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Editorial

Analysis of author gender in *TPB*, 1991–2018

With increasing awareness that women in science have often been underrecognized for their research, a variety of efforts have sought to recover and highlight past contributions of female scientists, including in *TPB*-related fields (e.g. Wellenreuther and Otto, 2016; Bronstein and Bolnick, 2018). A recent commentary turns the focus of one such effort specifically to *Theoretical Population Biology*, providing important recognition to the role of female programmers in *TPB* papers from 1970 to 1990 (Dung et al., 2019).

Writing in *Genetics*, Dung et al. observed that authors of early papers in *TPB* frequently acknowledged computer programmers for assistance. Among the programmers for whom they were able to assign a gender, they found that 43.2% were female, a substantially larger fraction than the 7.4% of gender-identifiable *TPB* authors in the same period who were female.

Based on the text acknowledging the programmers, Dung et al. commented that many of the tasks performed by programmers involved significant contributions, including development of statistical algorithms, programming of simulations, and sophisticated numerical analyses—roles that would likely result in authorship under current practice. Some of the programmers appear in acknowledgments of multiple papers, having contributed to a body of work in *TPB* reported over a period of several years.

With acknowledged programmers having had roles less apparent than those of authors, Dung et al. found that more contributions were made by women in the early years of *TPB* than is evident from the more visible metric of the fraction of female authorships. They note that female programmers were acknowledged in well-known early *TPB* papers, for example "Mrs. M. Wu" – Margaret Wu – in the influential article of Watterson (1975).

The analysis of Dung et al. (2019) ends in 1990, as the number of acknowledged programmers declined toward the end of the 1970–1990 period they examined. Dung et al. suggest that programming responsibilities increasingly shifted to graduate students, postdocs, and faculty credited as authors; it is also possible that under changing authorship practices, programmers performing tasks similar in magnitude to those completed by acknowledged programmers in the 1970s were more frequently credited with co-authorship toward the end of the period.

1. An analysis gender and authorship in *TPB*: 1991–2018

The commentary of Dung et al. (2019) on gender and early contributions to *TPB* provides an occasion to examine gender and authorship in *TPB* in recent years. To build upon their results, we sought to analyze the extent to which the journal has since advanced in representing the work of women. We therefore evaluated the proportion of female authors in the subsequent period, 1991–2018.

Factors cited as contributing to a continuing pattern of underrepresentation of women in scientific authorship metrics fall primarily into two main categories: (1) demographic delay, an age structure of the research community that continues to have lower female representation at more advanced and productive career stages, as a consequence of the relative recency of the entry of large numbers of women into scientific careers (e.g. Hargens and Long, 2002; Marschke et al., 2007); and (2) systematic bias, an accumulation of biases that negatively impact female researchers at various stages of career advancement in a "glass obstacle course" or "leaky pipeline," with an ultimate effect on measures such as publication (e.g. De Welde and Laursen, 2011; Lariviere et al., 2013; Grogan, 2019). Our purpose here is to generate data on gender and authorship in the journal as a step toward understanding factors that affect current authorship and toward promoting equal representation. To place the results into context, we compare female authorship in *TPB* to results for adjacent fields, assessing how the *TPB* female authorship fraction might reflect broader trends in the scholarly areas that the journal covers. Without seeking to disentangle the effects of factors such as demographic delay and systematic bias on *TPB* specifically, we hope that this report can provide a small contribution on a complex problem, augment the work of Dung et al. (2019) in describing underrepresentation of women in the journal, and set a baseline for future assessments.

2. Methods

The analysis focuses on three features of authorship in *TPB*: (1) the overall female authorship fraction, that is, the number of female authors divided by the total number of authors; (2) the temporal trend in the female authorship fraction; and (3) the female authorship fraction for different positions in sequential author lists.

Following Dung et al. (2019), we placed authors in binary gender categories using a similar manual approach. With fewer authors identified only by initials in the more recent period, and with recent authors having a greater internet presence than early *TPB* authors, we were able to make gender determinations for nearly all authors (Supplementary Table 1). We omitted three unassigned authorships from author counts that involved gender, treated them as missing in author order analyses, and counted their associated papers as having one fewer author in calculations tabulating papers with at least one female author. We considered

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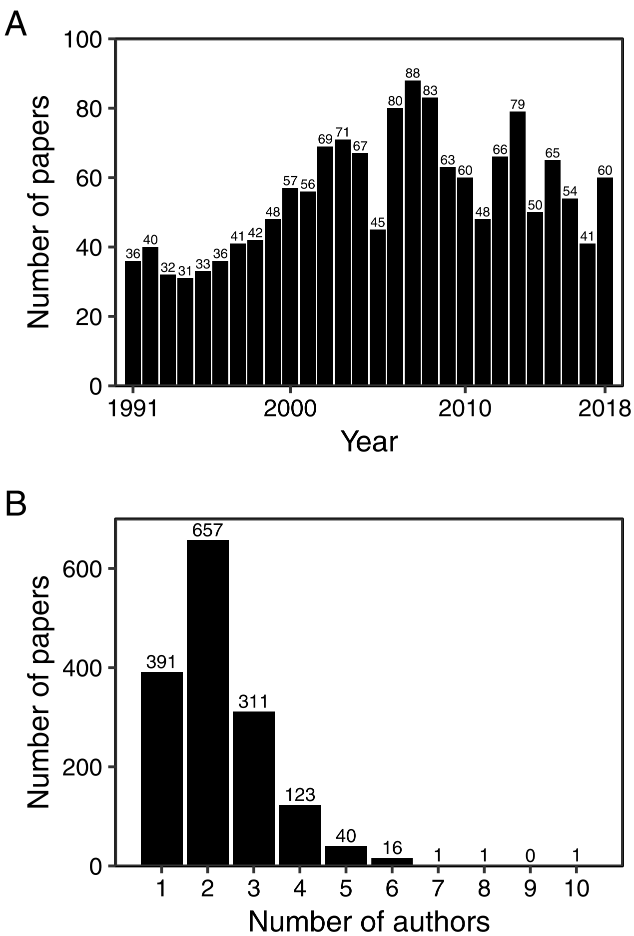

Fig. 1. Number of *TPB* papers and number of authors per *TPB* paper, 1991–2018. (A) Number of papers. (B) Numbers of papers with specific numbers of authors.

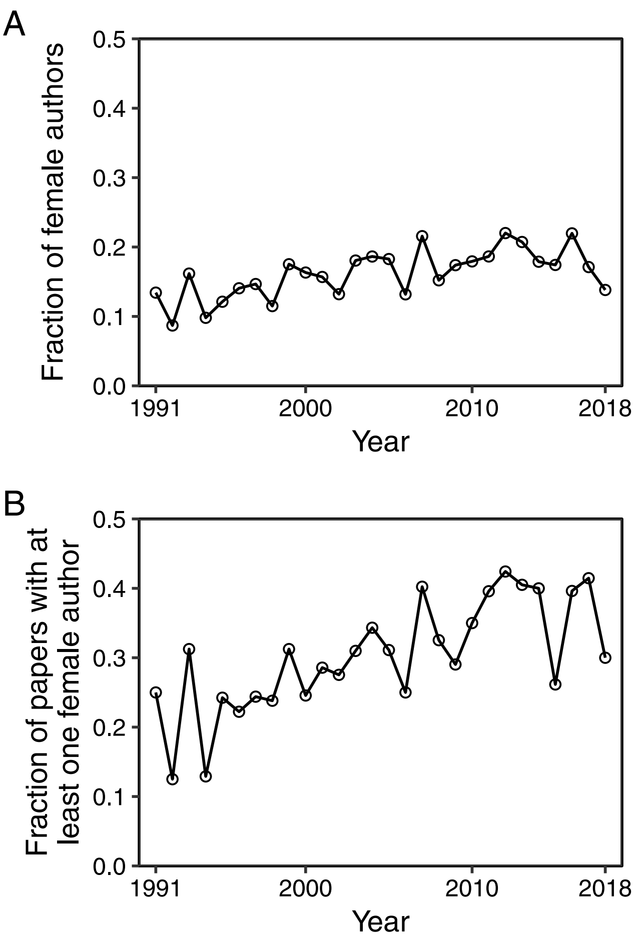

Fig. 2. Temporal trend in female authorships in *TPB*, 1991–2018. (A) Female authorship fraction: the fraction of authorships assigned as female. A linear regression gives $y = -5.20 + 0.0027x$ ($P = 2.73\times10^{-4}$, $R^2 = 0.40$). (B) Fraction of papers with at least one female author. The linear regression line is $y = -13.78 + 0.0070x$ ($P = 1.16\times10^{-5}$, $R^2 = 0.53$).

all signed contributions, including book reviews, editorials, introductions to special issues, and biographical commentaries; such categories account for ∼3% of *TPB* contributions during 1991–2018, and omitting them has minimal impact on the results (not shown).

Owing to the relatively small volume of the journal, for some analyses, we binned data from multiple years, separating the 28-year period into four periods of length seven years each.

3. Results

Fig. 1A shows the number of papers in each year of the period examined. The total number of papers was 1541, averaging 55.0 per year. In Fig. 1B, we plot the distribution of the number of authors per paper. Counting each author of each paper, the total number of authorships was 3451, for a mean of 2.24 authors per paper. Binning years into seven-year periods, this mean increased over time, from 1.85 during 1991–1997 to 2.48 during 2012–2018. The largest number of authors across all papers was 10.

The fraction of authorships assigned as female from 1991–2018 was 16.8%, greater than the 7.4% seen by Dung et al. for 1970–1990. This fraction increased over the period, from 12.8% for 1991–1997 to 18.8% for 2012–2018 (Fig. 2A), with linear regression slope 0.27% per year ($P = 2.73\times10^{-4}$). The fraction of papers with at least one female author also increased over the period. This fraction, which equaled 31.3% considering the whole 28-year period, was 21.7% for 1991–1997 and 37.1% for 2012–2018 (Fig. 2B), with linear regression slope 0.70% per year ($P = 1.16\times10^{-5}$). Note, however, that the increase in this fraction is partly due to an increase in the number of authors per paper over the period.

Let q denote the female authorship fraction. Let f_i denote the fraction of papers with i authors, $i = 1, 2, \ldots, i_{max}$, noting $i_{max} = 10$. Assuming that the number of female authors on a paper is independent of the total number of authors, the expected fraction of papers with at least one female author is equal to

$$\sum_{i=1}^{i_{max}} f_i \left[1-(1-q)^i\right]. \tag{1}$$

Applying Eq. (1) with $q = 16.8\%$ for 1991–2018, the expected fraction of papers with at least one female author is 32.5%, slightly greater than the observed value of 31.3%. Fixing the distribution of the number of authors across 1541 papers to that seen in Fig. 1B, we obtained an empirical null distribution of the fraction of papers with at least one female author by performing 1000 random assignments to papers of the 580 female authors. The observed fraction 0.313 of papers with at least one female author is generally slightly smaller than in the random assignments ($P = 0.007$).

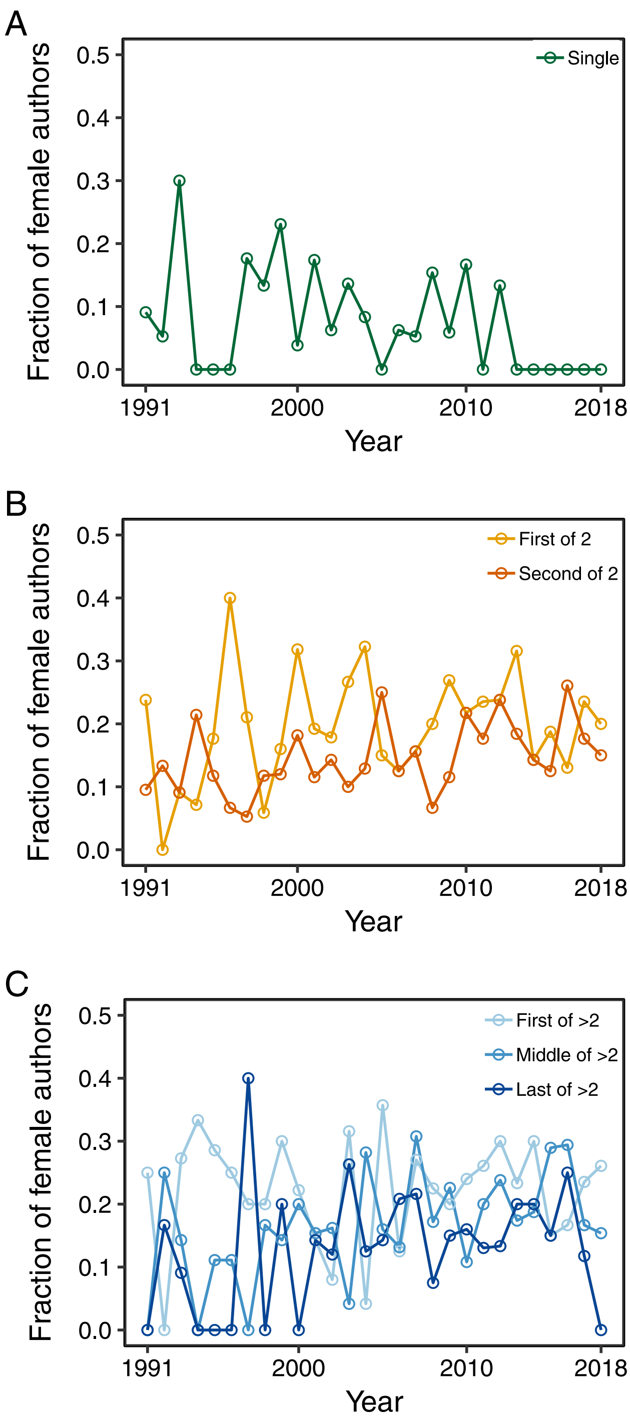

Fig. 3. Female authorship fraction in *TPB* by position in the author list, 1991–2018. (A) Among single-author papers, the fraction of female authors. (B) Among first authors and second authors of two-author papers, the fraction of female authors. (C) Among first, middle, and last authors of papers with three or more authors, the fraction of female authors.

That the number of papers with at least one female author is lower than expected is likely explained by a paucity of single-author papers by women. Separating authors by authorship position, we analyzed female authorship for papers with different numbers of authors. Among single-author papers during 1991–2018, the fraction of female-authored papers was 8.2% (Fig. 3A), substantially lower than the overall female authorship fraction of 16.8% ($P = 5.51 \times 10^{-7}$, one-tailed binomial test).

For two-author papers, the female authorship fraction of 20.1% is higher for first authors than the value of 14.5% for second authors (Fig. 3B). For papers with three or more authors, the female authorship fraction of 19.0% is intermediate for middle authors, and the fraction of 21.9% for first authors exceeds the fraction of 14.4% for last authors (Fig. 3C).

We next examined trends by considering, among all authorships, the fractions representing female single authors, first and second authors in two-author papers, and first, middle, and last authors in papers with three or more authors (Table 1). We see that although female authorships are increasing in both positions in two-author papers (Fig. 3B), the increase in female authorships over time seen in Fig. 2A reflects, to a greater extent, increasingly many papers with three or more authors and increases in the female authorship fraction for middle and last authors on such papers.

4. Comparisons to related fields

TPB reports mathematical contributions to demography, ecology, epidemiology, evolution, and genetics. Comparing female authorship in *TPB* to related fields can assist in understanding broader dynamics, providing context, and suggesting factors that affect authorship demographics and that are potentially relevant for mechanisms to increase representation of women.

Analyzing published articles indexed in JSTOR with algorithmic topic and gender assignments, West et al. (2013) estimated the fraction of female authorships for the period 1990–2011 in various fields. This assessment produced estimates of 10.64% in *Mathematics*, 22.76% in *Ecology and Evolution*, and 41.90% in *Demography* (West et al., 2013, Table 1). For comparison, the *TPB* fraction of female authorships during 1991–2011 was 15.97%. This value suggests that female authorship in *TPB* has been intermediate between fields adjacent to the content of the journal: greater than in mathematics, but lower than in associated biological domains. We next investigate this result in more detail by a closer examination of authorship trends separately within *Mathematics* and *Biology*.

4.1. Mathematics

Brisbin and Whitcher (2018) performed a detailed analysis of female authorship in mathematical subfields, examining thousands of preprints posted from 1995–2014 in arXiv. Their data used algorithmic gender assignments and subfield assignments submitted by authors. As they found that subfields varied considerably in female authorship, we examined *TPB* in relation to relevant mathematical subfields.

Six mathematical subfield categories that are among the most frequently used in theoretical population biology include *Analysis of PDEs*, *Classical Analysis and ODEs*, *Combinatorics*, *Dynamical Systems*, *Probability*, and *Statistics Theory*. According to Brisbin and Whitcher (2018, Table 7), *Analysis of PDEs*, *Combinatorics*, and *Statistics Theory* have more female authorships than expected given the overall fraction of female authors in the dataset; *Classical Analysis and ODEs* and *Dynamical Systems* have comparable fractions to the expectation; and *Probability* has a smaller fraction than expected. Because three of the subfields have above-average female authorship and only one is below average, it is possible that above-average female authorship in mathematical subfields employed in *TPB* partially accounts for the greater number of female authorships in *TPB* compared to mathematics in general.

Table 1
Change in female authorship in *TPB* from 1991–1997 to 2012–2018.

	Fraction of authors of a given authorship class who are female (%)		Fraction of all authors who are in a given authorship class (%)		Fraction of all authors who are both female authors and in a given authorship class (%)	
	1991–1997	2012–2018	1991–1997	2012–2018	1991–1997	2012–2018
Single authors	8.25	2.82	21.09	6.91	1.74	0.19
First authors of 2	17.86	20.79	24.35	17.32	4.35	3.60
Second authors of 2	10.71	17.98	24.35	17.32	2.61	3.12
First authors of >2	22.50	23.49	8.70	16.15	1.96	3.80
Middle authors of >2	10.17	21.64	12.83	26.17	1.30	5.65
Last authors of >2	10.00	15.06	8.70	16.15	0.87	2.43

The fractions of authors within specified authorship classes who are female appear in Fig. 3A–C. The fractions of all authors who are both female authors and authors in specified authorship classes appear in Figure S1.

Note that Brisbin and Whitcher (2018) and West et al. (2013), with their different data sources, time intervals, and topic classification methods, possibly disagree about the placement of the female authorship fraction in *Probability* in relation to that of *Mathematics*. West et al. (2013) had calculated a female authorship fraction for *Probability and Statistics*, an area that overlaps two of the categories of Brisbin and Whitcher (2018) – *Probability*, with lower female representation, and *Statistics Theory*, with higher female representation – at 18.11%, greater than the value of 10.64% for the whole of *Mathematics*. A third analysis, focused on preprints in 2016 (Holman et al., 2018, Table S2), also places *Probability* among mathematical subfields with higher female representation. It is thus possible that published work in *Probability*, the one of six most *TPB*-relevant subfields with below-average female representation according to Brisbin and Whitcher (2018), might not have as low a female authorship fraction as observed in their preprint data, or might have low female representation counteracted by greater representation in statistical subfields. Mathematical topics in *TPB* would then draw primarily from subfields with average or above-average female authorship. Comparison of topic assignment methods and an analysis of mathematical areas appearing in *TPB* are needed for assessing this claim.

Mihaljevic-Brandt et al. (2016) examined the temporal trend in female authorship, using algorithmic gender assignments and published articles in mathematics from zbMATH. Accounting for uncertain gender assignments, for 1991–1995, the estimated fraction of female authorships was 5%–9%, increasing to 9%–15% by 2014 (Mihaljevic-Brandt et al., 2016, Figure 1). The increase in female authorships in this dataset is comparable to that seen from 12.8% in 1991–1997 to 18.8% for 2012–2018 in *TPB*, for a rate of 0.3% per year between the middle years of these seven-year windows.

Mihaljevic-Brandt et al. (2016) also examined, at the level of individual researchers, the fraction of individual contributions that appeared in single-author papers. Irrespective of the length of publication record, they found that women reported a smaller fraction of their research in single-authored papers, 29%, compared to 38% for men. West et al. (2013) had also seen that across many scholarly fields, the fraction of single-authored papers with a female author was less than the overall female authorship fraction. These results align with the observation in *TPB* that the fraction of single-author papers with female authorship (8.2%) was lower than the female authorship fraction in general (16.8%).

4.2. Biology

Bronstein and Bolnick (2018) reported on female authorship in the *American Naturalist*, a journal overlapping in scope with *TPB* in ecology and evolution, but with a lower proportion of studies involving mathematics. Using manual gender assignment, they evaluated the fraction of articles for which at least one of the gender-discernible authors was female, finding that this value increased from 29.2% during 1995 to 66.2% during 2015 (Bronstein and Bolnick, 2018, Figure 1). These numbers exceed corresponding values of 23.1% and 37.4% for *TPB* during the periods 1993–1997 and 2013–2017, respectively. As the difference could reflect more authors per paper in *American Naturalist* compared to *TPB*, we can also compare first authors. The estimated fraction of *American Naturalist* articles with female first authors was 20.5% for a sample of articles during 1991–1995 and 37.1% during 2011–2015. By contrast, fractions of female first authors in *TPB* were lower: 12.8% for 1991–1995 and 20.5% for 2011–2015.

Bonham and Stefan (2017) performed an analysis of female authorship in biology, comparing computational biology to biology as a whole. This analysis, which used automated gender inference and PubMed papers from 1997–2014 in most analyses, found that papers with a PubMed *Computational Biology* classification had a lower female authorship fraction than *Biology* papers (Bonham and Stefan, 2017, Figure 1B). In one analysis, the female authorship fraction in both fields increased from 2004 to 2015, from ∼27% to ∼31% for *Computational Biology* and from ∼32% to ∼36% for *Biology*.

When Bonham and Stefan (2017) examined 149 specific journals, most of 21 computational biology journals, as classified by the appearance of *Bioinformatics*, *Computational*, *Computer*, *System(s)*, or *omic(s)* in the title, had relatively low female authorship fractions, with *Journal of Computational Biology* (20.6%), *IEEE/ACM Transactions on Computational Biology and Bioinformatics* (21.3%), and *Bioinformatics* (21.5%) having the three lowest values (Bonham and Stefan, 2017, Figure 2). For the period 1997–2014, the corresponding fraction for TPB was 17.3%. Note that the journal list of Bonham and Stefan (2017) did not include *American Naturalist* or *TPB*; it did include several related journals, such as *Journal of Theoretical Biology* (23.3%), *Evolution* (25.7%), *Proceedings of the Royal Society of London B: Biological Sciences* (26.3%), *Genetics* (27.3%), *Molecular Biology and Evolution* (27.4%), *Molecular Ecology* (30.0%), and *BMC Evolutionary Biology* (30.4%), all below the median across journals of 34.7%.

A study by Fox et al. (2018) examined 152 journals in ecology and evolution from 2010–2015 with automated gender assignment, finding a 28.9% female authorship fraction, below the median of Bonham and Stefan (2017) despite focusing on a later period. The reduced female representation for evolution journals in Bonham and Stefan (2017) and the comparable female authorship fraction for ecology in Fox et al. (2018) accord with the observation of West et al. (2013) of a larger female authorship fraction for the field of *Molecular and Cell Biology* (29.25%) than for *Ecology and Evolution* (22.76%) during 1990–2011. Thus, it is possible that *TPB* draws not only on mathematical subfields with above-average female authorship, but also on biological fields with below-average female authorship.

Bonham and Stefan (2017) performed analyses of arXiv papers indexed in the *Quantitative Biology* and *Computer Science* categories. This analysis found that during 2007–2014, the fraction of algorithmically assigned female authorships in *Quantitative Biology* preprints varied from 17%–21%, and in *Computer Science* ranged around 15%–18% (Bonham and Stefan, 2017, Figure 3B). The corresponding fraction for *TPB* for 2007–2014 was 18.9%, comparable to that seen in the *Quantitative Biology* preprints.

Holman et al. (2018), analyzing both arXiv and published papers with automated gender assignment, found a similar position for arXiv *Quantitative Biology* papers, above *Computer Science*, *Statistics*, and *Mathematics*, but well below *Biology*, and below *Computational Biology* and *Bioinformatics*. They split *Quantitative Biology* by subcategory, finding 22.5% female authorship for *Populations and Evolution* in 2016 (Holman et al., 2018, Figure S4). For *TPB*, the 2016 female authorship fraction was 21.5%.

To measure the change in female authorship fraction over time, Holman et al. (2018, Figure 1) estimated across many fields the absolute increase in the female authorship fraction from 1998–2002 to 2016, obtaining 0.005 for this quantity (0.5%). *Mathematics*, *Quantitative Biology*, *Bioinformatics*, and *Biology* were near the average, at 0.4–0.6%, *Computer Science* and *Statistics* were at 0–0.1%, and *Computational Biology* was at ∼0.9%. The rate for the arXiv *Populations and Evolution* category was ∼0.6% for 1998–2016. The *TPB* increase for this period from 14.8% to 17.6% gives a rate of 0.2%, considering 5-year windows centered on 1998 and 2016. Note that the increase for mathematics, based on arXiv preprints, exceeds that seen by Mihaljevic-Brandt et al. (2016) using zbMATH published papers.

For authorship position, in ecology, Fox et al. (2018, Figure 1B) found that the fraction of papers with female first authors exceeded the overall female authorship fraction, which in turn exceeded the fraction of single-author papers with a female author and the fraction of last authors of multi-authored papers who were female. In *Biology* in general, Bonham and Stefan (2017, Table 1) found that the fraction of first authors who were female exceeded the corresponding fraction for last authors, with the value for middle authors lying intermediate. West et al. (2013, Figure 3) had obtained somewhat comparable results, separating middle authors by numerical position. For *Computational Biology*, the pattern was similar, except that the fraction of middle authors who were female slightly exceeded the fraction for first authors (Bonham and Stefan, 2017, Table 1). This pattern, with a highest fraction in middle positions (21.0% for second, 19.6% for second-to-last, and 26.5% for other middle authors), followed by first (18.4%) and then last position (14.8%), was accentuated in *Quantitative Biology* preprints. *TPB* shares the same general pattern of higher female authorship fractions in the first (21.9%) and middle positions (19.0%) than in the last position (14.4%), with the greatest fraction for the first position. Note that Bonham and Stefan (2017) included single-author papers, treated as having a first author and no other author, and two-author papers, treated as having no middle authors, so that differences in distribution of the number of authors per paper across fields could influence relative values of the female authorship fraction across positions.

4.3. Summary of comparisons

Analyses of female authorship in various disciplines have used different sets of papers, subfield classifications, time intervals, methods of assigning gender, fractions of unassigned authorships, and treatments of papers with different numbers of authors. Although these differences make definitive comparisons difficult, the literature on gender and authorship gives rise to a view in which *TPB* has an overall fraction of female authorships greater than in *Mathematics* and *Computer Science*, but lower than in *Biology*. Subfields of mathematics most relevant to *TPB* have generally greater female authorship fractions compared to mathematics in general, and its adjacent areas of *Ecology and Evolution* and *Computational Biology* in turn have lower female authorship fractions than other areas of biology. The fraction of female authorships in *TPB* is comparable to that of *Quantitative Biology*, a subfield at the lowest level of female authorship across all fields of biology. The lower fraction of *TPB* single-author papers whose authors are female accords with results in *Mathematics* and *Ecology*, and the higher female authorship fractions in first and middle positions compared to last positions accord with similar results for *Computational Biology* and *Quantitative Biology*. *TPB* has witnessed an increase in female authorships over time, with a rate that lies within the range of increases seen for various related fields, though notably lower than that of the *American Naturalist*.

5. Conclusions

We have observed that the current fraction of female authorships, 18.8% for 2012–2018, exceeds the 7.4% identified by Dung et al. (2019) for 1970–1990, and that the trajectory continues to show a modest upward trend. We have also found that the fraction of female authors in *TPB*, the pattern of female authorship by position in author lists, and temporal trends in female authorship generally reflect patterns in adjacent disciplines.

We note that the areas of population biology covered by *TPB* possess tools capable of advancing scientific studies that can potentially explain results in authorship dynamics (e.g. Shaw and Stanton, 2012; Thomas et al., 2015; Clifton et al., 2019). For example, the "leaky pipeline" perspective for reduced female career progression at multiple stages can be viewed as a demographic life-stage transition model. This setting considers a stage-structured population, with career stages representing the life stages, with beginnings and ends of scientific careers analogous to births and deaths, and with biases against female researchers analogous to differential life-stage transition probabilities. *TPB*-style determination of the parameters driving population phenomena and of the effects of modulating them thus has potential to augment other perspectives for modeling career dynamics and gender patterns in authorship (e.g. Petersen et al., 2012; Fortunato et al., 2018) and for identifying opportunities for impactful intervention.

We hope to promote discussion of authorship representation and equity in science in relation to *TPB*. We are grateful to Dung et al. (2019) for enriching the understanding of the history of the journal and its contributors, and we share with them a view that reporting on authorship trends is informative for increasing knowledge of current patterns and advancing potential for equal representation.

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Appendix A. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.tpb.2019.04.001.

References

Bonham, K.S., Stefan, M.L., 2017. Women are underrepresented in computational biology: an analysis of the scholarly literature in biology, computer science and computational biology. PLoS Comput. Biol. 13, e1005134.

Brisbin, A., Whitcher, U., 2018. Women's representation in mathematics subfields: evidence from the arXiv. Math. Intell. 40, 39–49.

Bronstein, J.L., Bolnick, D.I., 2018. Her joyous enthusiasm for her life-work...: early women authors in The American Naturalist. Am. Nat. 192, 655–663.

Clifton, S.M., Hill, K., Karamchandani, A.J., Autry, E.A., McMahon, P., Sun, G., 2019. Mathematical model of gender bias and homophily in professional hierarchies. Chaos 29, 023135.

De Welde, K., Laursen, S.L., 2011. The glass obstacle course: informal and formal barriers for women Ph.D. students in STEM fields. Int. J. Gender Sci. Technol. 3, 571–595.

Dung, S.K., López, A., Barragan, E.L., Reyes, R.-J., Thu, R., Castellanos, E., Catalan, F., Huerta-Sánchez, E., Rohlfs, R.V., 2019. Illuminating women's hidden contributions to historical theoretical population genetics. Genetics 211, 363–366.

Fortunato, S., Bergstrom, C.T., Börner, K., Evans, J.A., Helbing, D., Milojevic, S., Petersen, A.M., Radicchi, F., Sinatra, R., Uzzi, B., Vespignani, A., Waltman, L., Wang, D., Barabási, A.-L., 2018. Science of science. Science 359, 107.

Fox, C.W., Ritchey, J.P., Paine, C.E.T., 2018. Patterns of authorship in ecology and evolution: first, last, and corresponding authorship vary with gender and geography. Ecol. Evol. 2018, 1–16.

Grogan, K.E., 2019. How the entire scientific community can confront gender bias in the workplace. Nature Ecol. Evol. 3, 3–6.

Hargens, L.L., Long, J.S., 2002. Demographic inertia and women's representation among faculty in higher education. J. Higher Educ. 73, 494–517.

Holman, L., Stuart-Fox, D., Hauser, C.E., 2018. The gender gap in science: how long until women are equally represented? PLoS Biol. 16, e2004956.

Lariviere, V., Ni, C., Gingras, Y., Cronin, B., Sugimoto, C.R., 2013. Global gender disparities in science. Nature 504, 211–213.

Marschke, R., Laursen, S., Nielsen, J.M., Rankin, P, 2007. Demographic inertia revisited: an immodest proposal to achieve equitable gender representation among faculty in higher education. J. Higher Educ. 78, 1–26.

Mihaljevic-Brandt, H., Santamaría, L., Tullney, M., 2016. The effect of gender in the publication patterns of mathematics. PLoS One 10, e0165367.

Petersen, A.M., Riccaboni, M., Stanley, H.E., Pammoli, F., 2012. Persistence and uncertainty in the academic career. Proc. Natl. Acad. Sci. 109, 5213–5218.

Shaw, A.K., Stanton, D.E., 2012. Leaks in the pipeline: separating demographic inertia from ongoing gender differences in academia. Proc. R. Soc. Lond. B 279, 3736–3741.

Thomas, N.R., Poole, D.J., Herbers, J.M., 2015. Gender in science and engineering faculties: demographic inertia revisited. PLoS One 10, e0139767.

Watterson, G.A., 1975. On the number of segregating sites in genetical models without recombination. Theoret. Popul. Biol. 7, 256–276.

Wellenreuther, M., Otto, S.P., 2016. Women in evolution — highlighting the changing face of evolutionary biology. Evol. Appl. 9, 3–16.

West, J.D., Jacquet, J., King, M.M., Correll, S.J., Bergstrom, C.T., 2013. The role of gender in scholarly authorship. PLoS One 8, e66212.

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