

Perspectives of Earth and Space Scientists

PERSPECTIVE

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Key Points:

- As a small community of postdoctoral researchers, we outline the leadership skills envisioned for an inclusive future in polar sciences
- Our vision is to increase the success of underrepresented individuals as leaders by creating a welcoming and supportive career environment
- Group norms and leadership skills focused on emotional intelligence are critical to equity and inclusion in polar sciences

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Postdoc Perspectives on Leadership and Matters of Equity and Inclusion in Polar Science

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Abstract In 2023, the first Polar Postdoc Leadership Workshop convened to discuss present and future polar science issues and to develop leadership skills. The workshop discussions fostered a collective commitment to inclusive leadership within the polar science community among all participants. Here, we outline challenges encountered by underrepresented groups in polar sciences, while also noting that progress has been made to improve inclusivity in the field. Further, we highlight the inclusive leadership principles identified by workshop participants to bring to the polar community as we transition into leadership roles. Finally, insights and practical knowledge we gained from the workshop are shared, aiming to inform the community of our commitment to inclusive leadership and encourage the polar community to join us in pursuing action toward our shared vision for a more welcoming polar science future.

1. Context

As a collective of 20 early career scientists (Figure 1) that participated in the 2023 Polar Postdoc Leadership Workshop (PPLW) (Doting et al., 2024; Dryák-Vallies & Pineda Velez, 2024) hosted by the Polar Science Early Career Community Office (PSECCO) and funded by the National Science Foundation (NSF), we want to punctuate the need to move toward more inclusive and just leadership, so that our polar science field can become a safe and welcoming space for all.

We recognize the privilege that afforded us seats at this workshop, and that we, as predominantly White, cis-gender individuals based in the United States, do not represent the diversity within our scientific community. Our perspectives are also shaped by the family backgrounds of our group, which includes first-generation Bachelor's degree holders (21%), Master's degree holders (58%), and Ph.D. recipients (84%). The opportunity to become a postdoctoral researcher is often held by those with the financial, social, for example, family background, and cultural privilege to do so. Therefore, we also recognize that our recommendations only represent a subset of the community, and that our group composition influenced the discussions during the workshop. We, and the greater polar science community, have a responsibility to amplify the voices and perspectives that are often absent from the conversation.



Figure 1. The participants in the Polar Postdoc Leadership Workshop hosted by Polar Science Early Career Community Office at The University of Colorado Boulder. Back row: Allen Pope, Eva Doting, Ben Fernando, Saas Ksenofontov, Jack Conroy, Jason Coenen, Heather Fair, Kirstin Schulz, Rebecca Batchelor. Middle row: Astrid Pacini, David Harning, Marie Bergelin, Emily Tibbitt, Marisa Sanchez Montes, Angela Szesciorka, Anne Sledd, Marisol Juarez Rivera. Front row: Mariama Dryák-Vallies, Radiance Calmer, Taylor Stinchcomb, Sophie Goliber, Devon Dunmire, Alexandra Ravelo.

Through this commentary, we articulate our collective vision for the future of inclusive leadership in polar science and the inherent responsibility we bear in fostering a more representative and welcoming scientific community by sharing what we feel are important traits of inclusive leaders. As future leaders, our commitment must not only be to advance our field's knowledge, but also to ensure that this journey is marked by inclusivity, equity, and an unwavering dedication to amplifying the richness of human diversity within polar science.

2. Introduction

Polar research is a broad term under which many fields of scientific research (e.g., physical, chemical, biological, geological) and methods of scientific study (e.g., fieldwork, remote sensing, laboratory work, engineering, modeling, logistics) are conducted in the Arctic and Antarctic (McGovern & Geller, 2022). The demographics of polar research in the early 20th century were dominated by White men and marked by pervasive gender bias and discrimination (Bloom, 1993; Rosner, 2009; Seag et al., 2023). The contributions of women and Indigenous scholars and Knowledge holders were historically overlooked, especially in Western narratives, even though they had been involved in polar research for centuries (Carlo, 2020; Herbert & Bowermaster, 2012). In recent years, attention has turned toward addressing inequities in the participation of underrepresented groups in polar science—which we define as women, Black, Indigenous, and People of Color (BIPOC), LGBTQ+ (lesbian, gay, bisexual, transgender, queer, questioning, and other sexual and gender identities) and people with disabilities.

Major advances have been made toward increasing the number of White women in academia. The percentage of women earning PhDs in earth, atmospheric, and ocean sciences has steadily climbed since the 1970s (Bernard & Cooperdock, 2018). However, the demographics of polar research remain largely monochromatic. For example, despite the significant increase in the total number of awarded masters and PhDs in the U.S., the largest demographic growth was that of White individuals (Bernard & Cooperdock, 2018), with the same group making up most of the science, technology, engineering, and mathematics (STEM) workforce (for Science & Statistics, 2023). Women of color, minorities, Indigenous Peoples, and individuals with disabilities continue to remain underrepresented in all realms of polar research.

Physical barriers have been the most obvious form of exclusion of underrepresented groups. For example, the U.S. Navy refused to transport women to Antarctica and women were banned from the U.S. Antarctic Research

Program until 1969 (Rejeck, 2009). More recently, researchers critical of the NSF Physical Qualification process reported that the process disqualified people from fieldwork in Antarctica for common, well-managed medical conditions and other minor reasons (e.g., diabetes, admitting to seeing a therapist, changing medications within a year) (Langin, 2023). Those who managed to participate in ship- or field-based research were met with other non-inclusive behaviors. A slew of investigative reports have revealed the challenges faced by underrepresented individuals working in remote polar environments. For example, in 2022 the NSF and the U.S. Antarctic Program released the results from an internal assessment on sexual harassment and assault. In a survey of 880 community members, 59% of women respondents reported having negative experiences with sexual harassment or assault while working in Antarctica (USAP, 2022). U.S. academic institutions also have a history of these same issues (Benya et al., 2018), with reports cataloging a long history of sexual assault and harassment at remote field sites (Clancy et al., 2014; USAP, 2022).

Other examples of persistent challenges that hinder the representation of diverse individuals in polar research include access to gender-appropriate polar clothing and hygiene resources and disparaging attitudes about the ability of women to perform physical labor (Nash et al., 2019). This is often compounded by significant cultural differences resulting from the international nature and mix of academic, military, and trades people participating in polar fieldwork. Female scientists were asked part-way through an Arctic cruise in 2019 not to wear tight-fitting clothing in the “interest of safety,” as some of the sailors on board would be spending months at sea (Taylor, 2020). This, combined with inequalities in the division of work assignments, led to an unwelcoming atmosphere for the women, who made up approximately one-third of the participants on the expedition (Harvey, 2020).

In addition to facing physical barriers in the polar sciences, there are issues of recruitment and retention of underrepresented groups due to a lack of role models, representation, support, and disparities in research grant support common to many areas of STEM. Research opportunities often come with the expectation of unpaid labor, which prevents students from low-income backgrounds from participating. Principal investigators often fail to provide alternative methods that would allow people with disabilities to participate in polar research, and underrepresented groups are often unaware of opportunities (Dowey et al., 2021; Frater, 2021; Whittaker et al., 2015).

Western science has long been used as a tool of colonization and thus has rarely included Indigenous scholars and Indigenous Knowledge holders in research projects as equal partners, despite the extensive history of Indigenous people in the Arctic and relatively recent “discovery” by western explorers (Held, 2023; Simonds & Christopher, 2013). Even though underrepresented researchers tend to produce more scientifically innovative work than their well-represented peers, the findings are more likely to be discounted, and they are less likely to obtain academic positions despite this innovative work (Hofstra et al., 2020). Equitable funding, for example, the possibility to fund indigenous project partners outside of the academic system as equal project partners or to support long-term relationship building with communities beyond the typically short duration of a research project, could better support local solutions to local challenges, recognize the impact of those outside academia, and aid the professional development underrepresented individuals toward advancing solutions to global challenges.

Thankfully, efforts are being made to tackle systemic barriers to inclusion. Institutions in the U.S. are beginning to set explicit expectations for researchers and organizations they are funding. The National Aeronautics and Space Administration (NASA) now requires notification if a principal or co-investigator has violated policies, which may result in the removal or substitution of the investigator, reduction in funding, or termination of an award. NSF now requires the submission of a “Safe and Inclusive Working Environment Plan” for off-campus work and a plan regarding the “Ethical Considerations and Approaches” with funding requests. Similarly, new funding opportunities to engage Indigenous communities, prioritize Indigenous Knowledge, and support knowledge co-production (e.g., NSF’s Navigating the New Arctic Initiative) have increased the involvement of Indigenous scholars and Indigenous Knowledge in research, scientific planning, and decision-making—though challenges with equity in these spaces still exist. Similar initiatives exist in other countries. For example, in the UK, government funding allowed for the creation of the Diversity in UK Polar Science Initiative in 2019, which seeks to increase the representation in Antarctic science by developing events, activities, and resources to elevate the conversation around diversity in polar science at national and international level.

Broader policy changes have been accompanied by training programs aimed at setting new standards for all future polar scientists. Within the last 4 years, NSF has funded the development of several formal training programs and organizations, including the American Geophysical Union Leadership Academy and Network for Diversity and Inclusion in the Geosciences (AGU LANDInG), Unlearning Racism in Geosciences (URGE), and PSECCO programs. The Polar Horizons Initiative was launched to connect students in the UK from underrepresented groups with established polar scientists and engineers to promote Antarctic science opportunities. Seminars and guides developed by the Fieldwork Initiative and International Thwaites Glacier Collaboration (Kingslake, 2021) aim to prepare researchers for the realities of fieldwork, including how to avoid and respond to discrimination and harassment and how to create safe and welcoming environments, particularly for those from historically marginalized groups. Grassroots and nonprofit organizations have formed networks to provide connection and support for historically excluded individuals in the polar sciences, including Polar Impact, Accessibility In Polar Research, Pride in Polar Research, Women in Polar Science, Women of the Arctic, and the Diversity in UK Polar Science Initiative.

As early career leaders, we applaud and commit to advancing and supporting these efforts. However, we also recognize that leadership toward increasing representation in polar research is extremely complex, especially as diversity, equity, and inclusion (DEI) efforts, including affirmative action, are received differently in different countries and can have an impact on those doing this work. Nearly one-fourth of all countries have some form of affirmative action for college admissions; however, in some countries, affirmative action is illegal (Laura Dudley Jenkins, 2014). In the U.S., recent Supreme Court rulings like *Students for Fair Admissions v. Harvard* and *UNC* have effectively ended race-based affirmative action in college admissions (SFFA v. Harvard, 2023; SFFA v. ; UNC, 2023). Combined with legislation in Republican-led states aiming to eliminate DEI initiatives (DEI Legislation Tracker, 2024), this redistributes the burden away from institutions and onto individuals (Heidt, 2023), often disproportionately adding to the workload of those already experiencing the challenges of under-representation (Jimenez et al., 2019).

Despite recent advances toward representation in polar science, systemic problems persist and it remains critical to highlight and prioritize the need for institutions and individuals to advance Belonging, Accessibility, Justice, Equity, Diversity, and Inclusivity (BAJEDI) in the polar sciences. With more intentional approaches to building new research groups, including recruiting, funding, supporting, and amplifying the voices of underrepresented groups (Chaudhary & Berhe, 2020), early career researchers can set the intentions for all future polar scientists and continue to grow the demographics of polar research. A diverse population in polar sciences improves the field, making it more inclusive and enhancing the quality of scientific work (Campbell et al., 2013). Increasing diversity in all facets of polar research will have far-reaching implications for underrepresented individuals in polar research, for innovative scientific progress, and for fostering a culture of respect in the polar sciences more generally. What happens at the poles does not stay at the poles, and we believe that the safety and representation of underrepresented community members in polar research should be of the utmost priority.

3. Community Priorities

In May 2023 we, a group of polar postdocs, convened for a week-long PPLW supported by PSECCO (Figure 1). The organizers invited speakers and panelists from across polar science research, with a range of expertise from inclusive mentoring and co-production of knowledge to proposal writing and building successful collaborations. Through deep conversations, we honed in on what we as early career polar scientists value and envision as vital facets necessary for inclusive leadership skills needed to build a stronger and more supportive research community (Figure 2). While this is what we envision to drive systemic inclusive change within polar science, we emphasize that this is only the perspective of a small subset of polar science researchers, and thus, may not be viewed the same by all.

We summarize the workshop results by categorizing what we as early career polar researchers felt represented optimal group dynamics interactions and ideal qualities for leaders in polar sciences. We also answered the questions, (a) “What skills are important for leaders to have?” and (b) “What makes someone a good leader?”. What follows is a summary of what we as a group developed during leadership exercises represented as the six facets of inclusive leadership skills (Figure 2).



Figure 2. Six facets the Polar Postdoc Workshop Participants identified as vital for inclusive leadership: (a) Collective group norms, (b) self-awareness, (c) empathy, (d) active listening, (e) transparent protocols, and (f) sharing resources.

organizers began our first group exercise with that statement, encouraging us to discuss qualities of what we felt were important as leaders. Like many exercises that week, this activated leadership skills already within ourselves and guided us in a self-assessment of our own leadership styles (including strengths, weaknesses, and motivators) and areas where we might consider self-correction (fine-tuning how we impact others).

As a leader, awareness of your leadership style is critically important and should serve as a reminder to support the psychological well-being of all participants and remove hostile barriers that women, BIPOC, LGBTQ+, individuals with disabilities, individuals from lower socioeconomic status, and foreign-born nationals often experience in STEM careers (Berhe et al., 2022). We encourage all polar science leaders to identify their leadership style and reflect on how their experiences and actions influence feelings of inclusion and belonging of those around them. Most importantly, we suggest constantly asking ourselves what our experiences would have been if we had been a part of a/another marginalized or underrepresented community and how our understanding of these communities can help us to eliminate barriers for those who need it the most.

3.3. Empathy

In a group leadership exercise where we were asked “What makes a good leader?”, 78% of responses indicated qualities and skills related to emotional intelligence (e.g., active listening skills, motivating others, empathy, and building teams) and the greatest proportion of open-ended response categories was empathy, at 35% of responses. Part of fostering a more inclusive leadership style includes embracing empathy for our peers and colleagues. Empathy includes the ability to understand and share the feelings of another. Not only does this involve active listening, but also actively learning more about other cultures, histories, and perspectives. We believe empathy is crucial for developing and fostering a more inclusive and diverse field for the future. Empathy while in the classroom, lab, during fieldwork or data collection, and informal learning environments is important for creating a thriving polar sciences community for all.

3.1. Collective Group Norms

On the first day of the workshop, we developed a list of collective group norms (Appendix A) to guide our interactions throughout the week. By defining our norms, which are shared patterns of thoughts, feelings, and behaviors (Hogg & Tindale, 2005), we set the tone for our interactions. Some of the group norms we brainstormed included “every voice matters regardless of career stage, ability, race, and gender,” “have a growth mindset,” “self-reflect,” and “be solution-focused.”

We realized that even within a small and fairly homogeneous group of workshop participants, group norms could have a tremendous influence on how our interactions occur, are received by others, and motivate us by creating a safe and respectful environment. We encourage everyone in the field to think critically about their own values and prioritize sharing and establishing collective group norms early on in any group setting.

While polar science has historically fallen under a leadership style of exclusion—by glorifying the achievements of rugged white men able to conquer remote wilderness under the ideals of colonialism—leadership by inclusion focuses on making sure participants feel safe, empowered, like they belong, and that they can actively participate in the group (Shore et al., 2011). Shore et al. (2011)’s model of inclusion was something we were unwittingly moving toward by developing our group norms.

3.2. Self-Awareness & Self-Correction

“Everyone in this room is already a leader.” Although we may not have realized it, the statement that kicked off the workshop was true. The workshop

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In the classroom, we seek to bring empathy in the form of learning from pedagogical experts in order to engage students of all learning styles. This includes providing transparent learning objectives and goals for the classroom and student learning. Inclusive approaches such as seeking out underrepresented authors when assigning reading material and including more diverse citations in publications helps elevate role models for underrepresented individuals in the classroom which will extend to field practices and role model building.

Within the polar sciences, fieldwork is a large part of training, data collection, and informal learning environments—geology, ocean sciences, ecology, anthropology, and social sciences often require long and extended research trips in the field, on research vessels, and in remote communities. By understanding that these settings can be particularly challenging for women and LGBTQ+ individuals, who may face sexual hostility in remote field situations with additional threats faced by working internationally under different cultural norms (Toone et al., 2023; Wadman, 2019), we practice empathy with those in our teams and work to stop problematic behavior. Focusing on ways to make all participants feel safe when conducting fieldwork is imperative for the future. For mentoring and working with students, empathy means working toward students feeling that their whole self is welcomed at all times. This includes addressing the two-way expectations for mentoring relationships; thoughtfully and actively providing resources such as fieldwork, grant, and job opportunities and professional recommendations; and connecting students with additional mentors and support groups to expand their networks and safe spaces.

3.4. Active Listening

Of the open-ended responses examining qualities of leaders and skills that make good leaders, more than 22% of the suggestions recognized the importance of communication and active listening. Part of self-awareness and self-correction is being able to be present and fully listen to our lab group, colleagues, students, and all others we interact with in the polar community.

As leaders, we need to focus on hearing all the voices in the room and building experiences and environments where active listening is encouraged and utilized. While we realize the importance of active listening, we are still figuring out the best ways to practice and teach this skill effectively. Renck Jalongo presented ideas on how to promote active listening at the grade school levels and highlighted that adults might be just as deficient as children in this crucial skill (Jalongo, 1995). Active listening is important for all aspects of our careers as scientists, collaborators, teachers, mentors, and mentees. Building skills in active listening is important for the classroom, lab, and mentoring and should be a focus for polar initiatives going forwards. In training programs like AGU LANDInG and other postdoc training programs, exercises should highlight this skill and provide opportunities to build these skills with peers and leaders.

3.5. Transparent Protocols

Here we define “transparent protocols” as clearly defined and readily accessible procedures or guidelines that are openly shared within a group, community, or organization. This ensures that information within an organization related to procedures and resources is easily understood and available to all stakeholders, promoting transparency, equity, and informed decision-making for all members of the scientific community.

The need for transparent protocols became evident when we gained valuable insights into the inner workings of the NSF through panel discussions and break-out groups with program managers at the PPLW. While NSF does not deliberately conceal this information, we found it surprising that such vital knowledge wasn't more integrated in our education as science students or postdocs and felt that the term “hidden” knowledge was appropriate for how we felt. The workshop afforded us access and insights not typically part of our daily experiences as early career scientists and led to conversations on how transparent protocols in any organization should be clear and widely disseminated. For example, resources related to writing a one-pager and how to decipher information in the solicitation and how to navigate the Proposal and Award Policies and Procedures Guide (PAPPG) (NSF, 2023) are topics we hope to share with other early career researchers to help build our community and work toward removing hidden barriers in the proposal writing process (see Sharing Resources for more information).

Transparent protocols are also a valuable tool for empowering positive relationships at an individual or research group scale. These protocols will look different in different contexts, and may depend on whether the relationship involves a student (which will also differ for undergraduate and graduate students), lab personnel, postdoctoral researchers, colleagues, etc., but should help everyone to understand what is expected of them. When there is a power dynamic, such as advisor/advisee or mentor/mentee relationships, these documents should allow room for both parties to develop and document agreed upon expectations and outcomes, including how to handle situations when one party does not adhere to the agreed upon expectations. The document should also allow for enforcing boundaries, such as maintaining a work-life balance and communicating when it is appropriate to contact either party outside of standard working hours (CLEAR, 2021; Masters & Kreeger, 2017). In the context of scientific collaborative, multi-stakeholder relationships, protocols should also include at a minimum a discussion about expectations and agreement of how authorship will be determined. For example, Brand et al. (2015) system of authorship framework (CRediT) is becoming widely established and even required for submission by a number of major peer-reviewed journals (Brand et al., 2015).

3.6. Sharing Resources

Coming out of this meeting, we committed to sharing the insights we gained into qualities and skills needed to be a good leader, and the norms we shaped, with the broader community. The postdoc position, as with many positions in academia, is transient; in many cases, “hidden knowledge” is associated with success. We articulated a need to continue challenging the community to work toward building spaces to inspire, support, and enable future polar scientists. These initiatives should be rooted in diversity, inclusivity, and equity in the polar science community and beyond, some of which we summarized above.

Our resources come from conversations and exercises in proposal writing, science communication, inclusive pedagogy and mentoring, community engagement, and collaboration. These resources are available for all to use on the PSECCO website. They also include valuable resources developed by others, such as mentoring map activities (Montgomery, 2017) and 10 simple rules for building an antiracist lab (Chaudhary & Berhe, 2020) to spark discussion and reflection. Additionally, we would like to highlight the number of programs planned for the PSECCO community in the coming years. PSECCO will be hosting more workshops and events to build leadership skills and foster a more inclusive polar science community. We encourage graduate students, postdocs, and early career faculty in polar sciences to follow the events shared on PSECCO’s event webpage and in PSECCO’s newsletters, as there are great workshops and materials developed to inspire, support, and enable the next generation of polar scientists.

We recognize the need to develop skills in navigating collaboration, inclusive mentoring, and networking during the postdoc position. Given the transience and uncertainty in our roles, it can be hard to advocate for ourselves and our time. However, open discussions on collaboration, mentoring plans, and meaningful thought experiments on what we should be looking for in our mentorship network and who we choose as mentors in our professional and personal lives are extremely important. Therefore, we would also like to encourage more major funding institutions to consider a greater scope in funding calls to support learning experiences in “soft” skills for early career scientists. This will ensure there are more opportunities for programs like the PPLW to foster community while developing leaders committed to a more diverse, inclusive and equitable polar science community.

4. Conclusion

As a collective of 20 early career scientists from the 2023 PPLW, we emphasize the ongoing need for a shift toward inclusivity within our field. In the evolving field of polar sciences, it is important that we continuously evaluate our leadership practices to create an inclusive and welcoming environment. This paper underscores the responsibility of the polar science community to amplify underrepresented voices. We hope this paper acts as both a signpost, indicating the aspirations of early career scientists for the direction of the field, and a call to action for the community.

Appendix A: PPLW Collective Group Norms

Table A1.

Table A1

Collective Group Norms Developed at the Polar Postdoctoral Leadership Workshop to Guide Our Interactions Throughout the Week to Encourage Healthy Group Dynamics, Mutual Understanding, and Inclusiveness

Group norm	Definition
Active listening	Be fully present to hear others and validate viewpoints and experiences of others, no matter how divergent from your own
Brave space	Do not be afraid to express ideas freely
Judgment-free zone	All ideas, perspectives, backgrounds, abilities, and individuals are respected and valued
No stupid questions	Everyone has a different background with different experiences
Encourage vulnerability	Asking questions encourages others to ask questions and participate
Keep stories here, take lessons out	Safe spaces allow for vulnerability, which translates into mutual learning and shared experiences
Your voice is important, make space	Rejoice in the shared experience that occurred and share the lessons with those who could not be present
Connect the dots	Ensure that you and others have the space and time to contribute to the community
Accept differences	Hear the issues and put forth tractable solutions
Advocate if unsafe	Every person is unique and invaluable to the group
Assume good intent	Ensure everyone feels safe in our space, stand up for others
Be conscious of who is not in the room	Listen and ask clarifying questions
Be constructive and solution focused	As we voice our own experiences, be mindful and consider the perspectives of those not present
	Be mindful of the direction but be willing to pivot to meet the end goal

Data Availability Statement

All resources listed under §3.6 Sharing Resources are shared at the PSECCO Resource Guide website (PPLW, 2024). Responses to the leadership exercise presented in §3 Community Priorities are located at Zenodo (Fair et al., 2024).

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