

# Is publication rate an equal opportunity metric?

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**Publication quantity is frequently used as a ranking metric for employment, promotion, and grant success, and is considered an unbiased metric for comparing applicants. However, research suggests that women publish fewer papers, such that the measure may not be equitable. We suggest reasons for the disparity, and potential future remedies. Publication quality and impact provide more equitable metrics of research performance and should be stressed above publication quantity.**

In the era of rankings, quantity is often stressed over quality or impact of publications. Quantity of publications has several benefits as a metric of success as it is easily measured, and many studies have shown that impact is correlated with productivity. Such parameterization of research quantity is generally considered an even playing field for comparing researchers within the same subject area. This relies on publication patterns being similar throughout a population with no systematic biases, assuming an equal opportunity for all researchers to conduct research and to have papers accepted for publication. If particular groups show systematic differences in publication rate, this could contribute to observed differences in promotion and grant success, and possibly loss of diversity in continuing academics. Furthermore, if funding models and grant agencies also rely on publication rate as well as or instead of impact, the effect will be compounded over time.

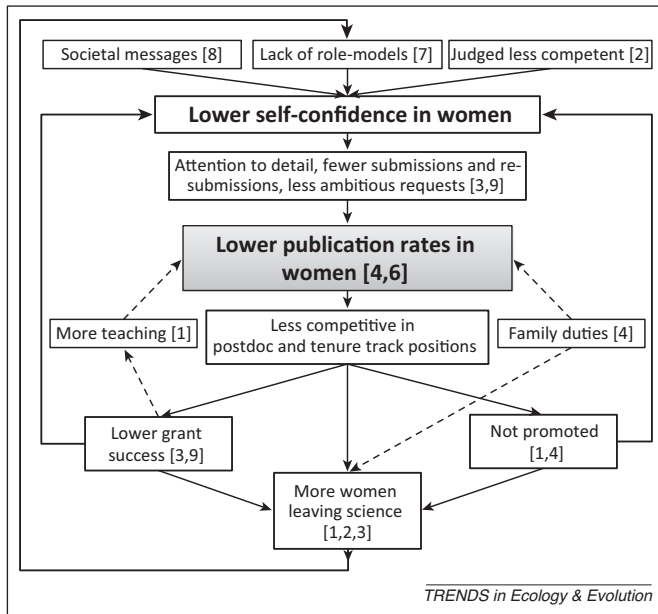
The increasing use of metrics occurs simultaneously with an increasing awareness that women are not progressing in science careers, despite the attraction of an increasing number of women into undergraduate programs [reviewed in 1,2], especially in fields like ecology [3]. The 'leaky pipeline' and 'glass ceiling' have both received considerable attention, with many attempts to identify the factors effecting decisions to leave academia. These are largely attributed to differences in family responsibilities [4], beginning with child birth when there is necessarily a greater female input, although some studies have shown that family-related variables have little impact [5]. Indeed, perpetuating the idea that an academic career is incompatible with raising a family may itself contribute to the attrition of women faculty [5]. Furthermore, this focus on maternal obligation, although contributing to the disparity, may cause us to dismiss other societal factors that

result in a loss of women to the sciences. Our experience, supported by research, suggests that other, less easily parameterized factors contribute substantially.

An increasing number of studies confirm that there are sex differences in publication patterns [4,6], which may lead to a systematic bias against women. Indeed, researchers have suggested that 'the careless application of metrics is likely to further reduce female participation in research' [1]. Most significantly, studies have shown that while publication rate is lower in women, citations can be higher, resulting in higher impact for a given publication rate [6]. Thus, in ecological terms, women may be following a relatively more K-selected strategy, and investing more effort into each individual manuscript. Concentrating mostly on publication rate rather than impact could contribute to observed patterns of lower grant success [3], slower promotion [1,4], and lower retention rates [1] for women. This is particularly pressing in ecology, where women exceed men at undergraduate levels but attrition rates with career progression are high [1]. Even if career absences, like those due to child rearing, are considered, women and men still demonstrate different publication strategies [4]. Furthermore, different expectations relating to other time demands, such as service on committees requiring female representation and higher teaching loads, probably contribute [1], but do not explain why publication rates deviate at an early career stage (e.g., [6]). While ways to address these differences may be looked at in the future, they currently exist, and should be considered in promotion and grant applications if women are to be retained in science.

Differences in publication rate may be driven by the manner in which women are assimilated into and experience the scientific community. For example, women are under-represented in ecology textbooks [7]. Women demonstrate less confidence in their own ideas, demonstrated by differences in types of articles and differences in authorship position (e.g., [3]), probably resulting from the societal assumption that women are less scientific [8]. This is confirmed by studies showing that women are judged as less competent with the same scientific productivity (e.g., [2]) reinforcing the societal message. These attitudes and messages impact self-confidence, which may change publication patterns and the experience of science [7,8]. Lower self-confidence is indicated by the sexual dimorphism in publication types, and supported by less ambitious funding requests [9] and perhaps moderate sexual dimorphism in self-citation rates [10]. We demonstrate in Figure 1 how we believe these factors may interact and escalate over the

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**Figure 1.** Inter-relationships between the experience of science, low scientific self-confidence, and low publication rates contributing to the attrition of women from academia.

course over an academic career, and contribute to decisions by women to leave academia.

Enhancing self confidence and expectations may be the single most significant step in encouraging and retaining women in science. In the interim, employers and funding

agencies should be aware that differences in publication rates exist and use more equal opportunity metrics, such as publication quality and impact.

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#### References

- O'Brien, K.R. and Hapgood, K.P. (2012) The academic jungle: ecosystem modelling reveals why women are driven out of research. *Oikos* 121, 999–1004
- Moss-Racusin, C.A. *et al.* (2012) Science faculty's subtle gender biases favor male students. *Proc. Nat. Acad. Sci. U.S.A.* 109, 16474–16479
- Martin, L.J. (2012) Where are the women in ecology? *Front. Ecol. Environ.* 10, 177–178
- McGuire, K.L. *et al.* (2012) Dramatic improvements and persistent challenges for women ecologists. *Bioscience* 62, 189–196
- Sax, L.J. *et al.* (2002) Faculty research productivity: exploring the role of gender and family-related factors. *Res. High. Educ.* 43, 423–446
- Symonds, M.R.E. *et al.* (2006) Gender differences in publication output: towards an unbiased metric of research performance. *PLoS ONE* 1, e127
- Damschen, E.I. *et al.* (2005) Visibility matters: increasing knowledge of women's contribution to ecology. *Front. Ecol. Environ.* 3, 212–219
- Barres, B.A. (2006) Does gender matter? *Nature* 442, 133–136
- Bedi, G. *et al.* (2012) Gender inequality in awarded research grants. *Lancet* 380, 474
- Hutson, S.R. (2006) Self-citation in archaeology: age, gender, prestige and the self. *J. Archaeol. Method Theory* 13, 1–18

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## Wisdom of the crowd and natural resource management

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**The 'wisdom of the crowd' approach suggests that independent estimates of natural resource sizes provided by resource users can be aggregated to approximate true stock sizes. If this hypothesis gains empirical support, an important contributor to sustainable natural resource management in data-poor situations has appeared on the horizon.**

Many of the world's marine commercial fisheries are in trouble, and although there are signs of recovery, lack of data about the states of many fisheries are of continued concern [1,2]. Improved information is particularly needed in the many freshwater and small-scale coastal fisheries where regular stock assessments are lacking resulting in

data-poor or even data-less situations (e.g., [2]). Most of the management in these fisheries is organized in co-management systems [3], where local fisher communities and associated managers are confronted with the difficult task of developing sustainable fisheries management in the absence of scientific data [2].

Reliance on local ecological knowledge constitutes an often-stressed approach to avoid overuse of natural resources in data-poor situations [2,3]. Nevertheless, and largely independent of the governance system in place, certain social contexts still promote people collectively organizing to overexploit resources rather than to sustain them [4]. There is thus much to learn about how to best organize stock assessments when managing a highly mobile and difficult to enumerate natural resource in data-poor situations. The challenge is particularly hard for