Sea Grant's Community Engaged Internship: *Expanding Participation and Cultivating Belonging in Coastal and Ocean Sciences*

Mona Behl (corresponding author), University of Georgia, Marine Extension and Georgia Sea Grant, Athens, Georgia, USA, mbehl@uga.edu, ORCID ID: 0000-0001-9788-4575

Jane Harrison, North Carolina State University, North Carolina Sea Grant, Raleigh, North Carolina, USA

Maya Walton, University of Hawai'i at Mānoa, Hawai'i Sea Grant, Honolulu, Hawai'i, USA

Catherine Riseng, University of Michigan, MI Sea Grant College Program, Ann Arbor, MI, USA

Deidre M. Peroff, University of Wisconsin Sea Grant Institute, Milwaukee, WI, USA; ORCID 0000-0001-7738-256X

Hallee Meltzer, National Oceanic and Atmospheric Administration, National Sea Grant Office, Silver Spring, Maryland, USA, ORCID ID: 0000-0002-9897-7631

Emily Maung-Douglass, University of Delaware, Delaware Sea Grant College Program, Newark, Delaware, USA

Susan Lovelace, South Carolina Sea Grant Consortium, Charleston, South Carolina, USA

Samuel J. Lake, University of Virginia, Office of Graduate and Postdoctoral Affairs, Charlottesville, Virginia, USA

Maddie Kennedy, National Oceanic and Atmospheric Administration, National Sea Grant Office, Silver Spring, Maryland, USA

Sarah Kolesar, Oregon State University, Oregon Sea Grant, Corvallis, Oregon, USA, ORCID ID: 0000-0002-9799-101X

Davin Holen, University of Alaska Fairbanks, Alaska Sea Grant, Anchorage, Alaska, USA, ORCID ID: 0000-0002-5232-8521

Guillermo Giannico, Oregon State University, Corvallis, Oregon, USA

Karen DeMeester, University of Georgia, Carl Vinson Institute of Government, Athens, GA, USA, ORCID ID: 0000-0003-4924-7269

Brooke Carney, National Oceanic and Atmospheric Administration, National Sea Grant Office, Anchorage, Alaska, USA

Linda Chilton, University of Southern California Sea Grant, Los Angeles, California, USA

Matthew Bethel, Louisiana State University, Louisiana Sea Grant College Program, Baton Rouge, Louisiana, USA

Author contributions
All authors contributed to the conception, design, and implementation of the Community Engaged Internship program. The evaluation of the program was led by Karen DeMeester. The first draft of the manuscript was written by Mona Behl and all authors contributed to subsequent versions of the manuscript. All authors read and approved the final manuscript.

Abstract

Providing hands-on experiences to undergraduates is a common strategy to recruit and retain diverse students in geosciences. And yet, without equal attention to science identity cultivation and culturally responsive mentoring, a lack of diversity plagues scientific fields. Sea Grant's Community Engaged Internship (CEI) program is a unique initiative that engages undergraduate students in place-based coastal and ocean science research, outreach, education, law and policy, and communication projects. Students are recruited from communities that are historically underrepresented and underserved, including local, Tribal, and Indigenous communities, into a multiple month paid internship. Recruitment and selection strategies draw applicants from diverse cultural, ethnic, and socioeconomic backgrounds with unique lived experiences, skills, abilities, and interests. Interns work on community focused projects that integrate traditional and local knowledge with western ways of doing science. The program includes mentorship education and training for all participants, multi-level mentoring for students, a vibrant learning community, and extensive professional development and networking opportunities. Program evaluation results demonstrate that CEI has achieved its primary goal of increasing recruitment and participation of students from underserved communities in coastal and ocean sciences. Evaluation also sheds light on attributes of the internship that are essential for its success, namely, engagement in community-based projects, culturally inclusive mentorship education, peer-to-peer and near-peer mentoring, and cohort-building. Competitive wages and stipends, professional development and training, network-building, and institutional support are also critical. Participants report numerous benefits including personal and professional gains from their participation in the program. To date, 183 students from all 34 Sea Grant programs have graduated from the community engaged internship program.

Keywords
Community engaged, mentorship, cohort-building, historically marginalized, Tribal and Indigenous

Statements and Declarations

Competing Interests: The authors declare competing interests.

Data Availability Statement: The data that support the findings of this study are available upon request from the authors.

Declarations: The authors are thankful to the CEI advisory board members for their thoughtful review of the manuscript.

Dedication: This paper is dedicated to our colleague and friend, Dr. Michael Fraker, who passed away on April 23, 2023, at the age of 44. Mike led Michigan Sea Grant's statewide research and fellowship efforts and served on the CEI coordination committee from 2021-2023.

Acknowledgments: Behl is supported by two institutional awards (# NA18OAR417008 and NA22OAR4170116) to the University of Georgia by the National Sea Grant Office, National Oceanic and Atmospheric Administration (NOAA). Kolesar is supported by Oregon Sea Grant under award number NA22OAR4170102 from the National Oceanic and Atmospheric Administration's National Sea Grant College Program, U.S. Department of Commerce, and by appropriations made by the Oregon State Legislature. The author team is grateful to Dr. Chris Pfund at Center for the Improvement of Mentored Experiences (CIMER) for their collaboration, guidance, and support. The statements, findings, conclusions, and recommendations are those of the authors and do not necessarily reflect the views of these funders.

I. Background and Introduction

Geoscience is an all-encompassing term used to refer to the study of the Earth system (UCAR Center for Science Education, 2024). It includes multiple fields such as oceanography, atmospheric sciences, hydrology, geology, and petrology, among others. Any profession that involves understanding how the Earth system works, how it worked in the past, how it is expected to change in the future, and/or planning for future change can be a geoscience career. Geoscience career pathways include environmental scientists, engineers, planners, and managers, science technicians, educators, and jobs that do not even exist today but will be essential in decades to come. Such jobs can offer purposeful and exciting problem-solving opportunities across multiple geographic scales (from local to global), sectors (public, private,

academic), and levels of government (local, state, Tribal, regional, national, international). The geoscience workforce is expected to grow by 4.9% from 2019-2029 (Gonzales et al. 2020), yet enrollment in the United States (U.S.) geoscience programs have declined for the last several years and progressively worsened after the COVID-19 pandemic (Keane 2022). In addition to declining enrollment, geosciences are the least diverse among science, technology, engineering, and mathematics (STEM) fields (Bernard et al. 2018, Dutt 2020, NCSES 2023). One reason for lack of diversity in geosciences is an educational culture that focuses on weeding out students instead of supporting their learning, professional development, and career success. Other reasons include lack of pre-college exposure, peer support, mentorship, and access to role models (Levine et al. 2007).

To prepare a workforce that can innovate and effectively manage our planet's changing climate and dwindling natural resources, steps must be taken to increase the participation and success of individuals from communities and groups that have been historically marginalized in geosciences [2]. One strategy to increase the persistence of historically underrepresented students is to provide them with exposure to STEM fields before or during the initial year of their undergraduate program (Ghazzawi et al. 2021). Several geoscience internship programs engage undergraduate students in research projects (e.g, National Science Foundation (NSF) Research Experience for Undergraduates program; REU) and provide job training and mentorship to prepare students for a variety of careers in academia and beyond (e.g., Hollings Internship, and Significant Opportunities in Atmospheric Research and Science; SOARS). Other programs specifically engage college students from historically marginalized communities, such as the National Oceanic and Atmospheric Administration (NOAA) José E. Serrano Educational Partnership Program with Minority Serving Institutions, Leadership Alliance Summer Research Early Identification Program, and the NOAA Woods Hole Partnership Education Program. Although these programs and others like them provide students with significant experiential learning opportunities in geosciences, they lack a focus on meaningful community engagement and outreach. Often, internship programs are focused on selecting students based on metrics that may not foster diversity.

Place-based curricula and projects can be transformative experiences for engaging underrepresented students in environmental science (DeFelice et al. 2018). Science identities have been shown to be enhanced in outdoor settings and with place-based pedagogies. Because students' day-to-day lived experiences influence science interest (Lemke 2001, Roth and Tobin 2007), pathways to science careers must be relevant. Semken and others (2018) explain that place-based education, "builds directly on what is familiar to students and instructors, connects science to other disciplines or ways of knowing, and gives local context and relevance to global concepts and practices that might otherwise appear abstract or disjointed to students." Acknowledging and integrating the diverse meanings that a place holds is an essential characteristic of place-based geoscience education (Semken et al. 2018). Participants in a place-based learning community for first-year undergraduate STEM students showed a stronger sense of belonging, improved academic performance, and increased first-year persistence relative to a matched reference group (Hoisch et al. 2010, Johnson et al. 2020). In a study of middle and high school racial and ethnic minority students, they recounted the "usefulness of science" after applying STEM learning to mitigate local environmental problems (Gallay et al. 2021). Geoscience preparation can provide a stronger foundation for sustained student interest and success by linking learning to local community needs.

Students who come from predominantly Indigenous communities or places where their families have lived for generations, often have a deep sense of place, tying them to the area's lands and waters. When these students study place-based issues, they inevitably encounter traditional and local knowledge (TLK), which allows them to synthesize different ways of knowing (Riggs 2004). Traditional knowledge system or worldview of human-environment relations incorporates spirituality, cultural values, ethics, and the basic norms of society, and is passed down through generations, often through oral tradition (Berkes 1993). Local knowledge reflects the observations and experiences of people living in a region who may be, but are not necessarily, Indigenous. Both traditional and local ways of knowing and living that are connected to a specific place, or locale. Working with students from areas in which they dwell, is one way to build local science capacity in that geographic area as well as encourage the next generation of

community leaders to bring unique place-based perspectives to the scientific enterprise. Viewing science through a cultural lens positions a student to make explicit the relationship between their own held values and the problem at hand (Harris et al. 2021).

To increase participation of undergraduate students from diverse backgrounds in coastal and ocean sciences, the National Oceanic and Atmospheric Administration's (NOAA) Sea Grant network launched a one-of-a-kind internship program for undergraduate students in 2020. The program, called Community Engaged Internship (CEI) (https://seagrant.noaa.gov/Community-Engaged-Internship), has two interconnected goals: (1) foster students' self-efficacy, science identity, and interest in and knowledge of coastal and ocean science careers, and (2) create a culturally responsive mentoring community to support and mentor students from diverse backgrounds. Students are recruited from communities that have experienced low access to Sea Grant opportunities, including low-income, Tribal, Indigenous, and historically marginalized groups. Throughout their summer internship, students participate in research, education, law and policy, outreach, or communication projects that integrate TLK with western ways of doing science. Their projects are typically community-based and involve Sea Grant personnel and additional community and academic partners. In addition, students get the opportunity to develop skills in science communication, outreach, project management, conflict resolution and negotiation, and program leadership that are desirable for employers, and make students more competitive in the job market (Blickley et al. 2013).

II. Origin of CEI and How it Works

The National Sea Grant College program is a national network of 34 university-based programs that supports research, education, and outreach to enhance the practical use and conservation of coastal, marine, and Great Lakes resources to create a sustainable economy and environment (Figure 1). The program is administered by NOAA and implemented through university based federal-state partnerships at the local level. The National Sea Grant Office (NSGO) develops a strategic plan that aligns with the mission of its parent agency (NOAA) and is responsive to the priorities of coastal and Great Lakes communities across the nation. Individual Sea Grant programs develop their strategic plans through a comprehensive engagement process with a range of partners and interested parties - including those in rural and urban areas representing different cultures, races, ethnicities, and socioeconomic backgrounds - that help identify local community priorities. The network collaborates closely with local, Tribal, and Indigenous communities to ensure that solutions to coastal challenges are grounded in respect and reciprocity (e.g., Alaska Sea Grant collaborates with ~86 Tribes and Tribal entities). This engagement builds trust and sustains relationships with local communities that have various demographics, cultures, histories, and geographies. It is these long-standing and trusted relationships that uniquely position Sea Grant to recruit students from diverse backgrounds who can work on a range of local issues.

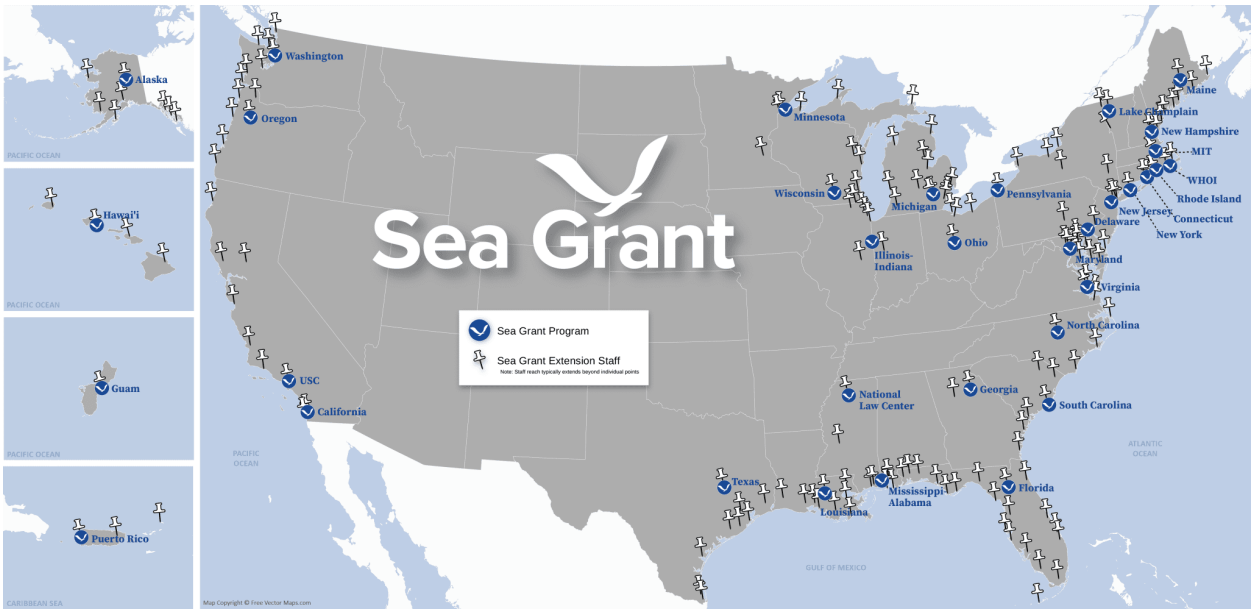

Figure 1: Map shows locations of 34 Sea Grant programs and extension staff

Central to Sea Grant's mission is preparing a diverse, innovative, and skilled workforce that contributes to enhanced health and well-being of coastal communities across the nation. Sea Grant achieves this goal by offering a range of training and professional development opportunities to individuals at different stages of their careers. For example, the John D. Knauss Marine Policy Fellowship program places graduate and recent graduate students in science-policy and policy positions within the Executive and Legislative branches of the federal government. These programs are just two examples of how Sea Grant provides technical assistance, offers continuing education credits, and hosts experiential educational programs to support individuals in a variety of different career stages and pathways.

The idea for developing CEI originated from two Sea Grant communities of practice supported by the NSGO in 2017: diversity, equity, inclusion, justice, and accessibility (DEIJA); and TLK. Through a year-long engagement process, these communities of practice developed comprehensive roadmaps outlining Sea Grant's 10-year DEIJA and TLK goals, and strategies to achieve those goals (see National Sea Grant's DEIJA and TLK visions, 2018). One of the key priorities identified by both communities of practice was to support undergraduate students from communities that historically have had less access to Sea Grant's opportunities including low-income, Tribal, and Indigenous, and historically marginalized groups. Despite support provided by individual Sea Grant programs to undergraduates, a unified national program was notably absent from the suite of student opportunities that Sea Grant provides. As a result, in 2020 the Sea Grant network launched the CEI program to provide training and professional development opportunities to undergraduate students and expose them to careers in coastal and ocean science. Funding for administration of the CEI program from 2020-2022 was provided by the NSGO through a grant to Georgia Sea Grant. This grant supported 20 CEI projects led by different Sea Grant programs during the award period. Students were recruited by individual Sea Grant programs and supported through a variety of mechanisms including state funding, omnibus funding, and other extramural support. North Carolina Sea Grant obtained a grant from the NSGO to administer the CEI program from 2023-2025.

CEI's overarching goal is to prepare a diverse, skilled, and responsible workforce that can manage risks faced by our planet and cultivate a culture of belonging in geosciences through mentorship and peer support. The unique positionality of the Sea Grant network also means CEI is a national program

implemented at a local scale. Students are recruited by 34 distinct Sea Grant programs, and work on place-based projects over a period of 10-12 weeks under the supervision of an academic faculty or non-academic professional. Student interns are also provided with mentoring, professional development, and networking opportunities coordinated across the Sea Grant network. Students are provided a competitive stipend or wage during their internship period. Paid internships mitigate the adverse economic and social impacts of unpaid internships and allow for a more structured, fully engaged experience as students don't have to work one or more side jobs to pay for living expenses. At the end of each summer, the CEI program culminates with a graduation ceremony wherein students present their work to a national audience, learn from their peers, and celebrate their success.

The CEI program has a flexible and dispersed leadership model consisting of a coordination committee and an external advisory board (figure 2). The coordination committee is composed of representatives from Sea Grant's DEIJA and TLK communities of practice and NSGO and is responsible for national CEI programming (e.g. virtual professional development series) including design and implementation. The committee is an open enrollment group, and participation fluctuates around 10-15 individuals who meet monthly. The coordination committee also hosts multiple informational webinars to facilitate cooperation and co-learning across the Sea Grant network and shares best practices for recruitment, engagement, and retention of students from historically marginalized, Tribal, and Indigenous communities.

Evaluation of the CEI program is led by an evaluation expert who annually assesses the program's progress and success. An external advisory board provides guidance and support to the CEI program. External advisory board members include representatives who are not affiliated with the Sea Grant network but are familiar with the mission of Sea Grant and have expertise and experience in broadening participation in geosciences and fostering culture change. These individuals serve a 3-year term. The external advisory board provides counsel on intern recruitment and selection, and engagement of students in the CEI program.

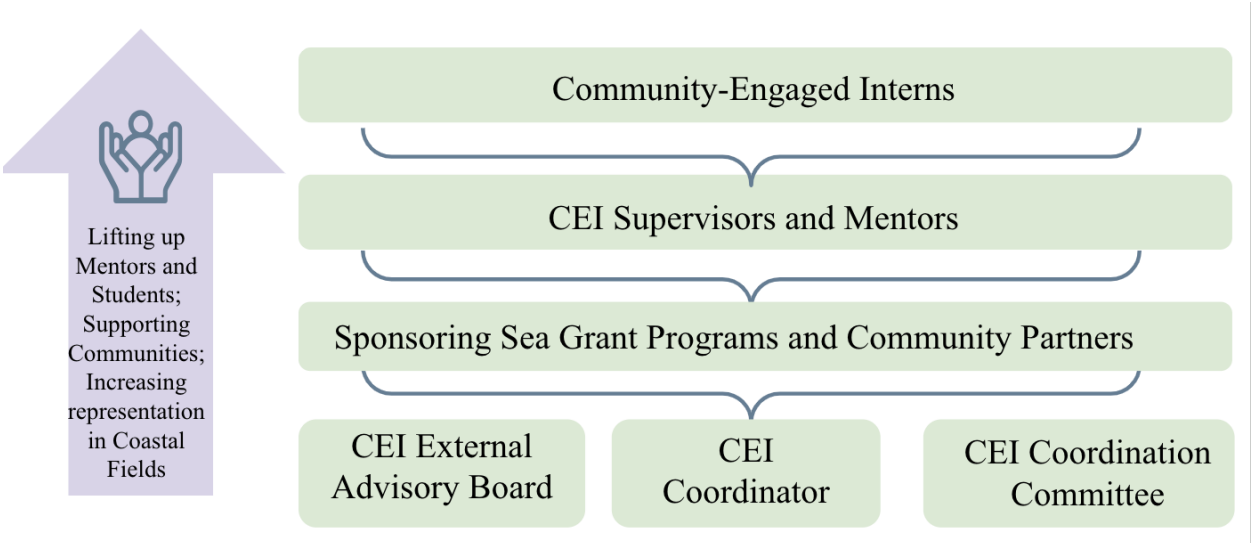

Figure 2: Schematic that shows various entities engaged in providing mentorship, guidance, and support to community-engaged interns

III. Unique Attributes of CEI

The uniqueness of CEI is multifold. Sea Grant's long-standing partnerships with coastal communities and university experts allow for *meaningful community engagement* in STEM related projects that interns undertake. Programs use a *variety of mechanisms to recruit and train students* from

historically marginalized communities, 2-year colleges, and minority-serving institutions. *Nationally coordinated professional development, mentorship, and networking opportunities* ensure that all participants - including intern supervisors and mentors and interns themselves - gain new skills and benefit from the program. Finally, CEI exemplifies a program that is *flexible, scalable, and transferable* at local and national levels. A brief overview of each of these aspects follows.

Meaningful Community Engagement: There is inherent value in including local voices in resource management and education through meaningful community engagement and outreach. Sea Grant holds this concept as a fundamental part of the program's mission and works to promote and facilitate this understanding more broadly by supporting coastal marine and Great Lakes communities in their efforts to manage the resources and ecosystems upon which their livelihoods depend. Sea Grant programs develop internship projects that link STEM training with community engagement. The intent is to foster reciprocal partnerships with communities instead of simply "checking the box" on community engagement. Student projects are funded by a variety of sources including state funding, extramural grants, and Sea Grant omnibus funding. The NSGO also provides funding to support additional student projects that are submitted by state Sea Grant programs, and competitively reviewed and approved by the CEI external advisory board.

Interns gain experience and professional skills in community engagement and outreach by working closely with an academic faculty and/or non-academic professional mentor. They are also connected to a Sea Grant liaison (usually the internship or fellowship coordinator) who provides students with guidance and support throughout their internship experience. Students learn how to work ethically with local, Tribal, and Indigenous communities, and receive training on specific methodologies, including citizen or community science, participatory research and mapping, co-development of research questions with community members, co-production of knowledge, and facilitation. A Kūlana Noiʻi professional development workshop hosted by Hawaiʻi Sea Grant teaches interns across the Sea Grant network how to build and sustain collaborative and mutually beneficial partnerships among university faculty and students conducting research, and the local communities who care for and utilize natural resources (Alegado and Hintzen, 2020). CEI mentors and supervisors are also coached to select and structure projects that are community-based and co-produced with community partners so that interns can not only learn theory and best practices for community engagement but also the chance to apply these methods in the real world. Educating and training students on meaningful community engagement contributes to a workforce that has a thorough understanding and skills for doing community-based work (Syed et al. 2010). CEI fills a unique niche in the STEM undergraduate internship landscape as it not only trains students to work on community-based projects, but it also draws on the lived and learned experiences of community partners to provide mentorship and support to students. This structure adds value to both the experience of the student and the connected community, and long-term continuity through the participation of the professional mentor. Doing so ultimately builds capacity for the workforce by educating and mentoring students from diverse backgrounds.

Diverse Recruitment Strategies: CEI uses several recruitment and selection strategies to draw applicants from diverse cultural, ethnic, and socioeconomic backgrounds with unique lived experiences, skills, abilities, and interests. In addition to a best practices document for recruitment, the CEI coordination committee solicits additional guidance from external advisory board members and facilitates knowledge and information exchange among the Sea Grant network to enlist the broadest pool of applicants. Recruitment and selection strategies include:

- Sharing announcements that clearly highlight Sea Gran's commitment to DEIJA, detailing how the program fosters an open and welcoming environment to support and mentor students.

- Drafting position descriptions such that they mention specific skills and/or experience required to undertake a project successfully as well as the professional skills the intern is likely to gain from the internship. Doing so ensures that non-traditional students get a chance to apply.
- Featuring former interns in social media and blog posts advertising the internship to recruit a more diverse applicant pool.
- Building relationships with local communities and Tribal or Indigenous partners to co-develop projects, collaborate on student recruitment efforts, and provide mentorship to students.
- Targeting recruitment of students from historically marginalized, Tribal or Indigenous communities.
- Collaborating with staff and faculty from Minority Serving Institutions (e.g., Tribal Colleges, Historically Black Colleges and Universities, community colleges) for recruitment and selection.
- Recruiting students through in-person visits, actively encouraging them to apply, and establishing open communication, instead of using traditional or remote methods (such as Handshake or online career fairs).

Professional Development: Professional development opportunities are a backbone for the CEI program and draw upon Sea Grant's decades-long experience in doing community-engaged science. Professional development opportunities offered through the CEI program have included webinars and interactive panel discussions on a suite of topics. These topics include career opportunities in coastal, ocean, and freshwater science; building and sustaining community partnerships; creating one's personal brand; how to identify and successfully apply to other research and fellowship opportunities; and how to effectively work with Tribal and Indigenous communities. Not only do these professional development sessions serve as education and training platforms, but they also provide interns with a forum to co-learn and discuss how they are using new skills in their projects and professional roles. Five to seven 60–90-minute professional development sessions have been offered over the internship period each summer. An ethnographic study of undergraduate research experiences noted that in addition to the hands-on experiences themselves, students' science identities were developed partially through participation in a community of practice, as well as working alongside senior practitioners and near-peer mentors (Hunter et al. 2006), similar to CEI's shared-learning professional development activities and intentional near-peer mentoring. Another framework for undergraduate professional development engagement developed by Blau and Snell (2013, and references therein) acknowledges the elective, extracurricular learning, such as through internships like CEI, and engagement in activities designed to cultivate "soft skills" or other job-related aptitudes, prepare college students for post-graduation employment.

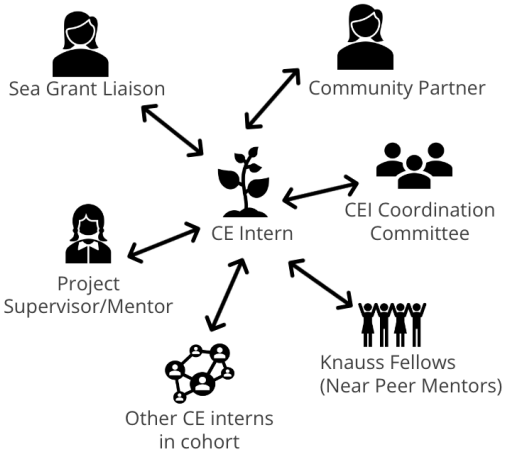

Figure 3: Constellation of mentors that guide and support interns

Mentorship Education: CEI is a highly leveraged and collaborative program, drawing on resources - both financial and institutional - from various sources, and bringing together interested parties that are invested in the program's success. Interns obtain mentorship and support from a constellation of mentors including Sea Grant professionals, community and industry leaders, government and non-governmental partners, and academic experts (Figure 3). Near-peer mentoring [3] for example is provided by a subset of Knauss Fellows who work in various science policy roles in the executive and legislative branches of the federal government. Doing so allows interns to connect with someone close in age and experience, conduct informational interviews, and gain knowledge about a range of policy-related careers in Great Lakes, marine, and coastal science. Knauss Fellows gain experience in mentoring and contribute directly to the growth and professional development of the next generation of ocean and coastal science professionals. Knauss Fellows and interns form mentoring circles (comprised of two Knauss Fellows and three to five CEI interns) that meet several times over the duration of the CEI program to discuss future career planning, how to develop a curriculum vitae, résumé, and cover letter, and how to find and apply to graduate school.

Sea Grant collaborated with the University of Wisconsin's Center for the Improvement of Mentored Experiences in Research (CIMER, https://cimerproject.org/) to provide mentorship education to *all* CEI participants- interns, supervisors and mentors, participating Knauss Fellows, and members of the CEI coordination committee. Using an interactive learning approach, CIMER facilitators help participants develop skills necessary for engaging in productive, culturally responsive, and mutually beneficial professional relationships. Mentoring guidance, tailored to the CEI program, instills a common language for communication among mentors and mentees, resulting in a shared understanding of internship expectations. Additionally, mentorship education provided to interns demystifies mentor-mentee expectations, empowers students to develop their identity as researchers, and equips them with skills to successfully navigate mentoring relationships. These are important concepts for all interns and may be especially useful for first-generation college students. Mentorship education also provides mentors with the skills and knowledge for engaging in productive and culturally responsive mentoring relationships and fosters a positive workplace culture. CIMER's "train the trainer" model in mentorship has expanded Sea Grant's training capacity as an organization enabling Sea Grant professionals to train future CEI mentors. Due to the autonomous nature of Sea Grant programs, mentors and mentees determine the nature of their mentoring relationship as well as the timing and frequency of their meetings.

Cohort-Building: Research shows that cohort-building leads to better engagement and retention of students as it cultivates a sense of togetherness, belonging, and purpose (for e.g., see Graham et al. 2013, Holloway-Friesen 2021, Hansen et al. 2023) Cohort-building in CEI is facilitated nationally by engaging interns through professional development webinars (e.g., "speed networking"), and through social media platforms (primarily Slack and Twitter). Students get the opportunity to broaden their professional network, share information about their projects, and engage with their peers across the Sea Grant network. Some Sea Grant programs that recruit larger number of interns also do cohort-building at the state-level by hosting professional development opportunities and events at their program. For example, Georgia Sea Grant hosts an annual student onboarding event that engages all Sea Grant funded students (not just community-engaged interns) in an in-person meet-greet-learn experience that spans a period of two days. By facilitating co-learning, training, and cohort-building in a culturally responsive manner, the CEI program cultivates a welcoming, inclusive, and nurturing environment for students.

Flexibility, Scalability, and Transferability: The CEI program began in summer 2020 when social distancing precautions and virtual learning were in place because of the COVID-19 pandemic. CEI was conceived to be an in-person program, engaging students face-to-face in projects and even a professional development experience in Washington, D.C. However, the design and format of the program were quickly changed to provide students with a remote or hybrid, flexible, and safe internship experience. Virtual and remote programming yielded unanticipated benefits allowing the development of a wider and more innovative range of projects, more professional development opportunities than originally planned, and engagement of partners who may not have otherwise been able to collaborate. It also made the CEI program more adaptable to meet the needs of diverse students and mentors including those with childcare or eldercare responsibilities, and different work schedules.

The CEI coordination committee develops an annual timeline and framework within which interns are provided with professional development, mentoring, and training. Since each Sea Grant program has different organizational goals, financing strategies, and relationships with their local community partners, they are given the autonomy to conduct CEI programming in an individualized manner. For example, some Sea Grant programs assign their interns to in-house projects, while other programs rely on external partners to determine duties. Some Sea Grant programs rely exclusively on funding provided by the NSGO, while many others leverage existing support and structures for supporting undergraduate internships, enabling students funded through different mechanisms to "opt in" to CEI professional development offerings. Regardless of their funding support, all interns are provided

with mentoring, cohort-building, professional development, and a defined internship project for the summer. By providing access to a range of tools and good practices to recruit and engage students from diverse backgrounds, including Tribal and Indigenous communities, the CEI coordination committee enables Sea Grant programs to adapt the CEI programming to meet their own needs, exemplifying the successful transferability of the program.

Case Studies: Authors of this paper who served as intern supervisors provide case studies below for each unique attribute of the CEI program to demonstrate how these attributes are reflected in the internship experience at individual Sea Grant program level.

Meaningful Community Engagement

- A University of Southern California (USC) Sea Grant intern received weekly mentorship from local organizations LA Conservation Corps and Compton Advocates staff. The intern conducted community outreach about water resources within the Compton Creek drainage and strengthened partnership ties between the USC Sea Grant programs and community groups.
- A Louisiana Sea Grant intern worked hand in hand with the Pointe-au-Chien Indian Tribe to conduct hydroacoustic sampling and employ cutting-edge high-resolution imaging sonar technology to examine how fish communities use a restored living shoreline habitat. The effort helped to protect a cultural heritage site important to the Tribe. TLK informed the project's design and guided actions for restoration and conservation of coastal resources.
- A South Carolina Sea Grant intern conducted a needs assessment with low resource communities to determine where to install water level sensors to monitor flooding. The Southeast Coastal Ocean Observing Regional Association helped to fund and guide the internship and eventually partnered to fund a permanent position for the student to work full time and install sensors in communities impacted by tropical storms.
- A Michigan Sea Grant intern worked within a local municipality to research water quality contaminants, monitoring and treatment efforts, and public health implications. The student worked with a water department manager and gained knowledge about the collaborative actions necessary to mitigate the effects of environmental pollutants to drinking water supply.

Diverse Recruitment Strategies

- An Oregon Sea Grant intern was recruited via Southwestern Oregon Community College for a U.S. Department of Agriculture funded project New Beginnings for Tribal Students. The intern was an Indigenous woman mentored by an Indigenous faculty member. The intern's role was to provide mentors with resources to best support their intern cohort and identify challenges to productive communications. The intern also evaluated the cultural competence and supervisory style of mentors and assessed mentor/intern progress for reporting and future program recruitment purposes.
- Alaska Sea Grant's small program (3-4 students a summer) is focused on providing opportunities for Alaska Native students and students who come from rural communities. For example, two Alaska Native students were recruited as part of a new Tribal-led climate partnership to work alongside Tribal environmental professionals to conduct water quality monitoring in their home community of Kake in Southeast Alaska. A University of Alaska postdoctoral scholar mentored the interns. Other Alaska Native students and students from diverse backgrounds have worked alongside Alaska Sea Grant personnel to get lab experience and conduct social science research. A key takeaway is students are more successful and engaged when they help develop their

internship project so that it fits with their unique interests, provides a class or capstone project, and project activities takes place in their own community to make it truly place-based.

- Louisiana Sea Grant folded the CEI program into an existing federally funded internship program, the Undergraduate Research Opportunities Program (UROP), resulting in eight UROP/CEI interns. Established in 1992, UROP aims to serve undergraduate students who are interested in pursuing advanced studies in coastal-related disciplines but are from groups with low or no access to such opportunities. UROP provides them with hands-on research experience mentored by a faculty member to increase their competitiveness as a graduate student and aid with career-related decisions. Leveraging the CEI program, UROP students now can connect with a national network of interns and access CEI professional development opportunities.

Professional Development

- In addition to the virtual professional development series offered to all interns, Louisiana Sea Grant hosted webinars for its state-wide intern cohort with content on effective presentations, communication, and meeting facilitation skills.
- Oregon Sea Grant offers application workshops to potential interns, which are now replicated by other programs. These virtual and in person sessions target students new to coastal and marine science internship application processes. They allow students to learn broadly about various Sea Grant opportunities, get advice and tips on application materials, and hear from recent scholars and fellows about similar experiences.

Mentorship Education

- Despite the importance of mentorship to an individual's personal and professional journey, there are lack of education and training opportunities to be an effective mentor or mentee. To address the gap in mentoring skills and competencies, Georgia Sea Grant collaborated with CIMER to integrate mentorship education into CEI's program design. The CEI coordination committee worked closely with CIMER facilitators to gain skills and knowledge needed to be effective in mentoring roles, and designed a mentorship education curriculum that meets the needs of various participants in the CEI program. Georgia Sea Grant has partnered with CIMER on another mentoring program, funded by NSF, focused on providing mentorship to women and non-binary scientists in physical oceanography (www.mpowir.org).

Cohort Building

- Wisconsin Sea Grant interns were encouraged to participate in weekly virtual "check-in" calls held on Zoom. At each session, students reported on progress made and/or skills learned through their project and obtained feedback from mentors and their cohort. For the second half of the meeting, interns met alone with other interns to build camaraderie and network.
- North Carolina Sea Grant interns in 2022 worked on distinct projects with different mentors but spent a few days traveling together to gain exposure to additional coastal and marine resource issues. They learned about the local seafood economy, helped to build a living shoreline out of oyster shells, and got to know one another in an informal setting over meals and listening to music while driving.

Flexibility, Scalability, and Transferability

- Several Sea Grant programs involved with the CEI had existing summer undergraduate internship programs (Michigan, Louisiana, Oregon, South Carolina, etc.). Having an existing structure made implementation of CEI easier because many barriers and challenges, including identifying suitable projects, recruiting mentors, and handling administrative logistics (student recruitment, housing, payment, etc.) had already been navigated. Some programs host a mix of CEI students and those affiliated with their local programs, which enhances the learning and experience of all students and allows for a larger cohort. Further, the overall CEI community benefited from the prior experience of these programs through knowledge transfer of good practices and foresight for avoiding potential pitfalls.

IV. Impact of CEI

All 34 Sea Grant programs have participated in CEI to date, with considerable growth in the number of interns supported each year. The first CEI internship cohort began in 2020 with 28 interns and 14 programs. In 2021, the cohort expanded to 60 interns representing 21 programs. In 2022, 85 interns participated from 27 programs. In 2023, 76 interns participated from 19 programs. The CEI program has evaluated interns and mentors about their experiences. These data are used to refine programming for future years and to provide important insights into program success. The UGA Institutional Review Board (IRB) determined the project was evaluation and not research as information was intended for program assessment and improvement. In this paper, we report on data collected in 2021 and 2022.

Surveys were developed in collaboration with the CEI Coordinating Committee. The post-internship survey was administered through an anonymous link that CEI leadership emailed to all interns immediately following graduation. The survey included open-ended, multiple choice, and Likert-scale items to collect input about program components (e.g., which professional development webinars did you find most beneficial and least beneficial, how could webinars be improved, and what additional webinars would be beneficial; rate your relationship with your Sea Grant/Supervisor mentor and describe what you gained from that relationship; what do you feel was the most beneficial aspect of your internship and how could it have been improved). In addition, interns were asked about gains in knowledge and skills they experienced because of their internship, including knowledge of careers in ocean science, skills in critical thinking and communication and confidence in identifying themselves as scientists.

In addition to participating in the post-internship survey, CEI alumni from 2021 and 2022 were asked to complete a follow-up survey in January 2023 to learn if and how they applied their CEI experiences since completing their internships. Intern supervisors/mentors who participated in mentorship trainings in 2021 and 2022 were surveyed by CIMER immediately following completion of the training to obtain feedback on the quality and usefulness of the training and to learn how mentors anticipated using what they learned in the training with their interns. As part of the evaluation, all CEI mentors were surveyed again in February/March 2023—after completing their mentorship experiences—to: (a) learn if and how mentors actually used what they had learned in the CIMER training in mentoring their interns; (b) obtain specific examples of how they fostered inclusive mentorship relationships with their interns and supported their engagement in place-based, community-focused projects; and (c) solicit suggestions for additional resources to support mentors, especially in building capacity for engaging in culturally responsive mentoring relationships.

Results from Community Engaged Interns: Fifty-six (56) of the 145 interns completed the immediate online post-internship survey (response rate of 37%). Three emails requesting participation were sent over a month period when the internships concluded. Interns from 22 of the 34 Sea Grant programs responded to the post-internship survey. Table 1 shows the number of intern survey respondents by the Sea Grant program.

Sea Grant Program	# of Survey Respondents
Alaska	4

California	3
Georgia	3
Hawaii	1
Illinois/Indiana	1
Lake Champlain/Vermont	2
Louisiana	2
Maine	3
Michigan	5
Mississippi/Alabama	1
North Carolina	3
New Hampshire	1
New Jersey	1
New York	3
Oregon	11
Pennsylvania	2
South Carolina	1
Texas A&M	2
Virginia	1
Washington	1
Wisconsin	4
Woods Hole	1
Total	**56**

Table 1: Distribution of CEI Intern Post-Internship Survey Respondents by Sea Grant Program

Most interns (93%) who completed the post-internship survey reported that because of their internship experience they knew more about careers in coastal and ocean sciences, and 81 percent (81%) reported being more interested in pursuing a career in coastal and ocean science fields. Ninety-five percent (95 %) of the interns agreed or strongly agreed that because of their internship they were more confident in their ability to succeed in a science career, and 90 percent (90%) of respondents reported feeling more confident identifying themselves as scientists. Over 90 percent (90%) of interns also agreed or strongly agreed they gained fundamental skills needed to succeed in a science career because of their internship: verbal communication skills (100%), project management skills (98%), critical thinking skills (95%), ability to explain science topics (94%), and presentation skills (92%). Ninety-two percent (92%) of interns who completed the survey agreed or strongly agreed they had improved their writing skills, and 89 percent (89%) agreed or strongly agreed they had gained collaboration and teamwork skills during their internship.

Interns from 2021 and 2022 cohorts were invited to complete a follow-up survey to learn if and how the CEI experience continued to influence their education and career paths. Thirty-seven (37) of the 145 interns invited responded to the survey (a response rate of 26%). Forty-one percent (41%) of respondents said that since completing their internship, they had engaged in additional education, research, and/or projects related to marine, coastal, or Great Lake science. Some responding interns also provided examples like taking marine science-related courses (e.g., hydrology); applying for additional Sea Grant projects; writing curricula for local organizations related to freshwater science; volunteering at a national fish hatchery and clipping adipose fins of juvenile Atlantic salmon; and becoming a Sea Grant Coastal Watershed Community Engagement Specialist. The interns also reported working in university

labs researching sea lice in salmon fisheries; agroecology; saltwater intrusion; and the use of coralline algae as a marine proxy.

Fifty-five percent (55%) of respondents said that since their internships they have engaged in projects that promote integration of community traditions, norms, and/or perspectives. Examples provided include taking a course in Indigenous Feminism; creating art programs built around themes of community values, culture, and freshwater science for community engagement workshops; conducting a research project on the Rites of Lakota culture; and promoting intentional and respectful harvesting in Lingít Aaní community. Interns were asked to describe other ways they have used the knowledge and skills gained during their internships since completing the program. Many comments noted being more open and aware of diversity and more culturally sensitive in their interaction with people—in both their personal and professional lives. One intern explained, "I have utilized culturally sensitive and appropriate communication and project development, project leadership and management, and social media skills at my job, all of which I honed at Sea Grant." In addition, interns described using the research, problem-solving, teamwork, communication, and presentation skills gained during their internships in their current schoolwork and jobs. For example, one intern explained, "I think it has benefited me in my classes in just my ability to understand the context and process of research more."

Interns were also asked if they had engaged in mentoring relationships (as a mentee or a mentor) since completing their internships, and if so, how their CEI experience influenced those relationships. Seventy-eight percent (78%) of those who responded to the question said they had engaged in a mentoring relationship since their internship. Interns commented that their CEI mentorship experiences helped them know what they did and did not want in a future mentor and helped them be more respectful, patient, and supportive of those they have mentored.

Results from Supervisors/Mentors: In fall 2023**,** 59 of 191 CEI supervisors/mentors responded to a survey about their experiences mentoring interns and its impact on their mentorship capacity (a response rate of 31%). Some interns had more than one supervisor/mentor. Approximately half of the respondents (52%) reported that as a CEI supervisor they learned new skills or strategies for fostering an inclusive and welcoming environment for students from underrepresented or Indigenous communities (52%) and for mentoring students engaged in place-based, community projects (49%). Sixty-three percent (63%) reported they attended the CEI mentorship training, and 91% of those said they were able to use what they learned with their interns/mentees.

In the survey, supervisors reported an increased awareness and understanding of their own DEIJA values due to CEI participation. They reported that instruction on the influence of relationship power dynamics was particularly impactful. Strategies from the mentorship orientation training those respondents described as useful included: (a) creating an agreement early on outlining the supervisor's expectations and the intern's goals for the internship; (b) establishing a welcoming environment that encouraged asking questions and discussing challenges and failures as well as successes; and (c) enabling interns to network with colleagues from underrepresented, minority, and Indigenous backgrounds. Supervisors reported belief that these strategies resulted in more frequent engagement with their interns, both during and post completion of the internship, as well as greater rates of persistence (e.g., interns completed assigned duties and achieved desired outcomes).

Supervisors also provided examples of practices they found particularly beneficial, including being candid and open about their lack of knowledge or insecurity around issues of identity, cultural diversity, and inclusivity; facilitating opportunities for interns to engage with other mentors of similar backgrounds; focusing on listening and learning during conversations with interns; and being more intentional and attentive to creating a comfortable and safe environment for diverse interns (e.g., correct name and place pronunciation, meeting attire, etc.). When asked to provide suggestions for additional

training or resources to enhance their capacity as mentors, respondents suggested information about best practices for recruiting interns from underrepresented and Indigenous communities; effectively communicating with intercultural sensitivity; and preparing young people to enter the workforce (e.g., approaches and resources for explaining professional and workplace expectations).

Future evaluation considerations: The purpose of early evaluations was not only to assess the degree to which the CEI program achieved its goals but also to better understand what components of the program were most beneficial to the students and support continued improvement in the design and implementation of the program. Participant survey responses were the primary data source for evaluating the program. In the future, strategies for increasing response rates, such as more frequent and automated reminders, would foster a larger and more diverse sample. In addition, the program could explore approaches for increasing the rigor of the evaluation by utilizing validated scales for measuring interns' gains in self-efficacy, knowledge, and skills to supplement the interns' self-reported perceptions obtained in the surveys. Similar measures could be examined for measuring mentor gains in competencies (including gain in mentorship skills and competencies by Knauss Fellows serving in near-peer mentoring roles) specifically associated with effective mentoring for culturally diverse students and for preparing students to engage effectively with historically marginalized communities. The addition of qualitative methods, such as focus groups and interviews, could add depth to the understanding of how and why programs like CEI are beneficial and how CEI can be adapted or replicated in other settings. Moving forward, program evaluations will also include demographic data collection to create a fuller picture of participants and assess outcomes related to diversity, equity, and inclusion. Evaluation will also be improved by collecting data on different funding sources that programs use to support community-engaged interns.

V. Evolution of CEI

The CEI program has made significant progress since it was conceived in 2020. It is a grassroots effort supported initially by a relatively small grant by the NSGO, with a handful of Sea Grant programs as participants. By facilitating sharing of resources and best practices, the CEI coordination committee has worked with an external advisory board to alleviate potential barriers that prevented Sea Grant programs from participating in the CEI program. As such, not only has the number of participating Sea Grant programs grown to encompass the entire network, but the funding mechanisms have also diversified to accommodate a greater number of students from diverse communities.

Annual assessment of the CEI program has shed light on areas that are working and where additional resources are needed. More broadly, Sea Grant program administrators have gained heightened awareness about social, cultural, economic, psychological, and systemic barriers that prevent students from a variety of different backgrounds from participating in research and fellowship opportunities, and ways in which some of these barriers can be alleviated. The CEI coordination committee now collectively documents and shares best practices after years of program facilitation. For example, the committee recognizes that recruitment efforts are greatly improved by building and sustaining relationships with groups and communities that have experienced little or no access to Sea Grant funding opportunities. The committee has also learned that the application process and selection efforts can be improved by establishing standard criteria that focus on the aptitude and potential of students to succeed in STEM disciplines resulting in inclusion of students lacking prior related experience. There is also more awareness about the challenges posed due to lack of affordable housing to students from diverse backgrounds who may not have the resources to move for an internship. Many students take summer jobs to help cover living expenses, and wages from the CEI program must be competitive with these other opportunities. The CEI coordination committee recognizes that increasing stipends/wages, offering housing and travel support, and providing additional mentorship and professional support is important to attracting a full range of applicants. There are certain barriers that are historic and systemic in nature

(such as racism and exclusion in STEM) and will require sustained and long-term commitment and support.

The success of CEI throughout the Sea Grant network is due to a focus on place-based experiences and providing community support for local students. New partnerships with educational institutions, college departments, and university clubs and organizations that serve students who may not typically pursue careers in coastal and marine fields are essential. Other programs could create similar experiences by engaging with local communities to understand their needs and by building relationships with Minority Serving Institutions (MSIs) and community colleges to identify students who would benefit most from these opportunities. A handful of Sea Grant programs are affiliated with MSIs and can provide useful examples to recruit students and engage faculty from those institutions. Due to Sea Grant's unique positionality within NOAA, there is the opportunity to connect CEI interns to other education and training opportunities such as the NOAA Ocean Exploration Explorer-in-Training Program, NOAA IN FISH Program, Margaret A. Davidson Graduate Fellowship, and National Coral Reef Management Fellowship, among others. Students benefit from these structured learning environments across various educational and career stages. Retention of CEI alumni in coastal and ocean sciences can be improved by facilitating collaboration and communication beyond the duration of the program.

CEI will continue to evolve with the changing needs of students from diverse backgrounds and communities. With a recent award from NSGO, the program hired its first program coordinator which is a full-time position dedicated to coordinating all aspects of the CEI program, provide sustained support, and improve the overall program design and implementation. For the first time, the CEI program design includes an in-person graduation ceremony for the 2024 cohort of community-engaged interns. Programs like Sea Grant's CEI are proving to be successful in preparing undergraduate students for a variety of geoscience careers and cultivating transdisciplinary teams with diverse skills, approaches, and perspectives.

References

Alegado R and Hintzen K (2020) Kūlana Noiʻi: A process for establishing dynamic equitable partnerships between community partners and researchers. https://seagrant.soest.hawaii.edu/wp-content/uploads/2021/09/Kulana-Noii-2.0_LowRes.pdf. Accessed May 1, 2024

Berkes F (1993) Traditional ecological knowledge in perspective. Traditional ecological knowledge: Concepts and cases, J.T. Inglis, Ed., Canadian Museum of Nature/International Development Research Centre, International Program on Traditional Ecological Knowledge International Development Research Centre, 1, 1-9.

Bernard RE, and Cooperdock EH (2018) No progress on diversity in 40 years. Nature Geoscience, 11(5), 292-295.

Blickley JL, Deiner K, Garbach K, Lacher I, Meek MH, Porensky LM, Wilkerson ML, Winford EM and Schwartz MW (2013) Graduate student's guide to necessary skills for nonacademic conservation careers. Conservation Biology, 27(1), pp.24-34.

Blau, G, and Snell C (2013) Understanding Undergraduate Professional Development Engagement and Its Impact. College Student Journal, 47(4), 689-702.

DeFelice A, Adams JD, Branco B, and Pieroni P (2014) Engaging underrepresented high school students in an urban environmental and geoscience place-based curriculum. Journal of Geoscience Education, 62(1), 49-60.

Dutt K (2020) Race and racism in the geosciences. Nature Geoscience, 13(1), 2-3.

Gallay E, Flanagan C, and Parker B (2021) Place-based environmental civic science: Urban students using STEM for public good. In Frontiers in Education (Vol. 6, p. 693455). Frontiers Media SA.

Ghazzawi D, Pattison D, and Horn C. (2021) Persistence of Underrepresented Minorities in STEM Fields: Are Summer Bridge Programs Sufficient? Front. Educ. 6:630529.

Graham MJ, Frederick J, Byars-Winston A, Hunter AB, and Handelsman J (2013) Increasing persistence of college students in STEM. Science, 341(6153), 1455-1456.

Gonzales L, and Keane C (2020) Geoscience Workforce Projections 2019-2029. Geoscience Currents. Data Brief 2020-025.

Harris LA, Garza C, Hatch M, Parrish J, Posselt J, Alvarez Rosario JP, Davidson E, Eckert G, Wilson Grimes K, Garcia JE, and Haacker R (2021) Equitable Exchange: A framework for diversity and inclusion in the geosciences. AGU Advances, 2(2), e2020AV000359.

Hansen MJ, Palakal MJ, and White LJ (2023) The Importance of STEM Sense of Belonging and Academic Hope in Enhancing Persistence for Low-Income, Underrepresented STEM Students. Journal for STEM Education Research, 1-26.

Holloway-Friesen H (2021) The role of mentoring on Hispanic graduate students' sense of belonging and academic self-efficacy. Journal of Hispanic Higher Education, 20(1), 46-58.

Hoisch TD and Bowie JI (2010) Assessing Factors that Influence the Recruitment of Majors from Introductory Geology Classes at Northern Arizona University, Journal of Geoscience Education, 58:3, 166-176.

Hunter A-B, Laursen SL and Seymour E (2007), Becoming a scientist: The role of undergraduate research in students' cognitive, personal, and professional development. Science Education, 91: 36-74. https://doi.org/10.1002/sce.20173.

Ingold T (2000) The perception of the environment: essays on livelihood, dwelling and skill. Psychology Press.

Johnson MD, Sprowles AE, Goldenberg KR, Margell ST, and Castellino L (2020) Effect of a place-based learning community on belonging, persistence, and equity gaps for first-year STEM students. Innovative Higher Education, 45, 509-531.

Keane C (2022) U.S. Geoscience Enrollment sand Degrees through 202, Geoscience Currents, Data Brief 2022-010 https://www.americangeosciences.org/sites/default/files/DB-2022-010-Enrollments-Degrees-2021.pdf

Lemke JL (2001) Articulating communities: Sociocultural perspectives on science education. Journal of research in science teaching, 38(3), 296-316.

Levine R, González R, Cole S, Fuhrma M, and Carlson Le Floch K (2007) The Geoscience Pipeline: A Conceptual Framework, Journal of Geoscience Education, 55:6, 458-468, DOI: 10.5408/1089-9995-55.6.458

National Center for Science and Engineering Statistics (NCSES) (2023) Diversity and STEM: Women, Minorities, and Persons with Disabilities 2023. Special Report NSF 23-315. Alexandria, VA: National Science Foundation. https://ncses.nsf.gov/pubs/nsf23315/report. Accessed June 13, 2023

National Sea Grant College Program (2018) Reaching Outward and Looking Inward: Building Sea Grant Resilience from the Lens of Diversity, Equity, Inclusion and Justice. Silver Spring, Maryland, USA. National Sea Grant College Program. Available at https://seagrant.noaa.gov/Portals/1/Network%20Visioing/DEI_VisionActions_2_0_Sea%20Grant_2022%20upload.pdf. Accessed June 13, 2023

National Sea Grant College Program (2018) Traditional and Local Knowledge: A Vision for the Sea Grant Network. Silver Spring, Maryland, USA. National Sea Grant College Program. Available at https://seagrant.noaa.gov/Portals/1/Network%20Visioing/Traditional%26Local_110118.pdf. Accessed June 13, 2023.

Riggs EM (2005) Field-based education and indigenous knowledge: Essential components of geoscience education for Native American communities. Science Education, 89(2), 296-313.

Roth WM and Tobin K (2007) Science, learning, identity: Sociocultural and cultural-historical perspectives. BRILL.

Semken S, Ward EG, Moosavi S and Chinn PWU (2018) Place-based education in geoscience: theory, research, practice, and assessment. J Geosci Educ 65 (4): 542–562.

Syed M (2010) Developing an integrated self: academic and ethnic identities among ethnically diverse college students. Developmental psychology, 46(6), 1590.

Thornton TF, and Scheer AM (2012) Collaborative engagement of local and traditional knowledge and science in marine environments: a review. Ecology and Society, 17(3).

Usher PJ (2000) Traditional ecological knowledge in environmental assessment and management. Arctic, 183-193.

UCAR Center for Science Education. (2024, May 1) "Understanding Earth as a System" https://scied.ucar.edu/learning-zone/earth-system/understanding-earth-as-system

[1] Includes earth, atmosphere, and ocean sciences.
[2] Communities or populations that have systematically been denied access to economic, political, and cultural participation.
[3] Near-peer mentors are usually within five- to seven-years in age and early in their education and career journeys.