Towards diverse representation and inclusion in soil science in the United States

Tiffany L. Carter, Lydia L. Jennings, Yamina Pressler, Adrian C. Gallo, Asmeret Asefaw Berhe, Erika Marín-Spiotta, Christopher Shepard, Teamrat Ghezzehei, and Karen L. Vaughan*

T.L. Carter, Department of Agriculture, Austin Peay State University, P.O. Box 4607, Clarksville, TN 37044; L.L. Jennings, Department of Environmental Science, University of Arizona, 1110 E. South Campus Drive, Tucson, AZ, 85719; Y. Pressler, Natural Resources Management and Environmental Sciences, California Polytechnic State University, 1 Grand Avenue, San Luis Obispo, CA, 93407; A.C. Gallo, Department of Crop and Soil Science, Oregon State University, 3017 Agriculture and Life Sciences Building, Corvallis, OR 97331; A.A. Berhe, Department of Life and Environmental Sciences, University of California, Merced, CA 95340; E. Marín-Spiotta, Department of Geography, University of Wisconsin-Madison, 550 North Park Street, Madison, WI, 53706; C. Shepard, Department of Plant and Soil Sciences, University of Kentucky, 1100 Nicholasville Road, Lexington, KY, 40546; T. Ghezzehei, Department of Life and Environmental Sciences, University of California-Merced, Merced, CA, 95340; K.L. Vaughan, Ecosystem Science and Management Dept., University of Wyoming, 1000 E. University Ave., Laramie, WY, 82071.

*Corresponding author (karen.vaughan@uwyo.edu, 307-766-3414).

This article has been accepted for publication and undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1002/saj2.20210.

ACKNOWLEDGEMENTS

The authors thank Beth Jacques and Susan Chapman at ASA-CSA-SSSA membership services for their timely, helpful responses to all data requests. EMS and AAB acknowledge support from NSF HRD **1725879 and 1725650.** We recognize and thank the countless individuals who walked this path before us, paving the way for equity and the strength to voice our concerns.

The authors acknowledge that this examination of diversity in soil science is in no way complete. Data are lacking for several dimensions of diversity, including gender, sexual orientation, gender identity, persons with disabilities, and socio-economic status, among others. The data and discussion presented here, though incomplete, are meant to serve as a critical starting point for further discussions and analyses about how our academic and professional community can equitably serve all members of our global society. We acknowledge that identity categorization is a complex topic with changing definitions over time. Here we use consistent terminology for clarity and recognize that some readers may prefer different terms.

Core Ideas:

- Soil science is one of the least diverse subdisciplines of the earth and natural sciences.
- Addressing the lack of diversity in soil science requires data on representation and a commitment from societies.
- We highlight some of the barriers to equitable representation in U.S. soil science.
- We provide actionable recommendations to improve equity in soil science.
- Diversity and inclusion pave the path towards a more equitable soil science.

Towards diverse representation and inclusion in soil science in the United States

ABSTRACT

Soil science is one of the least diverse subdisciplines within the agricultural, earth, and natural sciences. Representation within soil science does not currently reflect demographic trends in the U.S. We synthesize available data on the representation of historically marginalized groups in soil science in the U.S. and identify historical mechanisms contributing to these trends. We review education and employment information within academic and the federal government, land-grant university participation, and available Soil Science Society of America (SSSA) membership data to gain insight into the current state of representation within soil sciences and implications for the future of this discipline. Across all domains of diversity, historically marginalized groups are underrepresented in soil science. We provide recommendations toward recognizing diversity within the field, improving and encouraging diversity within the SSSA, and suggested responses for both individuals and institutions toward improving diversity, equity, and inclusion.

Keywords: diversity, representation, soil science, ethnicity, race, gender, soil scientists, soil science, inclusion

Abbreviations: BIPOC, Black, Indigenous people of color; DEI, Diversity, Equity, and Inclusion; LGBTQ+, lesbian, gay, bisexual, transgender, queer, plus other sexual and gender minorities;

MANRRS, Minorities in Agriculture, Natural Resources, and Related Sciences; NSF, National Science Foundation; STEM, science, technology, engineering, and math; SSSA, Soil Science Society of America; UNDRIP, United Nations Rights of Indigenous Peoples; USDA, United States Department of Agriculture.

BACKGROUND

The history of soil science, similar to the history of the United States, has been told through an incomplete lens, obfuscating and purposefully removing the contributions of Indigenous peoples and other groups persistently excluded and marginalized from the dominant narrative. This narrow view threatens the ability of soil science to contribute to solving some of our most pressing environmental and social challenges and hinders efforts to diversify the discipline (Berhe, 2020). Addressing the lack of diversity in soil science requires a clear understanding of representation within the discipline — a clarity that has not yet been achieved.

Here, we identify and discuss mechanisms that preclude marginalized voices in soil science, from both a historical and contemporary perspective. We frame the current lack of representation around the historical context in which the discipline developed, because meaningful change will only arise when soil scientists and their affiliated scientific institutions recognize and acknowledge this history. Then, we synthesize available data on the representation of historically marginalized communities in soil science in the U.S., including Black, Indigenous, and People of Color (BIPOC), international scholars, women, LGBTQ+ individuals, disabled people, and people from economically-disadvantaged communities. Finally, we explicitly outline a path forward for meaningful change for individual soil scientists, academic institutions, and scientific societies.

Representation in soil science as a legacy of historical policies

Redressing the current state of social inequity in soil science requires an acknowledgement of historical events that gave rise to our discipline today and shape our current institutions. Western soil science is rooted in colonization, manifest destiny, and westward expansion. This has led to the displacement of Indigenous people from their traditional lands and the enslavement of Indigenous and African people to work in agricultural production (Krauthamer, 2013). In the U.S., land-grant universities, in partnership with their respective states, have led the nation in agricultural advances since their establishment through the Morrill Act of 1862. The 1862 Morrill Act expropriated 11.3 million acres from more than 250 Indigenous tribes. This is the land upon which our agricultural research institutions are built and where the institutions, and the soil science education they elevated as a scholarly field, continue to operate (Nash, 2019; Red Shirt-Shaw, 2020). The land granted to these institutions (approximately the size of Denmark) is estimated to be worth 500 million dollars when adjusted for inflation (Gavazzi, 2020). Today, the endowment principals from the sale of these Indigenous lands and the value of unsold land of the top-ten beneficiaries exceeds 1.5 billion dollars (Lee and Ahtone, 2020).

Later, the Morrill Act of 1890 mandated that federal funds for state education be apportioned to institutions that educated African Americans, who at the time were denied admission to the majority of colleges and universities. This act encouraged continued segregation, as several states established separate, public institutions for African Americans in order to receive additional federal support, though states often underfunded these institutions (Brown and Davis, 2001). Several historically Black colleges and universities (HBCUs) were established with land-grant status.

Over 100 years later, the Equity in Educational Land-Grant Status Act designated tribal colleges and universities as land-grant institutions (1994 land-grant institutions) and provided funding to confer such land-grant status to pre-existing tribal colleges. Despite their land-grant designation, the 1890 and 1994 institutions were not granted land and were not permitted to apply for United States Department of Agriculture (USDA) integrated research, education, and extension competitive grants until 2002 (USDA NIFA, 2014). While all states meet the one-to-one non-federal matching funds requirement for their 1860 institutions, they fail to provide full match for the 1890 institutions (Congressional Research Service, 2019; Lee and Keys, 2013). Therefore, major disparities in allocation of funds to the 1860 (predominantly white) compared to the 1890 (HBCU), and 1994 (tribal) institutions still exist.

Outside the land-grant system, many US colleges and universities have a legacy of racist and exclusionary policies. Many institutions were funded by money acquired from the sale of enslaved Africans (Harris, 2015; Stein, 2016), and people of color have been repeatedly exploited by Western science for monetary and educational gain (Wynn-Grant, 2019). Until 1954, when the Supreme Court ruled that segregation in schools was unconstitutional (Brown V. Board of Education), the US education system was racially divided. Though legally changed, remnants of segregation and lack of equal education access are still present today, contributing to persistent racial and ethnic gaps in representation in higher education (Minor, 2008). While institutions of higher learning, especially land-grant institutions, are indispensable to our country's agriculture and play a major role in public education, research, and development, we must recognize that the origins of these institutions are embedded in systemic racism, discrimination, and exclusion.

Contemporary barriers to representation in soil science: Institutional and systemic bias and racism

To broaden participation in our discipline, soil scientists must also address present-day manifestations of systemic bias and discrimination. Academic institutions have historically excluded, and continue to exclude, segments of society from pursuing higher education and employment based on economic class, gender, race and ethnicity, religion and citizenship (Asai, 2020; Maríin-Spiotta et al., 2020).

Contemporary bias across the academic hierarchy affects recruitment into early-career and leadership positions, access to economic and material resources, and opportunities for career advancement. For example, racial and gender bias has been documented in faculty evaluations of postdoctoral candidates in physics and biology (Eaton et al., 2019) and in invited talks at scientific conferences in the earth and space sciences (Lerback and Hanson, 2017; King et al., 2018; Ford et al. 2019).

Bias also manifests in interpersonal relationships. Both macro- and micro-aggressions and other identity-based exclusions, coupled with feelings of isolation for groups that are numerically underrepresented, leads to lower retention in science, technology, engineering and mathematics (STEM) (Camacho and Lord 2011; Cabay et al. 2018; Yosso et al. 2009; Leath and Chavous, 2018). Harassment, exclusionary work climates, and unique challenges of fieldwork for minoritized individuals are recognized barriers to diversifying the geosciences (Nash et al., 2019; Marín-Spiotta et al., 2020). Minoritized scientists experience racial discrimination across disciplines, including the earth sciences (Dutt, 2020), ecology and evolution (Tseng et al. 2020), and medicine (Dzirasa 2020).

Racism experienced by Black, Indigenous, People of Color (BIPOC) scholars is wide ranging. Black scholars are grieving, traumatized, exhausted, infuriated, frustrated, and experiencing many other disparaging emotions as they attempt to operate in a system that presents extraordinary

barriers to their success (Dzirasa, 2020; Subbaraman, 2020). Incidents can range from having the police called on Black researchers in the field or at research institutions, seeing themselves reported in negative context in published literature, assumed to be the custodial staff at conferences, assumed to be students when they are tenured faculty, and an extra mentoring load compared to white colleagues because they are often the only Black researcher in the field (Dzirasa, 2020).

Though the Latinx population is rapidly growing in the United States, Latinx scholars remain underrepresented in STEM and soil sciences (Landivar, 2013). Farmworkers in the US are overwhelmingly Hispanic or Latinx. The children of Latinx farmworkers are more likely to be exposed to agricultural toxins (Rao et al, 2007; Fenske et al, 2000; Mills & Zahm, 2001; Simcox et al, 1995), live below the poverty line (JBS International, 2016), and face higher levels of food insecurity (Weigel et al, 2007; Quandt et al, 2004). Thus, the children of these farmworkers are not often compelled to willingly pursue careers within the field of agriculture. Latinx scholars who do pursue a STEM career often experience educational bias and racial discrimination (McGee, 2016). Latinx scholars receive differential treatment from their peers and lack mentorship from senior leadership because they are often wrongly assumed to be underqualified and incompetent (McGee, 2016; Millett and Nettles, 2006).

In addition to those shared experiences by their Black and Latinx colleagues, Indigenous scholars often face racism through invisibility (Shotton et al, 2012). In demographic literature, Native peoples continue to be relegated to an asterisk, if mentioned at all, justifying their exclusion. This leads to students feeling alone, alienated, and often derails matriculation (American Indian College Fund, 2019).

Many Indigenous people have place-based traditional knowledge that has been shaped by thousands of years of co-existence with their traditional homelands (United Nations, 2009).

However, Indigenous scholars and students often face epistemological hegemony and cultural imperialism in their studies, as they advocate for Indigenous ways of knowing, values, and contributions to be recognized in their research and education (Ogawa, 1995; Snively et a. 2001). Indigenous scholars often spend time educating peers and faculty about Indigenous people's current existence, policy, and rights, while navigating being a first generation student in higher education (American Indian College Fund, 2019).

Legacies of colonialism are alive today in research practices, most notably in what has been called "helicopter research" or "parachute research" (Willem van Groenigen & Stoof, 2020; Minasny et al., 2020). These terms describe the common practice of scientists from non-Indigenous groups and/or the Global North, conducting research on Indigenous land or in a country from the Global South (David-Chavez & Gavin, 2018). Such researchers benefit from local infrastructure and local knowledge but do not involve or value local scientists or knowledge owners as equal partners in the research process (Carroll et al, 2019; Chaudhary and Berhe 2020). Rather, "helicopter researchers" regard local communities as raw data, provide little to no benefit to local communities, and may cause these communities to rely on data that do not reflect their needs, priorities, and self-conceptions (Carroll et al, 2019). Therefore, many assumptions animated in the minds of researchers become self-verified leading to research practices that would not be ethical in other places. The journal *Geoderma* has dedicated a recent special issue (Volume 373) on how these practices enable colonial ideas to dominate the field of soil science.

Whereas, in the North America international or foreign-born immigrant students and scholars may not have the same legacy of segregation, genocide, stolen land, slavery, and barriers to intergenerational wealth as BIPOC U.S. citizens, many, in particular those from the Global South, are mistreated, harassed and discriminated in western educational institutions (Louis et al. 2017; Lee et al. 2020). Foreign-born People of Color (POC) experience persistent legacies of western colonialism,

racism, xenophobia, and discrimination during their education that leads to feelings of isolation, lack of mentorship, and underestimation of their scholarly potential (Lee et al. 2020; Mani, 2020; Yamanaka, 2018).

Many US-funded efforts to diversify STEM have focused on gender bias, and earth and soil science are no exception. Over the last decade and a half, the earth and soil sciences have seen an improvement in the percentage of faculty who are women, though these gains were small compared to the life sciences (Wilson, 2017; Vaughan et al., 2019). Still, soil science has one of the lowest proportion of women among geoscience research fields (Wilson, 2019). The focus on gender alone has primarily benefited white women, with little to no change observed for the representation of BIPOC individuals (Bernard and Cooperdock, 2018).

Other social identities are also underrepresented in soil science. Significant barriers exist to increased LGBTQ+ participation in STEM. LGBTQ+ earth scientists reported lower professional openness about their identity compared to other STEM fields, such as life and social sciences (Yoder and Mattheis, 2016) due to lower acceptance of gender non-conforming identities and assumption of heteronormative identities (Partridge et al., 2014; Hughes, 2018; Cech and Pham, 2017). Field-based training, research and work environments can be unsafe to LGBTQ+ and BIPOC (Pickrell, 2020). LGBTQ+ individuals were more likely to experience negative workplace environments in federal agencies (Cech and Pham, 2017) and in academic settings (Partridge et al., 2014). STEM LGBTQ+ professionals reported greater feelings of acceptance and openness in STEM fields with greater participation of women. Given this, we suggest that the low numbers of women in soil science (Vaughan et al., 2019) may contribute to a less inclusive culture for LGBTQ+ soil scientists. Until recently, the lack of federal protection in employment discrimination (*Bostock v. Clayton*

County, Georgia, 2020) prevented open self-identification of LGBTQ+ individuals and forced these individuals to weigh potential employment loss with being out about their identity.

Several factors cause disabled people to be under-represented in STEM fields, including, adequate preparation of students with disabilities; access to facilities, programs, and equipment; and acceptance by educators, employers, and co-workers (Burgstahler, 1994; Atchison and Libarkin, 2016). In educational and training settings, access to field excursions such as place-based field courses, can be barriers to disabled people, including mobility and vision challenges that could preclude individuals from accessing remote sites. Recent efforts have focused on overcoming challenges to accessibility in the geosciences, with a particular emphasis on field training and research, much of which would be relevant for soil scientists (Marshall and Thatcher 2019; Carabajal and Atchison 2020). Acknowledging challenges coupled with the benefits of immersive field work is important for ensuring individuals are welcomed into a safe, inclusive, equitable environment, ripe for learning and advancing (Slaton, 2013).

For many students, the lack of access to outdoor spaces and socioeconomic status can be early barriers to careers in soil science. Socioeconomic status is multifaceted as it incorporates income, financial security, social status, social class, and access to resources including higher education. Students from low-socioeconomic backgrounds are less likely to perform well in the classroom and are thus less likely attend college and pursue STEM majors than their higher-income counterparts (Rozek et al., 2019; Moakler and Kim, 2014). The academic achievement gap between students of high and low socioeconomic status can be greater than differences in racial achievement gaps (Rozek et al., 2019), and at times race and socio-economic status overlap. The reduction in academic achievement limits education and career opportunities, thus perpetuating the continued cycle of low-socioeconomic status (Rozek et.al, 2019).

Who are soil scientists? A look at the data

The lack of diversity in STEM has been acknowledged over the past few decades (Miriti, 2020). Although the enrollment rate of racially and ethnically diverse students at doctoral programs within the United States has increased over the past decade (de Bray et al., 2019), there has been little progress in the earth and soil sciences (Bernard and Cooperdock, 2018; Dutt, 2020). Due to the lack of demographic data for soil scientists, we sought information from several sources that, despite not explaining the entire field, sheds light on the lack of diversity. Bachelor and Doctorate degrees earned by field of degree, ethnicity, and race of recipients were collected for 2018 from the National Science Foundation, National Center for Science and Engineering Statistics (2019). Demographics of federal employment in Soil Science and related disciplines were collected from the United States Office of Personnel Management for 2019 (2020). United States population demographics for 2018 were collected from the United States Census Bureau (2020). Soil Science Society of America (SSSA) membership data were collected for 2019 and were obtained from Alliance of Crop, Soil Science Societies, and Environmental Science Societies.

The representation of minoritized racial and ethnic groups in the agricultural, natural resource, and earth sciences at the university-level is vastly smaller than their representation within the U.S. population (Figure 1). Though the U.S. population is diversifying quickly, access to higher education does not currently reflect this diversity. Conversely, when aggregated, all STEM bachelor's degrees awarded better reflect the ethnic and racial distribution of the United States with some discrepancies (Figure 1). Similarly, soil science, agronomy, ecology, and geology had an overall lower racial and ethnic diversity of earned doctorates than all of STEM combined in 2018 (Figure 1; National Science Foundation, National Center for Science and Engineering Statistics, 2019). Ethnic

and racial diversity among those who earned soil science doctorates is dismal with 88, 9, and 3% of recipients identified as white (non-Hispanic), Hispanic or Latinx, and Black or African American, respectively (Figure 1).

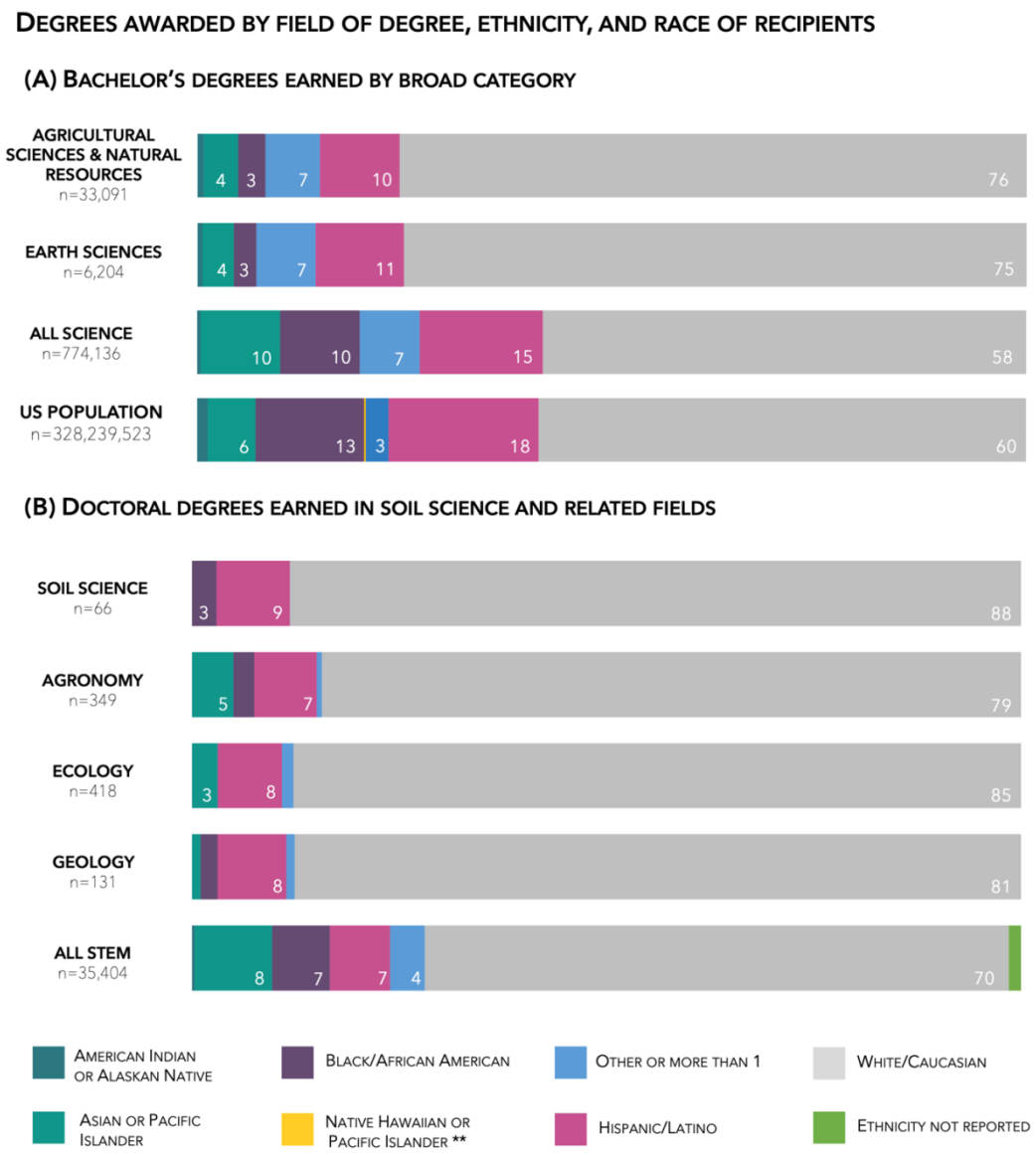

Figure 1. Summary of percentage of (A) bachelor's degrees earned by field of degree, ethnicity, and race of recipients in agricultural sciences and natural resources, earth sciences, all science disciplines in 2018 compared to the population of the United States (United States Census Bureau, 2020) and

summary of earned (B) doctorates in soil science and related fields in 2018 (National Science Foundation, National Center for Science and Engineering Statistics, 2019). Broad field of degree categories are presented to illustrate the general fields in which soil scientists are trained at the university level. Due to the interdisciplinarity of soil science, many soil scientists earn degrees that fall in categories outside of "soil science" specifically, and these are examples of some alternate disciplines. Numbers on the graph indicate the percent of total within each category with values only being presented if greater than 2%.

The ethnic demographics of professional soil scientists and those in related fields do not reflect the diversity of US citizens (Figure 2). The lack of racial and ethnic representation among federally-employed soil scientists is indisputable and contributes to the continued barriers to diversity and representation described above. Demographic data of the SSSA membership serves as a reflection of soil scientists in the United States, though members are not required to disclose demographic information and only approximately half submitted racial or ethnic background information in their member profiles (Figure 2).

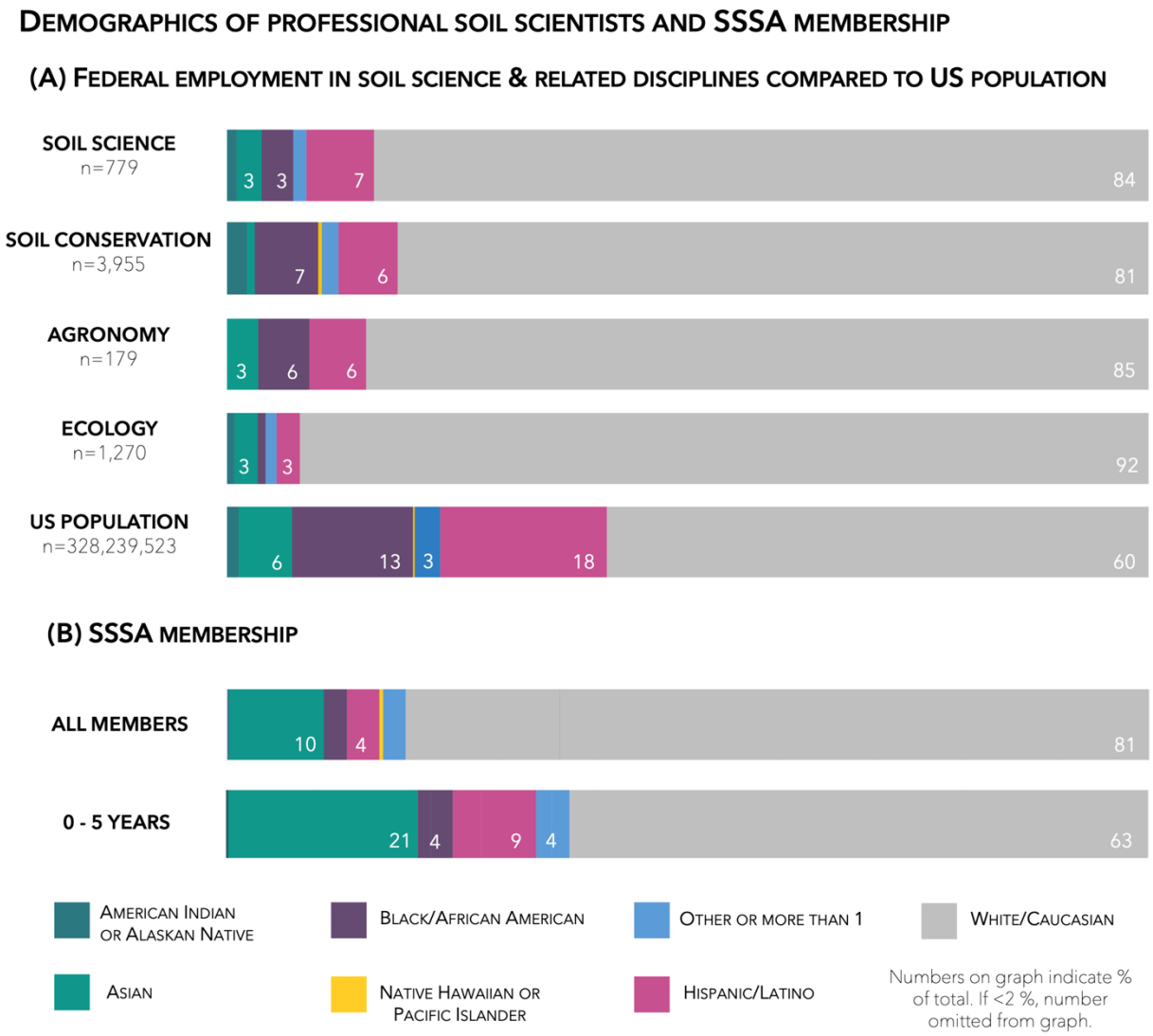

Figure 2. Demographics of (A) federal employees in soil science (0470, soil science series) and related disciplines (0457 soil conservation series, 0471 agronomy series, and 0408 ecology series) compared to the population of the United States (Office of Personnel Management, 2020; United States Census Bureau, 2020). (B) Soil Science Society of America (SSSA) members who self-identified both ethnicity and gender for all members (A, 52% of 5911 members reported) and those who have been members for only the past 0 to 5 years (B, 15.7% of 2,666 members reported). Of the total SSSA membership (n = 5911) who have been members for 0 to 5 years (n = 2,666), 20.9% are undergraduate students, 46.8 % are graduate students, 31.4% are professional members, and less than 1% are corporate

representative and emeritus members. SSSA membership data were obtained from Alliance of Crop, Soil Science Societies, and Environmental Science Societies, an umbrella organization of SSSA. Data are presented from 2019 and numbers on the graph indicate the percent of total within each category with values only being presented if greater than 2%.

The soil science discipline is, quite literally, the study of the land, however, the membership of SSSA does not equitably encompass members from all land-grant institutions. Approximately 84% (16 of 19) of the 1890's land-grant institutions (HBCUs) are represented in SSSA membership compared to 100% membership from original 1862 land-grant institutions. The SSSA is also represented by members from five HBCUs that are not land-grant institutions. Currently, SSSA has no members from any of the 1994 land-grant institutions (Tribal colleges). Though not necessarily land-grant institutions, it is important to note that SSSA membership is represented at only 6.5% (27 of 415) of the nation's currently eligible Hispanic serving institutions.

Representation and participation of women in soil science in the US has been extensively reviewed by Vaughan et. al (2019), however, it is important to consider that women of color experience additional barriers to participation in the soil sciences that their white counterparts do not. Soil scientists lack properly curated gender demographic data, due in part to the general lack of gender non-conforming identities available as options for data collected on gender demographics. The SSSA now provides the following options for voluntary gender data collected about members: *female*, *gender non-binary*, *male*, and *prefer not to answer* (Susan Chapman, personal communication, 2020). As a global scientific society, effort needs to be placed on understanding who our community is and what they need to be successful. Without these data, we, as a soil science community, will be unable to be inclusive and thrive into the future.

Women remain under-represented in soils-related careers, soil science leadership positions, and as soil science award recipients (Vaughan et al., 2019). Women account for far less than half of the membership (29% in 2018) of the SSSA (Vaughan et al., 2019). Of the individuals who self-reported both gender and ethnicity in 2019 (52% of members), women as a whole make up 21% of the SSSA membership (Supplemental Materials (SM1). Women who identify as racial or ethnic minorities (American Indian or Alaskan Native, Asian, Black/African American, Hispanic/Latino, Native Hawaiian or Pacific Islander, or other) make up 22% of all racial and ethnic minority reporters, meaning, women are generally represented in the same percentages overall as with members from under-represented groups in the SSSA (SM1). Only 15.7% of the 2,666 members of SSSA who have been members for 0 to 5 years reported both ethnicity and gender representing significant uncertainty in the future diversity of SSSA members (SM1). Within this group, 37.2% identify as non-white (SM1) and are a population within the soil science community that should a focus of inclusion efforts. These individuals are present, but either leave the soils community or do not matriculate into the professional society over time.

Individuals who self-identify as LGBTQ+ are estimated to make up approximately 4.5% of the US population (Newport, 2018). This percentage is an estimate, as we still lack a national assessment of the US LGBTQ+ community, as well as a comprehensive census of the LGBTQ+ community in STEM and soils-related fields. Yoder and Matthias (2016) completed one of the first assessments of the LGBTQ+ STEM professionals (including academic and non-academic); of 1427 surveyed LGBTQ+ respondents, 7% were in the earth sciences field. No data exist to assess LGBTQ+ representation in soils-related sciences or professional societies, such as SSSA. In soils-related federal employment, 2.7% of the USDA workforce identified as LGBT, and 84.4% identified as heterosexual or “straight” (2015 OPM FEVS). These data are not sufficient, as 13.0% of surveyed USDA employees preferred not to respond, and not all employees responded to the question, providing an incomplete view of

LGBTQ+ representation in soils-related fields. Self-selection of survey participants is a primary issue with many of these surveys, and therefore the results may not fully reflect the attitudes or participation of LGBTQ+ people in STEM.

Disabled people can face significant bias in science (Atchison and Libarkin, 2016). Of the non-institutionalized U.S. population between 18 and 64 years of age, 10.6% has one or more types of disability, ranging from hearing, vision, cognitive, ambulatory, self-care, and independent living challenges among others (U.S Census Bureau, 2016). Data available from NSF reports that 7.9% of employed US scientists and engineers within the biological, agricultural, and environmental life sciences reported one or more disabilities (NSF-NCSES, 2015). Data on disabled people within soil science specifically is lacking. We do not know how many disabled people work within the discipline nor what type(s) of disabilities are represented. These data are critical to identifying and removing the barriers to accessibility in soil science.

The international student population in the U.S. has been growing steadily since the 1950s and constitutes a significant proportion of higher education students, contributing $45 billion to the US economy (US Department of Commerce, 2018). International students represent 12% of all master's degrees and 26.7% of doctoral degrees earned in the United States (Davis, 1996), and 62% of all international students receive the majority of their funds from sources outside of the US (Open Doors, 2019). However, the representation of graduate students and professionals from international backgrounds in soil science remains unclear and more data is needed to address barriers to their success.

As STEM and the field of soil science continue in a diverse world, we must recognize and address the needs of the whole person, not just one aspect of their identity (Miriti, 2020). Strategies to enhance diversity in STEM from an intersectional perspective (e.g. Armstrong and Jovanovic,

2017; Nuñez et al. 2020) will continue to provide insight to the soil science discipline and SSSA to formulate new approaches for fostering diversity.

Actions for improving and encouraging diversity and inclusion in soil science

Increasing diversity, equity, and inclusion in soil science is a matter of social justice. We call on all soil scientists to actively engage in anti-racist, anti-misogynistic, and anti-exclusionary actions at the individual, institutional, and societal level. We urge soil scientists to reflect on their spheres of influence within their institutions and commit to the necessary path forward at each of these levels of engagement (*sensu* Schell et al, 2020). Scientific associations, in particular, have the opportunity to lead cultural and structural change in the discipline (Marin-Spiotta et al. in review). In the geosciences, two recent petitions led by the community outline important steps for societies and agencies to commit to breaking down many of the barriers to equitable participation (https://www.change.org/p/geoscientists-call-for-a-robust-anti-racism-plan-for-the-geosciences and https://notimeforsilence.org/).

Individual actions

- Reflect on your role within soil science and commit to building an anti-racist research group (Chaudhary and Berhe, 2020).
- Acknowledge racism and colonialism in soil science and educate students by developing and implementing an anti-racist pedagogy.
- Learn the history of the land in which your institutions and field sites reside, and discuss the history with your trainees, employees, and students.

- Encourage, support, and fund research and travel for undergraduate students from historically marginalized communities.
- Support students in their efforts to foster community through outreach activities, networking, and social media.
- Promote the scholarship of minoritized scientists, through collaborations, citations, invitations as keynote speakers, panelists, and symposia organizers.
- Be a publicly open ally for minoritized scholars.
- Acknowledge intersectionality. For example, the experiences of LGBTQ+ who identify as white and cis-gender are not equivalent to the experiences of BIPOC queer and transgender people.
- Intentionally work to hire, promote, and retain diverse faculty.
- Provide and participate in professional development focused on inclusivity for disabled students.
- Collaborate with research partners from international and Indigenous communities.
- Fulfill formalized obligations through the United Nations Rights of Indigenous Peoples (UNDRIP) (UN General Assembly, 2007; Wilkinson et al., 2020).

Institutional response and actions

- Build relationships with and recruit from community colleges, tribal colleges, and HBCUs.
- Partner with organizations already working to represent underserved communities such as National Black Farmers Association, Indigenous Food & Agriculture Initiative, The Native American Agricultural Fund, the Latino Farmers & Ranchers Association, Minorities in

Agriculture, Natural Resources, and Related Sciences (MANRRS), and the Society for the Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS).

- Provide accommodations that ensure inclusive pathways into soil science careers for diverse individuals while challenging social perceptions of ability (Atchison and Libarkin, 2016).
- Fairly compensate public engagement, outreach, and labor intended to increase diversity and improve workplace climate.
- Redesign evaluation and promotion processes to value contributions to DEI.
- Mandate that all scholars contribute to DEI efforts. Do not rely on volunteers or untenured faculty to perform the institutional work that helps the university, department, or college appear more diverse than it really is.
- Recognize the discriminatory nature and unnecessary hurdles of requiring internships for graduation. Provide paid internships for first generation and underrepresented students.
- Acknowledge and address the different educational needs of BIPOC students and scholars.

Scientific society-level response and actions

- Adopt a public statement of values around the society's commitment to diversity, equity and inclusion,
- Evaluate current practices in all society activities, including membership recruitment, grants, awards and honors, meeting planning, selection of journal review boards, society leadership, granting boards, and subdivision chair positions.
- Diversify membership of society leadership roles and all society committees.
- Implement DEI plenary sessions with no other concurrent sessions at national conferences to send a non-verbal message that DEI is a high priority.

- Do not organize society-level meetings and events in states and territories that have Religious Freedom Restoration Acts that allow businesses and private organizations to discriminate against members of the LBGTQ+ community on the grounds of religious objections.
- Fund and conduct systemic studies of society and workplace climate to evaluate and address barriers to participation specific to the society.
- Provide mentorship and funding for recruitment programs aimed at showcasing soil science disciples to historically underserved high schools (e.g. SSSA's Gateway Scholars program).
- Include leadership and senior society members on DEI committees, rather than relying only on early career researchers or POC, who have the most risk and may face reprisals for raising concerns.
- Normalize DEI work by deliberately mainstreaming it into all actions, processes, and policies of the society, rather than viewing the work as "additional".

Towards a diverse and inclusive soil science community

First and foremonst, building a diverse and inclusive scientific community is a moral imperative. Our soil science community should stive to achive this DEI goal because it is the right thing to do. But, we also acknowledge that, in addition to being end goals of their own, diversity and inclusion lead to more creative ideas, more productive teams, and greater scientific innovation (Page, 2017; Nielsen et al., 2014; Hofstra et al., 2020). In fact, scientific contributions from minoritized scientists are more novel and innovative than their non-minoritized counterparts, but these ideas are disproportionately devalued or discounted in scientific discourse (Hofstra et al. 2020). They also play a disproportionate role in advancing diversity and inclusion in the field (Jimenez et al., 2019). We do not suggest that we should address the lack of representation in soil

science only for scientific gain or improvement — it is a moral imperative to serve all people with equitable science practices. Despite this, members of historically marginalized communities are not well supported within the field of soil science.

As scholars, educators, and managers of the soil, our work is universally relevant. Soils are an integrated part of lived-in landscapes that are grounded in the varied perspectives and expertise of those who manage, study, and live within them. Soils are also central to addressing environmental degradation, a global crisis that continues to disproportionately impact historically marginalized communities and the diverse global population that depends on soil for food, nutritional security, and climate change mitigation (Berhe, 2020). More still, the demographics of the US are changing toward a more diverse, majority-minority population in the coming decades (Colby and Ortman, 2015). We need a diverse soil science workforce to effectively prioritize and implement critical resource management to serve the growing human population. We cannot address the grand environmental challenges that lie ahead of us while representing the communities we are here to serve without the diverse representation of ideas and lived-experiences in the soil science discipline. We call on all soil scientists to join us in creating a more just and equitable soil science to better serve and protect soils and humanity.

References

American Indian College Fund. 2019. Creating Visibility and Healthy Learning Environments for Native Americans in Higher Education: Declaration of Native Purpose in Higher Education: An Indigenous Higher Education Equality Initiative. Denver, Colorado. https://collegefund.org/wp-content/uploads/2020/01/Creating-Visibility-and-Healthy-Learning-Environments-for-Natives-in-Higher-Education_web.pdf (Accessed 23 September 2020).

Armstrong, M.A., and Jovanovic, J. 2017. The intersectional matrix: Rethinking institutional change for URM women in STEM. Journal of Diversity in Higher Education. 10:216-23. https://doi.org/10.1037/dhe0000021

Asai, David J. 2020. Race matters. Cell 181.4: 754-757.

Atchinson, C.L., and Libarkin, J.C. 2016. Professionally held perceptions about the accessibility of the geosciences. Geosphere. 12(4):1154-1165. https://doi.org/10.1130/GES01264.1

Avraamidou, L. 2020. Science identity as a landscape of becoming: rethinking recognition and emotions through an intersectionality lens. Cultural Studies of Science Education. 15:323-345. https://doi.org/10.1007/s11422-019-09954-7

Berhe, A. 2020. The climate-change community desperately needs to address historic inequities. Time. https://time.com/5864693/climate-change-racism/ (Accessed 23 September 2020).

Bernard, R.E., Cooperdock, E.H.G. 2018. No progress on diversity in 40 years. Nature Geoscience. 11:292–295. https://doi.org/10.1038/s41561-018-0116-6

Brown, M.C. and Davis, J.E. 2001. The Historically Black College as Social Contract, Social Capital, and Social Equalizer. Peabody Journal of Education. 76, 31-49. https://doi.org/10.1207/S15327930PJE7601_03

de Brey, C., Musu, L., McFarland, J., Wilkinson-Flicker, S., Diliberti, M., Zhang, A., and Wang, X. 2019. Status and Trends in the Education of Racial and ethnic groups 2018 (NCES 2019-038). Washington, DC: National Center for Education Statistics U.S. Department of Education. https://nces.ed.gov/pubs2019/2019038.pdf (Accessed 23 September 2020).

Camacho, M. M. and Lord, S.M. 2011. Microaggressions in engineering education: Climate for Asian, Latina and White women. 41st ASEE/IEEE Frontiers in Education Conference. Rapid City, SD. https://doi.org/10.1109/FIE.2011.6142970

Carabajal, I.G., and Atchison, C.L. 2020. An investigation of accessible and inclusive instructional field practices in US geoscience departments. Advances in Geoscience. 53:53-63. https://doi.org/10.5194/adgeo-53-53-2020

Carroll, S.R., Rodriguez-Lonebear, D. and Martinez, A., 2019. Indigenous Data Governance: Strategies from United States Native Nations. Data Science Journal, 18(1):31. http://doi.org/10.5334/dsj-2019-031

Charleston, L.J., Adserias, R.P., Lang, N.M., and Jackson, J.F.L. 2014. OINtersectionality and STEM: The role of Race and Gender in the Academic Pursuits of African American Women in STEM. Journal of Management Policy and Practice. 2:17-37.

Chaudhary, B. and Berhe, A.A. 2020. Ten Simple Rules for Building an Anti-Racist Lab. PLOS Computational Biology. https://doi.org/10.32942/osf.io/4a9p8

Cech, E. A., Pham, M. V. 2017. Queer in STEM organizations: Workplace disadvantages for LGBT employees in STEM related federal agencies. Social Sciences. 6(12). https://doi.org/10.3390/socsci6010012

Colby, S., J. Ortman. 2015. Projections of the size and composition of the U.S. population: 2014 to 2060. U.S. Census Bureau. March 2015. P25-1143. https://www.census.gov/content/dam/Census/library/publications/2015/demo/p25-1143.pdf (Accessed 23 August 2020).

Crenshaw, K. 1989. Demarginalizing the Intersection of Race and Sex: A Black Feminist Critique of Antidiscrimination Doctrine, Feminist Theory and Antiracist Politics. University of Chicago. https://chicagounbound.uchicago.edu/uclf/vol1989/iss1/8 (Accessed 10 August 2020)

Burgstahler, S. 1994. Increasing the representation of people with disabilities in science, engineering, and mathematics. Information Technology and Disability. December1994. 1(4). https://www.washington.edu/doit/increasing-representation-people-disabilities-science-engineering-and-mathematics (Accessed 23 September 2020).

David-Chavez, D.M., Gavin, M.C. 2018. A global assessment of Indigenous community engagement in climate research. Environmental Research Letters. 13:123005. https://doi.org/10.1088/1748-9326/aaf300

Dutt, K. 2020. Race and racism in the geosciences. Nature Geoscience 13:2-3. https://doi.org/10.1038/s41561-019-0519-z

Dzirasa, K. 2020. For Black scientists, the sorrow is also personal. Cell. https://doi.org/10.1016/j.cell.2020.06.028

Fenske, R.A., Kissel, J.C., Chensheng, L., Kalman, D.A., Simcox, N.J., Allen, E.H., Keifer, M.C. 2000. Biologically Based Pesticide Dose Estimates for Children in an Agricultural Community. Environmental Health Perspectives. 108(61):515-520.

Gavazzi, S.M. 2020. Why Congress Should Give An Additional $1.5 Billion To Historically Black Colleges And Universities. Forbes. https://www.forbes.com/sites/stephengavazzi/2020/04/24/why-congress-should-give-15-billion-to-historically-black-colleges-and-universities/#724fb4e2ec1e

(Accessed 23 September 2020).

Hanna, R., Linden, L. 2009. Measuring Discrimination in Education. National Bureau of Economic Research. Working Paper 15057. https://www.nber.org/papers/w15057.pdf (Accessed 23 September 2020).

Harris, L.M. 2015. Shades of segregated past in today's campus troubles. The conversation. https://theconversation.com/shades-of-segregated-past-in-todays-campus-troubles-38818 (Accessed 7 August 2020).

Hofstra, B., Kulkarni, V.V., Galvez, S.M.N, He, B., Jurafsky, D., and McFarland, D.A. 2020. The Diversity–Innovation Paradox in Science. Proceedings of the National Academy of Science of the United States of America. 117(17):9284-9291 https://doi.org/10.1073/pnas.1915378117

Hughes, B.E. 2018. Coming out in STEM: Factors affecting retention of sexual minority STEM students. Science Advances. https://doi.org/10.1126/sciadv.aao6373.

Keene, A., Tachine, A.R., Nelson, C.A. 2017. Braiding our (In)visibility: Native Women Navigating the Doctoral Process through Social Media. Journal Committed to Social Change on Race and Ethnicity. 43-76.

Krauthamer, B. 2013. Black Slaves, Indian Masters: Slavery, Emancipation, and Citizenship in the Native American South. Chapel Hill. University of North Carolina Press.

JBS International. 2016. Findings from the National Agricultural Workers Survey (NAWS): A Demographic and Employment Profile of United States Farmworkers. U.S. Department of Labor, Employment and Training Administration. Research Report No. 13.https://www.dol.gov/sites/dolgov/files/ETA/naws/pdfs/NAWS_Research_Report_13.pdf (Accessed 23 September 2020).

Leath, S. and Chavous, T. 2018. Black women's experiences of campus racial climate and stigma at predominantly white institutions: Insights from a comparative and within-group approach for STEM and non-STEM majors. Journal of Negro Education. 87:125-139. https://doi.org/10.7709/jnegroeducation.87.2.0125

Lee, A. 2020. Toward a conceptual model of hierarchical microaggression in higher education settings: a literature review. Educational Review, 1-32. https://doi.org/10.1080/00131911.2020.1793735

Lee, R. and Ahtone, T. 2020. Land-grab universities: Expropriated Indigenous land is the foundation of the land-grant university system. High County News. Know the West.

https://www.hcn.org/issues/52.4/indigenous-affairs-education-land-grab-universities/print_view (Accessed 7 August 2020).

Lee, J.M., and Keys, S.W. 2013. Land-Grant but unequal: State One-to-one match funding for 1890 land-grant universities. Association of Public Land-Grant Universities Office of Access and Success, Publication 3000-PB1. Washington, DC. https://www.aplu.org/library/land-grant-but-unequal-state-one-to-one-match-funding-for-1890-land-grant-universities/file (Accessed 23 September 2020).

Landivar, L.C. 2013. "Disparities in STEM Employment by Sex, Race, and Hispanic Origin," American Community Survey Reports, ACS-24, U.S. Census Bureau, Washington, DC.

Lombardi, A., Murray, C., and Dallas, B. 2013. University Faculty Attitudes toward Disability and Inclusive Instruction: Comparing Two Institutions. The Journal of Postsecondary Education and Disability. 26(3):221–232.

Louis, D. A., Thompson, K. V., Smith, P., Williams, H. M. A., and Watson, J. 2017. Afro-Caribbean immigrant faculty experiences in the American Academy: Voices of an invisible black population. The Urban Review. 49(4):668-691.

Mani, B.V. 2002. Fighting the shadow pandemic. Inside Higher Ed. 14 May 2020. https://insidehighered.com/views/2020/05/14/inclusive-teaching-needed-help-combat-xenophobia-racism-and-discrimination-brought (Accessed 14 May 2020).

Marín-Spiotta, E., Barnes, R.T., Berhe, A.A., Hastings, M.G., Mattheis, A., Schneider, B., and Williams, B.M. 2020. Hostile climates are barriers to diversifying the geosciences. Advances in Geoscience. 53:117-127. https://doi.org/10.5194/adgeo-53-117-2020

Marshall, A.M., and Thatcher, S. 2019. Creatig spaces for geoscientists with disabilities to thrive. https://eos.org/opinions/creating-spaces-for-geoscientists-with-disabilities-to-thrive (Accessed 23 September 2020).

McGee, E.O. 2016. Devalued Black and Latino Racial Identities: A By-Product of STEM College Culture?. American Education Research Journal. 53:1626-1662. https://doi.org/10.3102/0002831216676572

Millett, C.M., M.T. Nettle. 2006. Expanding and Cultivating the Hispanic STEM Doctoral Workforce: Research on Doctoral Student Experiences. Journal of Hispanic Higher Education. 5:258-287. https://doi.org/10.1177/1538192706287916

Mills P., S. Zahm. 2001. Organophosphate Pesticide Residues in Urine of Farmworkers and Their Children in Fresno County, California. American Journal of Industrial Medicine. 40:571-577. https://doi.org/10.1002/ajim.10007

Minor, J. T. 2008. Segregation residual in higher education: A tale of two states. American Journal of Educationl Research. 45:861–885. https://doi.org/10.3102%2F0002831208318258

Miriti, M.N. 2020. The elephant in the room: Race and STEM Diversity. BioScience. 70:237-242. https://doi.org/10.1093/biosci/biz167

Moakler, M.W., Jr. and Kim, M.M. 2014. College Major Choice in STEM: Revisiting Confidence and Demographic Factors. The Career Development Quarterly. 62:128-142. https://doi.org/10.1002/j.2161-0045.2014.00075.x

National Science Foundation, National Center for Science and Engineering Statistics. 2015. Characteristics of Scientists and Engineers in the United States: 2013. http://ncsesdata.nsf.gov/us-workforce/2013/ (Accessed 23 September 2020).

National Science Foundation, National Center for Science and Engineering Statistics. 2019. Doctorate Recipients from U.S. Universities: 2018. Special Report NSF 20-301. Alexandria, VA. Available at https://ncses.nsf.gov/pubs/nsf20301/. (Accessed 23 September 2020).

Nash, M.A. 2019. Entangled Pasts: Land-Grant Colleges and American Indian Dispossession. History of Education Quarterly. 59:437-467. https://doi.org/10.1017/heq.2019.31

Nash, M. Nielsen, E.F., Shaw, J., King, M., Lea, M., and Bax, N. 2019. Antarctica just has this hero factor…": Gendered barriers to Australian Antarctic research and remote fieldwork. PLOS ONE. 14(1). https://doi.org/10.1371/journal.pone.0209983

Nielsen, M.W., Alegria, S., Börjeson, L., Etzkowitz, H., Falk-Krzesinski, H.J., Joshi, A., Leahey, E., Smith-Doerr, L., Woolley, A.W., and Schiebinger, L. 2017. Gender diversity leads to better science. Proceedings of the National Academy of Sciences of the United States of America. 114(8):1740-1742. https://doi.org/10.1073/pnas.1700616114

Núñez, A.-M., Rivera, J., and Hallmark, T. 2020. Applying an intersectionality lens to expand equity in the geosciences. Journal of Geoscience Education. 68:97-114. https://doi.org/10.1080/10899995.2019.1675131

Office of Personnel Management. 2020. Fedscope. https://www.fedscope.opm.gov/employment.asp. (Accessed 29 July 2020).

Office of Personnel Management. 2015. Federal Employee Viewpoint Survey (FEVS). Washington, D.C. (Accessed 24 June 2020).

Ogawa, M. 1995. Science Education in a Multiscience Perspective. 79(5): 583-593. https://doi.org/10.1002/sce.3730790507

Page, S.E. 2017. The diversity bonuys: How great teams pay off in the knowledge economy. Princeton University Press.

Patridge, E. V., Barthelemy, R. S., Rankin, S. R. 2014. Factors impacting the academic climate for LGBQ STEM faculty. Journal of Women and Minorities in Science and Engineering. 20(1):75-98. https://doi.org/10.1615/JWomenMinorScienEng.2014007429

Quandt, S.A., A.T Arcury, J. Early, J. Tapiac, J.D. Davisa. 2004. Household Food Security Among Migrant and Seasonal Latino Farmworkers in North Carolina. Public Health Reports. December. 119:568-576. https://doi.org/10.1016/j.phr.2004.09.006

Rao, P., S.A. Quandt, A.M. Doran, B.M. Snively, A. Thomas. 2007. Pesticides in the Homes of Farmworkers: Latino Mothers' Perceptions of Risk to Their Children's Health. Health Education & Behavior. 34:335-353. https://doi.org/10.1177/1524839907301409

Rozek, C.S., Ramirez, G., Fine, R.D., and Beilock, S.L. Reducing socioeconomic disparities in the STEM pipeline through student emotion regulation. PNAS. 116, 1553-1558. (2019) https://doi.org/10.1073/pnas.1808589116

Scoones, I. 2015. Transforming soils: transdisciplinary perspectives and pathways to sustainability. Current Opinion in Environmental Sustainability. 25: 20-24.

Shotton, H.J., Lowe, S.C., Waterman, S.J., Garland, J. 2012. Beyond the Asterisk: Understanding Native Students in Higher Education. https://doi.org/10.15763/issn.2642-2387.2019.5.1.60-80

Simcox, N.J., R.A Fenske, S.A Wolz, I. Lee, D.A. Kalman. 1995. Pesticides in Household Dust and Soil: Exposure Pathways for Children of Agricultural Families. Environmental Health Perspectives. https://doi.org/10.1006/enrs.2000.4076

Slaton, A.E. 2013. Body? What body? Considering Ability and Disability in STEM Disciplines: 120th American Society for Engineering Education Annual Conference and Exposition. https://peer.asee.org/body-what-body-considering-ability-and-disability-in-stem-disciplines (Accessed 23 September 2020).

Snively, G., Corsiglia, J. 2001. Discovering Indigenous Science: Implications for Science Education. Science Education. 85:6-34. https://doi.org/10.1002/1098-237X(200101)85:1%3C6::AID-SCE3%3E3.0.CO;2-R

Stein, S. 2016. Universities, slavery, and the unthought of anti-Blackness. Cultural Dynamics. 28:169-187. https://doi.org/10.1177/0921374016634379

United States Census Bureau. 2020. QuickFacts United States. https://www.census.gov/quickfacts/fact/table/US/PST045219 (Accessed 29 July 2020).

Tseng, M., El-Sabaawi, R.W., Kantar, M.B., Pantel, J.H., Srivastava, D.S., and Ware, J.L. 2020. Strategies and support for Black, Indigenous, and people of colour in ecology and evolutionary biology. Nature Ecology and Evolution. https://doi.org/10.1038/s41559-020-1252-0

USDA NIFA. NIFA 1994s: The first 20 years of the 1994 land-grant institutions. (2015) https://nifa.usda.gov/sites/default/files/resource/1994%20LGU%20Anniversary%20Pub%20WEB_0.pdf (Accessed 7 August 2020)

Van Groenigen, J.W., Stoof, C.R. Helicopter research in soil science: A discussion. Geoderma. 373, (2020). https://doi.org/10.1016/j.geoderma.2020.114418

Vaughan, K., Miegroet, H.V., Pennino, A., Pressler, Y., Duball, C., Brevik, E.C., Berhe, A.A., and Olsen, C. Women in Soil Science: Growing Participation, Emerging Gaps, and the Opportunities for

Advancement in the USA. Soil Sci. Soc. Am. J. 83, 1278–1289 (2019).

https://doi.org/10.2136/sssaj2019.03.0085

Weigel, M.M., R.X. Armijos, Y.P. Hall, R. Orozco. 2007. The Household Food Insecurity and Health Outcomes of US–Mexico Border Migrant and Seasonal Farmworkers. Journal of Immigrant and Minority Health. 9:157-169. https://doi.org/10.1007/s10903-006-9026-6

Willem van Groenigen, J., Stoof, C.R. 2020. Helicopter research in soil science: A discussion. Geoderma. 373. https://doi.org/10.1016/j.geoderma.2020.114418

Wilson, C. 2019. Percentage of female faculty working within geoscience research fields. American Geosciences Institute: Current Geosciences. 8 March 2019. 136. https://www.americangeosciences.org/sites/default/files/currents/Currents-136-WomenResearchFields.pdf (Accessed 23 September 2020).

Wilson, C. 2017. Female geoscience faculty representation grewe steadily between 2006-2016. American Geosciences Institute: Current Geosciences. 17 August 2017. 119. https://www.americangeosciences.org/sites/default/files/currents/Currents-119-WomenFaculty2006-2016.pdf (Accessed 23 September 2020).

Wood, C.V., Campbell, P.B., McGee, R. 2016. An incredibly steep hill: How gender, race, and class shape perspectives on academic careers among beginning biomedical PhD students. Journal of Women and Minorities in Science and Engineering. 22:159-181. https://doi.org/10.1615/JWomenMinorScienEng.2016014000

Wynn-Grant, R. 2019. On reporting scientific and racial history. Science. 365:1256–1257. https://doi.org/10.1126/science.aay2459

Yamanaka, Aoi. 2018. Phenomenological Exploration on the Experience of Microaggression by Women Faculty of Color and Its Relations to Self-Efficacy. Diss. George Mason University. https://search.proquest.com/docview/2159484913 (Accessed 23 September 2020).

Yoder, J. B., Mattheis, A. 2016. Queer in STEM: Workplace experiences reported in a national survey of LGBTQA individuals in science, technology, engineering, and mathematics careers. Journal of Homosexuality. 63(1):1-27. https://doi.org/10.1080/00918369.2015.1078632

Yosso, T., Smith, W., Ceja, M., and Solórzano, D. 2009. Critical race theory, racial microaggressions, and campus racial climate for Latina/o undergraduates. Harvard Education Review. 79:659-691. https://doi.org/10.17763/haer.79.4.m6867014157m707l