The Gender Gap: Women as Authors and Leaders in International Publications in Fisheries Science

Brooke E Penaluna[a] **and Ivan Arismendi**[b], [a]U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Corvallis, OR, United States; [b]Department of Fisheries, Wildlife, and Conservation Sciences, Oregon State University, Corvallis, OR, United States

This article was reviewed for the Encyclopedia of Inland Waters, Second Edition by Section Editors Catherine Febria and Gail Krantzberg.

Glossary

Gender gap Is the difference between or among genders owing to gender. In this case, the gender gap incorporates differences in citations and first authorship for women compared to men.
Gender Is a person's internal sense of being a woman, a man, some combination of man and woman, or neither man nor woman, including a range of identities and expressions. Gender is distinct from a person's assigned sex at birth and is often independent of physical or secondary sexual characteristics.
Impact gap Is the difference in the significant effect between or among groups. In this case, the impact gap is the difference between impact of women versus men across their citations in 18 fisheries journals, especially as it relates to a scientist's reach within and beyond their field by influencing management, policy, or society.
Impact Is used to describe researchers having a significant or major effect within and beyond their field by influencing management, policy, or society.
Minoritized individuals Are defined as being of the minority by a dominant group in society, most often white, cisgender, heterosexual men.
Productivity gap Is the difference in productivity levels between or among groups. In this case, the productivity gap is the difference between productivity of women and men in publications in 18 fisheries journals.
Productivity Is the effectiveness of productive efforts (output per unit of input) leading to results and benefits.
Sexism Is prejudice, stereotyping, or discrimination against a person on the basis of their perceived sex; or behavior, conditions, or attitudes that foster stereotypes of social roles based on sex.

Introduction

Productivity and impact continue to be important qualities to evaluate a successful science career, especially as they relate to a scientist's reach beyond their field by influencing management, policy, or society. Productivity and impact are traditionally measured by the number of articles published, especially in the prestigious position as lead author (Sekercioglu, 2008; West et al., 2013), and the number of times each article is cited by others (Franck, 1999; Biagioli, 2003; Bornmann and Daniel, 2008), respectively. However, gender imbalance between men and women in science has been a widely recognized issue for decades, with women having shorter careers and higher dropout rates (Blickenstaff, 2005) leading to an overall reduced productivity and impact (Huang et al., 2020).

Globally, for every article with a woman first author, there are nearly two (1.93) articles first-authored by men in science (Larivière et al., 2013). Differences in the sustainability of women's careers is proposed to explain these numbers (Huang et al., 2020). Reasons for such gender imbalance are deeply rooted in social, cultural, and legal norms, owing to differences in family responsibilities, work absences, resource allocation, isolation, sexism, racism, workplace culture, lack of women leaders, and gender stereotypes. Indeed, the gender gap is a paradox, as the inclusion of women and diverse people leads to more productive (Horta, 2013) and innovative teams (Østergaard et al., 2011) that produce high-impact research (Freeman and Huang, 2015), yet they are not consistently included. Consequently, understanding productivity and impact by gender and other identities is important for identifying continued barriers to inclusion and advancement of minoritized individuals, but also because these metrics provide the foundation of the current reward system.

The science of management and conservation of inland waters (i.e., fisheries, aquaculture, and aquatic science communities) has broadly affirmed the importance of diversifying its workforce, including gender diversity (Arismendi and Penaluna, 2016; Abernethy et al., 2020; Gopal et al., 2020). These efforts raised awareness of the need for competitive advantages and innovation, expressly as the field faces unprecedented challenges from complex human-environmental issues related to inland waters. Specifically, diversity is part of what makes people who they are (Batavia et al., 2020), and the science of inland waters depends on people. For example, women make up half of the fisheries workforce and play a prominent role in fisheries and aquaculture economies around the world, including in small-scale fisheries, yet women are unrecognized in official statistics, policies, and development programs (Gopal et al., 2020). As sciences of inland waters are called to diversify, demographic information related to productivity and impact will also increasingly be relied upon to inform decisions about equality, advancement, and the status of women.

If there is a shift in fisheries of inland waters to include more women and in leadership roles, especially women of color, we predict a paradigm shift toward the infusion of new ideas, which could only improve the management and conservation of inland waters. For example, women represent around 30% of the professional workforce in fisheries science across federal and academic positions in the United States, which is 20% less than expected if considering the pool of qualified talent (Arismendi and Penaluna, 2016). The number is even lower for women in in the professional workforce in leadership positions such as full professor, where representation is around 15%. In addition to career level, a gender gap has been noted in fisheries science, including in the representation of women authoring the most-cited articles in the field (up to 21% of most-cited articles had female representation: Branch and Linnell, 2016) and holding influential positions in academic collaboration networks (Arismendi et al., 2021). To understand why these discrepancies exist for women, we raise a critical question: what is the current state of productivity and impact of women in fisheries science? And what can be done to close the gender gap in the field?

To address this need, we conducted a bibliometric analysis of 15 years of publications in international English-language journals with a focus on freshwater fisheries science, which is a key part of managing and conserving inland waters. One of the main goals of this research was to extract basic information about lead author and number of citations from primary research, and to assign binary gender to author names to understand the effect this factor on productivity and impact in fisheries science. Doing so will help us to understand disparities between women and men involved in fisheries science publications beyond the most-cited fisheries references (Branch and Linnell, 2016). We were unable to quantify gender diversity beyond the male-female dichotomy, which does not represent the full range of gender identities, owing to the lack of available data on nonbinary and gender-nonconforming fisheries researchers. Drawing on the large body of diversity scholarship outside of fisheries, we discuss the challenges of including women in fisheries science, the risks of not including them, and long-standing problems of success related to productivity and impact.

Overview of recent fisheries science literature and gender assignment

Our focus on authorship information limited our analysis to the publishing careers of scientists, and consequently does not capture aspects of teaching, administration, mentoring, or government-related research activities. For example, women in academia have been shown to spend a disproportionate time on "invisible" work, which leaves less time for them to work on tenure and promotion (Social Sciences Feminist Network Research Interest Group, 2017). We extracted authorship information of published articles from the Web of Science database (WoS) focusing on 18 fish-related journals (Mather et al., 2008; Table 1) between 2006 and 2020 (WoS uploaded electronic information of complete first names, when available, starting in 2006). Although the Web of Science does not index the entire journal literature in fisheries sciences, it provides a reliable sample of citations comparable to broader citation indexing services such as Scopus (Archambault et al., 2009). As our study was comparative in nature, complete citation counts were not required. We included all regular publications (those identified as "*articles*" in WoS) and considered "*articles*" and "*reviews*" from specialized journals that focused on reviews, including *Fish and Fisheries*, *Reviews in Fish Biology and Fisheries*, and *Reviews in Fisheries Science and Aquaculture*.

From each article published between 2006 and 2020, we extracted the following fields: journal, WoS accession number (unique identifier), year of publication, names of authors (surname and first name), and the number of citations (up to 15 January 2021). Although gender includes a range of identities and expressions, we are only able to assign gender as female or male based on first names using the genderizeR package (Wais, 2016) in R statistical software (R Core Team, 2017) and GenderAPI (https://gender-api.com/). These tools assign the probability of a first name being female or male based on large database of names (>6 million). We validated this gender assignment procedure using the membership list of the American Fisheries Society, AFS (pers. comm. Eva Przygodzki, 2015). We used 6542 AFS members who voluntarily provided demographic information including surname, first name, and gender. We tested our gender assignment procedure using the AFS names and then contrasted the degree of agreement between the predicted gender from this procedure and the actual gender for AFS members. Our procedure identified the actual gender in 97.6% of the cases ($n = 6542$) for men ($n = 4925$) and 96.8% from women ($n = 1617$), although there is gender diversity that we were unable to capture, which we discuss in more detail in the discussion.

The year that each journal included in our analysis was founded ranged from 1872 (*Transactions of the American Fisheries Society*) to 2000 (*Fish and Fisheries*; Table 1) and the journal impact factor ranged between 1.04 (*Fishery Bulletin*) and 6.79 (*Fish and Fisheries*). Half of the 18 journals were founded by professional societies or other organizations. We tested the association between the age of the journal and the proportion of women lead authors using a simple Pearson's correlation analysis. We performed a similar

Table 1 Journal information, including year founded, impact factor, society/organization that the journal is associated with, number of articles used in analyses, and % of articles used in the analyses for 18 journals included in our analyses.

Journal Name	*Year Founded*	*Impact Factor (2019)*	*Society/Organization*	*Number of articles (2006–2020)*	*% of articles with lead author gender assigned*
Aquaculture	1972	3.23		8662	79%
Canadian Journal of Fisheries and Aquatic Sciences	1901	2.85	Natural Research Council, Canada	2693	92%
Ichthyology and Herpetology	1913	1.16	The American Society of Ichthyologists and Herpetologists	1197	95%
Ecology of Freshwater Fish	1992	1.95		936	65%
Environmental Biology of Fishes	1976	1.52		1964	90%
Fish and Fisheries	2000	6.79		645	96%
Fisheries	1976	2.70	American Fisheries Society	474	92%
Fisheries Management and Ecology	1994	1.73		789	18%
Fisheries Oceanography	1992	2.20	The International Journal of the Japanese Society of Fisheries Oceanography	635	81%
Fisheries Research	1981	2.15		3449	82%
Fisheries Science	1932	1.17	The Japanese Society of Fisheries Science	1929	93%
Fishery Bulletin	1881	1.04	U.S. Dept. of Commerce, NOAA	575	92%
Journal of Fish Biology	1969	1.50	The Fisheries Society of the British Isles	4447	16%
Journal of Fish Diseases	1978	2.32		1845	20%
North American Journal of Fisheries Management	1981	1.49	American Fisheries Society	1686	94%
Reviews in Fish Biology and Fisheries	1991	4.40		568	86%
Reviews in Fisheries Science and Aquaculture	1993	3.76		362	87%
Transactions of the American Fisheries Society	1872	1.44	American Fisheries Society	1841	91%

analysis between the journal impact and the proportion of women lead authors. Lastly, we used a simple Mann-Whitney rank sum test and a Yates continuity correction to compare the median of article citations (one time or more) by binary gender. Similarly, we used a Kolmogorov-Smirnov Test (K-S Test) to compare the overall distribution of citations by binary gender.

Representation of women in publications of fisheries science

We were able to extract 34,697 articles between 2006 and 2020 from WoS. Some articles were excluded from our gender analysis because first names were incomplete (3.8%) or not provided (24%). Some journals have not adopted the use of a full first name in the article and some people intentionally use initials, resulting in our inability to assign gender. Thus, our gender analysis is based on 24,857 articles. Collectively, these articles have been cited 411,116 times (as of 01/15/2021). These articles represent a total effort from 157,024 individuals.

During the past decade and a half, around 30% of the fisheries articles published in fisheries science journals were led by women, whereas men led approximately 70% (Fig. 1). However, lead authorship by gender varies by journal, with women leading more articles in the *Journal of Fish Disease* (46%) and leading the fewest in the *North American Journal of Fisheries Management* (19%; Fig. 2). Pearson's correlation analysis showed that the proportion of women lead authors was not associated with the age of the journal (P-value = .79) or its impact factor (P-value = .85). Journals from publishing companies had slightly higher participation of women as lead author (33%) compared to journals associated with professional societies or organizations (27%). Similarly, 30% of total citations of woman-led articles were from publishing companies, relative to 25% from professional societies or organizations.

The proportion of articles with single authorship was higher for men (5%) than for women (2%) across fisheries journals. However, women lead authors include the same relative number of coauthors on their articles (3–6 coauthors) as those led by men (Fig. 3). Citations for articles by gender vary by journal, with woman lead authors being cited most in *Reviews in Fish Biology and Fisheries* (34%) and the least in *Reviews in Fisheries Science and Aquaculture* (14%; Fig. 4). Overall, women are undercited relative to the proportion of articles that they lead, except for *Reviews in Fish Biology and Fisheries* and *Ichthyology and Herpetology*(Fig. 5).

Articles published across these 18 fisheries science journals had an average of 11.8 citations per article. There were statistically significant ($T = 72{,}113{,}635$; $N_1 = 6667$; $N_2 = 15{,}450$; P-value $< .001$) differences between the number of times that articles with a

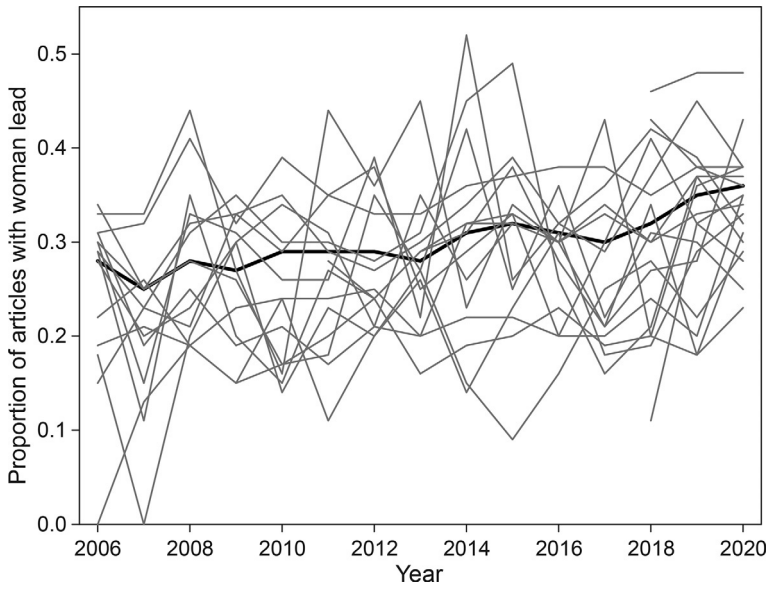

Fig. 1 Proportion of articles with woman lead over time from 2006 to 2020. Each gray line represents a single fisheries journal and the black line is the mean.

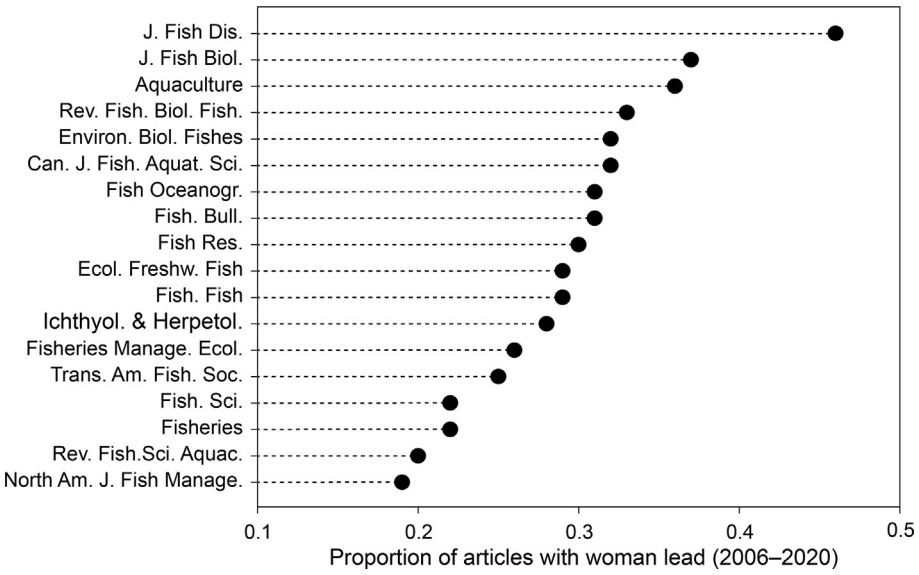

Fig. 2 Proportion of articles with woman lead by journal from 2006 to 2020.

woman lead author were cited versus a man lead author (Fig. 6). Similarly, only 10.6% of articles led by men authors had no citations compared to 12% of articles led by women authors. In general, the proportion of highly cited papers (30 or more citations) was dominated by men lead authors, as is shown by the different citation distributions by gender ($D = 0.027$; P-value $<.05$). More articles led by men authors (0.8%) had >100 citations compared to articles led by women authors (0.6%).

Identifying the gender gap for the management and conservation of inland waters

To advance women in science, the gender gap has been proposed as a 'productivity gap' (e.g., Abramo et al., 2009). We suggest that the productivity gender gap is not affecting women in fisheries science, at least superficially, because women publish in fisheries as lead author proportionate to their presence in the fisheries science community (~30%; Arismendi and Penaluna, 2016). The fact that women are keeping up in productivity is remarkable considering the barriers and biases that they face in their careers, including interactions with editors and peer reviewers (Bornmann et al., 2011). Similarly, research output of Spanish postdoctoral scientists shows no differences in publications by gender (Borrego et al., 2008). This is mirrored by results of professors in universities in the

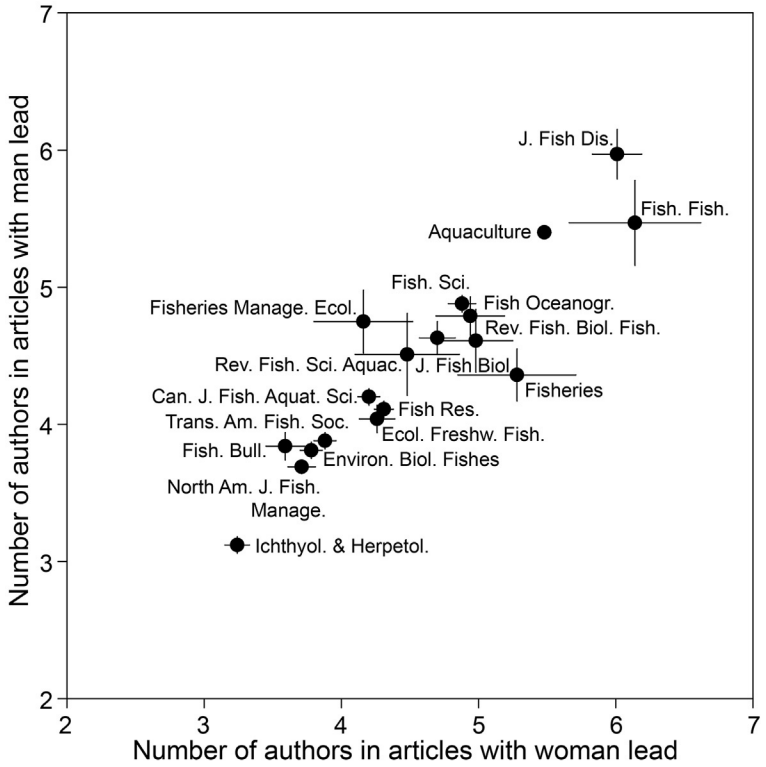

Fig. 3 Relationship between mean number of authors in articles with woman lead and mean number of authors in articles with man lead across 18 journals from 2006 to 2020. Each point represents the mean values for a journal with standard error.

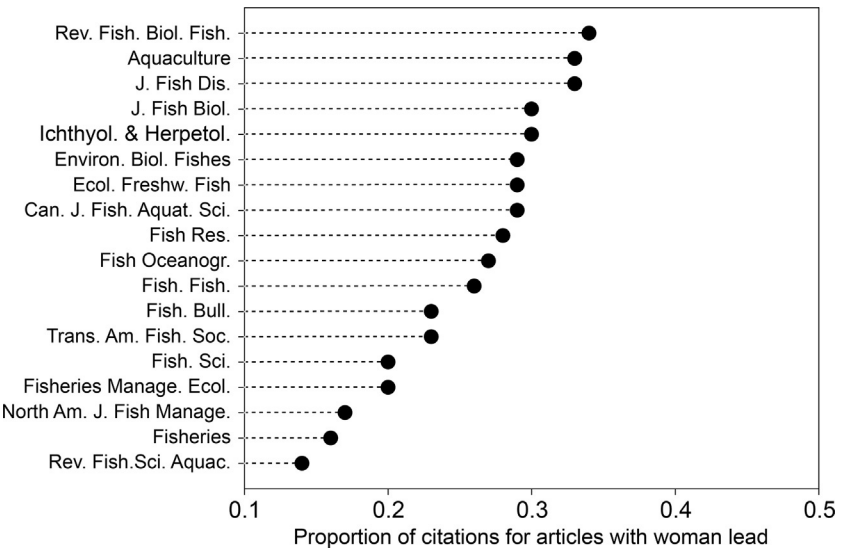

Fig. 4 Proportion of citations for articles with woman lead by journal from 2006 to 2020.

province of Quebec, Canada, where there are no differences in productivity between men and women until age 38, when women receive less funding, have fewer publications, and have less impact compared to men (Larivière et al., 2011). If women in fisheries are producing research at the same level as men, then the fisheries science community may consider improving the recruiting and retention of women in fisheries positions to achieve gender parity, in addition to addressing social, cultural, and legal aspects that contribute to the gender gap.

Women in fisheries have low numbers of citations relative to their productivity, suggesting that there is an 'impact gap' in fisheries, in addition to issues of recruitment and retention, rather than a 'productivity gap'. As impact incorporates the major effect

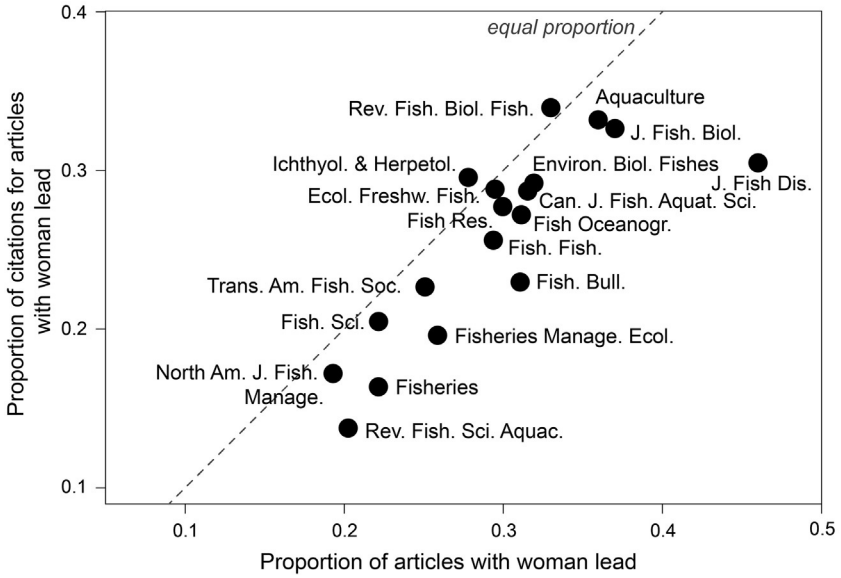

Fig. 5 Relationship between proportion of articles with woman lead and proportion of citations for articles with woman lead by journal from 2006 to 2020. Dotted line shows 1:1 relationship.

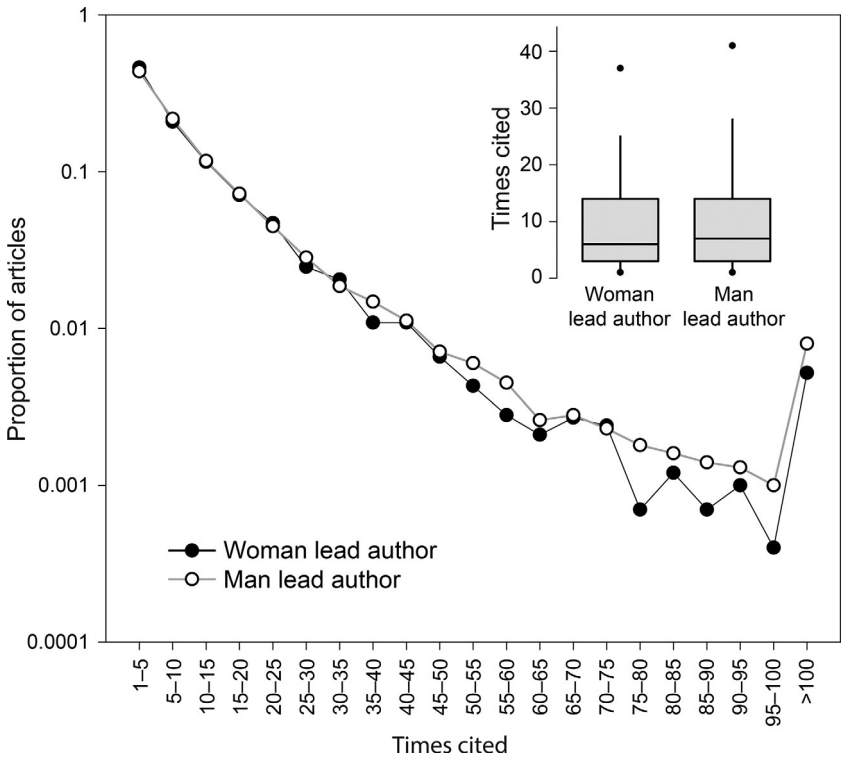

Fig. 6 Proportion of articles with woman lead author relative to man lead authors over time from 2006 to 2020. Inset shows number of times that articles are cited for articles led by women relative to those led by men.

of a person and their work both in their field and beyond by influencing management, policy, or society, our findings suggest that the reach of women is not as far as that of men. The challenges of impact for women fisheries scientists reflects the broader societal challenges that women face to both serve and be viewed as leaders. For example, the 'Matilda effect', a bias against acknowledging the achievements of women scientists whose work is attributed to their male colleagues, has been an ongoing problem for women for centuries (Rossiter, 1993). When considering co-authorship roles, women contribute to science by performing the experimental work disproportionately more often than men (Macaluso et al., 2016), and even when women are lead authors, they are less likely

to be the corresponding author, as demonstrated by Fox et al. (2016) for the journal *Functional Ecology*. When looking at impact, the most-cited fisheries articles come from men, with only 21% of most-cited articles including women coauthors (Branch and Linnell, 2016). We also show that articles that are highly cited are disproportionately led by men. Collaboration networks from top women researchers in the US fisheries science academic network show that top-ranked women have smaller networks than men, but their roles in the network are influential to the structure of the network (Arismendi et al., 2021). Collectively, we suggest that women are devalued relative to men, which makes it difficult to reach high-status or high-impact positions in their careers.

The value system in science could shift to broadly include metrics of justice, equity, diversity, and inclusion instead of continuing the perpetuation of citations and impact factors (Davies et al., 2021). This would help us to reimagine the fisheries science workforce as a collection of paths that change and adapt to the needs of the individual with a foundation of mentoring, which may also increase job satisfaction. For example, mentoring relates to more than a two-fold increase in job satisfaction for fish biologists in the USDA Forest Service (Penaluna et al., 2020). By broadening the value and rewards system in science, we would also add value to career pathways or duties that are not focused on publishing, including managers, private industry and policy makers, and it would make more visible work related to mentoring, relationships, and communication. If there were to be a shift in our scientific value systems, then inland fisheries science professionals would be additionally valued for contributions that influence aspects of mentorship, diversity, and well-being.

Single authorship was minimal for both women and men in fisheries, suggesting that fisheries science is inherently interdisciplinary, but the productivity and impact of women in fisheries varied by journal. In the journal *Fisheries*, there were some binary gender differences during the review process; articles led by women were published less often than expected by chance, suggesting bias (Handley et al., 2015). Overall, women publish less in journals associated with professional societies and organizations suggesting that women probably are less comfortable in those spaces and/or there is bias in the review process. We suggest that journal editorial teams should look for ways to increase the number of submissions and improve participation of women in their journals. They may strategically solicit and incentivize submissions by women, include women and people of color on their editorial boards, publish who is part of their editorial boards on their website, offer double-blind reviews, and require reviewers to check an agreement box that their reviewer comments will not be disrespectful or discriminatory.

The true gender diversity of fisheries science professionals includes people beyond the male-female dichotomy, such as nonbinary and gender-nonconforming individuals who identify as both male and female at one time, as different genders at different times, as no gender at all, or dispute the very idea of only two genders (Richards et al., 2016). For example, the prevalence of nonbinary genders was 1.8% in natal men and 4.1% of natal women in two separate data sets in one study (Van Caenegem et al., 2015) or as high as 35% in another study asking participants about their gender (Joel et al., 2013). The marginalization that transgender or nonbinary scientists face extends to the lack of information that we have about them related to their identities, professional roles, and successes in science. The victimization and stress from discrimination that these people face can be even higher than for women (Richards et al., 2016). Societal and institutional changes may be warranted to start quantifying the prevalence of nonbinary fisheries science researchers, including attention to safety and inclusion.

Although our study focuses on one dimension of social identity, there are additional barriers and specific challenges that people with multiple identities face, including able-bodiedness, race/ethnicity, age, class, country of origin, religion, or sexual orientation that could be explored. The interconnected nature of social identities leads to overlapping and interdependent systems of discrimination and disadvantage. Crenshaw (1989) posits that considering only one dimension of someone's being distorts the multidimensionality of their experience limiting our understanding of the issue, and rather by considering such intersectionalities the dynamics are more appropriately understood. If more information about social identities is known about people involved in inland waters, then a deeper understanding of who we are and how many lives are touched worldwide is possible.

Talented women have been and are leaders and role models in inland waters, including fisheries and aquaculture (Murphy et al., 2020; Zatkos et al., 2020). They continue to inspire new generations of women and girls to enter the field, or other fields of science. If we want women to be making high-level decisions about the management and conservation of inland fisheries, then we may invite them to the table where those decisions are being made and show that we value their experiences, ideas, and expertise.

Conclusions

The status of women in fisheries science publications brings attention to the broad problems that still exist globally, from low representation of women at all career levels, but especially in leadership roles, to discrimination and lack of access that affects career opportunities. To design science so that it represents everyone, we need to include women in conversations and in making decisions. Consequently, the fisheries science community may want to recruit women into fisheries positions, and particularly leadership, and put practices in place to retain them. Putting women in leadership roles is a first step in addressing gender inequalities in fisheries as it may also be important to rectify social, cultural, and legal issues more broadly. Women, like all people, are interested in being heard, and a key part of that is to accept and validate women's experiences, ideas, and expertise (Crandall et al., 2021). Consequently, it is increasingly important for researchers to devote time to issues that affect women in fisheries, to be better prepared to meet the ever-growing challenges facing society, and the management and conservation of inland waters. Binary genders do not represent the complete diversity of fisheries investigators. Accordingly, to understand more deeply about the complete diversity of genders in fisheries science, we need to create support systems and cultures of inclusion to recruit and retain people with diverse gender identities.

Knowledge gaps

- To address gender issues, or any diversity issue, information and data must be collected by asking individuals directly for information, and more than the English-speaking world may be considered. There is an information gap related to intersectional identities of people, including gender, race/ethnicity, sexual orientation, age, career/job, disability, and marital status (this may be particularly important for women who have small-scale fisheries).
- Additional information about people involved in inland waters would provide the opportunity for a deeper understanding of how many lives/sectors inland waters touches globally. For example, are there differences in representation of people if they are from countries in the Northern Hemisphere versus the Southern Hemisphere?
- To more deeply understand gender identities in fisheries and aquaculture, one would (a) have to recognize the legacy of oppression that affects nonbinary and gender nonconforming communities and (b) need more information than someone's name and presumed gender. Increasingly, as younger researchers enter the profession, names may not necessarily reflect a binary gender (e.g., Avery, Taylor, Skyler, McKenzie, Teal). Additionally, to capture racially, ethnically, and nationally diverse researchers whose names derive from many languages, a much larger database of first names is needed.
- Gender-diverse scientists need better protections against discrimination and harassment before we can expect them to publicly self-report. First steps can include offering a write-in option for gender and by offering non-gendered options for titles/honorifics such as Mx.
- With the information that is obtained from WoS, we are unable to determine whether women are not submitting articles to certain journals, or whether they remove their submission or are rejected during the review process. This type of information could be collected by journals and would offer insights to minimize bias during the publication process.
- We found that women publish less in journals associated with professional societies and organizations suggesting that women probably are less comfortable in those spaces, but that relationship should be evaluated more explicitly.

Acknowledgments

We thank Catherine Febria, Gail Krantzberg, Lee Cerveny, Farallon Broughton, and Kathryn Ronnenberg for their comments on the manuscript. Kathryn Ronnenberg also edited figures.

References

Abernethy EF, Arismendi I, Boegehold AG, et al. (2020) Diverse, equitable, and inclusive scientific societies: Progress and opportunities in the Society for Freshwater Science. *Freshwater Science* 39: 363–376.

Abramo G, D'Angelo C, and Caprasecca A (2009) Gender differences in research productivity: A bibliometric analysis of the Italian academic system. *Scientometrics* 79(3): 517–539.

Archambault E, Campbell D, Gingras Y, and Larivière V (2009) Comparing bibliometric statistics obtained from the web of science and Scopus. *Journal of the American Society for Information Technology* 60: 1320–1326.

Arismendi I and Penaluna BE (2016) Examining diversity inequities in fisheries science: A call to action. *BioScience* 66(7): 584–591.

Arismendi I, McLaughlin KR, and Penaluna BE (2021) The US academic fisheries co-authorship network in the era of diversity and inclusion. *Fisheries* 46: 372–382.

Batavia C, Penaluna BE, Lemberger TR, and Nelson MP (2020) Considering the case for diversity in natural resources. *BioScience* 70: 708–718.

Biagioli M (2003) Rights or Rewards? Changing frameworks of scientific authorship. In: Biagioli M and Galison P (eds.) *Scientific Authorship: Credit and Intellectual Property in Science*, pp. 253–279. New York: Routledge.

Blickenstaff JC (2005) Women and science careers: Leaky pipeline or gender filter? *Gender and Education* 17(4): 369–386.

Bornmann L and Daniel HD (2008) Selecting manuscripts for a high-impact journal through peer review: A citation analysis of communications that were accepted by Angewandte Chemie International Edition, or rejected but published elsewhere. *Journal of the American Society for Information Science and Technology* 59: 1841–1852.

Bornmann L, Mutz R, Marx W, et al. (2011) A multilevel modelling approach to investigating the predictive validity of editorial decisions: Do the editors of a high profile journal select manuscripts that are highly cited after publication? *Journal of the Royal Statistical Society* 174: 857–879.

Borrego A, Barrios M, Villaroya A, et al. (2008) Research output of Spanish postdoctoral scientist: Does gender matter? In: Kretschmer H and Havemann F (eds.) *Fourth International Conference on Webometrics, Informetrics and Scientometrics & Ninth COLLNET Meeting. Berlin, Germany.* http://creativecommons.org/licenses/by/2.0/.

Branch TA and Linnell AE (2016) What makes some fisheries references highly cited? *Fish and Fisheries* 17: 1094–1133.

Crandall C, Baumann J, Cooney P, et al. (2021) How to be an ally to women in fisheries science. *Fisheries* 10: 140–144.

Crenshaw K (1989) *Demarginalizing the Intersection of Race and Sex: A Black Feminist Critique of Antidiscrimination Doctrine, Feminist Theory and Antiracist Politics*. University of Chicago Legal Forum139.

Davies S, Putnam H, Ainsworth T, et al. (2021) Promoting inclusive metrics of success and impact to dismantle a discriminatory reward system in science. *PLoS Biology* 19(6), e3001282.

Fox CW, Paine CET, and Sauterey B (2016) Citations increase with manuscript length, author number, and references cited in ecology journals. *Ecology and Evolution* 6: 7717–7726. https://doi.org/10.1002/ece3.2505.

Franck G (1999) Scientific communication–a vanity fair? *Science* 286: 53–55.

Freeman RB and Huang W (2015) Collaborating with people like me: Ethnic coauthorship within the United States. *Journal of Labor Economics* 33: S289–S318.

Gopal N, Hapke HM, Kusakabe K, et al. (2020) Expanding the horizons for women in fisheries and aquaculture. *Gender, Technology and Development* 24(1): 1–9. https://doi.org/10.1080/09718524.2020.1736353.

Handley G, Frantz CM, Kocovsky PM, et al. (2015) An examination of gender differences in the American Fisheries Society peer-review process. *Fisheries* 40(9): 442–451. https://doi.org/10.1080/03632415.2015.1059824.

Horta H (2013) Deepening our understanding of academic inbreeding effects on research information exchange and scientific output: New insights for academic based research. *Higher Education* 65: 487–510.

Huang J, Gates AJ, Sinatra R, and Barabási AL (2020) Historical comparison of gender inequality in scientific careers across countries and disciplines. *Proceedings of the National Academy of Sciences of the United States of America* 117: 4609–4616.
Joel D, Tarrasch R, Berman Z, et al. (2013) Queering gender: Studying gender identity in 'normative' individuals. *Psychology & Sexuality* 5: 291–321.
Larivière V, Vignola-Gagné E, Villeneuve C, et al. (2011) Sex differences in research funding, productivity and impact: An analysis of Québec university professors. *Scientometrics* 87(3): 483–498.
Larivière V, Ni C, Gingras Y, et al. (2013) Bibliometrics: Global gender disparities in science. *Nature* 504: 211.
Macaluso B, Larivière V, Sugimoto T, and Sugimoto CR (2016) Is science built on the shoulders of women? A study of gender differences in contributorship. *Academic Medicine* 91(8): 1136–1142.
Mather ME, Parrish DL, and Dettmers JM (2008) Mapping the changing landscape of fish-related journals: Setting a course for successful communication of scientific information. *Fisheries* 33(9): 444–453.
Murphy CA, Zatkos L, Antonelli K, et al. (2020) Mothers of fishes. *Fisheries* 45: 369–376. https://doi.org/10.1002/fsh.10485.
Østergaard CR, Timmermans B, and Kristinsson K (2011) Does a different view create something new? The effect of employee diversity on innovation. *Research Policy* 40: 500–509.
Penaluna BE, Shively D, Roper BB, Cerveny LK, Witt S, and Rothlisberger JD (2020) Mentoring relates to job satisfaction for fish biologists: A longitudinal study of the USDA Forest Service. *Fisheries* 45(12): 656–663.
R Core Team (2017) *R: A Language and Environment for Statistical Computing*. R Foundation for Statistical Computing. https://www.R-project.org/.
Richards C, Bouman WP, Seal L, et al. (2016) Non-binary or genderqueer genders. *International Review of Psychiatry* 28(1): 95–102.
Rossiter MW (1993) The Matthew Matilda effect in science. *Social Studies of Science* 23(2): 325–341.
Sekercioglu CH (2008) Quantifying coauthor contributions. *Science* 322: 371.
Social Sciences Feminist Network Research Interest Group (2017) The burden of invisible work in academia: Social inequalities and time use in five university departments. *Humboldt Journal of Social Relations* 39: 228–245.
Van Caenegem E, Wierckx K, Elaut E, et al. (2015) Prevalence of gender nonconformity in Flanders, Belgium. *Archives of Sexual Behavior* 44(5): 1281–1287.
Wais K (2016) Gender prediction methods based on first names with genderizeR. *R Journal* 8(1): 17.
West JD, Jacquet J, and King MM (2013) The role of gender in scholarly authorship. *PLoS One* 8(7), e66212.
Zatkos L, Murphy CA, Pollock A, et al. (2020) Dr. Emmeline Moore, all things to all fishes. *Fisheries* 45(8): 435–443.

Further Reading

Perez CC (2019) *Invisible Women: Exposing Data Bias in a World Designed for Men*. New York: Abrams Press, 436.
Saini A (2017) *Inferior: How Science Got Women Wrong and the New Research That's Rewriting the Story*. Boston, MA: Beacon Press, 215.

Relevant Websites

https://hutton.fisheries.org/—American Fisheries Society's Hutton Junior Fisheries Biology Program.
https://diversity.fisheries.org/—American Fisheries Society's Diversity, Equity, and Inclusion in Fisheries
https://freshwater-science.org/awards-programs/instars-program—Society of Freshwater Science's Instars and Emerge Diversity and Mentoring Programs
https://www.mianpo.org/—Minorities in Aquaculture
http://kuahawaii.org/—Kua'āina Ulu 'Auamo (KUA)