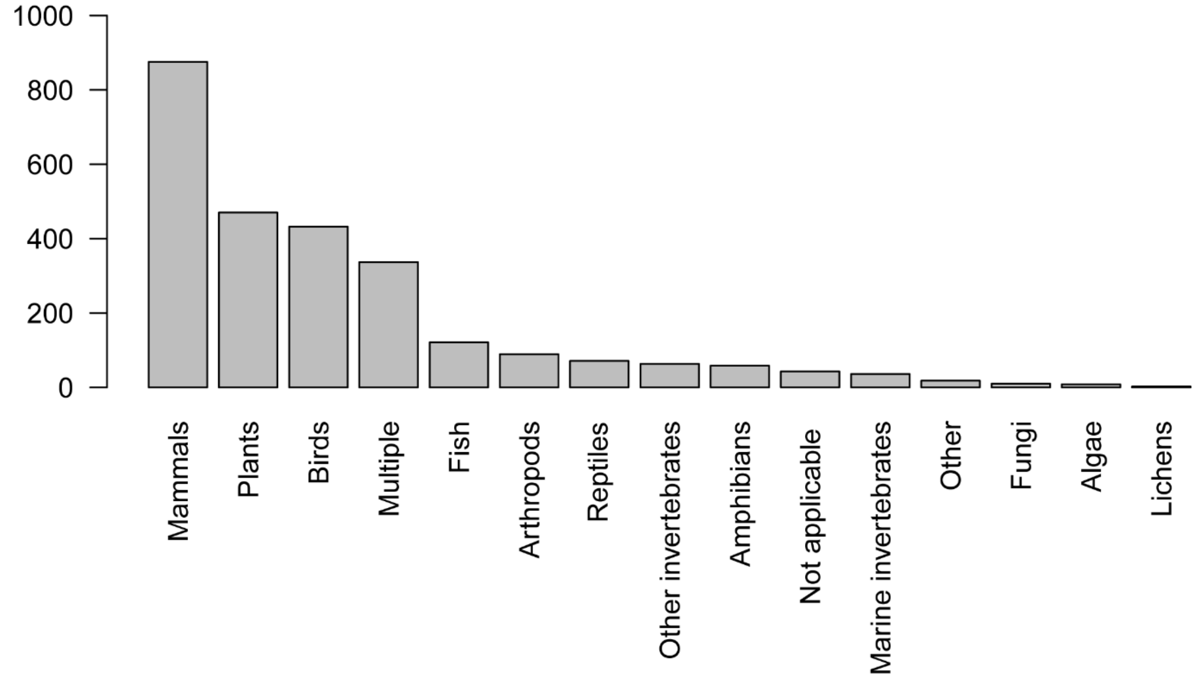

Figure 2. Taxonomic coverage across 2,489 conference sub-missions (excluding sub-missions with an ambiguous or no study taxon). Reviewers were explicitly asked to select the main species or higher taxonomic unit of interest. Where other species were described but were not the focus of the study, they have not been recorded.

3.2 Framing

On average, 38% (n = 1,003) of all studies focused on the state of nature, investigating patterns of biodiversity and processes, followed by 36% (n = 954) addressing pressure to biodiversity, and 26% (n = 671) addressing responses. No changes were observed between 2007 and 2019 in the proportions of state, pressure and response studies (Fig. 3a).

Of all the submissions, 31.3% (n = 983) mentioned the importance of conservation benefiting people and/or the importance of involving people in conservation decisions, with no change observed over time. While remaining relatively low, in absolute terms (mean = 11.8%) the number of submissions with a primary focus on the value of nature to people increased significantly (z-value = 2.62, p = 0.009, DF = 13) more than doubling from 2002 (estimate = 7.0%) to 2019 (estimate = 16.5%; Fig. 3b).

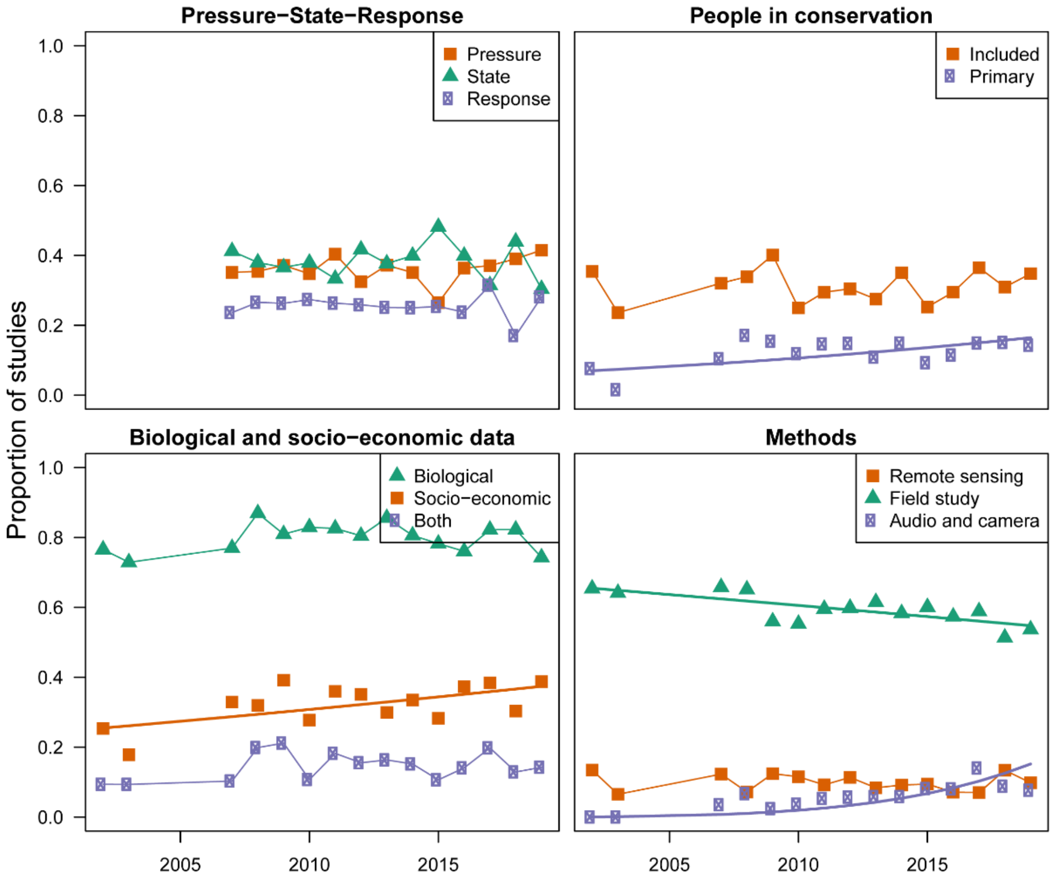

Figure 3. Change over time in the proportions of (a) studies that looked at pressure-state-responses, (b) studies that mentioned the importance of conservation to benefiting people and/or the importance of involving people in conservation decisions, or studies whose primary focus was to understand the values that nature provides to people, (c) studies that including biological data or socio-economic data, or both, and (d) studies using different methods. Studies that noted 'Not applicable', 'Not sure' or did not provide an answer for the questions involved were not included. Dots are connected where not significant relationship ($p \geq 0.05$) was identified while a regression line represents that a significant relationship ($p < 0.05$) was identified

3.3 Data and methods

Most submissions (80%, n = 2,442) contained biological data, while data on socio-economic aspects were less common (33%, n = 998). Only 15% (n = 454) reported both biological and socio-economic data in the submissions. For biological data and the combination of biological and socio-economic data, the proportions showed no change over time. However, the proportion of submissions including socio-economic data increased over time from 25.6% to 37.2% (estimate = 0.03, S.E = 0.01, p = 0.004, DF = 13; Fig. 3c). Most of the data, both biological (66%, n = 2,001) and socio-economic 75% (n = 852), were collected by the students themselves. Eighty percent (n = 2,457) of the submissions contained a field-collection element (Table 1) with 74% (n = 2,090) of the submissions covering local-scale studies that looked at one or a few sites, and only 17% (n = 475) of studies investigating patterns at national level, 7% (n = 186) looking at multiple countries, and 2% (n = 66) conducting global analyses.

The methods used to collect biological data remained relatively constant over time and were dominated by field-based approaches, such as transects, plots and trapping (58.4%, n = 1,691). A decrease (from 65.5% in 2002 to 54.8% in 2019) was observed in the use of traditional field-based methods (estimate

= -0.026, S.E = 0.006, $p < 0.001$, DF = 13), and there was an increase (from 0% in 2002 to 15.2% in 2019) in the use of audio and camera recordings (estimate = 0.21, S.E = 0.041, $p < 0.001$, DF = 13). This suggests a change in approach toward more automated methods, rather than a decrease in field-based data-collection (Fig. 3d).

4. Discussion

Our results show that the majority of submissions to SCCS between 2002 and 2019, were based on primary biological data from local-scale field studies. These findings suggest a different trend to the concerns raised in previous research: that there is a decrease in the proportion of field-based studies in the peer-reviewed literature (Carmel et al. 2013; Ríos-Saldaña et al. 2018). Likewise, contrary to the dominance of researchers from wealthier countries found by reviews of published papers (Amano and Sutherland 2013), the majority of submissions to SCCS were from Asian and African nationals. These two continents were even more prominent when looking at the countries in which people collected data (Fig 1). For example, citizens from the UK represented the second largest group of applicants, but the UK ranked 15th as a location for fieldwork.

The discrepancy, in terms of type and location of studies, between the published literature and submissions to SCCS, highlights a potential barrier in the pathway from fieldwork to publication that warrants further exploration. It is possible that conferences allow participants to present more creative and less fully developed ideas that will be filtered out or modified once they get submitted to peer-reviewed journals. Thus, conferences can play an important role in supporting and testing novel ideas that might be harder to get through a review process. It is possible that this explains the discrepancy between our findings, and studies of peer-reviewed papers that find a decrease in the proportion of field-work based studies. Thus, it may be that though the proportion of field-based research is not decreasing, field-based studies are being accepted less by journals. Furthermore, it suggests that the identified knowledge and data gaps in the published literature for the tropics (Christie et al. 2019; Collen et al. 2008; Mammides et al. 2016; Meijaard et al. 2015), may not only be driven by the lack of research effort and data-collection, but by publication bias. This is of particular concern given the significant biodiversity importance of tropical areas (Brooks et al. 2006; Myers et al. 2000).

There is an urgent need to improve the uptake of studies from the tropics in the peer-reviewed literature to ensure the availability of knowledge and data in conservation research and efforts. This will both directly benefit the conservation community and ensure a greater diversity in the people and views represented within conservation science. To achieve such improvements, it is important to support the data-collection-publication pipeline in areas currently underrepresented in the published literature. This may include reduced or waived publication fees (already applied by some journals), as well as language support for non-native English speakers, which is a major barrier in the publication process (Amano et al. 2016). In some cases, there might also a need for capacity building (Legg and Nagy 2006) and to assist people in scientific writing. For example, in a capacity-building program in Africa run by the Tropical Biological Association, a focus on how to write scientific articles resulted in 87 publications (*Pers obs.* R. Trevelyan).

While the peer-review process is foundational for the publication of scientific studies, it is not the only way to publish data. An increasing number of online data repositories allow for data sharing outside the traditional publication pathway. Similar to the role of GenBank (NCBI Resource Coordinators 2017) in molecular biology, such databases might help to publicize data currently unavailable in the public sphere. However, to be successful, this should be linked to transparent standards (Poisot et al. 2019), a formalized method of citing the data-collectors, and must be accompanied by the development of appropriate and fair crediting mechanisms for data collectors by institutions and funding bodies. Data can represent value, both monetary and cultural, thus where fieldwork is taking place outside the country of the institution, the access to data should be accompanied by benefit-sharing (Baker et al. 2019). If such mechanisms are not in place, data-sharing outside the peer-reviewed literature may not benefit data-collectors in the developing world but rather lead to exploitation of field efforts by other researchers.

Over the 18-year for which we had data, the number of submissions that focused on the value that nature provides to people increased. This corresponds with the emergence within the conservation community of a 'nature for people' framing (Mace 2014), which has profoundly influenced the strategies of some of the world's largest conservation organizations (e.g. Conservation International and The Nature Conservancy; Kareiva et al. 2014). However, this narrative has been criticized as western-dominated (Tallis and Lubchenco 2014) and as describing a polarization not actually found in the conservation community (Sandbrook et al. 2019). In this light, it is interesting that while we observed a significant trend over time, the proportion of SCCS submissions focused on the services and goods that nature provides to people remained low. Thus, our results suggest that while the emphasis on people is a component in conservation, it is by no means dominant. It is possible that our sample, with a majority from lower-income countries, might be less influenced by this trend in conservation than in higher-income regions. North America and Australia, which are among the largest contributors to peer-reviewed journal articles in conservation science, were almost entirely absent in our sample (potentially related to the distance to Cambridge, UK) while also being among the strongest proponents of a more people focused conservation narrative (Tallis and Lubchenco 2014).

The submissions we assessed support suggestions that conservation science is broadening (Teel et al. 2018) by revealing an increase over time in the use socio-economic data. However, the proportion remained relatively low across the 18 years. Additionally, the number of studies integrating both biological and socio-economic data did not increase, with only around 16% of studies combining biological and socio-economic data in the same study. This suggests that while conservation has become increasingly multi-disciplinary, there is still considerable scope for further integration (also see Guerrero et al. 2018). The call for integrating socio-economic perspectives into conservation research is not new (e.g. Adams and McShane 1992), and it is increasingly recognized that both biological and socio-economic perspectives are vital to conservation success (Martin et al. 2016). The continued paucity of socio-economic considerations in conservation science that we observed highlights the need to broaden the training of future conservation researchers. This requires university departments and faculties to foster integration and to break down silos between disciplines and departments.

The majority of studies focused on describing biological states or human pressures, while only 26% evaluated conservation interventions and solutions. Our results therefore mirror several papers that highlight the lack of studies assessing the impact of conservation responses (Geldmann et al. 2013; Schleicher 2018). While we recognize that an understanding and description of the state of nature and the pressures it faces provides a foundation for developing effective responses, the under-representation of studies assessing the impact of conservation efforts is concerning, given longstanding calls for increasing evidence on the effectiveness of conservation interventions (Pullin and Knight 2001; Sutherland et al. 2004). Assessing the impact of conservation responses is fundamental to improving their effectiveness (Balakrishna 1999; Ferraro 2009) as well as measuring progress towards achieving policy targets (Fisher et al. 2014). It is possible that the complexity of assessing conservation impact (Baylis et al. 2016) is limiting the number of such studies undertaken by students, who are often constrained by time and may lack the experience required to undertake complex impact assessments. Additionally, students attending conferences may wish to present earlier parts of their projects, even if this represents only a step towards the overall objective (i.e. submit the field stage if analysis isn't completed). However, it is vital that conservation science increasingly addresses this knowledge gap (Baylis et al. 2016; Miteva et al. 2012; Schleicher 2018) to better understand what works, when and why.

By following 18 years of submissions from the longest running student conservation conference, our study provides a unique temporal insight into the work undertaken by successive cohorts and early-career conservation scientists. In including all submissions to give a talk, our sample is not biased by the quality of submissions or by temporal shifts in the preferences of the selection committees but represents the full diversity of students applying for SCCS. Nevertheless, our sample might not represent the wider community as self-selection might exclude some from submitting. Conducting similar analysis of other student and/or conservation conferences where similar long-term data exists, would help to clarify these potential biases. As with published studies (Amano et al. 2016; Amano and Sutherland 2013), countries (often former British colonies) where it is more common to communicate in English were disproportionately represented and so the conference doubtless does not fully capture a representative sample of all conservation studies. Moreover, the low proportion of marine studies indicates that SCCS has tended to attract a lower proportion of those working on marine conservation, perhaps due to the organizers having mostly terrestrial experience and networks. In general, conferences can exacerbate such geographical and topical biases related to the organizer's areas of interest and the location of the conference. This might also have influenced the submission to SCCS Cambridge and thus how well suited this sample is for comparing to the wider academic conservation literature.

The dominance of field studies from the tropics in the conference submissions might not reflect a dominance of field studies in general. Rather, it is possible that fieldwork in temperate zones is framed more as ecological research without a conservation focus. Nevertheless, our study suggests that there is an untapped resource in field studies and more tropical research being undertaken by students from tropical countries than is suggested by the published literature.

5. Conclusion

Based on our findings we see an urgent need to make data generated by tropical fieldworkers more widely available, and for increased efforts in examining the impact of conservation interventions. It is important that any initiative focus on developing the capacity of and provide agency for the people conducting the data-collection to help further their careers as independent researchers in their own right. Our results also highlight that conservation science still needs to further integrate disciplines outside biology. Only through combining understanding of both the natural world and human behaviour can we successfully tackle the great challenges facing Earth's biodiversity, without jeopardizing the sustainable livelihood of our own species.

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