

Illuminating a Black Box of the Peer Review System: Demographics, Experiences, and Career Benefits of Associate Editors

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Abstract

Editors are often described as gatekeepers of scientific publishing, as they are responsible for maintaining journal standards, deciding what is published, and ultimately guiding discourse. Scientists who are journal editors gain career benefits, yet these are rarely described to early career researchers, much less how to prepare for such a role. Additionally, disparities at the editorial level could impact which scientists receive benefits of filling these roles. To better characterize the demographics and professional experiences of current associate editors, while also highlighting the benefits and potential challenges to this position, we conducted a survey of associate editors for the *Association for the Sciences of Limnology & Oceanography* society journals. Our results highlight potential demographic disparities present in the editorial pool, including that non-native English speaking editors assume the role after obtaining more experience serving as a peer reviewer than native English speaking editors. Our results also highlight several rewards along with challenging components of being an editor. We hope our results can inform early career researchers on steps they can take to prepare themselves for editorial

work, as well as provide strategies for scientific societies to minimize editorial board disparities.

Introduction

Peer review is foundational to modern scientific publication. Before scientific discoveries are disseminated in academic journals, they must pass through peer review. During this process, not only is the science scrutinized, including the scientific approach, data analysis, interpretation, and validity, but so too is the writing and presentation of the science. As part of peer review, journals have editorial boards that oversee the entire process and are responsible for the fate of submitted manuscripts. Because of the critical role that editorial boards play in deciding what is published, we examined the motivations and characteristics of board members to illuminate an often mysterious element of the peer review system.

Journal editorial boards typically consist of “editors” who serve in one of three main categories of roles. First, an Editor in Chief (EiC), who is typically a broadly trained scientist, is responsible for overseeing the editorial process and policies across the journal, managing other editorial staff, and making the ultimate editorial decisions on published content. Second, a managing editor, who is typically an expert in publishing rather than a

scientific field, often oversees the mechanics of manuscript submission, including monitoring the manuscript submission system, checking for formatting issues, and communicating with authors when there are specific issues to be resolved related to submission or, upon acceptance, publication. Finally, associate editors (AEs; also called subject-matter, senior, or handling editors), who are scientists with an established scientific track record, are responsible for selecting manuscript reviewers, evaluating the reviews, making recommendations for or against publication, and sometimes performing reviews themselves. Recommendations are typically passed on to the EiC who then makes the final decision based upon the recommendation of the AE. Because of the crucial role AEs play in the peer review process, they are often labeled as “gatekeepers,” and as such, an invitation to join a journal’s editorial board is considered an important career stepping-stone for many scholars (Haak 2002).

Despite the influence of AEs in publishing, their place in the peer-review system is not always obvious to researchers. This includes both early career researchers (ECRs) who have less experience with publishing, as well as experienced mid-career researchers who lack clarity about the tasks required of AEs (e.g., Saunders 2019), and whether it is something they are interested

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in pursuing in their own careers. This lack of knowledge prevents qualified researchers from making informed decisions about whether or not serving as an AE is something they should take on. When thinking about becoming an AE, scientists may ask themselves: will serving as an AE provide tangible career benefits? What are these benefits and do they outweigh the costs in terms of time that could be used for research, teaching, and writing? Do I want to be viewed as a gatekeeper, potentially alienating and upsetting other researchers in my field?

Even after a researcher decides they want to be an AE, understanding how to make their way into the role is often unclear. Often, the selection process for editorial boards is not transparent, and heavily reliant upon networking with current editors (Feldman 2008), masking from view the specific steps taken by AEs before acquiring the position. Such practices can prevent researchers from recognizing, and taking specific actions to position themselves for the role. Moreover, this network-based approach is likely to be influenced by implicit and explicit biases against researchers of particular genders, geographic locations, career positions, and ethnicities (among other things). Although the potential for gender and geographic biases in the peer review system are well-established (Helmer et al. 2017; Murray et al. 2018; Fox and Paine 2019), relatively fewer studies have investigated disparities on editorial board composition (but see Murray et al. 2018, Fox et al. 2019). Even less is known about the professional trajectories of AEs, particularly their publishing experiences before becoming editors (but see Metz et al. 2016).

Given the lack of clarity surrounding how scientists become AEs and their experiences, we examined three questions:

1. What experiences in research and publishing did AEs in the aquatic sciences have before joining an editorial board?
2. Does professional experience appear to intersect with identity (i.e., gender, country of origin, native language) to shape the pool of AEs for a family of society journals?
3. What are the self-reported costs and benefits of being an AE?

We conducted a survey of AEs for three society journals of the *Association for the*

Sciences of Limnology & Oceanography. We also provide a list of self-reported pros and cons of serving as an AE to highlight both the benefits and costs for researchers considering the role. Because of the critical role that AEs play (through influencing what is published), we also provide recommendations to editors and societies on ways to improve editorial training and to enhance diversity on their editorial boards.

Methods

We surveyed 103 AEs who were serving on the editorial boards of three ASLO journals as of January 2019: *Limnology and Oceanography*, *Limnology and Oceanography Letters*, and *Limnology and Oceanography Methods*. We asked three types of questions: (1) professional experience/demographics (which included position type, years post Ph.D., number of publications, and number of peer reviews before becoming an AE), (2) personal demographics (which included gender, native language, country of origin, etc.), and (3) perceptions of the most rewarding and challenging aspects of serving as an AE. To ensure confidentiality, we did not ask questions related to research field or country of residence. All questions were optional and the complete survey can be found at <https://doi.org/10.6084/m9.figshare.9553121>.

We compared the demographics of the AE population to mean ASLO membership data for 2018, which contained information on gender and country of residence. To compare native language of AEs to the broader membership pool, we then categorized each membership country as primarily English or non-English speaking using official language information. Mann–Whitney tests were performed in Graphpad Prism v.8 to determine any statistically significant differences between the distributions of male and female editors and native vs. non-native English speaking AEs. Specifically, we compared distributions of AEs for years post Ph.D., number of authorships, and number of peer reviews.

Results and discussion

Our response rate to the survey was 70% ($n = 72$). Although we do not suggest that this population represents all AEs across all journals in all fields, this is one of the few

surveys to examine motivations of AEs and compare editorial boards of society journals to the membership. Moreover, we also investigated peer review performance as a measure of AEs' experience with the publication system, while previous studies focused on authorship as the sole measure of productivity (e.g., Metz et al. 2016). Below we describe several themes related to our research questions that emerged from this data set and provide supporting evidence from other studies for our interpretations.

AEs are most often tenure-track faculty at research-focused institutions

The results of our survey revealed that when they first became an AE, 58% of respondents were tenured or in a tenure track position at a research-intensive university, whereas 17% were scientists at research institutions with little to no teaching expectations. A smaller number of AEs identified as tenure track faculty at a teaching-focused institution (7%), non-tenure track faculty at a university (3%), with even smaller numbers working as part of university administration or at non-profit organizations. When asked about their current positions, 67% responded that they are currently tenured/tenure track professors and only 8% are scientists at research institutions. Only 10% of respondents are currently scientists at government agencies. To the best of our knowledge, no studies have investigated the position type of AEs for aquatic science journals, and our results highlight how homogenous the AE pool is in terms of position type.

Some ECRs are AEs

We assessed research experience before becoming an AE, both in terms of years since earning a doctoral degree as well as experience with publishing, and found that many ECRs are AEs. Over half (58%) of respondents reported first becoming an AE within 10 years of earning their doctorate, and quite a few (13%) are still less than 10 years removed from their graduate work (Fig. 1A). This shows that although the majority of ASLO AEs (88%) are currently at least mid-career researchers (>10 years post Ph.D.), ECRs are key components of editorial boards for the society.

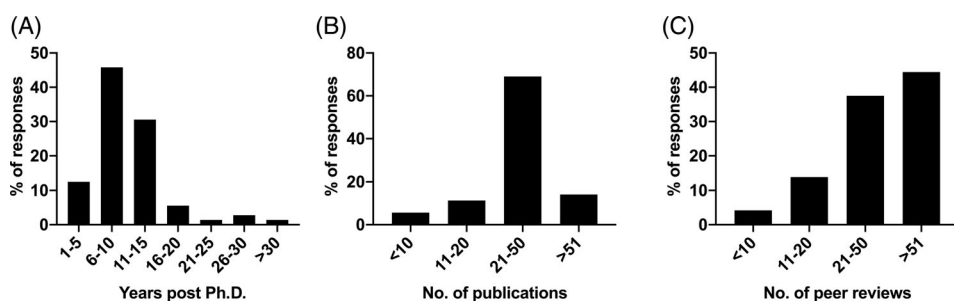


FIG. 1. Research and publishing experiences of AEs. (A) Years post Ph.D. at which respondents became an AE, (B) number of publications before serving as an AE, and (C) the number of peer reviews performed by AEs before appointment to an editorial board.

Given the representation of ECRs in the AE pool, it is perhaps surprising that a number of respondents explicitly stated that ECRs should not focus on becoming an AE until being more established in their careers (e.g., after receiving tenure). Others noted that while ECRs may have an interest in serving as an AE, these scientists should first consider other time commitments they may have, and not prioritize serving as an AE early on:

It is a truly rewarding experience, but make sure that it is the best place to spend your time, especially if you are still on the job market or just starting a new post (pre-tenure).

Conversely, similar numbers of AEs enthusiastically encouraged ECRs to work toward becoming AEs by actively seeking peer review opportunities. Many also noted that networking and communicating their interest in reviewing and editing to current journal editors would go a long way to ensure that ECRs get opportunities to review manuscripts:

Get lots of experience as a reviewer. Step up and let editors know you are available to review submissions. Be pro-active.

Together, these results indicate that although ECRs may not be traditionally viewed as appropriate AE candidates, early career AEs are not uncommon. Notably, several societies and society journals have recognized the unique perspectives of ECRs, and seek to develop their editorial talents through ECR advisory boards (e.g., American Institute of Physics APL Photonics Early Career Editorial Advisory

Board) and various editorial mentoring programs (e.g., ASLO's Raelyn Cole Editorial Fellowship and American Society of Plant Biologists Assistant Features Editor program). However, these types of initiatives remain rare.

AEs have substantial authorship and reviewing experience, regardless of career stage

The vast majority of AEs (83%) had co-authored >20 papers by the time they had started as an AE for any journal (Fig. 1B). A robust publication record is not the only thing characteristic of AEs. Many respondents (44%) served as a peer reviewer >50 times before becoming an AE, while 38% had performed 21–50 peer reviews (Fig. 1C). Notably, this work was also distributed across multiple journals as the vast majority of AEs (99%) served as a peer reviewer for more than six different journals, and 19% had served as a reviewer for >20 different journals. The majority of AEs (71%) had reviewed for the journal in which they began their AE career fewer than 10 times, suggesting that extensive peer reviewing experience for multiple journals, and not just a select few, may be essential to be recognized as a potential future AE. This is not surprising, given the networking approach traditionally used to build many editorial boards.

Gender and geographic diversity of ASLO AEs mirror the society

Despite reported gender disparities in scientific publishing, ASLO AE pools are approaching proportional gender representation: 46% of ASLO members are women

compared to 42% of survey respondents (Fig. 2A). Generally, editorial boards of academic journals do not display such gender parity (e.g., Dickersin et al. 1998; Cho et al. 2014; Metz et al. 2016). Helmer et al. (2017) reported a maximum of 35% female editorial composition in the *Frontiers* journal group (across all disciplines), while another study reported that for 10 different environmental biology and natural resource management journals only ~15% of editors were women (Cho et al. 2014). Among a subset of ecology journals, the proportion of female AEs has risen substantially in recent years, with current representation between 21% and 35%, depending upon the journal (Fox et al. 2019). Because there is some evidence that women may be less likely to accept an invitation to become an AE (Fox et al. 2019), the representation of female editors in our survey is even more striking.

While some journals strive to select AEs with the variety of expertise that is reflective of the society's scientific disciplines, they should also consider whether their editorial boards display broad geographic diversity (Feldman 2008). We found that 60% of AEs were originally from North America, 30% were from Europe, and only 10% of respondents are originally from Asia, Central/South America, the Middle East, and Oceania combined (note that our survey did not assess the current geographic location of AEs). In 2018, ASLO members represented 65 countries, with the majority (70%) from North America, 17% from Europe, and 14% from Asia, Central/South America, the Middle East, and Oceania. Thus, the current ASLO editorial boards overall appear to have similar representation as the society, particularly given that our sample size is relatively small. We also examined membership based on primary language: ASLO members affiliated with English speaking nations account for 72% of our members, which is similar to the proportion of AEs who indicated that English was their primary language (Fig. 2B).

Subtle gender disparities among AEs in terms of seniority and publishing experience

Although we did not observe any statistically significant differences between the career stages of male and female editors (self-

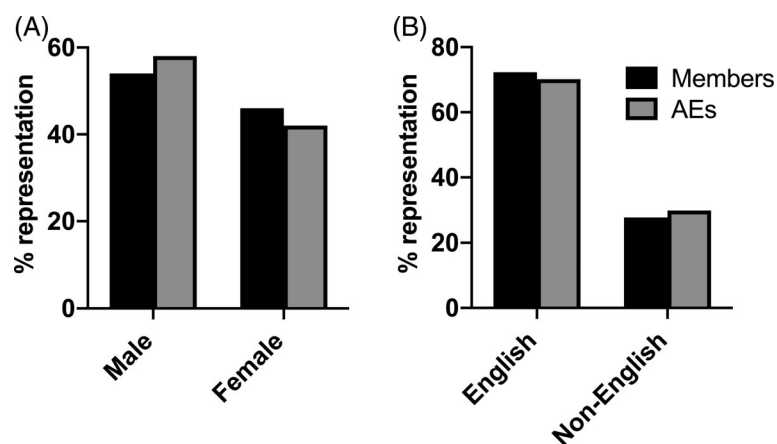


FIG. 2. ASLO society membership data compared to AE demographics. (A) Percentage of male and female scientists as part of ASLO (black bars) and AEs (gray bars), (B) percentage of ASLO members and AEs affiliated with native English speaking countries and non-native English speaking countries.

reported, with five individuals not reporting), we note several striking observations within our small sample size. Specially, males were more likely than females to become an AE earlier in their career (Fig. 3A) such that over three times as many male editors started within only 5 years of earning their Ph.D. compared to female editors (18%; $n = 7$ vs. 7%; $n = 2$, respectively). However, more females became editors between 5 and 10 years post Ph.D., meaning that, overall, similar proportions of men and women editors began as ECRs (63% of male AEs vs. 60% of female AEs; Fig. 2A).

No statistically significant differences were observed between males and females in terms of their authorships ($p = 0.15$) and peer review experiences ($p = 0.54$) overall, but there were notable differences in the distributions worth discussing. For instance, when starting as an AE, 73% ($n = 27$) of male respondents had published between 21 and 50 papers whereas only 64% ($n = 18$) of females had published to that degree (Fig. 3B). In addition, more female than male AEs had <20 publications when they became an AE (25% and 11%, respectively). We noted similar trends with regards to peer reviewing: a larger proportion of females than males served as a reviewer <20 times when starting as an AE (24% and 13%, respectively; Fig. 3C) Conversely, most male respondents have served as a reviewer >20 times before becoming an AE. Whether or not these female editors have published less than their male counterparts over the course of their entire careers is unknown, but our results mirror similar studies

demonstrating that women publish less (Larivière et al. 2013; West et al. 2013; Bendels et al. 2018; references in Cho et al. 2014), and that women are asked to serve as peer reviewers less often than men (Lerback and Hanson 2017), possibly due to homophobic tendencies of editors (Helmer et al. 2017, Fox et al. 2019).

Native language disparities exist in AE peer review experience

We also examined native language to investigate the impacts of geography and identity on editorial board composition. We found no clear differences between when native English speakers (70% of AE responses) and non-native English speakers became AEs ($p = 0.95$), despite a small number of non-native English speaking AEs who began the role much later in their careers (Fig. 4A). There were also no significant differences between English speaking and non-native English speaking AEs and their publication record ($p = 0.18$; Fig. 4B) although no non-native English speaking AEs assumed the role with fewer than 10 publications. This is in contrast to a small number of native English speaking AEs who began with fewer than 10 publications (Fig. 4B).

Native and non-native English speaking AEs did significantly differ in the number of peer reviews performed before becoming an AE ($p = 0.007$). Seventy percent of non-native English speaking AEs performed >50 peer reviews before becoming an AE, whereas only 32% of native English speakers had the same experience beforehand

(Fig. 4C). Only native English speaking AEs performed fewer than 10 peer reviews before starting an AE role.

In addition to established gender disparities in editorial board representation, other studies have shown that geographic disparities exist on editorial boards (which we also considered by asking AEs about their country of origin, see above). For instance, among ecology journals, the representation of scientists from low human development index (HDI) countries on editorial boards is an order of magnitude less than the representation of such scientists as authors in those same journals (Livingston et al. 2016). Despite growing scientific output by researchers from low HDI countries, the diversity (calculated as an inverse Simpson diversity index) of editorial boards among 24 environmental biology journals has remained consistent since the 1980s, with indices ranging from 3 to 5 (Espin et al. 2017). This is on par with results from our survey, which yielded a diversity index of 3.7 for ASLO journals. Improving geographic representation on editorial boards may also ensure that the science published is relevant to researchers beyond North America and Europe (Livingston et al. 2016; Espin et al. 2017). Because some regions, such as Central/South America and Eastern Europe, also display greater gender parity in authorships (Larivière et al. 2013), better inclusion of these regions in editorial boards may also naturally lead to future improved gender parity.

Being an AE is challenging, but rewarding, work

Serving as an AE is generally recognized as beneficial to researchers, most notably through increased visibility and prestige (Haak 2002), which might be especially important for the 70% of ASLO AEs who are tenure-track scientists. However, no respondents of our survey described “prestige” as a benefit of being an AE (Table 1). Rather, our survey revealed additional, intangible benefits of serving as an AE that are missing from this standard portrayal of editorship as a career “stepping stone” (Haak 2002, Fox et al. 2019). When asked to describe what they have learned or gained the most as an AE, two clear themes emerged: serving as an AE provides

TABLE 1. Rewards and challenges of serving as an AE

Rewards	Challenges
Better understanding of publication system	Locating qualified peer reviewers
Improved communication skills	Making difficult decisions on submissions
Greater perspective of science	Potentially heavy, unpredictable workload
Staying current in your discipline	Synthesizing conflicting peer reviews
Serving the greater scientific community	

(1) greater perspective on the publishing system ($n = 27$), and (2) it improves communication skills ($n = 21$), particularly when it comes to crafting manuscripts and framing scientific arguments. Others responded that being an AE has allowed them to gain broader, more holistic views of science

($n = 12$), likely as a result of encountering work in subdisciplines to which they may not be normally exposed. The fact that a variety of benefits were mentioned showcases the different ways AEs value this role beyond the prestige it confers.

We also asked AEs about the most challenging aspects of the job. There seemed to be less variety in the kinds of challenges that were described in comparison to their descriptions of the potential benefits (Table 1). Finding qualified reviewers was the most frequently reported challenge for AEs ($n = 31$), with other common challenges dealing with conflicting or ambiguous peer reviews ($n = 15$) and juggling the workload ($n = 14$). Editors also noted challenges related to the detection of ethical issues ($n = 1$), as well as maintaining rigor while also being sensitive to issues surrounding diversity and inclusion ($n = 1$). When we assessed peer review requests for manuscripts submitted to *Limnology and Oceanography: Letters* between 2016 and 2019, we found that the median number per submitted manuscript was 5, with a maximum of 19 separate requests to review. Indeed, the frequency of reviewers denying peer review

requests appears to be increasing at ecology journals (Fox et al. 2017), although the reasons for this remain unclear. Clearly, locating reviewers who are willing to perform the task is a substantial editorial challenge.

Recommendations

When we conceived of this survey, our plan was to develop recommendations for how ECRs can better prepare themselves to be AEs. Developing this list became challenging as we viewed the data through the lenses of gender and native language, since these aspects of identity appear linked to the opportunities afforded current AEs. Therefore, in addition to ECR recommendations, we also created recommendations for editors as well as publishers and scientific societies. Recommendations geared toward ECRs focus on steps they can take to increase their experience in publishing and/or editorial training (Box 1), whereas recommendations toward editors and publishers/societies include strategies to address disparities on editorial boards, or to set aspirational goals to include scientists from countries and regions that are not currently represented in the professional society and journal pages. We also include steps editors and publishers

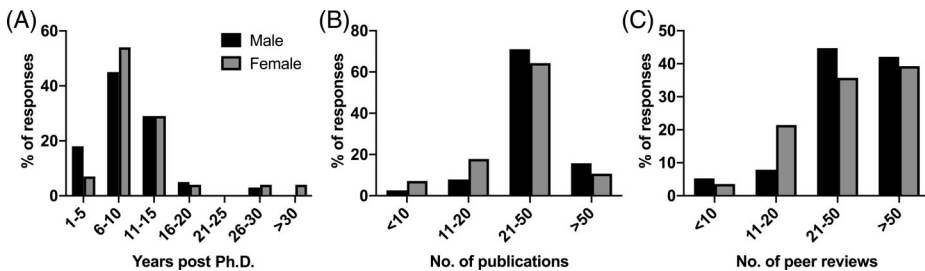


FIG. 3. Research and publishing experiences of AEs by gender. Black bars represent male AEs ($n = 38$) while gray bars represent female AEs ($n = 28$). (A) Years post Ph.D. at which respondent became an AE, (B) number of publications before serving as an AE, and (C) the number of peer reviews performed by AEs before appointment to an editorial board.

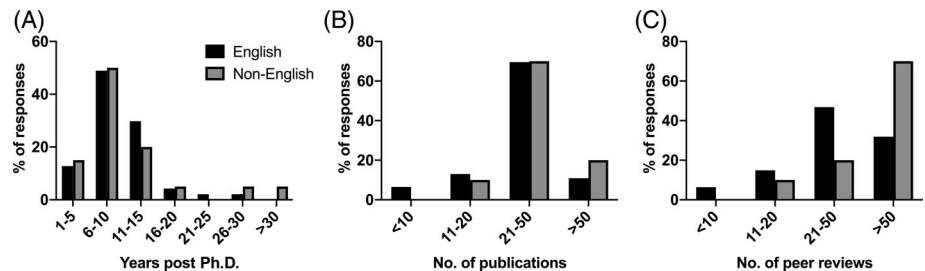


FIG. 4. Research and publishing experiences of AEs by native language. Black bars represent native English speaking editors ($n = 47$) while gray bars represent non-native speakers of English ($n = 20$). (A) Years post Ph.D. at which respondent became an AE, (B) number of publications before serving as an AE, and (C) the number of peer reviews performed by AEs before appointment to an editorial board.

Box 1
Recommendations for early career researchers

Serving as an AE can be very rewarding, and beneficial to your professional development. In order to best position yourself for this role, we recommend the following:

- Stay active in scientific publishing, as both an author and a peer reviewer. Prioritize publishing your own work regularly.
- Peer review often, and for many different journals.
- Network and communicate with AEs about your interest in peer reviewing and serving as an AE in the future.
- Join a database of peer reviewers; inform your PI or advisor about your interest in peer reviewing.
- Make your research area and contact information widely known; that is, fill in your author information on journal websites.

Box 2 Recommendations to editors

Because of the critical roles that editors serve as stewards of science, we propose the following to minimize bias and to maximize inclusion within editorial boards.

- Develop alternative editorial roles for ECRs who express interest. This can include editorial fellowships, serving as deputy editors, or being involved in the development of a special issue.
- Be deliberate when considering gender and geographic locations of candidates when selecting editors.
- Be mindful of whether your AE pool is an accurate reflection of your authorship diversity.
- Solicit peer reviews from researchers from the Global South.
- Invite perspectives and review articles from women and underrepresent minority groups.
- Minimize ECR ghost writing reviews (Benderly 2019) and clarify confidentiality rules so that PIs are encouraged to work with trainees on reviews.
- Encourage first authors to be corresponding authors.

Box 3 Recommendations to societies and publishers

- Create training and mentoring tools for ECRs who express interest in publishing. This can include editorial fellowships, workshops, online materials, meet n' greets, etc.
- Develop databases of ECRs interested in serving as peer reviewers and promote this database globally.
- Increase transparency of criteria and processes used to build editorial boards.
- Be mindful of whether your editorial board is a reflection of your membership, and your society's values and guiding principles.

Editors, publishers, and societies

To better prepare researchers for future roles as AEs, current editors, scientific societies, and publishers should consider developing roles for ECRs to be integrated into the publishing system early in their careers (Boxes 2 and 3). These may include adding ECRs to editorial boards, creating ECR deputy editor positions, or initiating editorial internships/fellowships. These programs would not only better prepare ECRs for a future editorial role, but also allow scientists with a genuine interest in being an editor to self-select for the role early in their career. EiCs should also consider geographic distribution and gender of scientists when it comes to AE selection, with a specific focus on building the editorial board to meet a range of broader goals. In some cases, these goals may be mutually exclusive and can change over time. For instance, societies could work toward making sure that editorial board diversity reflects the professional society membership or the broader scientific population. Societies could also seek out potential editors that are from countries currently underserved by their society (or science as a whole) to grow journal submissions from these regions. Editors can also use other mechanisms to foster an environment that attracts and retains underrepresented individuals by: (1) inviting women and scientists from low HDI countries to be peer reviewers, (2) soliciting reviews and prospective pieces from these researchers, and (3) reaching out to ECRs in particularly via

social media, their scientific society, and their own professional networks in the search for peer reviewers. Editors, scientific societies, and publishers should also take steps to increase the transparency of AE selection, so that a broader pool of researchers can apply and be considered for the role.

Conclusions

Our survey captured the perspectives of AEs serving ASLO journals and several conclusions about AE diversity can be drawn from this unique data set. First, research experiences of AEs vary with gender, with men appearing to become AEs earlier in their career than women. Second, scientists from non-English speaking countries become AEs after obtaining more reviewing experience than their native English-speaking counterparts. Our survey also reveals that there are a myriad of benefits to being an AE, yet there may be practices currently in place that limit which scientists can obtain them. Thus, maximizing AE diversity will likely be an important part of efforts to decrease disparities in the peer review system while also allowing journals to leverage the skills and expertise of their entire scientific community. Despite the disparities noted here and elsewhere, ASLO editorial boards are composed of scientists from a variety of geographic and professional backgrounds and are largely representative of the gender composition of the society's membership. We hope that editors (EiCs and current AEs) can use this information as well as our recommendations to make educated decisions about how to build editorial boards to limit such disparities.

Acknowledgments

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can take to better prepare ECRs for editorial roles (Boxes 2 and 3).

Early career researchers

ECRs should work to increase their experiences with publishing, both as an author and as a peer reviewer (Box 1). While it is critical to maintain steady productivity as a researcher in order to be recognized as an expert (and therefore be more likely to be asked to be an AE), ECRs should also seek opportunities that increase their exposure to the publishing system. This includes engaging with editors via conferences and workshops, as well as social media, to express an interest in peer reviewing. ECRs should also make their interests in peer reviewing known to advisors and other mentors, as they may be able to provide access to opportunities as well. Finally, seek out and take advantage of training opportunities such as ASLO's Raelyn Cole Editorial Fellowship and ECR editorial advisory boards.

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