MENTORS
THE HIDDEN BENEFICIARIES OF MENTORING

By Mona Behl, Sarah Clem, Colleen Mouw, Sonya Legg, Erin Hackett, Kristin Burkholder, Kristopher B. Karnauskas, Sarah T. Gille, Lauren A. Freeman, Karan Venayagamoorthy, and Jerry L. Miller

ABSTRACT. The community-based mentorship program MPOWIR (Mentoring Physical Oceanography Women+ to Increase Retention) supports late-stage graduate students and early-career professionals who identify as women or non-binary genders. Its participants engage in mentorship training and professional development, facilitate group mentoring, and draw attention to barriers women and non-binary genders face in physical oceanography. MPOWIR was created to increase the retention of women in physical oceanography in early career stages but has unexpectedly benefited the MPOWIR community beyond graduate students and early career professionals. Senior leaders participating as mentors in MPOWIR report a renewed sense of purpose, new research collaborations, a chance to challenge their own biases, learning new ways to support mentees at their home institutions, awareness about career trajectories outside academia, and a stronger sense of community amid researchers who often felt isolated due to lack of diversity in their ranks. As they guide and inspire the next generation, mentors reflect on their own career struggles and advise on changes that will create a more equitable future for the discipline. This paper highlights the impacts of MPOWIR mentorship on senior leaders in physical oceanography and demonstrates that mentorship is a two-way exchange that energizes and inspires all participants to become active agents of change. It concludes with reflections on how institutions and organizations can facilitate effective mentoring and remove barriers to the professional development of senior leaders in mentoring roles.

POSITIONALITY STATEMENT

The authors of this paper are a gender diverse group of US-based oceanographers from varied organizations, backgrounds, and ethnicities united by their roles as senior leaders in MPOWIR and their commitment to sustaining this community-driven program.

INTRODUCTION

Mentoring Physical Oceanography Women+ to Increase Retention (MPOWIR) is a community-driven program dedicated to improving the culture of oceanography, primarily through supporting individuals who identify as women or non-binary (women+) and are trained in physical oceanography. MPOWIR participants are predominantly based in the United States, but the program has recently expanded to include physical oceanographers worldwide (22% of registrants at MPOWIR's Virtual Conference have been international participants). While the program's original goal was to improve retention at early career stages, its unexpected impact on senior leaders—those in later career stages—has revealed critical insights into the challenges faced by established scientists as they navigate their own career trajectories while mentoring the next generation.

Later-career physical oceanographers encounter unique hurdles: sustaining research productivity while also performing administrative duties, adapting to evolving institutional expectations, and confronting persistent gender disparities at senior ranks. Simultaneously, despite compelling evidence that mentors experience higher degrees of job satisfaction than non-mentors (Wanberg et al., 2006; Gosh and Reio, 2012), they grapple with the complexities of effective mentorship, including the time needed to balance mentoring with research, teaching, and leadership roles; addressing career challenges (e.g., work-life balance, imposter syndrome) that differ from their own early-career experiences; and advocating for equity in environments where mentoring is undervalued in promotion criteria.

MPOWIR's framework—particularly its cross-institutional, co-mentorship model—provides senior leaders with tools to navigate these challenges. This paper highlights how MPOWIR's reciprocal mentorship model not only benefits early-career scientists but also equips senior leaders to thrive in their own careers while fostering a more inclusive discipline.

BACKGROUND

Gender parity in oceanography has been increasing in recent years, particularly at early career levels (Legg et al., 2023). While women have received approximately half the PhDs in oceanography in the United States since about 2007 (Lewis et al., 2023), only recently have women occupied 50% of oceanography assistant professor positions (Ranganathan et al., 2023). However, at higher levels, the percentage of women still lags—in 2020, 39% of associate professors and 22% of full professors in oceanography were women.

In 2007, women were also less well represented in physical oceanography faculty positions (21%) than in other fields of oceanography (31%) (Ranganathan et al., 2023). Nonetheless, the gender ratios have improved in all subdisciplines and at all levels compared to earlier data (Orcutt and Cetinić, 2014; O'Connell, 2014). For non-faculty positions, data are less readily available, but globally, the proportion of women ocean science researchers has increased slightly from 38% to 39% from 2013 to 2020 (IOC-UNESCO, 2020). Women's representation at leadership levels shows variable improvement over the past few years—notably, three out of six US oceanographic institutions were led by women in 2014,[1] four out of seven presidents of the American Geophysical Union (AGU) Ocean Sciences section have been women since 2010,[2] and five out of 21 presidents of the American Meteorological Society (AMS) have been women since 2004.[3] The proportion of women co-chief scientists of International Ocean Discovery Program (IODP) expeditions was 32% between 2014 and 2018, and only two out of 23 presidents of the International Association for the Physical Sciences of the Oceans (IAPSO) have been women. According to the 2019 annual report on the federal workforce published by the US Equal Employment Opportunity Commission, only 25.9% of all leaders in STEM are women (EEOC, 2019). This scarcity of senior women creates dual challenges—those who achieve leadership positions face isolation while bearing disproportionate mentoring responsibilities for the next generation.

In 2005, under the leadership of Susan Lozier, 29 senior leaders came together to collectively address the so-called "leaky pipeline" of women in physical oceanography, whereby large fractions of women trained in physical oceanography were not obtaining permanent positions in the field (Mackenzie, 2015). Several senior leaders faced systemic barriers in their own careers while simultaneously needing to develop mentoring approaches without established models. They hosted a workshop and conducted a community survey to assess mentorship needs of women in physical oceanography (Lozier, 2006). Survey participants answered questions about their mentoring experiences, including when in their career paths they obtained mentors, whether their mentors were also their advisors, the genders of their mentors, and areas of advice they received from their mentors. Lozier (2006) reported that results of this survey highlighted differences between males and females in relation to mentoring experiences: "All of the male respondents had male mentors, while only 12% of the women had female mentors. Twenty-four percent of the female respondents said the gender of the mentor was important to them, while none of the male respondents did." Generally, female respondents acquired mentors later in their careers than male respondents, typically finding mentors while in postdoctoral positions (Mackenzie, 2015). While many factors impact women's career paths, it became apparent that mentorship is one way forward for improvement in gender equity because women, who were often geographically isolated from one another, lacked access to mentors and role models. MPOWIR was established to address these mentoring gaps, providing much-needed support for both early-career scientists and their overburdened mentors. Within a decade of its inception, MPOWIR's impact on mentees (late-stage graduate students and early career professionals) was already notable (Clem et al., 2014; Mouw et al., 2018).

The program serves as a powerful platform for professional growth and career advancement. By cultivating mentoring relationships, MPOWIR provides invaluable opportunities for knowledge transfer, career guidance, and emotional support—benefits that flow both ways. For senior leaders, it offers solutions to long-standing challenges: lack of access to women mentors, geographic isolation, lack of resources, harassment, and care-giving responsibilities, among others (Figure 1). While mentees gain access to seasoned perspectives, mentors report refined leadership skills, including heightened awareness of systemic barriers and stronger advocacy for equity in hiring and retention.

MPOWIR measures its success through longitudinal tracking of participants' appointments and broader field-wide trends. An analysis conducted by Thompson et al. (2011) for physical oceanography PhDs from six institutions from 1989 to 2009, showed that whereas 25% of graduating men eventually obtained faculty positions, the percentage of women PhDs obtaining faculty positions decreased from 23% in the first decade to 8% in the second. Those who persisted to achieve senior roles often did so

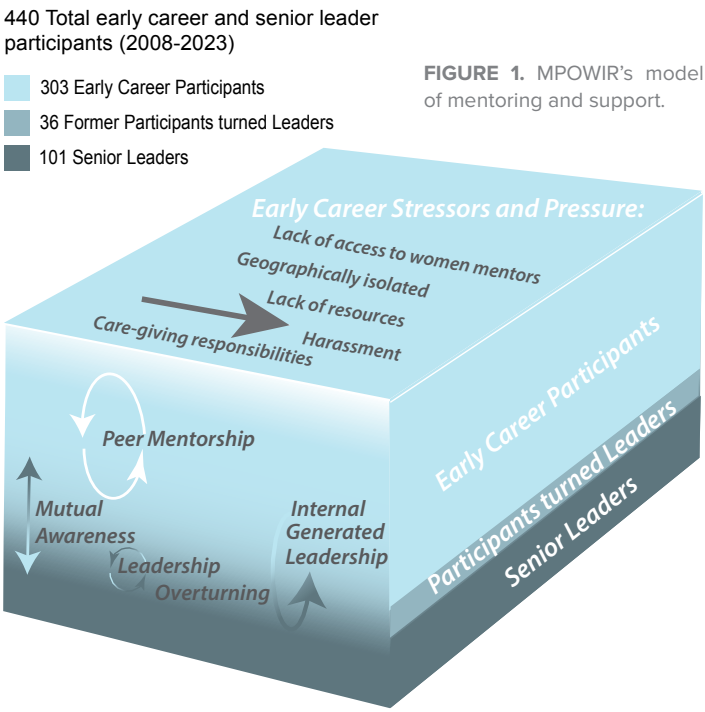

FIGURE 1. MPOWIR's model of mentoring and support.

[1] Margaret Leinen was the Director of the Scripps Institution of Oceanography, Virginia Armbrust was Director of the University of Washington College of Oceanography, and Susan Avery was President and Director of the Woods Hole Oceanographic Institution.

[2] https://connect.agu.org/oceansciences/about/leadership/past-leaders

[3] https://www.ametsoc.org/index.cfm/ams/about-ams/ams-organization-and-administration/past-presidents-directory/

without institutional support for mentoring activities. Repeating this analysis for the decade 2010–2019, Legg et al. (2023) showed that men and women with PhDs in physical oceanography were equally likely to obtain faculty positions in recent years. Further evidence for the improvement in gender ratio in academic positions in physical oceanography is given by Mouw et al. (2018), who examined statistics for a set of 13 universities and laboratories and found an overall increase in the percentage of women physical oceanography faculty from 18% in 2007 to 26% in 2017. Given that MPOWIR was launched around the same time frame as these later studies, the authors assert that the program and its reaching effects may have contributed to these changes in demographic statistics.

Critically, senior leaders affiliated with MPOWIR have helped to drive institutional changes while navigating their own career challenges. For example, although often lacking formal leadership training, MPOWIR-trained mentors have led department initiatives to address implicit bias in hiring and have promoted flexible career pathways. Retention data further underscores the program's effectiveness—in 2017, 95% of participants who were at least five years beyond their PhDs remained in the field, working across commercial, policy, academic, research, and nonprofit sectors (Mouw et al., 2018). This retention spans not only mentees but also senior participants, whose sustained engagement as mentors and advocates helps perpetuate a culture of inclusion despite competing professional demands.

MPOWIR relies on a self-sustaining model of leadership and culture change with broad applications across STEM fields. One of the most genuine measures of MPOWIR's impact is demonstrated by the number of former participants who take on mentorship roles to support the next generation of mentees. The continuity of the program is proof of MPOWIR's success, as women and men who have participated in the program invite and encourage students and postdocs who identify as women+ to participate. In fact, after almost 20 years, 70% of the senior leaders of MPOWIR mentoring groups are former MPOWIR mentees. As perceived by former mentees, the value and effectiveness of the MPOWIR program is reflected in this large percentage of former mentees interested in becoming mentors. MPOWIR has therefore instilled lasting cultural change in the first-generation mentees, who are now passing it along to the next generation.

MPOWIR is not alone in this finding: in general, those who have previously received mentoring feel better prepared and are more willing to mentor others (Allen et al., 1997). Mentors also report higher job satisfaction and commitment than those without mentoring experience (Ghosh and Reio, 2012). According to a study by Wanberg et al. (2006), individuals who served as mentors reported changes in how they interacted with their staffs, a new awareness of their behavior, and a better understanding of the problems faced by earlier career professionals. While numerous factors contribute to these associations, mentors may constantly update their knowledge to provide support for mentees, which also drives success in their own careers (Ghosh and Reio, 2012).

MPOWIR's MENTORING FRAMEWORK

Since its inception, MPOWIR has utilized a formal mentoring arrangement, wherein participants are intentionally organized into groups of six to seven junior participants that meet regularly with two senior mentors, as opposed to informal mentoring, which relies on the mentee initiating and maintaining a relationship (Wanberg et al., 2006; Clem et al., 2014; Mouw et al., 2018). Participation in MPOWIR mentoring groups is limited to individuals who identify as women+. Formal mentoring frameworks, like MPOWIR mentor groups, have been shown to have potential benefits similar to those of informal mentoring relationships (Ragins et al., 2000), with participants benefiting not only from the advice of their senior leaders but also from their peers. In establishing groups, participants are intentionally paired with senior leaders who work for institutions different from their own, and to the extent possible, with peers close to their career stage and affiliated with separate institutions. This framework allows participants to feel comfortable talking openly about advisee/advisor relationships and difficult situations they face on their respective career paths. Early career scientists gain seasoned confidants to help them navigate challenges, set goals, build confidence, and reduce feelings of isolation. Furthermore, the mentor group relationships help participants build out and diversify their peer networks for lasting career support.

In addition to facilitating formal mentoring arrangements, MPOWIR cultivates mentorships through a host of activities. While mentoring groups engage senior leaders who identify as women+, all other MPOWIR activities involve senior leaders from all genders. During odd-numbered years (e.g., 2011, 2013), the program hosts the Pattullo Conference, an event that brings together 25 junior women+ physical oceanographers and 12 senior physical oceanographers of all genders for a 2.5-day long in-person meeting focused on discipline-based mentoring and professional development. During even-numbered years (e.g., 2022, 2024), the Virtual Conference (modeled after the Pattullo Conference) occurs remotely in order to allow participation of individuals constrained by their ability to travel and to facilitate international participation. At the nine Pattullo Conferences sponsored by MPOWIR, 100% of senior leaders indicated they would recommend the conference to an early-career participant. These MPOWIR-run conferences feature various mentoring formats, including one-on-one conversations, small group dialogues, and speed mentoring, where all mentees interact with each senior leader for several minutes. In addition, MPOWIR webinars and virtual discussions are held semiannually and focus on topics of interest to early-stage physical oceanographers, provide continued support for past participants, and connect a broad range of scientists and professionals. Town halls at major conferences (e.g., Ocean Sciences Meeting) inform the whole community of MPOWIR's activities and initiate community-wide discussion on mentorship-related topics, while informal social events at these conferences help maintain the connections created through MPOWIR participation. Early-career

scientists can also apply to be guest speakers at Goddard Space Flight Center or the Jet Propulsion Laboratory through a NASA speaker series facilitated by MPOWIR. The visit is multiple days long with an opportunity to give a seminar and meet formally with many NASA scientists.

Since 2022, MPOWIR has collaborated with the University of Wisconsin's Center for the Improvement of Mentored Experiences in Research (CIMER) to integrate evidence-based mentorship education and resources into MPOWIR activities. Participants are introduced to the science of mentorship (NASEM, 2019), opportunities and challenges of group mentorship, framework for mentorship discussions (Pfund et al., 2016), and a set of evidence-based tools they can use to align expectations for their mentoring relationships. Other topics covered through mentorship education include building career self-efficacy (Butz et al., 2018), fostering independence and addressing equity and inclusion. A condensed version of MPOWIR's mentoring curriculum is also offered to senior leaders at the Pattullo and Virtual Conferences. Specific skills that mentors develop in association with MPOWIR include a broader capacity to empathize, listen, relate, and understand others. They also learn to be culturally responsive mentors. As more well-trained mentors move into leadership roles, institutional- and community-wide change can evolve more quickly.

A steering committee that includes gender-diverse individuals in physical oceanography oversees the design and implementation of MPOWIR activities. These individuals represent different career stages, job sectors, backgrounds, and experiences. New committee members are identified through open nomination and community feedback processes, and they serve for three years.

Figure 1 illustrates MPOWIR's framework of mentoring and support. Based on prior literature (NASEM, 2019) and surveys (Thompson et al., 2011; Mouw et al., 2018) conducted by MPOWIR between 2008 and 2023, the figure includes several stressors, such as lack of access to women mentors, geographic isolation, lack of resources, harassment, and caregiving responsibilities that women+ in physical oceanography face. Since its inception, MPOWIR has engaged over 440 early career participants and senior leaders in physical oceanography to address some of these challenges and provide mentorship and support to women+.

IMPACT OF MPOWIR ON SENIOR LEADERS IN PHYSICAL OCEANOGRAPHY

MPOWIR measures its activities' effectiveness, benefits, and impact via periodic interviews and surveys of its participants (both early-stage oceanographers and senior leaders). MPOWIR mentors anecdotally find mentoring others to be a mutually beneficial process that allows them to continue building their professional skills and networks. In addition, past mentees who continue their oceanographic careers have reached leadership positions outside of MPOWIR and now serve as role models and mentors for their peers and early-career scientists.

METHODS

To assess MPOWIR's impact on senior leaders, we employed a mixed-methods approach, combining surveys and semi-structured interviews (see the survey questions in the online supplementary materials) with senior leaders affiliated with the program. Surveys were distributed to 270 senior leaders, including steering committee members, past/present mentors, and leaders at Pattullo and Virtual conferences who had engaged with MPOWIR since 2005. Eighty-seven leaders responded to the survey, which was administered anonymously via Qualtrics, with reminders sent at three weeks after the initial survey distribution. Survey questions focused on how leadership with MPOWIR impacted their overall mentorship, benefits unique to mentorship with MPOWIR, and challenges associated with mentorship. Twenty senior leaders (purposely selected to represent diversity in gender, career stage, and employment sector) participated in hour-long semi-structured Zoom interviews conducted by the MPOWIR leadership team, including authors Behl, Clem, and Mouw. Members of the author team were also included in the interview sample; their responses were anonymized in the analysis to mitigate bias. During these interviews, participants were asked to share their experiences around the following five questions:

1. What are the personal and professional outcomes of participating as an MPOWIR leader?
2. Are there any unexpected outcomes?
3. How did participation in MPOWIR impact your mentorship style?
4. Are there aspects of leadership within MPOWIR that provide a unique experience?
5. Are there examples of how your MPOWIR leadership has shifted the culture in some way (in your lab, working group, institution, professional society, etc.)?

Survey data were analyzed descriptively (e.g., percentage of respondents reporting specific benefits) and via thematic coding of open-ended responses. The data collected for this study were anonymous and did not involve sensitive or identifiable information. Institutional Review Board (IRB) approval was deemed unnecessary for this study (by one of the authors' institution's IRB); nonetheless, the study adhered to ethical guidelines, including ensuring participant confidentiality and voluntary participation.

In the following paragraphs, we highlight the benefits senior leaders have identified as resulting from MPOWIR's mentorship framework. While these benefits—spanning individual, institutional, and community levels—are well documented in broader STEM mentoring literature (Pfund et al., 2016; NASEM, 2019), they remain underexplored in the specific context of oceanography, where interdisciplinary collaboration and knowledge transfer are critical (Figure 2). We also highlight challenges senior leaders face as they navigate mentoring relationships with their mentees. Senior leaders who have served as MPOWIR mentors' reported benefits, such as a greater sense of belonging, increased awareness

of challenges in the field, professional development, and improved networking possibilities. They report that these benefits far outweigh the challenges that come with mentoring.

CULTIVATING SCIENCE IDENTITY, SELF-EFFICACY, AND SENSE OF BELONGING

Mentorship is a relationship based on reciprocity that profoundly impacts both the mentor and mentee. Previous literature (including the meta-analysis done by Ghosh and Reio, 2012) has pointed out that mentors frequently report being more satisfied with their jobs and more committed to their organizations because of their mentorship (Fowler et al., 2019; Kumari et al., 2022). However, when MPOWIR surveyed senior leaders, it was unclear whether this sense of commitment to an organization or group would translate, given the non-traditional structure of the MPOWIR mentorship framework. In other words, would senior leaders, mentoring women+ from institutions other than their own, experience an enhanced sense of belonging or commitment? If so, how?

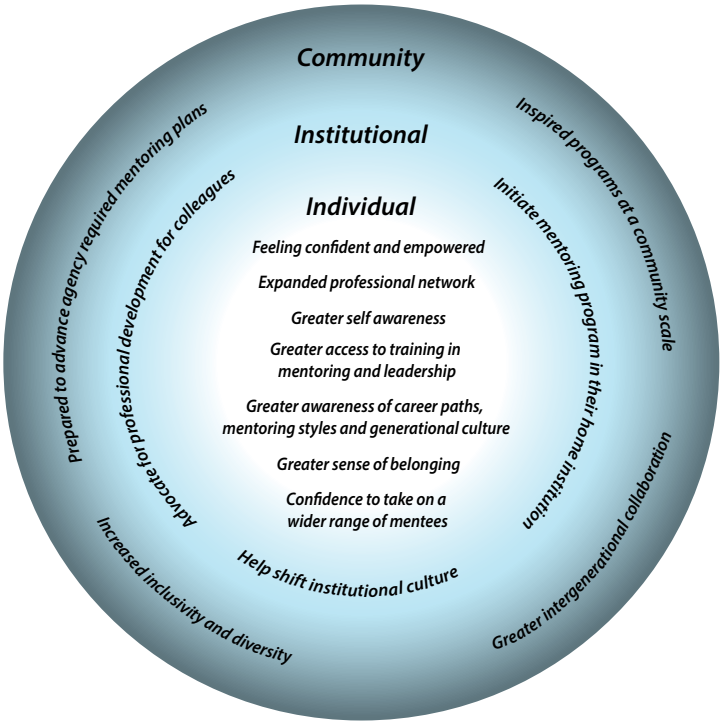

FIGURE 2. Anecdotal reflections from senior leaders where benefits at the individual level radiate out, and community scale impacts reflect back to the individual level.

One of the most frequently identified benefits of mentorship from interviews with senior leaders was an enhanced sense of science identity and self-efficacy (94% of respondents indicated that they experienced gains in this area). By sharing knowledge and expertise, mentors reinforce their own understanding of the field and revitalize their passion for research. Moreover, witnessing the growth and success of their mentees significantly enhances mentors' self-efficacy, validating their career choices and accomplishments. The opportunity to inspire and guide the next generation of scientists creates a fulfilling sense of purpose and legacy. As per self-perception theory, mentors provide "greater mentoring support as a form of role-prescribed, organizational prosocial behavior" (Chun et al., 2012). One MPOWIR mentor described this phenomenon as creating "a safe space within a small discipline" in which feelings of connection (to other senior leaders, mentees, and the field itself) were strengthened because of participation.

Results of a 2023–2024 mentorship survey administered to MPOWIR mentors (Figure 3) also revealed an increased sense of belonging that resulted from serving as a mentor that persisted beyond the specific mentoring activity, even given a non-traditional mentorship structure. The large number of mentors that serve after first connecting with MPOWIR as mentees likely enhances these feelings of fulfillment, belonging, and connection. Additionally, mentors feel empowered and confident. This gain is evidenced in Figure 3 by the large percentage of mentors who indicate that their senses of belonging and self-efficacy have been enhanced through mentoring and expanding their professional networks. Such leaders have greater self-awareness and more confidence to take

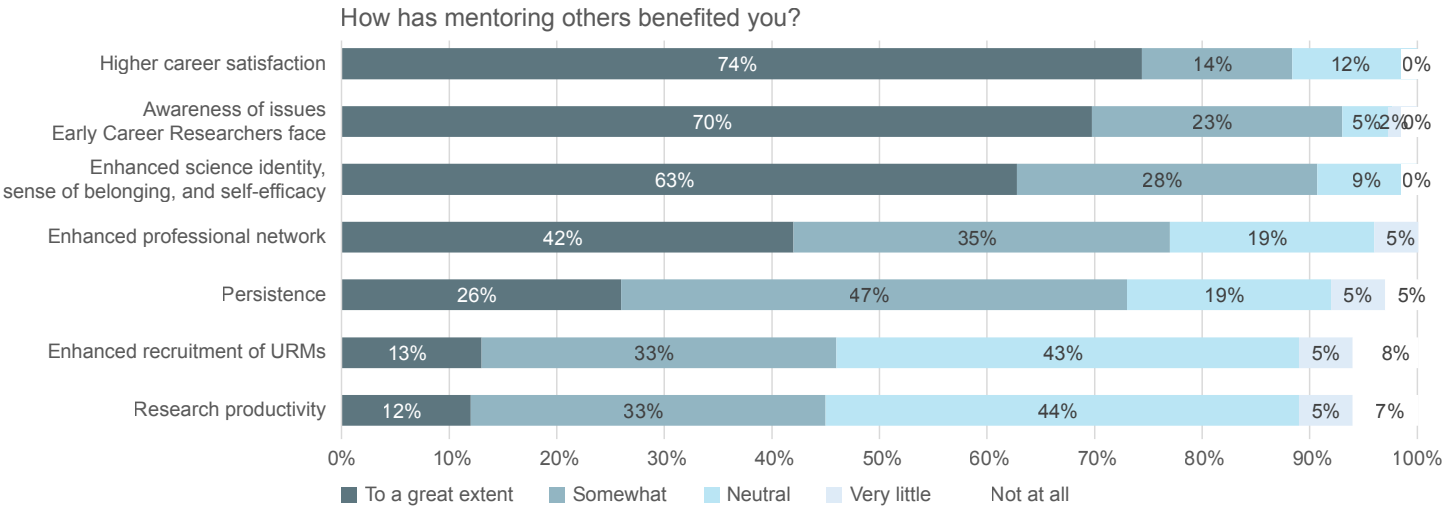

FIGURE 3. Overview of the benefits of mentoring as rated by former and current MPOWIR mentors (n=43).

on mentoring roles with a broader range of mentees, including underrepresented groups at the mentors' home institutions and beyond. MPOWIR's mentoring framework engages individuals from a variety of institutions. For example, approximately 50% of current mentor group leaders have career paths outside traditional research and academic tracks and represent 23 different institutions and backgrounds. Thirty percent of mentor group leaders in 2024 identify with two or more intersecting minoritized identities. These individuals add to the overall diversity of the program and serve as role models for junior scientists.

HEIGHTENED AWARENESS AND KNOWLEDGE SHARING

MPOWIR offers ocean scientists exposure to perspectives beyond their usual institutional, research, or conference networks, fostering connections with a diverse pool of mentors and advisors. This broadened access benefits both mentees and mentors: mentees gain insights into varied career trajectories, while mentors expand their professional understanding and may even discover new opportunities beyond their current career paths. For senior leaders, participation in MPOWIR cultivates three forms of awareness. First, it sharpens their recognition of challenges early-career scientists might overlook. Second, it reveals how other institutions operate, offering comparative insights into problem-solving and workflows. Third, it exposes them to non-traditional career paths, broadening their perspective on professional possibilities.

Cross-institutional programs like MPOWIR uniquely benefit mentors by fostering open dialogue. Because mentees often feel safer discussing challenges with mentors outside their home institutions, these conversations uncover concerns rarely voiced internally, whether due to conscious or subconscious fears of retribution. The confidentiality of an external mentoring relationship encourages candid discussions about systemic issues, such as workplace dynamics or barriers to advancement, that might otherwise remain hidden. These revelations can inspire mentors to adapt their leadership approaches within their own institutions, anticipating challenges their local mentees might hesitate to raise. Additionally, discovering shared experiences across institutions helps mentors feel less isolated, reinforcing their sense of self-efficacy.

Anecdotal feedback highlights these impacts, particularly among male mentors, who report lasting improvements in their leadership and mentorship styles—such as adopting more inclusive practices to support women+ colleagues. One leader noted, "At the Pattullo meeting I learned a lot about inclusive practices. These lessons helped me to refine my advising documents and style. I also regularly recommend my students and postdocs attend MPOWIR gatherings, and the feedback from them has been excellent." By integrating these insights, mentors often become more effective advocates within their home institutions.

A key outcome of this knowledge sharing is the recognition that traditional academic mentoring often neglects non-academic career paths. Early-career scientists, typically guided solely by academic advisors, have historically lacked exposure to alternative opportunities. Programs like MPOWIR are helping to close this gap by promoting a culture of broader career awareness and exploration.

While MPOWIR aims to increase the retention of late-stage graduate students and early career professionals who identify as women+, the pace of progress is accelerated by involving the whole community. Welcoming the participation of those who identify as men in certain aspects of the program has extended the benefits of mentorship across the scientific community. To date, 48 men have participated as senior leaders at the Pattullo Conference, and several men have served on the MPOWIR steering committee. Such engagement opportunities also allow men to listen and engage in thoughtful dialog toward strategies and solutions (e.g., at the Pattullo and Virtual Conferences). Formal and informal feedback from male physical oceanographers demonstrates that they have a greater awareness of the challenges faced by women+, serve as better allies, and are intentional in their approaches to increase recruitment: working together toward the retention and success of women+ in physical oceanography. Among men in leadership roles affiliated with MPOWIR who were surveyed for this manuscript, 93% reported an increased awareness of the challenges faced by early-career researchers. Additionally, 80% stated that mentoring through MPOWIR influenced the way they lead teams within their organizations. To further illustrate the impact of MPOWIR on leadership practices, several male participants shared their personal reflections, including one who wrote, "I obtained heightened sensitivity to diverse life experiences and perspectives, plus challenges that I haven't faced."

IMPROVEMENT IN MENTORING STYLES THROUGH CO-MENTORSHIP

A further benefit noted by MPOWIR mentors is the opportunity to learn new mentorship styles through MPOWIR's co-mentoring model. Mentor groups are always assigned two leaders to allow for redundancy and provide a more diverse set of perspectives for mentees. Similarly, breakout groups at the Pattullo and Virtual Conferences usually include at least two senior leaders. This model contrasts with one-on-one mentoring that commonly occurs in university settings. Co-mentoring has clear benefits for early-career scientists, giving them quick access to a broad range of advice, variability in perspectives, and readily exposing points where experienced scientists might offer divergent guidance. Mentors have found this relationship of additional benefit to themselves as they observe techniques and mentoring styles from their co-leads throughout group meetings.

TWO-WAY GENERATIONAL KNOWLEDGE TRANSFER

Another benefit from mentor group interactions not inherently expected in the initial group design is a generational knowledge transfer from mentees to mentors. Some specific issues facing students and early career scientists shift over time. MPOWIR's mentoring groups are not affiliated with member institutions, allowing

for more open sharing within the group and giving mentors a clear window into the issues faced by another generation. This insight enables better mentorship within MPOWIR, as well as at mentors' home institutions and in their primary roles. Co-mentorship also allows senior mentors to learn about each other's career trajectories, opening ideas and opportunities to pursue paths that may not have been evident otherwise.

TRAINING FUTURE SCIENTISTS AND LEADERS

Engagement in MPOWIR activities not only trains senior leaders to be effective mentors but also prepares them to be more competitive for leadership roles. Mentors from academia, public, and private positions all report that they gain leadership skills through MPOWIR that they did not otherwise receive through their own institutional training, professional development programs, and workplace resources. Within academia, the authors and MPOWIR mentor community note that leadership training is often not provided, or if it is available, the audience is limited, and faculty may have to compete for the opportunity to participate. Further, it can be challenging to get access to leadership training from faculty roles, particularly for more junior positions. Government positions often offer a range of leadership training; however, they tend to focus on direct mentorship and leadership of a project team or department. According to personal communications, neither government nor academic mentors within the MPOWIR community felt that their work setting offered access to the breadth of mentoring and leadership training made available to them through their involvement with MPOWIR.

Though mentorship training programs for graduate students, postdocs, and junior faculty are starting to emerge (e.g., the programs and resources available through the University of Wisconsin's CIMER), many current faculty members received no formal training in mentorship or leadership prior to stepping into a supervisory role. In a survey of over 7,000 full-time faculty members from 56 institutions, 42.4% of faculty members indicated that they had not received any training in preparation for being a mentor (Stolzenberg et al., 2019), though STEM faculty members were slightly more likely than their non-STEM peers to have been trained (36.2% of STEM faculty members reported no training). In training mentors, the MPOWIR program clearly fills a critical gap in the leadership training of junior scientists and professionals in STEM. Moreover, through role modeling, MPOWIR mentoring training provides benefits that move beyond the recognized MPOWIR mentees and positively impacts the departmental peers and mentees such as students, postdocs, and staff that work with the MPOWIR participants at their home institutions.

A fundamental shift in scientific priorities is reflected in the growing emphasis on mentoring plans in funding solicitations from regular single-PI National Science Foundation (NSF) awards (Gage et al., 2024) to large Science and Technology Centers, which are aimed at fostering the next generation (NSF Office of Integrative Activities, 2024). These requirements are not merely bureaucratic checkboxes but signal a deeper, lasting commitment by the scientific community to cultivate a more inclusive, sustainable, and well-prepared workforce. Programs like MPOWIR play a critical role in translating these priorities into practice. By equipping scientists with evidence-based mentoring strategies and cross-institutional perspectives, MPOWIR participants are better prepared to develop compelling, actionable mentoring plans that meet funding requirements while advancing broader community goals. For example, the US Office of Naval Research's Task Force Ocean (TFO) Initiative—launched in 2017 to advance Navy-relevant ocean science—explicitly prioritized graduate student and postdoctoral engagement in ocean acoustics research. A senior leader involved in TFO, drawing on MPOWIR mentoring experience, reported fostering deeper connections with early-career researchers and implementing more effective support structures across the initiative.

This alignment between funding mandates and community values underscores a larger trend: mentoring is increasingly recognized as integral to scientific progress, not just an ancillary activity. While funding requirements may evolve, the scientific community's investment in mentorship reflects an enduring priority to ensure that the next generation of researchers is equipped to tackle complex, interdisciplinary challenges. MPOWIR's role in facilitating these discussions helps institutionalize mentoring excellence, creating cultural change that outlasts any specific funding cycle.

CASCADING MENTORSHIP

MPOWIR mentoring training has inspired a cascade of other mentoring activities including the Society for Women in Marine Science, a community support organization that used MPOWIR's published mentoring structure in developing its mentoring model, and the pilot mentoring program Polar Impact, an early-career run network for historically marginalized racial and ethnic groups in polar science, which brought in a former MPOWIR senior leader to help initiate its mentoring program. The AGU mentoring programs also incorporated aspects of MPOWIR's mentoring framework, facilitated when former MPOWIR chair Susan Lozier was AGU President. Many MPOWIR mentees have not only assumed mentoring roles in future MPOWIR groups but are also mentors at their home institutions. The skills learned and training received during the Pattullo and Virtual Conferences have highlighted to many participants the lack of such training at their institutions, and in many cases led to a realization that it is up to them to implement programs if they want to see change. From initiating mentoring groups to one-to-one mentoring programs, mentees have become pioneer mentors within their work environment, well beyond their home institutions, expanding and sharing the community, and providing network links that support that community of women+ oceanographers.

Equally significant is how MPOWIR participants apply training insights to daily professional life—whether by vocally rejecting discrimination or mentoring junior researchers beyond their immediate teams.

CALL TO ACTION

Until recently, MPOWIR's success has relied on sustained federal agency funding and the dedicated voluntary efforts of the physical oceanography community. Moving forward, ensuring MPOWIR's long-term success will require collective action—increased collaboration, advocacy, and investment from all stakeholders in oceanographic research. To achieve gender parity in oceanography and related disciplines, organizations and institutions need to develop mentors who are career investors (Abel et al., 2024). There is a pressing need to strengthen mentorship support in oceanography, particularly in academia, where professional development opportunities are often more limited compared to industry or government sectors with robust training programs (NASEM, 2019). Mentoring and mentoring training are undervalued at many academic institutions because they are perceived as detracting from research productivity, which is often more heavily weighted in promotion and tenure decisions. Unfortunately, only 48% of undergraduate faculty report that their institutions take mentoring into account during performance reviews (NASEM, 2019). As shown in Figure 3, at least in the near term, research productivity is not typically helped by mentoring, with only about one-third of respondents showing any benefit of mentoring to research productivity at any level. Thus, researchers may see mentoring as competing with their primary job functions, which leads to less mentoring engagement. But clearly, as outlined in this article, mentoring can lead to long-term benefits to an organization even when the activity may not have direct short-term benefits (e.g., loss of employee work time on research).

Institutions and organizations should prioritize mentoring and explicitly recognize its value as a strategic investment in sustaining and developing their workforces. By implementing clear initiatives and incentives, they can effectively communicate to employees that mentoring is essential for long-term organizational success and professional growth. First, as recommended in the National Academies of Sciences, Engineering, and Medicine report on effective mentorship in STEMM (NASEM, 2019), organizations should make mentoring part of performance evaluation criteria so that employees who engage in mentoring (internal or external to the organization) are recognized for making valuable contributions to the organization. Second, mentoring excellence should be publicly recognized in a manner that is comparable to the recognition given for teaching effectiveness (NASEM, 2019). Finally, organizations can include budget line items that provide financial support for employees to obtain mentoring and leadership training. Mentoring strengthens relationships, enhances career development, and builds a culture of collaboration and support. As demonstrated by MPOWIR, sustained investment in mentoring programs can lead to a culture change, driving more diversity, equity, and inclusion in STEM fields.

ADVANCING ORGANIZATIONAL CULTURE AND DIVERSITY

The lessons learned via MPOWIR mentoring and training carry over to home institutions. Senior leaders report shifts in their perceptions of their home institutions in terms of mentoring support (e.g., perceived strengths and weaknesses), changes in how they work with their home institutions (e.g., whom to involve—who are the stakeholders), increased confidence in suggesting changes in the way an institution assists with mentoring professional development, initiating mentoring programs at their home institutions, and even how an individual might interact with lab mates. Collectively, these initiatives institute cultural changes across many organizational types (academic, nonprofit, government, industry), across levels within organizations, and over a diverse set of geographical locations. This widespread dissemination of new knowledge gained through mentoring advances diversity in our field and at our institutions.

APPLICATIONS EXTEND TO PERSONAL RELATIONSHIPS

Developing mentorship skills helps to improve listening, enhances patience and empathy, allows people to see things from alternative perspectives, shifts mentors to a more positive and flexible mindset, and acts in the service of others, among many other benefits. While these expanded skills help improve professional mentoring relationships, they undoubtedly also translate to personal relationships. Improvements in one aspect of our responsibilities directly and holistically impact our entire being. The individual benefits of mentorship, such as an increased sense of belonging, improved self-efficacy, and reduced isolation, can improve overall work satisfaction and reduce stress. The authors speculate that nearly everyone has the experience of bringing stress and dissatisfaction home from work and has seen the negative impact it can have. Thus, reducing job dissatisfaction and stress has the potential impact of improving interpersonal relationships. Further, expanded mentoring skills are invoked in relating to our children, parents, domestic partners, friends, and neighbors, improving our interactions with others and resulting in healthier and deeper personal relationships.

CONCLUSIONS

Gender parity in oceanography is essential for several reasons, including the inclusion of diverse perspectives on a wide range of oceanographic issues, improved problem-solving and decision-making, increased public engagement, and promotion of social justice and equity. One way the physical oceanography community is advancing gender parity is through the MPOWIR program. By cultivating mentoring relationships between senior leaders and early-career oceanographers through a variety of activities, MPOWIR enables far more open, deep, and intimate relationships between mentors and mentees. This authenticity fosters trust and deepens connections and growth opportunities for both mentee and mentor. Senior leaders serving as mentors grow in their understanding of the challenges that mentees face and in building their own leadership and mentoring skills through training with CIMER and engaging in MPOWIR's activities. Leaders

selected to participate in MPOWIR conferences also gain access to additional coaching on negotiation, goal-setting, and inclusive leadership. MPOWIR senior leaders feel more confident in suggesting improvements to policies and procedures impacting the career success of women+, initiating mentoring programs at their home institutions, and taking on leadership roles.

Mentoring, while rewarding, also presents some challenges, notably in terms of time commitment, as mentors juggle demanding research and administrative responsibilities, limiting the time available for dedicated mentorship. This commitment often requires flexible scheduling and the willingness to dedicate significant personal time. Balancing the role of advisor, confidant, and career coach can be complex, requiring emotional intelligence and adaptability. Addressing sensitive topics like work-life balance, imposter syndrome, or career setbacks requires empathy, tact, and discretion. Mentors can experience stress over the perceived quality of their advice, questioning whether their guidance is beneficial and relevant. This concern is compounded by the emotional weight of mentorship of exceptional young scientists subject to systemic challenges and a well-known "leaky pipeline." MPOWIR's leadership and mentorship training, combined with the advantages of co-mentoring and being part of a mentor community, equips mentors to effectively navigate these challenges.

SUPPLEMENTARY MATERIALS

The supplementary materials are available online at https://doi.org/10.5670/oceanog.2025.e307.

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All authors contributed to all aspects of the article.

COMPETING INTERESTS

The authors declare no competing interests.

AUTHORS

Mona Behl (mbehl@uga.edu), Marine Extension and Georgia Sea Grant, University of Georgia, Athens, GA, USA. **Sarah Clem** and **Colleen Mouw**, University of Rhode Island, Graduate School of Oceanography, Narragansett, RI, USA. **Sonya Legg**, Center for Ocean Leadership, University Corporation for Atmospheric Research (UCAR), Boulder, CO, USA. **Erin Hackett**, Coastal Carolina University, Conway, SC, USA. **Kristin Burkholder**, Stonehill College, Easton, MA, USA. **Kristopher B. Karnauskas**, University of Colorado, Boulder, CO, USA. **Sarah T. Gille**, Scripps Institution of Oceanography, University of California San Diego, La Jolla, CA, USA. **Lauren A. Freeman**, Naval Undersea Warfare Center Division Newport, Newport, RI, USA. **Karan Venayagamoorthy**, Department of Civil, Architectural, and Environmental Engineering, Missouri University of Science and Technology, Rolla, MO, USA. **Jerry L. Miller**, Science for Decisions LLC, Hemingway, SC, USA.

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