Gender and conservation science: Men continue to out-publish women at the world’s largest environmental conservation non-profit organization

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Abstract
The biodiversity and climate crises require diverse solutions, yet peer reviewed literature is dominated by men from the Global North. The Nature Conservancy (TNC), as one of the world’s largest conservation non-profit organizations, provides a case study to better understand how women publish relative to men in conservation science. By examining all papers from Web of Science with at least one TNC author (1968–2019), we found that women at TNC are underrepresented: only 36% of authors were women, just 31% of all first authorships were women, and 24% of last authorships were women. Women in the Global South were the least represented group, making up less than 2% of all TNC authorships. By comparison seven individual men in the Global North comprised 9% of all TNC authorships. Encouragingly, the total number of women publishing at TNC has improved over the decades; however, the proportion of women to men remains below gender parity, and the proportion of women from Global South remains consistently below 3%. These results align with overall trends in conservation and science, and we provide recommendations for the global conservation science community on how to address this enduring and significant issue in publishing.

Keywords
climate, conservation, diversity, environment, gender, global south, publication, science, the nature conservancy, women

1 INTRODUCTION
The biodiversity and climate crises are urgent, global, and require diverse solutions; yet, literature is persistently shaped by a relatively homogeneous group of authors: men from the Global North. An article published in the prestigious journal Nature listed “100 articles every ecologist should read,” including 97 authored by men and just...
three by women (Courchamp & Bradshaw, 2018). Furthermore, a recent study of 13 leading journals in ecology, evolution, and conservation revealed that just 11% of the top 100 publishing authors between 1945 and 2019 were women, and more than 75% of all authors were from a small number of countries in the Global North (Maas et al., 2021). Similarly, in a recent analysis of the 1000 most influential climate scientists, only 122 were women, and women authored just 22% of the most-cited climate science papers (Tandon, 2021).

Gender diversity represents an important first step in increasing diversity among leaders who drive research decisions and guide conservation science (Vollan & Henry, 2019). However, women face many structural disadvantages and barriers to leading research and publishing (Davies et al., 2021). These barriers can include leave and pay inequity; women’s heavier care, domestic and office workloads; and conscious and unconscious bias in institutions, including discrimination and harassment (Jones et al., 2020; Jones & Solomon, 2019). Such conditions stymie women, especially women from the Global South (e.g., where the costs of accessing literature may also be prohibitive), from opportunities for research collaboration and publishing (Davies et al., 2021). Given publication rates often influence career progression for conservation and science professionals, this inequity also leads to significant and ongoing career impacts for women (Veríssimo et al., 2020).

Biases and barriers that keep women from publishing also limit diversity of ideas and innovation needed to address the ongoing conservation and climate crises. Importantly, women are more likely than men to investigate gendered components of conservation and climate change: a recent review showed that more than 70% of articles investigating the gendered impacts of conservation were authored by women (James et al., 2021). Such research can also demonstrate how intentionally including women can lead to better conservation and climate outcomes (e.g., McLeod et al., 2018; Westerman, 2021). For example, studies in Asia and Africa have found that greater representation of women leads to more equitable benefit sharing and improved conservation in forest programs (e.g., Upreti, 2001). Conversely, failure to address the gendered components of conservation and climate can inadvertently harm women and girls (e.g., Mariki, 2016; Poor et al., 2021; Ram-Bidesi, 2015).

Its inception is interconnected with the broader U.S. conservation movement in the 1900s that was led primarily by white men, with a focus on buying and protecting land for outdoor recreation, including hunting and fishing (Taylor, 2016). This male-dominated and colonial movement often led to dispossession and social exclusion of women, and especially First Nations people (Zurba et al., 2019). Although still headquartered in the United States and with operations in all 50 states, TNC identifies itself as a global organization. It expanded its work to Latin America and the Caribbean in the 1980s, the Asia Pacific region in the 1990s, the African continent in 2007, and by 2014 it had established work in Europe. Like other large conservation organizations, TNC has expanded to address global conservation and environmental issues, including climate change and biodiversity loss, and increasingly focuses on people and social inclusion (The Nature Conservancy, 2021b). As the organization has evolved, it has emphasized the importance of gender equity in its work and workplaces (The Nature Conservancy, 2021b).

As of 2019, the organization employed around 3600 staff working across more than 74 countries and territories (The Nature Conservancy, 2019). It has grown to be the largest global environmental non-profit by revenue and assets, with $USD 1.05B in total revenue in 2019 (Armsworth et al., 2012; The Nature Conservancy, 2019). TNC also self-identifies as a science-driven organization, producing scientific literature to inform locally led conservation as well as national and global policies (The Nature Conservancy, 2021a). Its scientists and conservation staff are expected to publish scientific research, policy recommendations, and conservation practices in academic journals (Fisher, 2016).

This research considers the case of The Nature Conservancy, as the world’s largest environmental conservation non-profit organization, to further examine publication trends by gender. It considers some of the conservation and policy implications of these findings and provides recommendations to support both TNC and other conservation science organizations to foster gender diverse publication strategies.

## 2 | METHODS

To develop the list of TNC based-author publications, details of every paper with at least one TNC author in the author affiliation was extracted directly as an Excel file from Web of Science from 1968 to 2019. We chose Web of Science as it is the world’s largest independent global citation index, and all peer-reviewed conservation and related science journals are searchable via this database.

### 1.1 | The case of The Nature Conservancy

The Nature Conservancy (TNC) was founded in the United States (U.S.) in 1951 with origins as a land trust.
We acknowledge that many important publications for conservation are found in gray literature, but for this study we focused on peer-reviewed conservation science literature given this is a key metric (including journal ranking and citation index) against which careers in science are measured.

We classified every TNC author as man, woman, or unknown where gender was unclear. We determined the gender of each author by reviewing their full name, searching their online presence, and by direct inquiry when there was any doubt. We acknowledge that, in limited cases, we may have wrongly assigned gender. This study also lacked data to shift beyond a binary definition of gender (women/men); however, we acknowledge and respect that this does not reflect the lived experience of many people.

We then determined a country of primary affiliation for each author by identifying the country location of the office address for each author. For this study, we classified authors by location, not race/ethnicity/nationality.

We further classified each author’s location country as either in the Global South (Asia, Africa, Caribbean, Eastern Europe, South America, and the Pacific Islands) or the Global North (Western Europe, Northern America, Australia, New Zealand, and Israel). Global South countries are defined as those that have typically been marginalized through many factors: colonization, lower levels of wealth, economic development, and lack of political freedom and weak governance (Demeter, 2020).

For this study, we examined both individual authors as well as authorships. For example, a TNC author named “Robyn James” would be counted as one individual TNC author. If “Robyn James” is an author on five papers, we would count five authorships. If “Robyn James” co-authors with one other TNC author on a paper, we would count two separate authorships (one for “Robyn James” and one for the other TNC author).

We classified every TNC authorship into one of three categories: first/only, middle, or last author. We assigned all middle authors to the same category regardless of how many co-authors were on a paper.

After assigning every TNC author a gender and location, we then measured the ratio of men to women as individual authors. We also looked at the number of publications for individual authors by gender and the total number of authorships by gender.

We also examined how the gender ratio of TNC authorships changed over time by evaluating the data at points in each decade over the last 50 years. We deliberately omitted data from 2020 onward to avoid potential impacts of the COVID-19 pandemic on the results.

We were able to retrieve records of total numbers of TNC conservation and science staff by gender and country location for the years 1996 to 2019. In 1996, of 306 conservation and science staff, 100 (33%) were women, compared with 1856 staff in 2019, of which 828 (45%) were women. In addition, women in the Global South have increased over time with only one woman in 1996 compared with 164 (42% of Global South staff) by 2019. This enabled us to calculate how the percentage of TNC staff who authored papers varied over this period for both gender and location.

Given we had open access to a complete data set (population) of all papers in Web of Science with at least one TNC author, statistical analysis was not required.

3 | RESULTS

Our search produced a list of 2947 papers with at least one TNC author; a list of 1287 unique TNC authors (many authors had multiple publications); and a total of 4350 authorships (count of any time a TNC author was represented on any paper).

Our results showed:

1. **Individual authors**: Overall, there were fewer women than men from TNC who published. From a total of 1287 individual TNC authors published since 1968, 458 (36%) were women and 745 (58%) were men, with 84 (7%) unknown.

2. **Authorships**: Overall, women authors at TNC were less represented in the literature than men. They comprised 1312 (30%) of the total number of TNC authorships in Web of Science since 1968 compared to 2950 (68%) men (88 [2%] were unknown).

3. **Prolific publishing authors**: There were very few women authors from TNC who published prolifically. For example, the most prolific woman was an author on 41 papers, while 7 men at TNC had between 46 and 81 authorships each. Of those men, 3 were in Australia and 4 were in the United States. These 7 men authors made up 401 (9%) of total TNC authorships since 1968.

4. **Author Location**: The United States was by far the most common location for authors, with 1045 (81%) of all authors and (85%) of all authorships. 1189 (90%) of women authorships were based in the United States. Less than 125 (3%) of all TNC authorships were from women outside the United States. The most underrepresented group in our study was women in Global South countries. They made up less than 70 (2%) of all authorships (Figure 1).

5. **Author Order**: Of all TNC authorships, only 8% were women as first authors compared to 17% of men. Only 9 first authorships (1%) were women in the Global
South. Women were also less likely to be the last author. Of total authorships, 5% last authors were women compared to 14% with men as last authors. Only 7 (<1%) last authorships were women located in the Global South (Figure 2).

6. Changes over time: The percentage of women authorships started at 4% (2) in 1960s and 1970s, but has steadily increased since then to 9% (5) in 1980s, 20% (55) in 1990s, 26% (224) in 2000s), and to 33% (1026) in 2010s. From 2014 to 2019 there were 2196 TNC authorships – 745 (34%) women and 1442 (66%) men (with less than 1% unknown). Authorships from women located in the Global South has not increased beyond 3% since 2008 (Figure 3).

7. Publication rates of women compared with the publication rates of men over time for TNC

![Figure 1: Pie chart illustrating the total of all individual authors from The Nature Conservancy (TNC) that have at least one publication in Web of Science between 1968 and 2019 (n = 1287). The data are shown by gender (man, woman, unknown) and location (Global North and Global South).](image1)

![Figure 2: Graph of authorships (each time an author appears on any paper) from The Nature Conservancy (TNC) published in web of Science between 1968 and 2019 (n = 4350). The data are shown by gender (man, woman, unknown) and location (Global North and Global South) as well as author order (first, last, and middle).](image2)
The total number of conservation and science staff employed at TNC has grown each decade since 1996. By comparing the proportion of individual authors by gender and location with the total number of conservation and science staff over time, we found that although more individuals were publishing, the proportion of women to men publishing remained below parity. The percentage of women staff publishing increased from 3% (7) in 1999 to 5% (32) in 2009, 10% (60) in 2014 to 11% (91) in 2019 compared with men 4% (15) in 1999 to 8% (89) in 2009, 10% (95) in 2014 to 13% (133) in 2019. The percentage of women staff in the Global South who published did not exceed 3% (Figure 4).

**FIGURE 3** Graph showing how the proportion of The Nature Conservancy (TNC) authorships by gender (man, woman, [unknown omitted for clarity]) and location (Global North and Global South) has changed for each decade from 1968 to 2019 and in the last 5 years (2014–2019) (n = 4350).

**FIGURE 4** Graph showing the number of individual authors by gender and location as a percentage of the total number of The Nature Conservancy (TNC) conservation and science staff of that gender and in that location. This shows change in the proportion of men and women in each location publishing across each decade since 1999 (which was the first decade TNC staff numbers were available).

**DISCUSSION**
A lack of gender diversity can impact what sort of research is undertaken and published. Globally, men and women continue to demonstrate different perspectives related to conservation and climate issues. This is often tied to a persistent and highly gendered division of labor and social norms in both their communities and in
research organizations themselves (James et al., 2021; McCammon et al., 2018). With 68% of all TNC authorships from men (and 9% from just 7 men in the United States and Australia), compared with only 30% from women (and less than 2% from women located in the Global South), the results indicate TNC’s contribution to the conservation science peer-reviewed literature lacks diversity of perspective. These gender gaps in publishing align with global trends where women in science and publishing remain below parity (Larivière et al., 2013; Maas et al., 2021). Over time, the total number of women TNC authors has increased from 53 (27%) in 2009, 84 (35%) in 2014 to 129 (34%) in 2019; however, the proportion of women to men publishing remains stubbornly below parity (Figure 3).

Despite TNC now identifying as a global organization, working in more than 74 countries and territories, our data show that the United States, with 85% of all authorships, continues to be overrepresented for both men and women TNC authors. Men and women in the Global South are the most underrepresented groups (Figure 1). Comparing rates of publishing with total numbers of TNC conservation and science staff revealed that the lack of diversity in publishing aligns with lower numbers of staff located outside of the United States and particularly in Global South countries (Figure 4). However, the proportion of women staff in the Global South who are publishing also remains lower than men and has not moved beyond 3% since 2009 (Figure 2 and 3). As a result, men from the Global North, and particularly the United States, dominate TNC’s research publications. Women located in the Global South, including geographies where gender inequality, land degradation, and climate impacts are most felt by women themselves remain largely absent (James et al., 2021).

Not only does this impact conservation and science outcomes, women conservationists and scientists are also impacted negatively when they fail to publish. TNC, like universities, recognizes publications as a measure of career success (Fisher, 2016). Authorship order is also important; with first author in conservation science commonly denoting leadership and workloads related to research conceptualization, design of the study, and manuscript writing and frequently receiving most acknowledgment. Women as first authors made up just 342 (8%) of the total number of authorships in our dataset, with only nine first authorships from women located in the Global South (Figure 2). Women are therefore less able to use this metric for career development and are less likely to be shaping conservation and climate debates through their research and the scientific literature (Maas et al., 2021). The last author commonly has a position of seniority and may guide the paper’s overall direction or supervise the first author. Although prestigious, this position does less work than the first author. TNC women as last authors made up only 198 (5%) of total TNC authorships, and with only seven last authorships for women from the Global South, this indicates a lack of women in these guiding roles that are often senior and influence the direction of research and publishing (Figure 2).

4.1 Recommendations for building gender equity in publishing

Over time, there has been an increase in both the total number of women publishing at TNC and the percentage of women conservation and science staff who publish, especially in the Global North. To build on this improvement, specific strategies and ongoing investments are needed to address gender diversity of authors, especially women from outside the United States and specifically the Global South. The playing field is not level and women, and especially all authors in the Global South, need specific investment to ensure they have opportunities to research and publish (James et al., 2021; Maas et al., 2021).

Based on these findings, we conclude with the following recommendations. While these recommendations are primarily directed to conservation and science leaders at organizations like TNC, they can also guide individual researchers as they develop their research and publication teams. We stress that these recommendations must be considered alongside ongoing policy and structural reforms in conservation and science organizations that actively address systemic discrimination in hiring, pay and benefits, performance expectations, and promotion opportunities, all of which prevent women achieving their potential (McKinsey, 2019). Importantly, while methods of support should be informed directly by women, the onus cannot be on underrepresented groups alone to ideate, resource, and implement these solutions.

- **Build awareness around bias and systemic barriers.** Decisionmakers in conservation and science should acknowledge that inequities face women in conservation science and these barriers are compounded by the intersectionality of race, class, sexuality, ability, education, location, caregiving, and/or origin. Organizations can begin to address this inequity by investing in and implementing opportunities for all staff to better understand and actively address unconscious bias, power and privilege, and the historical contexts of science and conservation disciplines.

- **Men should collaborate and co-author with women and authors in the Global South.** Research
has shown that when men led a publication or research group there were, on average, less than 20% women co-authors compared with 60% when women were research leaders (Salerno et al., 2019). There is a vital need to examine this inequity and the often-unacknowledged power dynamics in the entire research and publishing process. This can then drive research principles that ensure and/or mandate diversity on leadership, editorial, research, and authorship teams. Organizations can also consider performance metrics where men must include at least one woman (and authors from outside the Global North) on research and support teams to lead and publish their research.

- **Include women who perform “invisible labor” as paper co-authors.** Women who lead data entry, literature review, and other tasks can contribute their insights and be included as co-authors. This strengthens different perspectives in research, gives women (such as early career researchers) recognition, and helps women gain valuable exposure and networks relating to the publishing process.

- **Acknowledge inequitable resourcing and directly support women to focus on research and publishing.** Women’s higher burden of home and office “care work” limits the amount of time for focused writing (McKinsey, 2019). Organizations should require men to equally share in office housekeeping, and actively encourage and support women to have dedicated time for research and writing. Women in the Global South may face compounding challenges, such as unreliable internet connection while juggling caring and work responsibilities and will require extra and deliberate consideration (McKinsey, 2019; Westberg & Powell, 2015).

- **Organizations should support women who primarily speak languages other than English to publish.** The difficulty and extra work for men and women to research and publish in English, which is considered the publishing language of science, should be purposefully resourced and accommodated (Di Bitetti & Ferreras, 2017; Valenzuela-Toro & Viglino, 2021). Leaders should actively encourage and resource women to develop their research and publish. Organizations should resource English translation and editorial support throughout the entire process to final submission (for which directions are often in English). This can be a long and intimidating process for many.

- **Offer dedicated research and publishing support for women.** Many organizations, including TNC, offer courses to help staff publish. Support can have greater impact when tailored specifically for underrepresented groups such as women. This support should be designed to recognize and value women’s ideas, work, and contributions in a system which does not always do so (e.g., Courchamp & Bradshaw, 2018). Trainings that are accessible in preferred/spoken languages and culturally relevant, may facilitate an increase in writing and publishing. Ongoing and dedicated mentoring support from experienced authors should be provided throughout the entire process. Experienced authors should also be compensated as mentors and/or included as co-authors. The entire process needs to be resourced and formally built into staff and team work plans.

  - **Anticipate and manage the potential negative impacts of COVID-19 on women.** We are already seeing negative impacts of the pandemic on women as they publish less, leave science, and exit the workforce more generally (Hansen, 2020; Muric et al., 2021). Science leaders and researchers can anticipate ongoing pandemic-related challenges and create enabling environments for women to research and publish, such as: longer deadlines, mentoring partnerships with experienced authors, flexible working agreements/time management processes, and purposeful engagement with women scientists who are not currently employed by an institution.

This study is an example of ways individual authors, as well as conservation and science organizations like TNC, can improve the representation of women in publishing. Over several years, and with organizational support, we deliberately invested in women, including early career researchers and women authors in the Global South, to publish. The result was a diverse authorship team that added unique and robust insights to this issue. Addressing these recommendations is an ongoing process for TNC and the authorship team.

Climate change and biodiversity loss present urgent, crucial challenges to our planet, and we cannot afford to persistently exclude women’s perspectives (see also Alston, 2014). With a vast underrepresentation of women in the Global South authoring conservation science papers, their unique perspectives remain sidelined, and important ideas and solutions are missed. This, in turn, risks limiting the conservation and climate sector’s effectiveness in successfully influencing research and policy. Change will require the conservation and climate sector to invest in understanding and addressing the well-documented systemic barriers women face, so that women across all countries can have the space, confidence, and support to work in conservation and science and develop and publish their research. Future research must actively include women who have been particularly marginalized from publishing including women of color, women in the Global South, women living with a disability, and women with caring responsibilities.
AUTHOR CONTRIBUTIONS
RJ developed the concept for the paper and designed the research with advice from KL, HP, and JF. RJ led the writing of the manuscript with guidance from KL and HP, and inputs from MB, JF, JA, JH, and CN. RJ, CC-G, BG, JF, and S-KN analyzed the data. All co-authors reviewed and approved the final MS.

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CONFLICT OF INTEREST
Authors declare they have no competing financial interests for this study, although several authors are current or former employees of TNC.

DATA AVAILABILITY STATEMENT
Data were retrieved directly from Web of Science (publicly available), and total staff numbers at TNC were supplied by TNC. Ethics Exemption was received by University of Queensland.

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