



# Long-Term Retention of Diverse Paleontologists Requires Increasing Accessibility

Aja Mia Carter<sup>1\*</sup>, Erynn H. Johnson<sup>2</sup> and Elena R. Schroeter<sup>3</sup>

<sup>1</sup> General Robotics, Automation, Sensing and Perception Lab, Electrical and Systems Engineering, University of Pennsylvania, Philadelphia, PA, United States, <sup>2</sup> Yale Institute for Biospheric Studies, Earth and Planetary Sciences and Mechanical Engineering and Materials Science, Yale University, New Haven, CT, United States, <sup>3</sup> Department of Biological Sciences, North Carolina State University, Raleigh, NC, United States

Geoscience encompasses a variety of scientific subdisciplines aimed at exploring, understanding, and predicting global phenomena. Yet despite its global reach, the geosciences are the least diverse of the STEM disciplines. Paleontology, a subdiscipline which prides itself on unearthing the diversity of life, comprises no greater level of diversity among its researchers than geosciences overall. This deficiency is in direct opposition to the level of public interest generated by paleontological research. Paleontology has broad educational appeal and has been leveraged in various ways to promote STEM learning. However, despite this widespread interest, there is an overwhelming decrease in the diversity of participants in paleontology at increasing levels of academia. At each academic career stage, from undergraduate to tenured faculty, the number of underrepresented (URP) and underserved persons (USP) dwindles. Here we highlight and discuss barriers to access experienced by URP and USP researchers that hinder their ability to progress at every level of the academic journey post-K-12, focusing on the track to a tenured professorship. Neglecting to consider the unique barriers faced by URPs and USPs when developing curricula, building programs, and evaluating productivity perpetuates the chronic lack of diversity in paleontology, regardless of individual interest in pursuing a career in the field. We also suggest actionable items for instructors, as well as members of the scientific community in positions of power and policymakers. While the lack of diversity in paleontology is dire, the field is small enough that individuals have the potential to make a meaningful difference.

**Keywords:** mentorship, accessibility, paleontology—general, equity, retention

## 1. INTRODUCTION

In the wake of civil unrest in the United States during the summer of 2020, there has been a renewed interest in diversity, equity, and inclusion worldwide. Recent studies have highlighted that the geosciences, specifically, remain the least diverse STEM discipline, having shown no increase in diversity metrics over 40 years (Bernard and Cooperdock, 2018; Dutt, 2020; Ali et al., 2021b). The lack of diversity paleontology is particularly striking; thus, small successes in diversity initiatives could represent proportionately large increases in overall diversity. Yet, over the past 20 years, the total number of non-white students in the United States who have received a Ph.D. with a paleontological

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### \*Correspondence:

Aja Mia Carter  
caja@seas.upenn.edu

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focus has been in the single digits (**Figure 1**) (Kang, 2021).<sup>1</sup> However, paleontology as a broad appeal. Beyond museum displays of extinct organisms that draw visitors from all walks of life, dinosaurs capture the public's attention to the extent that billion-dollar media franchises have been built from their appeal (e.g., *Jurassic Park*). In K-12, student encounters with fossils often spark enthusiasm for discovery. At the university level, courses that address the history of Earth and its changing life often draw students from a broad range of majors (often non-STEM majors completing a credit requirement in science). The widespread appeal of paleontology is not reflected in its researchers, as underrepresented and underserved scientists are lacking at all academic levels (Ranganathan et al., 2021) (**Figure 1**). This is a problem that requires we look beyond "promoting interest in STEM" as a solution.

A solution *must* be found, as the perpetual lack of diversity in paleontology is costly to the field. It is well-documented that diversity breeds innovation (Medin and Lee, 2012; Hofstra et al., 2020). Without meaningful efforts to expand its diversity in all capacities, paleontology is missing out on the innovative approaches to studying ancient life that a field with a myriad of different perspectives can produce.

## 2. DIVERSE IDENTITIES: UNDERSERVED, UNDERREPRESENTED, AND INTERSECTIONAL BACKGROUNDS

To begin, we must identify the often vague concept of "diversity" to understand the complex identities held in the term. In this perspective we use "diversity" to encompass "underserved" and "underrepresented" populations (**Figure 2**). An individual may belong to both underserved and underrepresented groups, these groups are not mutually exclusive or always related. For example, impoverished white students are underserved, but not racially underrepresented, in STEM. Layered on top of an USP/URP identity there is an additional identity derived from familial history of college education. USP and URP students are much more likely to be the first person in their family to attend college (1G) (Bui, 2002; Short et al., 2020; Hamrick, 2021). Thus, the host of challenges faced by 1G students when it comes to their long term retention (Hutchison, 2017) must be addressed as part of any efforts to foster diversity in geoscience fields.

Acknowledging the unique identities of USP/URP scientists is an essential part retention initiatives in paleontology. Differences in cultural norms and expectations, access to monetary resources, and academic literacy can create obstacles to participation that impact a person's productivity and success as a paleontologist (Collier and Morgan, 2008; Núñez et al., 2020). Moreover, there are many complexities regarding the intersection of race, gender, socioeconomic status, and other identities within individuals that must be carefully considered when making efforts to increase accessibility and diversity within scientific communities (Collins, 2019). We urge readers interested in developing more diverse programs to explicitly consider an intersectional approach

(Bernard and Cooperdock, 2018; Núñez et al., 2020; Ormand et al., 2021).

Many discussions about increasing diversity in the geosciences and related fields have involved a call to action, which includes listening to, and learning from, the experiences of marginalized groups (Ali et al., 2021b; Cramer et al., 2021). It is our assertion that the key to building diversity in paleontology is in recognizing and addressing the barriers that exist to the participation of underserved and underrepresented populations in higher academia, so that diverse scholars may be retained long-term. Therefore, increasing diversity and long-term academic retention requires diverse scientists to be visible at the highest levels of academia, as these researchers play a critical role in supporting future paleontologists from diverse backgrounds.

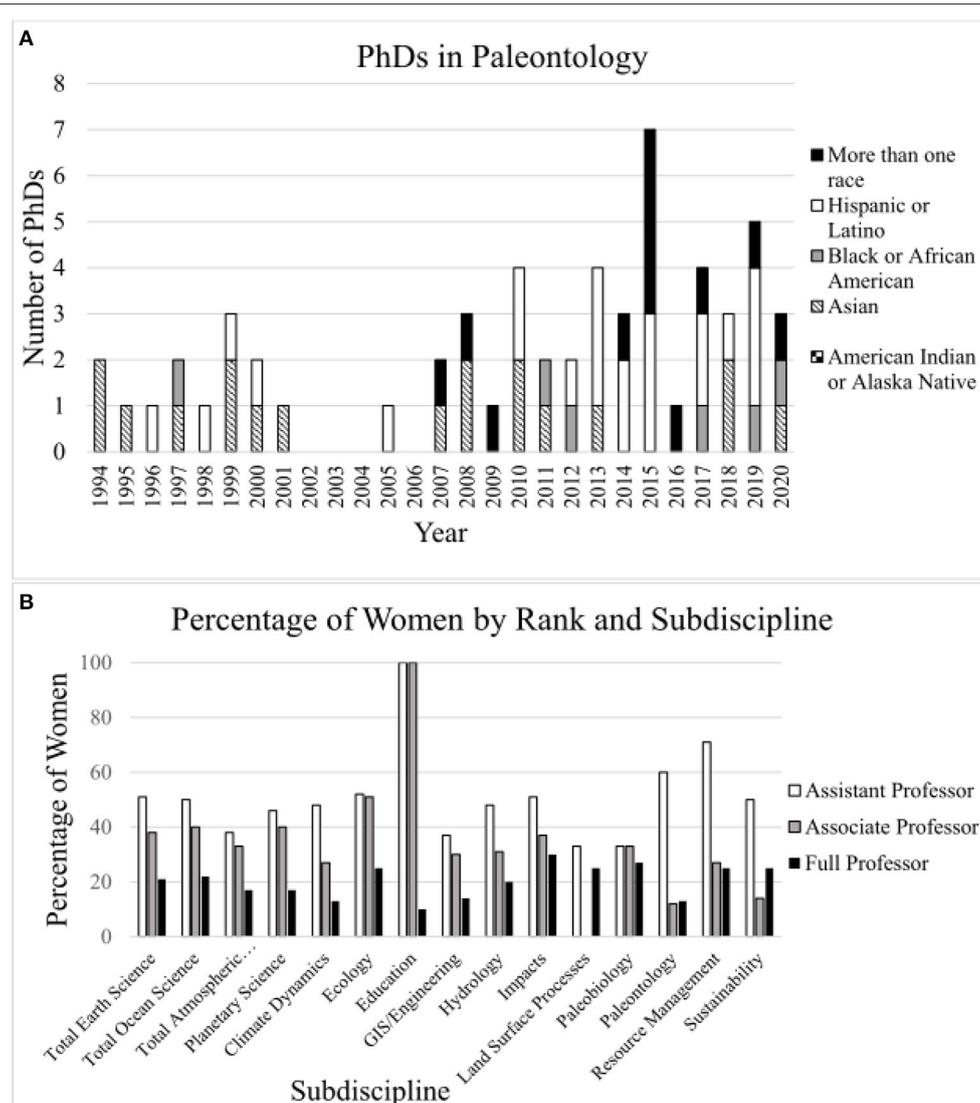
**Positionality statement:** We, the authors, are former students and now early career professionals and educators representing different intersections of underrepresented and underserved women in paleontology. Dr. Aja Carter is a black, American-born daughter of Bajan immigrant and African American parents. With the benefit of financial assistance, she attended a private high school in Fort Washington, PA and received a full scholarship to attend Drexel University for her undergraduate degree. Dr. Erynn Johnson is an Asian-American, multiracial daughter of an immigrant. She is the second generation in her family to attend college. Dr. Elena Schroeter is a white, first-generation college student from a working-class, blue-collar family and a graduate of the public school system of Chicago's south side. Her path into science research was made possible by access to informal science outreach programs targeted for low-income students and financial aid scholarships. Thus, we are personally aware that inadequate long-term accessibility for these groups creates distinct barriers to academic career progression within paleontology. In this perspective, we speak to our own experiences; however, many other identities are crucial to the growth of diversity in paleontology (e.g., sexual orientation, gender identity, physical capabilities), and we highly encourage readers to actively listen to the voices that represent diversity in all forms.

## 3. UNDERGRADUATE STUDENTS: EFFORTS TO INCREASE ACCESSIBILITY IN AND OUTSIDE THE CLASSROOM

### 3.1. Inside the Classroom

Paleontology is often part of large lecture courses in earth science that reach broad audiences (including non-STEM majors), and it can be challenging to address a diverse range of students different backgrounds and experiences. Suggested methodologies to bridge the gap between 2G+ students and 1G/USP/URP students include: a detailed discussion of the syllabus, encouraging or requiring office hours, highlighting free University resources like tutors and teaching centers, and relating topics of study to student background (Collier and Morgan, 2008; Bang and Medin, 2010). The inclusion of explicit language in the syllabus that invites students to discuss obstacles they are experiencing to their participation in class with their professor is of particular benefit

<sup>1</sup>Data collected from NSF Survey of Earned Doctorates 1990-2021.



**FIGURE 1 | (A)** PhDs awarded to paleontologists in the U.S. 1994–2020 (Kang, 2021). **(B)** Percentage of women in geoscience subdisciplines at 62 U.S. universities (Ranganathan et al., 2021).

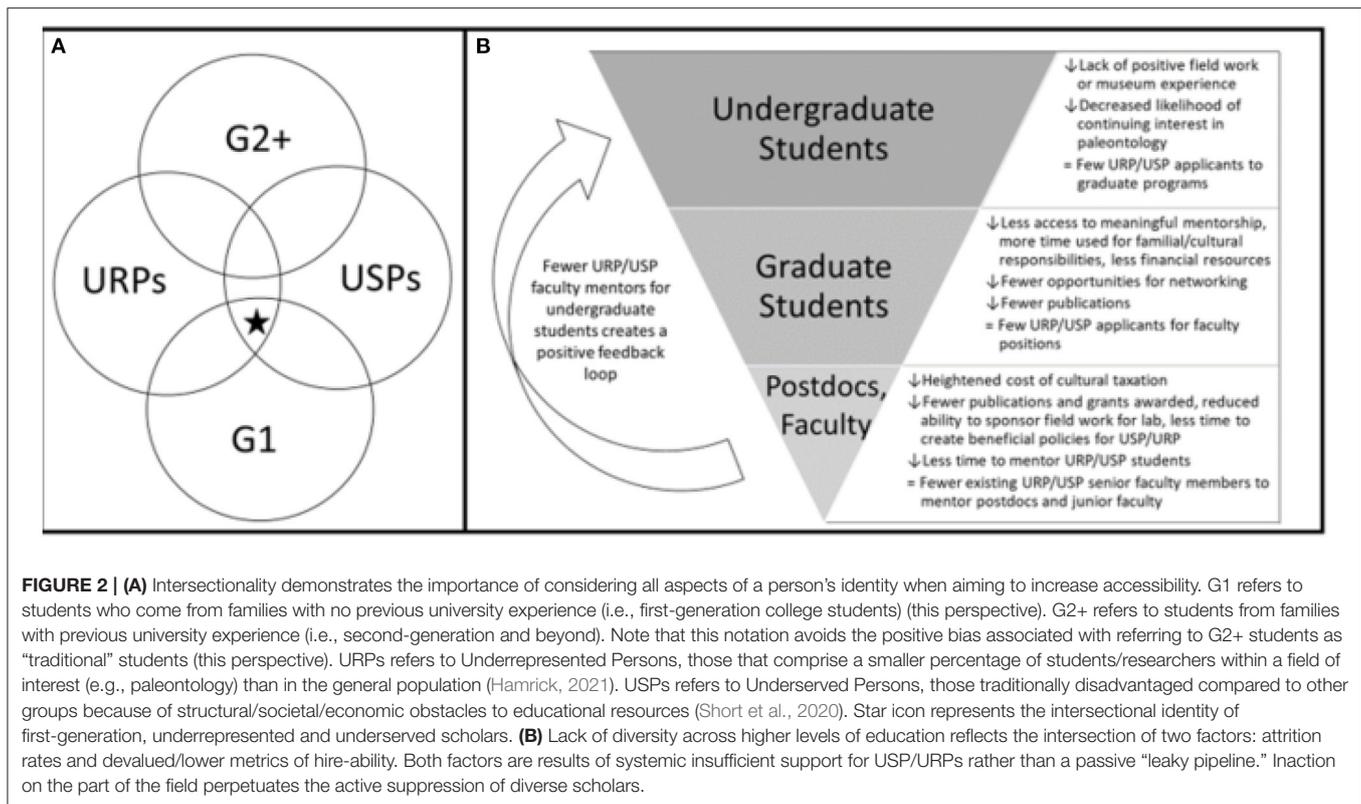
to 1G students: 1G students often struggle to reach out because of perceptions that instructors are unwilling to help (Hutchison, 2017). By making accessibility changes 1G/USP/URP students perform as well as their white 2G+ cohorts, drop out less from courses, and generally raise average overall class performance (Stephens et al., 2012). We have identified two main categories of activities that can be modified to increase accessibility in paleontology-related courses: bringing museums to students, and intentionally discussing diverse paleontologists in class.

### 3.1.1. Bringing Museums to Students

Visiting museums is a time-honored tradition of paleontology courses. However, many USP/URP students experience significant financial difficulties that may result in their inability to pay for a museum ticket, transportation, or other associated

fees. Even if expenses are covered, students may not be able to afford taking time off work outside of class time. We suggest alternatives including: bringing in departmental, museum-loaned, or personally owned specimens for students to observe and discuss, or using 3D scanned specimens that have been uploaded to museum websites<sup>2</sup>. Additionally, many universities have facilities where 3D scanned specimen files can be transformed into physical objects that can be brought to the classroom (Johnson and Carter, 2019). Rather than creating assignments that ask students to identify or assess skeletal mounts in a museums, one can also ask students to evaluate their choice of toys, movies, or webcasts that depict paleontological ideas. Such assignments allow students to

<sup>2</sup>Smithsonian 3D CollectionsMorphoMuseumMorphoSource.



utilize existing resources/interests, demonstrate their new found knowledge, and make paleontology accessible and relevant (Jackson et al., 2016). If museum visits are included, care should be taken to explicitly consider how to remove financial barriers for USPs. Simply assigning a visit as an optional/extra credit assignment, does *not* increase accessibility. Although this approach technically removes a mandatory financial burden from USPs, they may remain unable to access enrichment/course credit their peers benefit from.

### 3.1.2. Diverse Representation in Curricula

Creating an inclusive atmosphere entails demonstrating that all students' presence is meaningful. We recommend creating a syllabus that includes diverse paleontologists<sup>3</sup> (e.g., Mary Anning) and scientists (e.g., Marguerite Thomas Williams) alongside those who are classically referenced. Additionally, discussing fur trappers and Native American navigators highlights how enslaved and native persons found the first fossils in the western United States (Pickrell, 2020; Monarrez et al., 2021).

It is also important to acknowledge the context of early paleontological research, especially when it was harmful. For example, Edward Drinker Cope used his work on evolution to dehumanize recently freed African Americans and prevent women's voting rights (see Padian, 1998). Although it may seem prudent to avoid these topics for fear of alienating USP/URPs, we

argue that ignoring these topics sends the message that members of the field are unwilling to reconcile the plights of USP/URPs. In our experience, it is beneficial to discuss historical context and highlight the need for USP/URP perspectives. We recommend working with University diversity and equity offices on how best to broach these topics.

### 3.2. Outside the Classroom

Conducting field research can be a powerful experience for future paleontologists. However, the culture surrounding fieldwork is often antithetical to creating a sustained interest in paleontology. Sometimes, fieldwork is treated as a rite of passage that defines whether a student is suited for rugged outdoor research (Black, 2018; Marin-Spiotta et al., 2020; Pickrell, 2020; Viglione, 2020). This exclusionary culture, combined with the (often insurmountable) financial barriers (e.g., affording camping equipment or travel expenses, Figure 2) to fieldwork some students experience, must be addressed if a diverse field is to be achieved.

Just like in a classroom, it is essential to make students feel safe and welcomed in the field. However, additional factors must be considered when developing a field program. Many 1G/USP/URP students may not have outdoor experience, making fieldwork uninviting or intimidating. If they are the only person from their socioeconomic or ethnic background, USP/URP students may feel isolated and uncomfortable on a prolonged trip. URPs may feel unsafe in some geographic areas because of their

<sup>3</sup>Paleontological Research Institute's Daring to Dig.

race, ethnicity, gender identity, or sexual orientation (Marín-Spiotta et al., 2020). Women often feel unsafe in the field due to experiences with harassment, which are exacerbated by the predominant drinking culture in the geosciences (Black, 2018; Forrester, 2021).

We have compiled several suggestions for increasing the accessibility of fieldwork from our own experiences and discussions with others:

1. Providing lodging (hotel/motel) removes the assumption of pre-existing experience camping.
2. Local trips are more accessible to students that are uncomfortable with prolonged or overnight excursions for health, personal, or safety reasons.
3. Syllabi should acknowledge students may have a wide variety of concerns about fieldwork (i.e., not only logistical concerns), and voicing any and all concerns is welcomed (see Ali et al., 2021a; Demery and Pipkin, 2021 for additional recommendations).

Of course, these suggestions are also applicable for making fieldwork accessible to graduate students, whom we will focus on in the following section.

#### 4. GRADUATE STUDENTS: PROTECTING TIME

The transition to the role of a graduate student creates *new* challenges for URP/USP students as they are tasked with generating and disseminating knowledge through research and scientific communication (e.g., publications, presentations). Again, financial barriers can create significant obstacles for 1G/URP/USP, who often do not have and will not generate financial resources, and allocate more of their stipend to support families than 2G+ students (Nunez and Cuccaro-Alamin, 1998). Thus, their participation in some key research activities (e.g., conferences) can be stifled. Conference attendance is an essential, yet expensive endeavor (Ford et al., 2019). Even if some structural expenses (e.g., membership) can be offset, personal expenses (e.g., professional attire) can be burdensome on a 1G. It is unlikely that the student will have networking opportunities conferences provide unless they enter into a cycle of revolving debt. The systemic nature of funding issue is beyond what any one PI can fix. However, we wish to highlight how the lack of institutional funding for research activities heavily impacts and disproportionately excludes URP and USP graduate students from progressing in academia. We discuss additional barriers below.

While contending with academic and department culture, USP/URP graduate students often manage unseen and unsupported responsibilities. USP/URP students often have different cultural motivations and familial responsibilities than 2G+ students, which may affect their productivity, not due time-management difficulties, but because the academic systems does not hold space for their most immediate priorities. Many USP/URPs are care-takers for family members (Orbe, 2004). Faculty can support students who have these additional

cultural roles by discussing timelines and expectations within a framework of compassion, understanding that URP/USP students may have such additional commitments.

As a sole representative of an URP group, students can be hypervisible in a department and called upon to discuss geosciences' re-commitment to increasing diversity. This additional commitment takes time that could otherwise be allocated to research. The cost of being required to use one's time for outreach/diversity initiatives by virtue of one's identity is known as cultural taxation (Lee and Maynard, 2017). As the discipline aims to increase diversity, we must create a culture that recognizes this work *as* work, and values these efforts more significantly when evaluating the productivity of graduate students and early career professionals (Davies et al., 2021).

#### 5. EARLY CAREER RESEARCHERS AND DOCTORATE HOLDERS

A recent sample of geology departments in the United States demonstrated a great gender disparity in faculty in the subdisciplines of paleontology and paleobiology (Ranganathan et al., 2021). Furthermore, of the few female scientists present in geology departments, the majority were white women (the authors were unable to account for whether these women had been 1G or USP students). The unsurprising lack of diversity in paleontology at the faculty level, if unacknowledged, can be self-perpetuating because when present, USP/URP faculty can serve as essential mentors and representation for the USP/URP students (Lee and Maynard, 2017). Moreover, diverse professors can become policymakers for their departments and be vital advocates for increasing accessibility for USP/URP students. Thus, efforts to create an environment in which USP/URP faculty in paleontology remain supported throughout their early career are an essential part of building and maintaining diversity among the lower academic ranks.

Achieving a doctoral degree does not immediately confer security. USP/URP scientists may enter this stage of their career with considerably fewer resources, due to the lingering effects of a lack of resources as a graduate student. USP/URP researchers are left at a disadvantage precisely at a time in their career when these skills are most needed. For researchers with no generational wealth or personal savings, factors like cost of relocation, length of initial contract, and access to health benefits can dictate what postdoctoral/faculty positions they apply for, regardless of whether there are positions more suitable for their research interests, expertise, and experience level.

Consistently across STEM fields *effective* mentorship is the prevailing framework for helping URP/USP early researchers and faculty members feel their strongest sense of self-efficacy (i.e., belief that one's actions will enact what one wants). Self-efficacy is the most significant predictor of faculty retention (Towers et al., 2020). Without focused practice in mentorship, faculty mentors generally pick junior faculty most similar to themselves leaving many USP/URP junior faculty without mentorship (Lee and Maynard, 2017; Towers et al., 2020).

Finally when it comes to evaluation for early career professionals, we recommend considering again cultural taxation. The cost of cultural taxation is even higher for early career professionals than for graduate students, as a person's publication record is of more significant concern for pre-tenure faculty. If the field seeks to increase diversity through initiatives that require this extra commitment, it must be commensurately valued by hiring and tenure review committees (Lee and Maynard, 2017; Davies et al., 2021).

## 6. DISCUSSION

Paleontology is a highly interdisciplinary science—applying various ideologies and methods from other fields. Unfortunately, the field also carries the biases and inequities of related fields. While issues of accessibility stemming from racism and socioeconomic barriers are not unique to paleontology, the combination of existing problems across STEM compound in such a small field. It is concerning that despite the well-documented impacts of phenomena like cultural taxation, the field of paleontology has yet to make meaningful progress in retaining URP/USPs across all levels of academia.

Our hope is that with our suggestions, persons with the power to make decisions for their students/departments will consider allocating existing funding to complement ongoing accessibility initiatives. There are also actionable items to lower barriers for URP/USP students that do not require additional financial resources. Firstly, consider intersectional approaches to accessibility initiatives: consider how different aspects of students' identities impact their learning. Second, it is important to have diverse scholars at the faculty level, as not only to increase visibility for students, but also to advocate for students with similar experiences. Third, we ask scholars in positions of power (faculty, committees, department chairs) to consider how cultural taxation affects 1G/USP/URP scholars. We urge those

on committees which evaluate CVs (hiring, tenure, etc.) to value these activities afford them weight that reflects the urgency of increasing diversity in paleontology. While the lack of diversity in the field is dire, paleontology labs (which constitute a minor fraction of biology/earth science departments) are small enough that changes from a single advisor can make meaningful impacts. We hope that by sharing our experiences and suggestions for actionable items we have demonstrated that the effort to increase diversity in paleontology is achievable.

## DATA AVAILABILITY STATEMENT

Publicly available datasets were analyzed in this study. This data can be found here: <https://www.nsf.gov/statistics/srvydoctorates/>, <https://zenodo.org/record/4749665#.YgxdSojMJPY>.

## AUTHOR CONTRIBUTIONS

AC and EJ compiled the data from literature and created the figure. AC, EJ, and ES wrote the manuscript. All authors contributed to the article and approved the submitted version.

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## REFERENCES

- Ali, H., Anadu, J., and Jackson, C. (2021a). *Ten Steps to Protect BIPOC Scholars in the Field*. EOS. doi: 10.1029/2020EO150525
- Ali, H. N., Sheffield, S. L., Bauer, J. E., Caballero-Gill, R. P., Gasparini, N. M., Libarkin, J., et al. (2021b). An actionable anti-racism plan for geoscience organizations. *Nat. Commun.* 12, 1–6. doi: 10.1038/s41467-021-23936-w
- Bang, M., and Medin, D. (2010). Cultural processes in science education: supporting the navigation of multiple epistemologies. *Sci. Educ.* 94, 1008–1026. doi: 10.1002/sce.20392
- Bernard, R. E., and Cooperdock, E. H. (2018). No progress on diversity in 40 years. *Nat. Geosci.* 11, 292–295. doi: 10.1038/s41561-018-0116-6
- Black, R. (2018). *The Many Ways Women Get Left Out of Paleontology*. Washington, DC.
- Bui, K. V. T. (2002). First-generation college students at a four-year University: Background characteristics, reasons for pursuing higher education, and first-year experiences. *Coll. Student J.* 36, 3–12.
- Collier, P. J., and Morgan, D. L. (2008). "Is that paper really due today?": Differences in first-generation and traditional college students' understandings of faculty expectations. *Higher Educ.* 55, 425–446. doi: 10.1007/s10734-007-9065-5
- Collins, P. H. (2019). *Intersectionality as Critical Social Theory*. Durham, NC: Duke University Press. doi: 10.1515/9781478007098
- Cramer, B. D., Peate, D. W., and Saltzman, M. R. (2021). Gsa statement on diversity and a challenge to the society, geoscience departments, and the geoscience community at large. *Geoscience* 31, 3. doi: 10.1130/GSATG472GW.1
- Davies, S. W., Putnam, H. M., Ainsworth, T., Baum, J. K., Bove, C. B., Crosby, S. C., et al. (2021). Promoting inclusive metrics of success and impact to dismantle a discriminatory reward system in science. *PLoS Biol.* 19, e3001282. doi: 10.1371/journal.pbio.3001282
- Demery, A.-J. C., and Pipkin, M. A. (2021). Safe fieldwork strategies for at-risk individuals, their supervisors and institutions. *Nat. Ecol. Evol.* 5, 5–9. doi: 10.1038/s41559-020-01328-5
- Dutt, K. (2020). Race and racism in the geosciences. *Nat. Geosci.* 13, 2–3. doi: 10.1038/s41561-019-0519-z
- Ford, H. L., Brick, C., Azmitia, M., Blaufuss, K., and Dekens, P. (2019). Women from some under-represented minorities are given too few talks at world's largest earth-science conference. *Nature* (2019) 576:32–5. doi: 10.1038/d41586-019-03688-w
- Forrester, N. (2021). Reconsidering the role of alcohol in the scientific workplace. *Nature* 600, 86–88. doi: 10.1038/d41586-021-03773-z
- Hamrick, K. (2021) *Women, Minorities, and Persons With Disabilities in Science and Engineering Glossary*. National Science Foundation.

- Hofstra, B., Kulkarni, V. V., Galvez, S. M.-N., He, B., Jurafsky, D., and McFarland, D. A. (2020). The diversity-innovation paradox in science. *Proc. Natl. Acad. Sci. U.S.A.* 117, 9284–9291. doi: 10.1073/pnas.1915378117
- Hutchison, M. (2017). Influence of first generation status on students' perceptions of faculty. *College Q.* 20, n1.
- Jackson, M. C., Galvez, G., Landa, I., Buonora, P., and Thoman, D. B. (2016). Science that matters: the importance of a cultural connection in underrepresented students' science pursuit. *CBE Life Sci. Educ.* 15, ar42. doi: 10.1187/cbe.16-01-0067
- Johnson, E. H., and Carter, A. M. (2019). Defossilization: a review of 3D printing in experimental paleontology. *Front. Ecol. Evol.* 7, 430. doi: 10.3389/fevo.2019.00430
- Kang, K. (2021). *Survey of Earned Doctorates*. National Science Foundation.
- Lee, E., and Maynard, T. (2017). In class, sharing class: faculty members from low-socioeconomic status backgrounds and status visibility. *J. Work. Class Stud.* 2, 36–53. doi: 10.13001/jwcs.v2i2.6083
- Marin-Spiotta, E., Barnes, R. T., Berhe, A. A., Hastings, M. G., Mattheis, A., Schneider, B., et al. (2020). Hostile climates are barriers to diversifying the geosciences. *Adv. Geosci.* 53, 117–127. doi: 10.5194/adgeo-53-117-2020
- Medin, D. L., and Lee, C. D. (2012). Diversity makes better science. *APS Observer* 25. Available online at: <https://go.nature.com/2EixIjk>
- Monarrez, P. M., Zimmt, J. B., Clement, A. M., Gearty, W., Jacisin, J. J., Jenkins, K. M., et al. (2021). Our past creates our present: a brief overview of racism and colonialism in western paleontology. *Paleobiology* doi: 10.1017/pab.2021.28. [Epub ahead of print].
- Nunez, A.-M., and Cuccaro-Alamin, S. (1998). *US. Department of Education. National Center for Education Statistics. First Generation Students: Undergraduates Who Parents Never Enrolled in Postsecondary Education, NCES 98-082*. Washington, DC
- Núñez, A.-M., Rivera, J., and Hallmark, T. (2020). Applying an intersectionality lens to expand equity in the geosciences. *J. Geosci. Educ.* 68, 97–114. doi: 10.1080/10899995.2019.1675131
- Orbe, M. P. (2004). Negotiating multiple identities within multiple frames: an analysis of first-generation college students. *Commun. Educ.* 53, 131–149. doi: 10.1080/03634520410001682401
- Ormand, C. J., Heather Macdonald, R., Hodder, J., Bragg, D. D., Baer, E. M., and Eddy, P. (2021). Making departments diverse, equitable, and inclusive: engaging colleagues in departmental transformation through discussion groups committed to action. *J. Geosci. Educ.* 69, 1–12. doi: 10.1080/10899995.2021.1989980
- Padian, K. (1998). Jane pierce Davidson: the bone sharp: the life of Edward drinker cope. *J. Verteb. Paleontol.* 18, 243–246. doi: 10.1080/02724634.1998.10011050
- Pickrell, J. (2020). Scientists push against barriers to diversity in the field sciences. *Science* 374, 10–1126. doi: 10.1126/science.caredit.abb6887
- Ranganathan, M., Lalk, E., Freese, L. M., Freilich, M. A., Wilcots, J., Duffy, M. L., et al. (2021). Trends in the representation of women among us geoscience faculty from 1999 to 2020: the long road toward gender parity. *AGU Adv.* 2, e2021AV000436. doi: 10.1029/2021AV000436
- Short, R. A., Struminger, R., Zarestky, J., Pippin, J., Wong, M., Vilen, L., et al. (2020). Spatial inequalities leave micropolitan areas and indigenous populations underserved by informal stem learning institutions. *Sci. Adv.* 6, eabb3819. doi: 10.1126/sciadv.abb3819
- Stephens, N. M., Fryberg, S. A., Markus, H. R., Johnson, C. S., and Covarrubias, R. (2012). Unseen disadvantage: how american universities' focus on independence undermines the academic performance of first-generation college students. *J. Pers. Soc. Psychol.* 102, 1178. doi: 10.1037/a0027143
- Towers, G. W., Poulsen, J. R., Carr, D. L., and Zoeller, A. N. (2020). Mentoring for faculty from working-class backgrounds. *J. Work. Class Stud.* 5, 101–118. doi: 10.13001/jwcs.v5i1.6255
- Viglione, G. (2020). Racism and harassment are common in field research—scientists are speaking up. *Nature* 585, 15–16. doi: 10.1038/d41586-020-02328-y

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